USING NATURALISTIC PROCEDURES TO ENHANCE LEARNING IN INDIVIDUALS WITH AUTISM: A FOCUS ON GENERALIZED TEACHING WITHIN THE SCHOOL SETTING

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Children with autism often have difficulty successfully applying newly acquired skills to novel situations. Naturalistic teaching procedures have been developed to help address this problem with generalization. These naturalistic procedures promote generalization through the use of natural consequences, diverse training, and the incorporation of mediators. The purpose of this article is to define these tactics and then describe and review three popular naturalistic teaching approaches: incidental teaching, pivotal response training, and script-fading. The article will also review the research support for these procedures and conclude with a discussion of implications for research and practice. © 2007 Wiley Periodicals, Inc.

According to the *Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition, Text Revision* (DSM-IV-TR; American Psychiatric Association, 2000), autism is characterized by qualitative impairments in social interactions and communication coupled with restricted, repetitive, and stereotyped patterns of behavior, interests, and activities. Due to the pervasiveness of these symptoms, children with autism often perform poorly in school and various community settings. Indeed, providing educational programming and positive behavior supports for students with autism is a challenging endeavor for educators and school psychologists alike. The need for comprehensive, evidence-based teaching and behavior management strategies for children with autism has prompted decades of research in the fields of education and psychology.

Early behavioral research evaluating the treatment of children with autism used principles of reinforcement and punishment to create highly effective teaching interactions. This operant training technology focused on taking children out of the "natural" environment and teaching them in individualized, tightly controlled situations where distractions could be minimized, correct responding could be prompted, and consequences could be reliably delivered. Often called "discrete trial training" (DTT), this teaching made sense because basic behavioral research had clearly demonstrated that the rate of learning could be increased through the immediate and frequent delivery of potent consequences. In addition, teaching these children the complex discriminations required for language and social development also required careful control of the teaching conditions. This type of teaching has been labeled "artificial" or "analog" (Delprato, 2001), precisely because it is different in structure than the "natural" conditions of everyday life at home or in the classroom. Teaching under these analog conditions resulted in impressive gains in the areas of social and language skills, as well as a reduction in disruptive and injurious repetitive behaviors (McGee, Almeida, Sulzer-Azaroff, & Feldman, 1992).

Unfortunately, this analog approach was not without problems. Teaching in a highly controlled situation resulted in responding that was under the control of a few highly specific stimuli. That is, the treatment gains observed in the controlled clinic setting seldom carried over to novel situations, people, or tasks (McGee et al., 1992). Indeed, early behavioral technology tended to rely on a "train and hope" approach in which teachers would train in the analog setting and then hope that the skill would transfer, or generalize, to other critical settings, people, or tasks without needing to be specifically taught (Stokes & Baer, 1977).

An alternative to the passive train and hope approach characterized by discrete trial training is to systematically arrange training so that generalization is more likely to occur. The generalization problem has occasioned numerous discussions over the years (e.g., Edelstein, 1989; Kendall, 1989; Stokes & Baer, 1977; Stokes & Osnes, 1989), and generalization continues to be an area of significant interest. There is widespread agreement that generalization should not be expected unless there are specific procedures implemented to facilitate its occurrence (Kendall). Although a number of tactics have been proposed for promoting generalization, they can be grouped into three areas of general principles: use natural consequences, train diversely, and incorporate mediators (Stokes & Osnes). An appeal for the use of natural consequences acknowledges that behaviors are more likely to generalize when teachers use reinforcing consequences that occur naturally and do not need to be specifically programmed by the teacher. Training diversely means using less rigid programming, allowing for natural variations in the conditions of training and using a variety of different stimuli with which to teach. Incorporating mediators involves using stimuli in training that will also be present in other situations and natural conditions. Each of these procedures serve to "loosen up" the tightly controlled teaching environment, making it more like the conditions the learner will experience in natural everyday life. That is, these procedures arrange for teaching to be more "naturalistic" and less analog.

A number of researchers (e.g., Delprato, 2001; Koegel, Koegel, & Carter, 1999; Miranda-Linne & Melin, 1992) have highlighted the distinctive qualities of such naturalistic procedures by comparing them to less naturalistic, analog strategies (see Table 1). For example, analog procedures typically are implemented through highly structured sessions that are preplanned, initiated and paced by the teacher, take place in a controlled one-to-one setting, and use the same stimuli repeatedly and consecutively (Delprato; Miranda-Linne & Melin). On the other hand, naturalistic procedures typically take place through loosely structured sessions, which are initiated and paced by the child, take place in a variety of locations and positions, and employ a variety of stimuli. In addition, whereas analog learning trials usually require that the learning stimulus be selected by

Table 1
Primary Differences Between Analog and Naturalistic Procedures

Analog procedures	Naturalistic procedures
Incorporate highly structured sessions	Incorporate loosely structured sessions
Trials initiated and paced by the teacher	Trials initiated and paced by the child
Take place in the same one-to-one setting	Take place across a variety of settings
Stimulus always selected by the teacher	Stimulus may be selected by the child
Use the same stimuli repeatedly	Use a variety of stimuli across trials
There is often a single acceptable response	No predetermined order of responses
Teacher uses the same prompt repeatedly	Teacher uses a variety of prompts
Rely on artificial reinforcers	Incorporates naturalistic reinforcers

