Journal of Autism and Developmental Disorders, Vol. 31, No. 3, 2001

Comparisons of Discrete-Trial and Normalized Behavioral Language Intervention for Young Children with Autism

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This critical review examined a series of 10 controlled studies in which traditional operant behavioral procedures were compared with more recently developed normalized interventions for teaching language to young children with autism. Main characteristics of the older treatments include highly structured direct teaching sessions of discrete trials, teacher initiation, artificial reinforcers, and response shaping. Normalized interventions consist of loosely structured sessions of indirect teaching with everyday situations, child initiation, natural reinforcers, and liberal criteria for presentation of reinforcers. The main conclusion was that in all eight studies with language criterion responses, normalized language training was more effective than discrete-trial training. Furthermore, in both studies that assessed parental affect, normalized treatment yielded more positive affect than discrete-trial training.

KEY WORDS: autism; children; behavioral intervention; discrete-trial treatment; normalized treatment; language intervention.

INTRODUCTION

Traditional operant behavioral procedures have been effective in enhancing autistic children's language performance (Koegel, Rincover, & Egel, 1982; Lovaas, 1977; Risley & Wolf, 1967; Wolf, Risley, & Mees, 1964). Many attributes of the first-generation behavioral protocols reflect their close ties to experimental research. The main procedural characteristics of the original behavioral interventions used with autistic children are summarized in Table I, where they are described by the labels discrete-trial, direct instruction, and artificial.

Behavioral language teachers of autistic children now have available protocols that depart from the original ones in several important ways. Although the principles behind the newer, normalized procedures remain linked to basic research, their actualization in language teaching does not readily remind one of conventional experiments. Table I presents the main procedural characteristics of normalized interventions next to corresponding ones found in discrete-trial training. The normalized list was extracted from Hart and Risley (1974, 1975, 1982); Koegel, O'Dell, and Koegel (1987); and Koegel, Schreibman, Good, Cerniglia, Murphy, and Koegel (1989). Comparison of the normalized guidelines with those for discrete-trial treatment reveals striking differences. When properly conducted, normalized teaching does not give the appearance to the casual observer of anything special occurring. Yet, more expert analysis reveals systematic applications of behavioral principles, such as those pertaining to stimulus control, consequation, and motivation.

Like discrete-trial treatments, normalized therapies have multiple components. That is, their implementation involves more than one procedural step. The procedural characteristics of normalized interventions provided in Table I are found, in varying degrees, under different key words. Hart and Risley (1974) may have first referred to the earliest incarnation of normalized teaching as incidental teaching in a follow up

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0162-3257/01/0600-0315$19.50/0

Table I. Main Procedural Characteristics of Two Classes of Behavioral Language Intervention Used with Autistic Children

Discrete-trial/ direct instruction/ artificial interventions	Normalized interventions
Sessions and teaching episodes	
Highly structured sessions that are paced by the teacher, who initiates teaching episodes by providing occasions (discrete trials) for the child to respond that are separated by a specified interval.	Loosely structured sessions that are paced by the child who initiates teaching episodes under free-operant conditions by attending to stimuli or evidencing a particular want.
Directness of instruction and setting	
Direct instruction conducted with teacher and child seated for discrete-trial episodes with distractions minimized.	Indirect-instruction episodes conducted with teacher and child in a various places and positions in the presence of a variety of stimuli; typically a play setting.
Stimuli preceding response opportunities	
Antecedent stimuli are teacher selected and represented until the child reaches criterion.	Antecedent stimuli are child selected which, therefore, can vary from episode to episode.
Targeted response	
Same response targeted for several successive teaching episodes.	No particular order of target responses within a session.
Prompt strategies	
Remain constant for particular target responses.	Vary according to the child's initiating responses.
Reinforcers	
Functionally unrelated to target responses and relatively invariant across teaching episodes.	Functionally related to target responses and variant across teaching episodes.
Criteria for presentation of reinforcer	
Reinforcer presentations for correct response or successive approximations.	Liberal shaping whereby attempts to respond are positively reinforced.