Note. Compiled from the following sources: Delprato, 2001; Koegel, Koegel, and Carter, 1999; Miranda-Linne and Melin, 1992.

the teacher and remain the same across multiple trials, naturalistic training procedures often require that the stimulus be selected by the child and that it can vary from episode to episode. An additional critical distinction between these two approaches is related to the targeted response and the prompts used to elicit the desired response. Specifically, in an analog learning trial there often exists a single acceptable response that is targeted for multiple successive training episodes using the same prompt repeatedly, whereas under naturalistic conditions there typically is no predetermined order of responses and a variety of prompts may be used to elicit a desired response (Delprato). Finally, analog conditions often necessitate reinforcers that are not functionally related to the stimulus (e.g., if the student points to the yellow block when instructed, he receives a piece of his favorite candy; Koegel, Carter, & Koegel, 1999). In contrast, naturalistic conditions allow the desired object, selected by the child and used as the training stimulus, to serve as a natural reinforcer, where correct responding results in continued access to the desired stimulus. This eliminates the need to fade artificial reinforcers in learning trials.

Although this dichotomous approach to classifying training procedures as either naturalistic or analog may be helpful to some extent, perhaps it is more beneficial to think of "natural" and "analog" interventions as falling on a continuum with respect to their ability to help children discriminate and generalize. Analog procedures have been demonstrated to be quite effective at teaching complex and conditional discriminations to children and thereby produce good stimulus control. This can be particularly valuable when teaching new or complex skills. However, stimulus control always comes at the expense of generalization and vice versa. That is, poor stimulus control is generalization. A child who calls all four-legged animals "doggie" or who confuses the letters b, d, and p has demonstrated stimulus generalization and it is clear that better discrimination training is required to produce better stimulus control. Analog training procedures can meet this need. At the same time, children who perform only in the classroom or with certain teachers demonstrate poor generalization but good stimulus control, and it is clear that better generalization training under more naturalistic conditions is required. Thus practitioners should not interpret the continuum as a reflection of "good" versus "bad" but instead recognize that effective teaching may require selecting from a continuum of approaches, depending on the goals of the training. Further, not all procedures represent opposite ends of the continuum but instead reflect components of both. Perhaps the most important guideline is to first determine the individual child's strengths and needs with regard to a skill and intentionally select and execute the teaching approach linked to the current learning objective.

What follows is a description and literature review of three popular naturalistic approaches and modifications of those approaches that are increasingly used in teaching children with autism: incidental teaching, pivotal response training, and script-fading. Although the specific tactics they employ in the pursuit of more generalized responding are somewhat different, each relies heavily on the use of natural rather than arbitrary consequences and on diverse rather than restricted training. In addition, investigators who have modified these approaches in clinical trials have taken considerable liberty in incorporating additional components that often are more analog than naturalistic. Of course, identification of where different teaching approaches fall on the analog–natural continuum is not always easy, but generally speaking, those approaches that incorporate proportionately more of the three generalization programming strategies will be considered more "naturalistic."

Incidental Teaching, Pivotal Response Training, and Script-Fading

Incidental teaching (IT), first introduced to the literature by Hart and Risley (1968), is one of the most popular naturalistic intervention procedures. Incidental teaching was initially designed to facilitate the generalization and spontaneous use of language in disadvantaged preschoolers (Hart

& Risley, 1968, 1974, 1982). Although IT was not originally developed for use with children with autism, it has been modified to meet the social and educational needs of these students, with the assumption that it can be powerful in promoting the generalization and spontaneous use of communication in students with autism (Miranda-Linne & Melin, 1992).

Incidental teaching generally begins by arranging a teaching environment that contains materials and activities that are attractive to the child. Once the teaching stimuli are in place, the child's interest in or initiation toward a stimulus item denotes the beginning of the teaching trial. In its original form, IT occurs only when a child reaches for or requests access to the preferred stimuli or activities. For example, a child might look at a ball and say "want ball" or simply reach for the ball. However, teaching may also be initiated by presenting stimuli or activities to the child that have been found to reliably function as reinforcers in the past. For example, an incidental teaching episode might begin with either a verbal cue such as, "Push the button on the toy," or a nonverbal cue such as blocking the door handle until the child asks for the door to be opened (Wilczynski et al., 2003). Because these types of interactions can occur in many different situations and with many different stimuli, depending upon the child's interests, incidental teaching involves training diversely. Once the initiation or cue is present, the student is given the opportunity to respond and the behavior is reinforced with access to the preferred object. The response to the child's behavior is followed by a pause marking the end of one episode. The teacher then waits for the child to initiate another learning trial or begins the next trial by presenting a motivating stimulus. These discrete learning trials can appear similar to analog procedures; the primary difference in this case is that these episodes are guided by the child's interests, rely on natural consequences, and are performed in natural settings, using a diverse set of stimuli. These latter features distinguish IT as a naturalistic procedure.