to their earlier report (Hart & Risley, 1968) on work with disadvantaged children's use of descriptive adjectives. An incidental teaching episode occurs in a naturalistic setting that contains stimulus objects and opportunities for activities that are likely to promote verbal behavior. An episode begins when the child gives an indication that they are prepared to participate in some form of communication in relation to an object or activity. Upon child initiation of the episode, the teacher attends to the child to provide a normal condition for one person to speak to another. If the child exhibits appropriate speaking, the teacher ends the episode by confirming the child's successful responding. This is accomplished by verbally telling the child they were correct or just what they said that was appropriate and by supplying what the child asked for or expressed interest in (i.e., naturalistic reinforcer). Typically, the teacher uses an elaboration request after child initiation in order to assist the child in improving their language performance. Finally, an intricate aspect of incidental teaching consists of the teacher's use of prompting and modeling to develop elaboration.

Incidental teaching, originating with Hart and Risley (1968, 1974), was followed by some procedural elaborations that developers first referred to as the natural language teaching paradigm (Koegel *et al.*, 1987) and later, after further procedural additions, pivotal response training (Koegel *et al.*, 1989). The main procedural components pivotal response training added to those of incidental teaching are greater attention to presentation of multiple cues (antecedent stimuli with multiple components), frequent interspersal of maintenance

tasks, and presentation of positive reinforcers contingent on response attempts (Koegel *et al.*, 1989).

Researchers have found that normalized procedures are effective in teaching language to autistic children. Carr and Kologinsky (1983) used a rudimentary set of normalized procedures in teaching sign language by allowing children to determine signs that would be functionally reinforced on particular occasions and found that spontaneous signed requests increased over baseline with six children. Two severely language-delayed autistic children showed greatly improved receptive labeling for four sets of food-related objects in conjunction with an adaptation of incidental teaching during lunch-preparation activities; furthermore, the language skills generalized to an untrained setting (McGee, Krantz, Mason, & McClannahan, 1983). Laski, Charlop, and Schreibman (1988) found that after eight parents were trained, they exhibited increased frequencies of application of certain key components of pivotal response training in a play setting. Furthermore, the children of these parents showed corresponding increases in appropriate speech.

Although Carr and Kologinsky (1983), McGee *et al.* (1983), and Laski *et al.* (1988) used multiple-baseline designs to provide convincing data that their normalized procedures were more effective than minimal treatment baseline conditions, it is possible that discrete-trial treatment would have been equally effective as the normalized interventions. Indeed, given the absence of discrete-trial comparison conditions, one cannot rule out that discrete-trial procedures would be more effective than normalized ones under the same conditions. Clearly, conclusions regarding the possible contribution of normalized interventions require controlled comparative investigations that include both discrete-trial and the more recently developed treatments.

The remainder of this paper reviews studies in which researchers used experimental methodology to compare discrete-trial and normalized behavioral language interventions with young children who were diagnosed as autistic. Determination of the relative interventive power of discrete-trial and normalized procedures is important for several reasons. Discrete-trial behavioral treatments are widely adopted (e.g., Holmes, Smith, Thomas, & Delprato, 1999; Maurice, Green, & Luce, 1996), and clinicians might be advised to reconsider routinely prescribing them in the face of satisfactory data indicating superiority of alternative normalized procedures under certain conditions. Normalized treatments application in free play and other everyday conditions, as well as their child-centered orientation, contribute to their appearance of being more humanistic than discrete-trial procedures. Because of this, it appears that parents and others often are more receptive to normalized treatments. The social appeal of normalized procedures, if coupled with greater efficacy, has implications for public acceptability of behavioral interventions. Finally, normalized treatments depart significantly from discrete-trial procedures in terms of basic assumptions. The former derives from assumptions that language learning can be enhanced by everyday settings and tasks, indirect instruction, liberal ("loose") shaping, no prearranged protocol for the sequence of teaching episodes in a session, and a child-led strategy. If normalized treatments are more effective than discrete-trial treatments for at least some problems, researchers might be encouraged to continue probing as yet unexplored renditions of normalized procedures as well as problem areas to which these interventions might advantageously apply.

INCLUSION CRITERIA AND SAMPLE CHARACTERISTICS

Contemporary standards for psychosocial intervention research were used to select and evaluate studies included in this review (Lonigan, Elbert, & Johnson, 1998; Nathan & Gorman, 1998; Task Force on Promotion and Dissemination of Psychological Procedures, 1995). An inviolate requirement was that studies had to meet basic prerequisites for experimental research. Single-case studies were required to exert experimental control via either reversal or multiple-baseline designs, and group studies had to use random assignment. The inclusion criterion requiring that normalized treatments were compared with established discrete-trial training ensured a rigorous assessment of the power of the newer approach.

All children in the included studies met at least one criterion for autism. With few exceptions, criteria were those of the Diagnostic and Statistical Manual of Mental Disorders (American Psychiatric Association, 1987, 1994) and the National Society for Autistic Children (Ritvo & Freeman, 1978). The authors of two studies did not supply the sex of children and one provided the sex on 2 out of 3 children. Of the participants on whom sex data were available, 29 were male and 12 were female. The best estimate of the median age of children over the 10 reviewed studies yielded a range of 3 to 8 years with an overall median of 5 years.

Inclusion required that researchers target some aspect of language performance that was measured with at least one scientifically acceptable criterion variable

based on the requirement of satisfactory interobserver agreement. Agreement between independent observers, who coded at least a substantial sample of data, reported in the reviewed studies was uniformly 80% or higher. Not all studies reported using blind assessment. Five of them obtained data from coders who were naive to all or a substantial portion of the data (Koegel, Bimbela, & Schreibman, 1996; Koegel & Williams, 1980; McGee, Krantz, &McClannahan, 1985; Schreibman, Kaneko, & Koegel, 1991; Williams, Koegel, & Egel, 1981). In only three studies in the sample did researchers evaluate treatment fidelity by confirming with empirical data that treatment procedures were carried out as described (Koegel, O'Dell, & Dunlap, 1988; Koegel, Koegel, & Surratt, 1992; Schreibman *et al.*, 1991).

The most methodologically sophisticated psychosocial intervention studies are conducted with a treatment manual (e.g., Nathan & Gorman, 1998). No study in the sample explicitly indicated that a printed manual guided treatment. However, two considerations mitigate the omission of treatment manuals in the series. First, both incidental teaching (Hart & Risley, 1982) and pivotal response training (Koegel *et al.*, 1989) have treatment manuals that closely follow procedures supplied in the published reports of studies included in the present review. Second, procedural descriptions in all studies were very detailed.

RESULTS

The studies covered in this review are briefly summarized in Table II.

Single-Component Modifications of Discrete-Trial Training

The multicomponent nature of discrete-trial and normalized treatments allows for research manipulating as few as one component that varies between them. Three studies examined one variable on which the two types of treatment differ. Two of these studies manipulated the relation between response occurrences and the reinforcer. Normalized treatments require what Ferster (1967) referred to as natural reinforcers. Natural reinforcers function as reinforcers because of their direct relation to the response. Reinforcing a child with a sip of juice following the to-be-learned spontaneous verbalization, "I want juice" is more natural than making a piece of cookie contingent on the desired response. Given the response, the latter is a nondirect, contrived, arbitrary, or artificial reinforcer. A sip of juice is more functional than a cookie for the response, "I want juice."

Koegel and Williams (1980) used a single-subject multiple-baseline design to assess three children's acquisition of 1–3 responses, including four receptive language responses and one verbal imitation response. The baseline condition was discrete-trial teaching (Koegel, Russo, & Rincover, 1977; Lovaas, 1981) with arbitrary reinforcers. The experimental condition was identical to baseline treatment except the researchers identified and used individual natural reinforcers for each target response. Experimental control was enhanced by using the same stimulus object in both arbitrary and natural reinforcer conditions. For example, when teaching the child to respond to "Pick up white [box]," in the arbitrary condition, the teacher handed the child a cracker following a correct response. In the natural reinforcer condition, the child had access to a cracker upon responding correctly because the reinforcer was located in a recess under the box. Percentage correct responses and trials to criterion measures consistently favored the natural reinforcer condition. Correct responding in the arbitrary reinforcement condition rarely exceeded 40% and usually was much lower. Changes to natural reinforcement were uniformly accompanied by rapid increases in correct responding with 100% attained for all responses except one on which training terminated at 86% correct performance after 12 trials.