Pivotal response training (PRT; Koegel, Koegel, Harrower, & Carter, 1999) is another common naturalistic approach to intervention. The purported goals of PRT are to (a) teach the child to be responsive to multiple learning opportunities taking place in naturalistic settings, (b) decrease the need for constant coaching and directing of child behavior, and (c) decrease the time the child is removed from natural settings (Koegel, Koegel, Harrower, et al., 1999). These goals are approached via teaching children with autism a common set of "pivotal" behaviors or skills (i.e., "behaviors that are central to wide areas of functioning such that a change in the pivotal behavior will produce improvement across a number of behaviors"; Koegel, Koegel, & Carter, 1999, p. 577). Teaching children to respond to multiple cues is one of the pivotal behaviors targeted in PRT. This is achieved by teaching with multiple examples of a given stimulus, hopefully compensating for the tendency of children with autism to attend to irrelevant or noncritical features of a stimulus (Koegel, Koegel, Harrower, et al., 1999). Motivation is another pivotal area emphasized in PRT; specifically, PRT utilizes the following procedures to incorporate motivation into training: (a) child choice in materials selection; (b) the use of natural reinforcers, functionally related to the task; (c) interspersing of mastered tasks along with learning tasks; and (d) reinforcing attempts (Koegel, Koegel, Harrower, et al., 1999). PRT also incorporates teaching of self-management and self initiations as pivotal behaviors. Self-management involves teaching the individual to identify, observe, and record each occurrence of a target behavior and to self-administer consequences (Koegel, Koegel, Harrower, et al., 1999). Teaching self-initiations relies primarily on teaching children to query for information, a common means of both initiating social interactions and of acquiring information.

PRT has several naturalistic features in common with IT. For example, as with IT, PRT follows the child's choice, lead, or interest, and teaching episodes occur when the child has sustained attention to the target object. Further, there is an emphasis on use of natural consequences, using reinforcers that are directly related to the response being taught in applied settings. In

contrast to IT, however, PRT pursues diversity in training more aggressively, by interspersing mastery tasks and by purposely varying the training stimuli to include multiple cues. PRT procedures also encourage reinforcement of all attempts at responding when initial acquisition is of interest. Finally, PRT specifically incorporates mediators through self-management training, which is one naturalistic means of promoting generalization.

Interestingly, PRT also has some features that are more consistent with analog interventions. For example, PRT includes elements of discrete trial training, with a strong emphasis on structured teaching interactions, delivery of instructions from the teacher, and providing consequences for every response by the child. In addition, PRT systematically incorporates prompting procedures into the model to assist a child with learning to respond to multiple cues. For example, PRT typically includes within-stimulus prompting, which involves the exaggeration of relevant features of a stimulus (e.g., Schreibman, 1975). It also includes conditional discrimination training, which requires students to attend to multiple cues and narrow their response upon consideration of available information (e.g., Schreibman, 1988). These techniques are focused more on discrimination than is generalization training. Nevertheless, these procedures are thought to produce children who will respond to multiple environmental cues, better preparing them for learning conditions likely to occur in the typical classroom setting.

Script-fading (Krantz & McClannahan, 1993) is a third naturalistic procedure that incorporates the use of scripts into applied settings as a means of enhancing the quantity of social initiations and quality of social interactions between children with autism and others. Guided by the observation that children with autism demonstrate inadequate initiation and topical conversational skills, script-fading provides setting-specific visual or auditory cues to guide children's verbalization during social interactions. They are taught to initiate using socially valid scripts in naturalistic settings. Moving beyond analog training conditions, script-fading incorporates mediators between training and generalization conditions in an effort to enhance both trained and spontaneous verbal initiations. For example, at lunch, children may talk about (a) what they did in class prior to lunch, (b) what they will do at recess immediately following lunch, and/or (c) what they are eating for lunch. Scripts designed to assist a child in initiating and sustaining interactions might include both questions and statements about each of these activities. A facilitator would prompt the child to follow the scripts in the applied setting. Once the student is regularly reading a variety of visual scripts, the facilitator retreats and the printed sentences are shortened successively until faded almost completely. Scripts are then incorporated across a variety of settings, individuals, and activities as a means of insuring diversity in training.

Script-fading may be modified for children who are beginning readers by incorporating one or two word phrases along with a picture into a child's visual schedule as a cue to initiate during the next scheduled activity (Krantz & McClannahan, 1998). Once taught, these scripted prompts may be systematically faded by removing sections of the visual scripts until they are absent. Script-fading may also be modified for children who are nonreaders through the use and fading of audiotaped scripts in applied settings (Stevenson, Krantz, & McClannahan, 2000).