When teaching three children a variety of receptive responses, Williams *et al.* (1981) obtained results very much like those of Koegel and Williams (1980). Only one child's performance of one response gave any indication of improvement over as many as 325 discrete trials, and it reached 50% correct. All three children exceeded 90% criterion on all responses by 25 trials under the natural reinforcement condition. A rigorous test of stimulus control was used by randomly alternating tests of target responses with other previously acquired responses over two children; 5/6 responses were performed at 100% correct and the other response was correct on 80% of the test trials.

Goetz, Schuler, and Sailor (1983) expressed concern over shortcomings of conventional operant approaches to teaching language to handicapped students and suggested that behavioral interventionists explore more normalized procedures, including motivational analysis. Koegel *et al.* (1988) proposed a procedural modification of artificial behavioral treatments to address children's motivation to respond. Specifically, they hypothesized that a liberal set of criteria for presenting reinforcers would increase children's motivation to speak and thus improve training outcomes. The

Table II. Summary of Ten Controlled Studies Comparing Discrete-Trial and Normalized Behavioral Language Intervention for Young Children with Autism[a]

Study	Criterion responses	Procedural departure from DTT	Design	Total *n*	Results for acquisition phase	Results for generalization testing
			Single component modification of discrete-trial training			
Koegel & Williams (1980)	Child specific	Natural reinforcers	Multiple baseline	3	Percentage correct responses and trials to criterion consistently superior for normalized condition	Not assessed
Williams *et al.* (1981)	Receptive language	Natural reinforcers	Multiple baseline	3	Percentage correct responses consistently superior for normalized condition	Not assessed
Koegel *et al.* (1988)	Speech production and child affect/behavior	Reinforced attempts	Reversal	4	All comparisons for correct speech production and child affect/behavior favored normalized conditions	Not assessed
			Multicomponent modification of discrete-trial training			
Neef *et al.* (1984)	Yes/no responses	Incidental teaching	Multiple baseline	4	Normalized condition accompanied by increased percentage correct responding with 4/4 children	After normalized training, correct responding obtained to nontrained questions but no controlled comparative data
McGee *et al.* (1985)	Preposition use	Incidental teaching	Multiple baseline	3	DTT and normalized teaching resulted in comparable rates and levels of acquisition	Normalized teaching contributed to correct responding (a) in a nontraining setting with a different treacher, (b) to describe novel positions, and (c) in spontaneous use of prepositions
Koegel *et al.* (1987)	Imitative responses	Natural language teaching paradigm/pivotal response training	Multiple baseline	2	Virtually no acquisition with DTT over 2 or 19 months; normalized teaching accompanied by clinically meaningful increases in imitative, deferred imitative, and spontaneous utterances	Generalized immediate imitative responding outside the clinic to adults not associated with training
Koegel *et al.* (1992)	Speech production and disruptive responses	Natural language teaching paradigm/pivotal response training	Repeated reversal	3	Normalized training consistently led to higher production means and lower disruptive percentages	Not assessed
Koegel *et al.* (1998)	Speech intelligibility	Pivotal response training	Reversal	5	Generalization performance was of concern; most children did show evidence of some acquisition in association with DTT	In nontraining setting: DTT seldom different from from baseline; normalized training regularly led to 80% or more correct responding
Schreibman *et al.* (1991)	Parental affect	Pivotal response training	Random groups	19	Greater positive affect with normalized training ($ps < .01$)	Not assessed
Koegel *et al.* (1996)	Parental affect	Pivotal response training	Random groups	17	Not assessed	At home dinnertime: Greater positive affect with normalized training ($p < .032$)

[a] DTT, discrete-trial training.

researchers used a reversal design with four severely communication-delayed children to evaluate discrete-trial treatment under two conditions of reinforcer delivery. One, standard shaping, required that teachers reinforce successive approximations of motor speech. In the experimental condition, the teacher reinforced attempts to speak, regardless of whether they were correct according to phonetic requirements. Reinforcers in both conditions consisted of opportunities to play with preferred toys used as part of the verbal modeling of target words that was followed in all phases of training.

Koegel *et al.* (1988) used two sets of criterion measures. One was the the mean number of phonemic steps, out of 12 levels based on distinctive features, gained or lost. When children's scores on this measure were compared under each condition, all comparisons strongly favored the reinforced attempts sessions. Differences on eight comparisons across the four children ranged between approximately .3 and 4.2 (against a maximum possible difference of 12 points). The other set of criterion measures consisted of ratings of children's affect and general conduct during sessions. Without fail, affect levels were higher in the reinforced attempts condition and, furthermore, only this condition yielded affect ratings in the positive range of the bipolar scales (with neutral represented by scores of 1.7 to 3.3 on the 5-point scales).

Two of the studies that experimentally examined outcomes of a single alteration of discrete-trial training in language training with autistic children (Koegel & Williams, 1980; Williams *et al.,* 1981) found that natural or functional reinforcers were more effective than the more frequently used arbitrary reinforcement conditions. The third study (Koegel *et al.,* 1988) obtained superior motor speech production gains and higher affect ratings when attempts to speak were reinforced, as compared with conventional operant shaping rules for reinforcer presentation.

Multicomponent Modifications of Discrete-Trial Training

Several studies went beyond examinations of the effects of variations of a single component of behavioral language intervention to comparisons of more complete normalized treatments with discrete-trial procedures. The typical study in this group used all or most of the procedural features of normalized interventions seen in Table I.

Neef, Walters, and Egel (1984) first used sit-down discrete-trial sessions to teach generative "yes/no" responses to four children enrolled in a special education program for autistic children. Subsequently, a form of incidental teaching was introduced via a multiple-baseline design across children. The normalized teaching took place throughout the school day in the context of regular classroom activities. Episodes were child-initiated requests of objects and the teaching instructional stimulus was a question in the form of an enquiry regarding the object: "Do you want _____ ?" Correct "yes" responses were followed by descriptive praise and presentation of the requested object. "No" responses to apparently desired objects were followed by witholding of the object and the statement "No, you don't want it? O.K. I'll ask again later." Discrete-trial teaching occurred in segregated and dedicated sessions with episodes teacher initiated by presentation of an object (toy or edible) and a question in the form of "Is this a _____ ?" Correct "yes" or "no" responses were followed by descriptive praise and delivery of the object. When the student responded incorrectly, the teacher modeled the correct response and re-presented the question until the student supplied a correct response.

All four of Neef *et al.*'s (1984) students showed convincing increases in correct responding in conjunction with the normalized teaching. Although performance during discrete-trial training tended to remain at a chance level of 50%, the normalized condition led to 80% and above correct responses after 1–8 sessions. Furthermore, in addition to its favorable impact on acquisition, normalized teaching generalized to questions involving nontrained objects and other attributes, i.e., actions, possession, and spatial relations.

Because their methodology did not permit direct comparison of the contribution of discrete-trial and incidental training to performance under extratraining conditions, Neef *et al.*'s (1984) data are only suggestive regarding the impact of the two methods on generalization. McGee *et al.* (1985) devised a controlled comparison of the two approaches for acquisition and generalization, including spontaneous use of speech. They taught three children three pairs of prepositions (e.g., on-under) via discrete-trial and incidental teaching. One member of each pair (e.g., on) was taught by one method and the other member (e.g., under) was taught by the alternative method in the same session. The order of teaching procedures alternated from session to session. Probes for correct responding were used to monitor performance (a) during a procedurally inert baseline period of different lengths across prepositions and children, (b) in active teaching sessions, and (c) on generalization tests during baseline and teaching phases.

In contrast to Neef *et al.*'s (1984) finding of superior acquisition with incidental teaching, McGee *et al.* (1985) obtained similar rates of improvement with each procedure. Both were highly effective, as indicated by terminal performance levels on the last three sessions ranging between 87 and 100% over children and procedures. The normalized method of teaching yielded convincingly greater generalization than did the artificial set of procedures. One measure of generalization was the mean frequency of correct preposition use in a different location during a 10-minute nontraining free-play session with a different teacher. The mean of these frequencies over children was either 1 (for prepositions assigned to discrete-trial teaching) or zero (for prepositions assigned to incidental teaching) during baseline, 3 following discrete-trial teaching, and 7 after incidental teaching. These means reflected all children's patterns over conditions.