Script-fading has some naturalistic features in common with both PRT and IT. Specifically, through the use of multiple scripts across a variety of settings, script-fading incorporates training diversely. This feature teaches the student the skill of initiation, which Koegel and colleagues identify as a pivotal behavior within the PRT paradigm. IT also relies on training diversely as a defining naturalistic feature. Incorporating mediators is a naturalistic feature common to both script-fading (i.e., peers as mediators) and PRT (i.e., self-management training); IT does not share this particular naturalistic feature. Given its reliance on both diversity in training and incorporating mediators, script-fading is strongly grounded in approaches designed to facilitate generalization and spontaneity. With regard to the naturalistic–analog continuum, script-fading falls within

close range to both PRT and IT, which anchors it somewhere between the naturalistic and analog ends of the continuum.

These three predominant forms of naturalistic intervention—incidental teaching, pivotal response training, and script-fading procedures—and numerous modifications thereof, have undergone considerable evaluation as interventions designed to produce both acquisition and generalization of skills widely considered to be critical in the treatment of autism spectrum disorders (ASD). Perhaps not surprisingly, these critical domains are aligned closely with the DSM-IV-TR (American Psychiatric Association, 2000) diagnostic categories and include procedures to develop and strengthen language and communication skills, to enhance social interactions, and to expand the range of play skills. That literature is now reviewed.

Naturalistic Procedures to Enhance Communication

The ability to effectively communicate is a critical life skill. For students within the school setting, functional communication is important for gaining access to desired items or activities and as a means of making choices and requesting assistance and information throughout the day. Students also require effective communication skills to initiate and maintain social interactions. Such communication allows educators to assist students in those areas for which the student requests clarification or additional direction. Without adequate communication skills, individuals with autism may experience academic frustration and/or failure.

Perhaps because language is such an important prerequisite to both social competence and successful academic performance, research on using naturalistic procedures for language development in individuals with autism has received considerable attention in the literature.

Almost 40 years ago, Hart and Risley (1968) developed their naturalistic "incidental teaching" procedures as a means of increasing the generalization and spontaneous use of language in young children. Subsequent to that, Rogers-Warren and Warren (1980) modified the standard incidental teaching procedures to rely more heavily on teacher directedness for teaching children to request specific objects. In their "mand-model" technique, when a child approaches a specific object, the teacher tells the child to request the object. If the child successfully requests the object, he is given the desired object immediately. If the child does not ask for the object, the teacher models the desired request (e.g., "Can I have the truck?"). Rogers-Warren and Warren successfully taught teachers to use the mand-model approach, and contingent praise was delivered to enhance the use of requests in children with significant language delays. In addition to increasing their use of modeled requests, the child participants demonstrated an increase in both novel words and word combinations. Recently, the mand-model approach has been described as useful for teaching children with autism across multiple natural settings. For example, Wilczynski et al. (2003) described a "working walk" strategy whereby a teacher and student move around a natural environment to take advantage of preplanned and naturally occurring language learning opportunities. For example, a teacher might block access to a door and ask the student what he or she would like. If the student does not respond with either "move please" or "open the door," the teacher models the request. If the student still does not respond, the teacher models it one more time and access through the door is granted. Although this mand-model procedure is naturalistic in that (a) it follows the child's interest as a means of setting up a natural consequence, and (b) it allows for training diversely, it also relies on traditional DTT components such as teacher control of stimulus presentation to initiate learning trials, which may be particularly helpful for children who are less likely to initiate an interaction (Rogers-Warren & Warren).

In the early 1980s, McGee, McClannahan, Krantz and colleagues began investigating their own modifications of the incidental teaching procedures. Their concerns were that the original incidental teaching procedures required an initiation of interaction by the student, a component

that would clearly help identify natural reinforcers, but something that children with autism do not do well. Thus, they altered the procedure to rely more on adult initiations in a natural setting. However, the procedure retained the important naturalistic components of contingent access to natural reinforcers and training diversely. In an early study, two children were taught receptive object labels during a lunch-making activity using four different sets of lunch-making stimuli (McGee, Krantz, Mason, & McClannahan, 1983). During training, an adult initiated an interaction by asking for a specific object (i.e., "Give me _____"), using gestural prompts if necessary, and then rewarding the student for correct responses with verbal praise and access to the object necessary for making lunch. In a multiple baseline design across object sets, the researchers were able to demonstrate within-subject replications of increased use of correct, unprompted receptive object labels during a lunch-making activity. In addition, the newly acquired language skills generalized to both a different setting and time of day, building evidence in support of the naturalistic approach as a means of enhancing generalization.

In a related study, McGee, Krantz, and McClannahan (1985) compared a naturalistic and an analog teaching strategy in terms of their effects on the acquisition and generalization of preposition use in three children with autism. In the analog condition, all stimuli were selected by the teacher, the consequence for the appropriate response was access to an arbitrary reward not related to the training stimuli, and training took place at a table in a traditional one-to-one DTT format. In contrast, within the naturalistic condition, teaching stimuli were child selected, the consequence for appropriate responses was access to the desired teaching stimulus, and training took place in a playlike setting with all stimuli contained on a nearby shelf. Generalization probes took place during free-play settings not originally used for teaching. Although both the naturalistic and analog conditions resulted in an overall increase in the correct use of prepositions, careful analysis revealed that the naturalistic condition resulted in greater generalization of preposition use across settings, teachers, and stimuli. This study was important because it provided evidence supporting the effectiveness of naturalistic procedures in teaching language skills and showed using naturally occurring reinforcers and training in more diverse settings resulted in greater generalization than that found using an analog teaching procedure.