Another measure of generalization was the children's correct use of prepositions to describe novel positions of training stimuli in the free-play setting. Two of the children were far more likely to correctly use prepositions after incidental than after discrete-trial training. One child's mean number of correct uses per session was .09 and 2.0 for discrete-trial and incidental teaching, respectively. The other's corresponding means were 3.0 and 6.0. The third child never exhibited novel position generalization following discrete-trial training and did so only two times with prepositions learned via incidental teaching over all tests. Finally, the mean percentages of correct spontaneous use of prepositions favored incidental teaching for all three children: child 1 (3 vs. 19%); child 2 (9 vs. 36%), and child 3 (25 vs. 36%).

In summary, McGee *et al.* (1985) found that discrete-trial and incidental teaching were equally effective in promoting acquisition but the latter produced greater generalization on different measures. The comparable effects of the two methods on acquisition do not appear to be attributable to a ceiling effect in that all children took approximately 35 sessions at 20 episodes per session to reach asymptote.

As described above, Koegel and his collaborators investigated single-component variations from artificial discrete-trial procedures (Koegel *et al.*, 1988; Koegel & Williams, 1980; Williams *et al.*, 1981). This research group also has conducted several controlled comparative evaluations of the multicomponent program they now refer to as pivotal response training. One study with two children who were extremely delayed in language development targeted imitative labeling in a multiple-baseline design (Koegel *et al.*, 1987). After 2 or 19 months of discrete-trial teaching, were taught with the normalized set of procedures. In- and outside-clinic probes for imitative, deferred imitative, and spontaneous utterances were taken prior to treatment and monthly at random points throughout the study. Correct responses were virtually nonexistent during the extended discrete-trial training periods. On the other hand, with normalized treatment in-clinic performance on all three measures reached clinically meaningful levels. Outside-clinic responding in the presence of adults who were not associated with training also was encouraging, especially for immediate imitations. To summarize Koegel *et al.*'s (1987) findings, normalized treatment was more effective than discrete-trial procedures for acquisition and generalization.

Koegel *et al.*'s (1988) single-component modification of discrete-trial training in the form of reinforced attempts to respond facilitated language learning and was associated with improvements in children's affect and conduct during sessions (see above). Koegel *et al.* (1992) examined these same criterion measures with a more complete multicomponent pivotal response training intervention. Participants were three preschool children with autism, each of whom exhibited a variety of problem responses. Language targets were identified individually based on the child's level of language development. The researchers assessed treatments over a 3-month period via repeated reversals with a range of one to six consecutive 10-minute sessions per phase.

Two criterion language measures were used for two children, and a single measure tapped the third child's language behavior. The normalized intervention yielded higher means for all five measures. Greatest differences were for child 2's attempts to produce words (13.5 for discrete trial vs. 35.1 for normalized), the same child's correct words (0.28 for discrete trial vs. 3.4 for normalized), and child 1's rate of single-word utterances per minute (72.5 for discrete trial vs. 82 for normalized). Not only was the normalized treatment more effective in language training, it also contributed to notably less problematic responding as measured in 10-second intervals throughout sessions. The child with the smallest difference in mean percentage of intervals with disruptive behavior showed a reduction from 31 to 4% between discrete-trial and normalized treatment. Corresponding reductions for the other children were 53–4% and 65–8%.

Koegel *et al.*'s 1992 results are consistent with all those thus far covered in this review. Normalized procedures were superior to the discrete-trial method for language training and in reducing problematic responses. The reversal-based design was not conducive to producing acquisition curves; however, given the

target responses in relation to the children's level of language development, it is likely that criterion responses represent a combination of acquisition and performance. Generalization was not tested.

Speech intelligibility is a critical factor in children's social use of language. Although intelligibility scores are not absolute characteristics but are dependent on nonspeaker factors, such as the speaker-listener dyad, test material or content, and setting (Kent, 1993), it is possible to obtain clinically and socially meaningful ratings of direct speaker performance. Five children diagnosed with autism were participants in a comparison of discrete-trial and pivotal response training for increasing speech intelligibility (Koegel, Camarata, Koegel, Ben-Tall, & Smith, 1998). The researchers used an ABA design in which the active interventions were preceded by a period of inert baseline data collection. Discrete-trial training followed orthodox procedures. After the child met 80% criterion on a target sound, the clinician selected a picture of an object containing the target to teach the sound in a word. The complexity of speech production was gradually increased to using the sound spontaneously to a picture, in phrases, in a sentence, and in increasing numbers of sentences. Normalized teaching followed most of the procedures of pivotal response training (Koegel *et al.* 1989), including play interactions, reinforced attempts, natural reinforcers, and child choice of the activity within which teaching stimuli were embedded. The target sound was taught during natural interactions as opposed to isolated sessions.

The most important measures were functional use data prior to treatment sessions in a different room in the clinic building and periodic samples at the child's school and at home. In all cases, children's percentage correct production of target sounds was obtained from a minimum of six productions of each sound while interacting with at least one individual other than their therapist. On these generalization tests, all children exhibited much higher percentage correct responses when in the normalized teaching condition. Discrete-trial performance was seldom different from baseline which, in turn, hovered at or close to zero on numerous occasions. On the other hand, as training in the normalized condition progressed, all children regularly attained at least 80% correct responding. The near null effect of discrete-trial training on functional use of the targeted words led Koegel *et al.* to examine whether children gave any indication of acquisition within sessions. Inspection of the criterion level reached in treatment sessions revealed that, in most cases, children did learn to produce targeted speech sounds.

Koegel *et al.* (1998) provided convincing data showing that both discrete-trial and normalized treatment were effective in producing acquisition of speech intelligibility. However, only the normalized intervention was associated with functional use of targeted sounds during generalization assessments involving conversation.

Research reviewed thus far indicates that normalized therapy produced positive effects on more than children's targeted language responses. Two studies showed that, in comparison with discrete-trial training, normalized intervention targeting language responses was considerably more effective in reducing disruptive responding (Koegel *et al.*, 1988, 1992). Other research has compared the collateral effects of artificial and normalized behavioral language training on parents' behavior. Schreibman *et al.* (1991) randomly assigned 19 parents (17 mothers and 2 fathers) to either discrete-trial or pivotal response training. An additional five mothers received training in the discrete-trial protocol and, subsequently, the normalized one. The researchers monitored parents' acquisition of treatment procedures and used randomly selected 5-min videotaped segments after parents reached 80% mastery to assess parents' enthusiasm, interest, and happiness via 6-point Likert scales, which were anchored with negative, scored 0, e.g., for happiness, parent appears to be discontented, disappointed, or frustrated and seems not to be enjoying self, and positive, scored 5, e.g., for happiness, smiles, laughs appropriately, seems to be enjoying self. The outcome was statistically equivalent whether based on only the 19 parents who received training in one condition or on data from 12 parents in each condition. Parents using pivotal response training displayed more positive affect than those applying discrete-trial treatment on all three scales (all $p < .02$). The smallest difference between means was obtained for interest ratings (3.81 vs. 3.09, for pivotal response training and discrete-trial training, respectively).

Schreibman *et al.* (1991) obtained data while parents were conducting training with their children. A subsequent study by Koegel *et al.* (1996) asked whether discrete-trial and normalized training differentially affected family interactions outside of prescribed teaching sessions. Families were randomly assigned to either discrete-trial procedures ($n = 10$) or pivotal response training ($n = 7$). After parents reached a minimum of 80% adherence to the procedural requirements of each component of their training condition, observers blind to each family's condition began scoring 5-minute videotaped segments of family interactions at home during dinnertime. A pretraining sample of dinnertime

interactions was obtained to empirically check on equivalence of groups. A coding system much like that of Schreibman *et al.* (1991) was used to code parental behavior for each adult–child interaction. In addition to happiness and interest from the earlier scale, Koegel *et al.* (1996) included stress and communication style. The low end of the stress scale was anchored by an adult's look of frustration; seem tense; exhibit little patience; quick to correct child. Zero scores of the communication style scale were anchored by adults placing demands on child in unpleasant manner; little positive feedback is said to child; adults seem to insist more than request.

The authors reported that prior to training, the two groups of parents were statistically equivalent on all four measures. After parent training, the normalized teaching method was reliably associated with more positive scores on all four measures (all $p < .032$). In comparison with parents who received instruction in discrete-trial training, during dinnertime interactions, parents who had been instructed in pivotal response training were visibly happier, more interested in interacting with their child, less stressed, and more pleasant in their communication style.

DISCUSSION

The main conclusion of this review is that in all eight studies with language criterion responses, normalized language training was more effective than discrete-trial training for young children with autism. In addition, both studies in which parental affect was measured favored normalized treatment.