Similar results have been reported in related subsequent studies. Miranda-Linne and Melin (1992) compared naturalistic teaching and traditional DTT procedures in a study designed to facilitate the acquisition, generalization, and spontaneous use of color adjectives in two school-aged children (i.e., a 10-year-old and a 12-year-old) with autism as related to preferred toys and food items. These researchers discriminated between analog and naturalistic procedures in a manner almost identical to methods described by McGee et al. (1985), changing only who initiated the interaction (i.e., child vs. adult), what the consequences were for appropriate responses (i.e., naturalistic vs. artificial reinforcers), and where training took place (i.e., criterion setting vs. one-to-one session). Generalization to a novel setting (i.e., at home, with parents) and novel items in the classroom were monitored closely throughout this study. Initially, when compared to naturalistic teaching procedures, the analog approach resulted in faster acquisition and greater generalization for both students. However, follow-up observations indicated that the naturalistic teaching procedure resulted in equal retention, greater generalization, and equal-to-greater levels of spontaneous use of color adjectives in both target and novel settings. The results of Miranda-Linne and Melin's study confirm that effective teaching strategies can take place in natural settings throughout the classroom and may result in more powerful, generalizable outcomes for students with autism. At the very least, this research builds evidence suggesting that naturalistic procedures can be at least as effective as analog procedures.

In another study investigating the efficacy of naturalistic procedures for increasing communication skills, McGee et al. (1992) modified the traditional incidental teaching approach by incor-

porating mediators as an additional means of enhancing generalization. They employed peer tutors as treatment agents in applied settings to assist children with autism in the acquisition and use of labels during play-based sessions with peers. Specifically, the clinicians trained peers in a procedure similar to those adult-initiated procedures described above. In a naturalistic play setting containing preferred toys, peers were taught to use incidental teaching by waiting for the child with autism to initiate a request, asking the child to label the toy, giving the toy to the child when he labeled it, and then praising the correct response. The tutors were also taught to engage the children with autism in turn-taking to increase the opportunity for more incidental teaching trials. In addition to demonstrating appropriate use of labels, McGee et al. reported that one of the children demonstrated an increase in reciprocal interactions with peers during a novel, free-play situation. This study demonstrates that teaching self-initiations can not only aide in enhancing communication, it can enhance social interactions between children with autism and their typically developing peers.

The reliance by McGee and colleagues on more analog-like adult- and peer-initiated interactions within their naturalistic procedures allowed them to circumvent the fact that children with autism do not typically initiate frequent interactions. Koegel and colleagues choose to deal with this problem in a different way. Their PRT procedures first target self-initiations and then teach the child to use specific language skills for a range of stimuli in naturalistic settings. Specifically, highly desirable stimuli and/or novel stimuli were hidden in paper bags and children were prompted to question "What's that?" (Koegel, Camarata, Valdez-Menchaca, & Koegel, 1998). Once the child initiated an interaction by asking the question, the experimenter modeled the name of the object and the child repeated the noun. All prompts were faded over time and generalization probes in both training and novel settings were used to determine whether the child would generalize his use of self-initiations and labels to new stimuli across settings. This approach utilizes many of the common defining characteristics of naturalistic procedures, including using naturalistic consequences (i.e., the child gains access to a desired item following the behavioral response), training diversely (i.e., a variety of stimuli were used across settings), and incorporating mediators (i.e., using common prompts, then fading).

In a related study, Koegel, Carter, and Koegel (2003) trained children to self-initiate by using books with pop-up features to prompt the question, "What happened?" or "What is happening?" Once the child self-initiated a question in response to a pop-up, the researcher answered the question and then provided the child with access to the highly desired pop-up book. In addition to successfully self-initiating, children were taught to use appropriate temporal morphemes under naturalistic conditions. Gains were also made in untrained generalization settings including increased mean length utterances, number of questions asked, total number of verbs used, and diversity of verb usage. Again, PRT incorporated naturalistic consequences, diverse training, and the programming of common mediators. This line of inquiry is critical because, in addition to teaching children to self-initiate as a means of increasing the number of naturally occurring opportunities to practice communication skills, such procedures teach children to interact with others under a variety of socially valid conditions. That is, children are provided with an opportunity to practice both language development and social exchanges.

In sum, naturalistic approaches to developing communication skills have included natural consequences, diverse training environments, and peer mediators. These approaches have been subjected to numerous evaluations. Variations have addressed the fact that children with autism do not reliably self-initiate, but in general, naturalistic procedures have proven effective in producing both acquisition and generalization of language skills. In addition, when compared to more analog-like procedures, naturalistic procedures tend to result in more favorable outcomes for students, including increased generalization and enhanced spontaneous use of language (Delprato, 2001).