Adequate sample size is especially an issue when an intervention evaluated by a random group design is not differentially effective from an alternative (Lonigan *et al.*, 1998). This methodological matter does not pose a direct problem for the research examined here. In the series of 10 studies under review, differences convincingly favored normalized treatment in virtually all comparisons in the eight single-case studies over which sample sizes ranged between 2 and 5. The two group-comparison studies (Koegel *et al.*, 1996; Schreibman *et al.*, 1991) favored normalized treatment at conventional levels of significance on all measures. Yet, the total number of children over all of the eight single-case studies was 27. The two group studies added another 36 cases to the composite total of 63 cases in the entire sample of studies. This relatively small number of cases (be it taken as 27 or 63) might lead to some tempering of conclusions drawn in this review. Countering concern regarding the number of cases in the series are the guidelines for designating a treatment well established, as set forth by a methodological task force of the Division of Clinical Psychology of the American Psychological Association. According to the task force, provided the studies used good experimental design and compared the intervention to a control treatment or to another active treatment, "a large series of single-case designs demonstrating efficacy" (p. 21) meets the criterion for a well-supported empirically validated (supported) treatment (Task Force on Promotion and Dissemination of Psychological Procedures, 1995). Given that the series under review here met requirements for design and comparative testing, the eight single-case studies themselves may qualify normalized treatment as empirically well established using the criteria of the Task Force on Promotion and Dissemination of Psychological Procedures (1995).

It does seem that the preponderance of the evidence supports the possible superiority of normalized behavioral training over discrete-trial training for developing a significant range of language responses in young children with autism and that the main factor limiting the contribution of this series of studies is their restricted habilitative scope. Specifically, widespread developmental change was not the aim of the research under review. Researchers have come to agree that successful intervention requires large-scale, comprehensive treatment programs that seek to impact the general outcome in autism by improving the overall functioning of the individual (Dawson & Osterling, 1996; Rogers, 1998; Simeonsson, Olley, & Rosenthal, 1987). Encouraging outcomes of behavioral intervention to date have derived from comprehensive outcome studies in which discrete-trial training predominated (Anderson, Avery, DiPietro, Edwards, & Christian, 1987; Birnbrauer & Leach, 1993; Fenske, Zalenski, Krantz, & McClannahan, 1985; Harris, Handleman, Gordon, Kristoff, & Fuentes, 1991; Lovaas, 1987; McEachin, Smith, & Lovaas, 1993; Sheinkopf & Siegel, 1998; Smith, Eikeseth, Klevstrand, & Lovaas, 1997). The relative efficacy of normalized intervention suggested by the focused studies reviewed here calls for large-scale, comprehensive outcome research that allows for comparisons between programs oriented to discrete-trial versus normalized interventions.

Discrete-trial and normalized interventions may be complementary, not antagonistic, at least in facilitating language development. Carr and Kologinsky (1983) proposed that discrete-trial procedures might be more effective in teaching acquisition of language structure, whereas normalized teaching is needed for consistent application and generalization of language responses.

None of the three studies manipulating a single component of training assessed generalization. However, the normalized condition yielded superior acquisition performance in all three (Koegel *et al.*, 1988; Koegel & Williams, 1980; Williams *et al.*, 1981). One of the studies with multicomponent modifications of discrete-trial training and a language criterion variable (Koegel *et al.*, 1992) did not assess generalization; acquisition data consistently favored normalized training. The remaining studies with language criterion variables assessed both acquisition and generalization, at least to some degree. Results of three (Koegel *et al.*, 1987, 1998; Neef *et al.* 1984) favored normalized training for both acquisition and generalization. In only one study (McGee *et al.*, 1985) did normalized treatment not differ from discrete-trial training in acquisition; the normalized condition was superior on generalization performance data. Thus, the series under review provided no evidence for the relative efficacy of discrete-trial training for acquisition. Normalized language intervention seems capable of producing more successful acquisition and generalization performance.

In conclusion, Harris (1975) reviewed the status of teaching language-impaired children and suggested that clinicians may have to provide training in everyday settings rather than in classrooms for maximum efficacy. It appears that the consistent superiority of normalized teaching over discrete-trial training in controlled comparisons with autistic children supports Harris's recommendation and justifies further examinations of normalized interventions.

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