Naturalistic Procedures to Enhance Social Competency

    School-aged children are faced with multiple social demands throughout their educational career. For example, breakfast programs, lunch programs, play time, recess, and "specials" classes rely heavily on social exchanges for successful functioning. Social competencies necessary for success in these environments include entry skills (e.g., initiating a conversation), the ability to maintain interactions (e.g., taking turns, cooperating), and problem-solving skills (e.g., dealing with a disagreement on the playground) (Sheridan, 1995, 1998). These skills also apply to the classroom as children engage in more traditional academics such as learning to read, write, and perform mathematical computations. Developing and maintaining meaningful social relationships with adults and peers in the educational setting is deemed critical—so critical, in fact, that a lack of such skills is a defining characteristic for children with social–emotional disabilities (Gresham, 1997). A qualitative impairment in social functioning is also a defining characteristic of children with autism. The commonality between these two disorders is that the educational system views students' lack of sufficient social competency as interfering with their educational progress (IDEA, 2004). Given the relationship between social competence and successful academic performance, social skills intervention is often targeted in individualized education plans for students with autism. Researchers have investigated whether naturalistic interventions can be effective in increasing the frequency, duration, and generalization of social behaviors across applied settings (e.g., Pierce & Schreibman, 1995, 1997; Storey, Smith, & Strain, 1993). A unique feature of this line of inquiry is the incorporation of both peer tutors and script-fading procedures as means of incorporating mediators.

    Pierce and Schreibman (1995) taught peer "tutors" to function as treatment agents, training the peers to make certain the student is attending prior to stimulus delivery, to give the student choices, to vary toys regularly, to model appropriate discrete social behaviors, to reinforce attempts, to extend conversation, to encourage turn taking, to narrate play sequences, and to teach the student to respond to multiple stimulus cues. Many of these procedures are naturalistic in their reliance on natural consequences through student choice and reinforcement of attempts, diverse training, and the use of peers as instructional mediators. The application of this intervention package resulted in prolonged interactions with peers, the demonstration of initiation of both play and conversation, and increased engagement in language and joint attention behaviors in two school-aged children with autism. Response generalization—defined here as the demonstration of joint attention, a response not targeted by intervention—was evident in both participants.

    Although some evidence suggested generalization, a limitation of this study was that there was no reported evidence of generalization of the target behaviors to more than one peer tutor. In a related study, Pierce and Schreibman (1997) employed peers as treatment agents by teaching them the procedures described above (Pierce & Schreibman, 1995). However, a primary difference between this study and the original study is that the latter study incorporated data collection on the primary dependent variables across both trained and untrained peers. Outcome data provided evidence that two school-aged children with autism improved performance in the following social skills: maintaining interactions, initiating conversations, and initiating play. Perhaps more importantly, results suggested that the target behaviors generalized to other trained and nontrained peers.

    In a parallel line of inquiry spanning across decades of research, Strain and colleagues (e.g., Odom & Strain, 1984, 1986; Strain & Odom, 1986; Storey et al., 1993) have demonstrated that incorporating peers as mediators to enhance social interactions among children with autism and their typically developing peers is indeed an evidence-based mode of treatment. A unique feature of this line of inquiry is the movement away from clinical (e.g., center-based) research

settings (e.g., Odom & Strain, 1986) to applications in the public school settings, utilizing teachers as trainers of peer confederates (Storey et al.). Within the context of this approach to intervention, student confederates are taught to use a variety of skills (e.g., sharing, sharing requests, using complements) to increase social interactions between the children with autism and their peers—an approach very similar to those procedures described earlier in this section. A complete review of this line of inquiry is beyond the scope of this article. However, the interested reader is referred to an article by Bass and Mulick (2007, in this special issue) for a thorough review of this literature.

Scripts have also been used as prompts to enhance social interactions between children with autism and their typically developing peers. Specifically, researchers have investigated the efficacy of incorporating written or audiotaped scripts as mediators across training and generalization conditions, with the goal of increasing the number of initiations children with autism demonstrate toward peers. For example, Krantz and McClannahan (1993) used papers containing socially valid written scripts as prompts to guide the students with autism during interactions with peers. The researchers used scripts reflecting activities students had recently engaged in with other students, activities students were planning for in the future, and objects within the classroom setting. For example, during a classroom activity one student was prompted to ask another, "Mike, what do you like to do best on Fun Fridays?" (p. 125). During training, some manual prompts were necessary. Manual prompts included guiding the student to look at the script and teaching the student to use a pencil to follow the words as he read. Once manual prompts were faded, the teacher positioned herself in a periphery location within the classroom setting and scripts were systematically faded by gradually decreasing the number of words on the visual prompt (i.e., they began with a full phrase in printed text and ended with merely a pair of quotation marks). In this investigation, scripts were faded using a five-step gradual reduction of written text.

Using the number of initiations and responses as the primary dependent variables, Krantz and McClannahan (1993) reported that the school-aged participants demonstrated an increase in social initiation with and responsiveness to peers in applied settings. In addition to tracking the scripted initiations, data were maintained on unscripted initiations. Analyses of these data revealed that as scripted initiations decreased, unscripted initiations systematically increased. Similar findings have been reported elsewhere under slightly different conditions. For example, Sarokoff, Taylor, and Poulson (2001) incorporated scripts into classroom activities by attaching textual phrases to either snack packages or videogame boxes. Once the students were taught to read the script in the applied setting through manual prompts, scripts were systematically faded using the same five-step fading procedure described in Krantz and McClannahan (1993). In addition to demonstrating an increase in scripted interactions, the participants demonstrated unscripted statements and they generalized such a statement to novel conditions.

Unique modifications to script-fading have been studied for use with both early readers and nonreaders. For example, Krantz and McClannahan (1998) embedded scripts into the visual schedules of preschool-aged children who were beginning readers. These scripts were incorporated to increase the boys' initiations with others within applied settings. Because their interactions with adults were significantly fewer than desired, scripts targeting initiations with adults were the primary focus of this study. These scripts were less elaborate than those in the initial study with older children, incorporating the following scripts into regular activities: "Watch me" and "Look." Because these scripts contained fewer words, script-fading took place in three phases. Each phase involved cutting away part of the visual cue until it was entirely faded. Once the students were trained to use the scripts to increase their use of scripted initiations, their demonstrated increase in verbal elaborations and unscripted interactions were maintained as new teachers were introduced into the naturalistic setting. In addition, after scripts were faded, treatment gains were maintained

and unscripted interactions generalized to different activities and topics. This study builds further evidence in support of the use of incorporating mediators to enhance generalization.

In another extension of script-fading, Stevenson et al. (2000) incorporated scripts through audiotaped messages for students who were nonreaders. This study relied on the use of Language Master, a device that reads and plays aloud small plastic cards containing various audiotaped scripts for social interactions. The participants were taught to incorporate the use of this technology into applied social settings. Specifically, students were prompted to use their Language Master cards through the use of visual icons on their visual schedule books. In addition to the visual cues, the teacher manually prompted the student through a visual sequence that walked them through the use of the Language Master. Once the children began to demonstrate the skill reliably, manual prompts were faded. The scripts were systematically faded through an eight-step procedure that began by fading one word at a time, which was followed by the removal of the Language Master and clipboard, ending with the removal of the cards as cues. Data demonstrated an increase in both scripted and unscripted interactions between the students and targeted adults across settings. A unique feature of this study was its use of an audiotaped script as a mediator across training and generalization conditions. This unique application allowed teachers to implement script-fading for students who were nonreaders.

Together these studies demonstrate that script-fading can be an effective means of improving social functioning in children with autism. Reliance on diverse training and the incorporation of peers as mediators identifies script-fading as a naturalistic procedure that has produced both increases and generalization of important social skills. Interestingly, although script-fading is typically discussed as an intervention targeting social development, it clearly addresses development of communication skills as well. Likewise, naturalistic procedures designed to develop communication skills also indirectly address social relationships. In sum, there is much overlap in the application of naturalistic procedures designed to target communication and social skills development.

Naturalistic Procedures to Enhance Play Skills

Children with autism demonstrate a restricted range of interests often revealed in qualitative impairments in symbolic, functional, and sociodramatic play (Seigel, 2003). Even when children with autism are taught more adaptive play skills, they are often rigid and limited and do not generalize well to novel toys and settings (e.g., Terpstra, Higgins, & Pierce, 2002). Play skills are important because they provide means by which children socialize and communicate with peers. In addition, children with inadequate play skills have been found to exhibit more disruptive behavior problems (e.g., Thorp, Stahmer, & Schreibman, 1995). Given the relevance of play skills to overall adaptive functioning, it is not surprising that researchers have explored the application of naturalistic procedures to the development and enhance of advanced play.

Stahmer (1995) developed a naturalistic approach to teach children to perform symbolic play. This researcher defined symbolic play, in part, as activities in which the child uses an object as if it were something else, such as a child pushing a block across the carpet pretending it is a boat. Symbolic play was also defined as using objects in ways that reflect features not really present, such as pretending to peel a plastic banana and pretending to throw the peel away. Finally, symbolic play could include reference to imagined objects as if they were physically present, such as pretending to eat an apple not really present. Treatment consisted of discrete trial training in naturalistic settings. Each discrete trial began by showing the child a preferred toy or object. Once the child's attention was captured, the teacher modeled symbolic play with the toy or object. If the child did not respond, symbolic play was modeled again. The procedure also included numerous naturalistic elements. Both approximations to and exact responses were reinforced with access to

the preferred object. In addition, the teacher trained diversely by interspersing mastered functional play along with trials teaching symbolic play to increase variation and allow for success.

As compared to baseline observations, data showed that following treatment, the children demonstrated an increase in both symbolic play and play complexity. In addition, it was observed that as the complexity of their play skills increased, their responsiveness to peers also increased. Follow-up probes indicated maintenance at 3 months postintervention. In addition, the play skills treatment generalized to new situations. Finally, the students were observed to develop their own unique play actions and to demonstrate them at rates similar to those of their typically developing peers, enhancing the quality and breadth of social interactions.

In a related study, Thorp et al. (1995) used a naturalistic procedure to teach children socio-dramatic play skills. Sociodramatic play skills included role-playing (i.e., adopting the role of a real or fictitious character), make-believe transformations (e.g., substituting make-believe objects for real objects, as related to dramatic play sequence), and persistence (i.e., carrying out an entire theme from beginning to end). Treatment consisted of the same analog and naturalistic training procedures as used in the Stahmer (1995) study, with the exception of focusing on sociodramatic play instead of symbolic play. In addition to increased demonstrations of sociodramatic play skills, again the children demonstrated an increase in positive responses to their peers.

The initial results of this line of inquiry suggest that combined analog and naturalistic procedures can be used to enhance the child's play skills repertoire, which increasingly "normalizes" their ability to engage in play-based activities mimicking those of their peers. Furthermore, the data suggest that as the quality of their play increases, their responsiveness to peers is also improved. Finally, although these studies offer no endorsement of the relative merits of analog or naturalistic procedures, they suggest that the two can be combined to effectively address both acquisition and generalization of skills important to the treatment of children with autism.

Conclusions and Implications for Research and Practice

Teaching children with autism can be a challenge. Arranging for an intensive, structured, and controlled analog teaching environment can help. Extensive research has demonstrated that these types of teaching interactions are important in the development of basic communication, social, and play skills. However, that help comes at a cost. Skills learned under these highly structured and controlled analog teaching environments often do not generalize well. Naturalistic procedures can help in addressing that concern. A well-developed line of research has repeatedly demonstrated that less controlled teaching that occurs within the diversity of the natural environment, driven by the interests of the child and prompted by peer or scripted mediators can produce important communication, social, and play skills that do generalize to natural and novel settings.

Must one choose between analog and naturalistic procedures? We think not. Our review of the research suggests that the dichotomy is often more apparent than real. Certainly naturalistic procedures have distinctive features characterized by the use of natural consequences, diversity in training, and the incorporation of mediators of training. However, much of the research on the most popular naturalistic procedures shows that they commonly are modified to incorporate elements of analog procedures as well. Perhaps the best teaching procedures are those that combine both. Unfortunately, direct comparisons of exclusively analog interventions, exclusively naturalistic interventions, and combinations of the two have yet to be conducted.

Are there times that choosing makes sense? We believe so. Analog procedures appear to be best suited for conditional discrimination training and the establishment of tight stimulus control. Thus, if one is attempting to teach a child to make a complex discrimination, using a largely analog approach may be in order. On the other hand, naturalistic procedures appear to be best suited for generating generalized responding. Thus, if one is most concerned with the generaliza-

tion of acquired skills across settings, stimuli, and/or related conditions, a more naturalistic approach may be warranted. Note, however, that this distinction is not always clear and the recommendation is speculative at best. The field is only just beginning to build some evidence to support the validity of linking the outcome objective to the choice of treatment. There remains a need for controlled studies comparing and contrasting various approaches as linked to the objectives of both discrimination and generalization. These kinds of studies may yield data that inform practice with greater confidence.

In the meantime, practitioners are encouraged to increase their knowledge and understanding of both analog and naturalistic approaches to teaching children with autism. The research reviewed here strongly supports the merits of naturalistic teaching and also analog procedures that incorporate naturalistic modifications. In addition, the three key elements of naturalistic procedures have considerable conceptual support in other literature as well (Stokes & Osnes, 1989). Thus practitioners should feel confident in their efforts to incorporate natural consequences, diverse training, and functional mediators into their everyday classroom routine.

Recommended Resources

We end this article with a brief discussion of resources for school psychologists, educators, and other practitioners interested in learning more about the naturalistic procedures described earlier. To begin, we highly recommend R. Koegel and L. Koegel's (2006) latest volume on PRT entitled *Pivotal Response Treatments for Autism*. This edited volume provides a thorough discussion of PRT as applied to enhancing communication and social development, reducing disruptive behaviors, and broadening children's interests and behavior skills. Additional information about PRT is available at the Koegel Autism Center's Web site (http://www.education.ucsb.edu/autism/index.html). This Web site contains information about how to target initiation and motivation to enhance learning for children with autism, including training manuals for educators. It also contains information and resources to assist educators in working with parents and families to enhance learning in the home environment.

Another seminal volume for those interested in learning more about naturalistic procedures is B. Hart and T. Risley's (1982), *How to Use Incidental Teaching for Elaborating Language*. Although this book is somewhat dated, it contains information about the conceptual and theoretical bases of the incidental teaching approach to language development. Further, it summarizes Hart and Risley's earlier research and provides a context for additional research spanning several decades. Finally, we recommend a volume edited by Maurice, Green, and Foxx (2001) entitled *Making a Difference: Behavioral Intervention for Autism*. This book covers a variety of topics related to behavioral intervention for children with autism spectrum disorders. Although many of the chapters in this book may be valuable to educational professionals, we particularly recommend a chapter on incidental teaching by P. Krantz and L. McClannahan. We feel that these resources will be helpful to practitioners in their efforts to incorporate natural consequences, diverse training, and functional mediators into their daily classroom routines.

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