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Individual Behavioral Profiles and Predictors of Treatment Effectiveness for Children With Autism

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Differential responsiveness to intervention programs suggests the inadequacy of a single treatment approach for all children with autism. One method for reducing outcome variability is to identify participant characteristics associated with different outcomes for a specific intervention. In this investigation, an analysis of archival data yielded 2 distinct behavioral profiles for responders and nonresponders to a widely used behavioral intervention, pivotal response training (PRT). In a prospective study, these profiles were used to select 6 children (3 predicted responders and 3 predicted nonresponders) who received PRT. Children with pretreatment responder profiles evidenced positive changes on a range of outcome variables. Children with pretreatment nonresponder profiles did not exhibit improvements. These results offer promise for the development of individualized treatment protocols for children with autism.

Keywords: autism, behavioral treatment, behavioral profiles, individualized treatment, pivotal response training

Initially identified by Kanner (1943), autism remains a perplexing disorder that results in significant lifelong disability for most affected individuals (e.g., Gillberg, 1990; Rogers, 1998). However, a substantial number of children who have received intensive behavioral treatment during the preschool years have shown remarkable improvement (see reviews by Erba, 2000; Smith, 1999).

The early intervention research that has generated the greatest amount of interest has been Lovaas's (1987) Early Intervention Project. In this investigation, 19 children with autism received intensive discrete trial training (DTT). The results from this study were dramatic: Of the intensive (40 hr per week) treatment group, nearly half (47%) achieved "normal intellectual and educational functioning" (Lovaas, 1987, p. 3). Partial replications of this methodology have been conducted (e.g., Eikeseth, Smith, Jahr, & Eldevik, 2002; Smith, Groen, & Wynn, 2000), and although no researchers have reported the level of recovery of Lovaas's participants, they have reported improvement in the treatment groups compared with control groups not receiving the high-intensity intervention.

These studies have produced remarkable changes in the lives of many children with autism and have raised optimism as to the prognosis for children with this disorder. They have also incited a proliferation of DTT programs in schools, clinics, and homes, with some leaders in the field promoting this approach as the intervention to be prescribed for all children with autism (Green, 1996; Smith, 1996). This enthusiasm, however, is appropriate only for the subset of the children who achieved the most favorable response and fails to recognize the unexplained outcome variability that consistently has been documented with this approach.

Of the 19 children in Lovaas's (1987) intensive therapy group, 9 made significant progress. There is little information, however, regarding the poorest outcome participants in this and other DTT studies. There is also little insight as to why some children, up to 50% in most cases, did not respond favorably.

This outcome variability is not unique to Lovaas's (1987) treatment approach but rather has been frequently reported in early intervention research (e.g., McClannahan & Krantz, 1994; Olley, Robbins, & Morelli-Robbins, 1993; Weiss, 1999). Advocating one type of treatment program for a population that exhibits such variability seems ingenuous and is not supported by current empirical evidence. In fact, many researchers have begun to decry a "one size fits all" approach and instead have recognized the need for the individualization of treatment for autism (e.g., Anderson & Romanczyk, 1999; Pelios & Lund, 2001). This shift in philosophy seeks to identify the important variables that influence the effectiveness of specific interventions (Gabriels, Hill, Pierce, Rogers, & Wehner, 2001; Schreibman, 1997, 2000) to move beyond advocating for a single approach to defining when and with whom different interventions are effective. Research that furthers our understanding of how to match clients with efficacious treatments will enable consumers to make better choices between procedures (Prizant & Wetherby, 1998), decrease the outcome variability that characterizes early intervention research at present, and provide for the most efficient allocation of resources during the critical early intervention time period (Ozonoff & Cathcart, 1998).

Our purpose in the current investigation was to identify potential predictor variables via an examination of archival data and then conduct a prospective study to assess the validity of these variables

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to accurately predict a child's responsiveness to a specific, well-documented, behavioral treatment program—pivotal response training (PRT; further described in the Method section). This naturalistic intervention has been successful in treating many of the symptoms of autism, and years of investigation with this intervention have created a rich database from which to analyze outcome data. This provided the foundation for this investigation.

Method

Analysis of Archival Data

An examination of outcome data from 28 children who had participated in previous investigations with PRT identified two subgroups of children. On the basis of standardized assessments and behavioral measures obtained at posttreatment, 6 children were identified as exceptional responders to the intervention, and 5 children were identified as poor responders. The exceptional responders showed the greatest increases in raw scores on language assessments administered at pre- and posttreatment. This best outcome group also exhibited substantial increases in appropriate language use and toy play during a structured social setting conducted at pre- and posttreatment (further described in the Screenings subsection). Those participants identified as poor responders evidenced little or no gain on these same measures. The majority of participants had outcomes that fell between these two groups. These two sets of data represent the extremes in outcome and were selected to maximize the effect of the variables.

Development of Responder and Nonresponder Profiles

All 11 (5 most favorable, 6 least favorable outcome) children had participated in videotaped structured laboratory assessments (further described in the Screenings subsection) conducted at intake. Analysis of these tapes was conducted to determine whether specific child characteristics, other than IQ or standardized language measures, that were present at intake might be predictive of treatment outcome. Two distinct behavioral profiles emerged: one for the children with the best outcomes (i.e., responders) and one for children with the poorest outcomes (i.e., nonresponders).

Relative to the poorer outcome group, children with the most favorable treatment outcome exhibited a moderate-to-high interest in toys, were tolerant of another person in close proximity to them, had low-to-moderate rates of nonverbal self-stimulatory behavior, and had moderate-to-high rates of verbal stimulatory behavior. Children with the least favorable treatment outcome exhibited very low rates of toy play, approach behaviors, and verbal self-stimulatory behaviors. They exhibited modest rates of avoidant behavior and nonverbal self-stimulatory behavior at intake. These profiles were used as selection criteria for the current study, which empirically tested their validity as predictors of treatment outcome in a prospective investigation.

Composite profiles, based on the characteristics of these groups, and ranges and standard deviations for both profiles are presented in Figure 1. The ranges for three of the behaviors overlapped both categories. However, a participant had to meet the range requirements for all of the composite behaviors to be categorized as a responder or nonresponder.

Participants

All potential participants received a diagnosis of autism according to *Diagnostic and Statistical Manual of Mental Disorders* (4th ed.; American Psychiatric Association, 1994) criteria from psychologists who had expertise in autism and who were not affiliated with this project. As part of the intake process, we confirmed these diagnoses using both the Autism Diagnostic Interview—Revised (Lord, Rutter, & LeCouteur, 1994) and the Autism Diagnostic Observation Schedule—Generic, Module 1 (DiLavore, Lord, & Rutter, 1995; Lord et al., 2000). The Childhood Autism Rating Scale (CARS; Schopler, Reichler, DeVellis, & Daly, 1980) was used to establish a symptom severity rating for each participant.

Screenings

After a diagnosis was confirmed, potential participants for the study participated in the same type of structured laboratory assessment as the original children on whom the profile was based. Each mother was given verbal and written instructions prior to the assessment and was observed through a large one-way mirror. The child and mother were in a closed living room setting within the research laboratory. A variety of toys was placed in the room within reach of the child. At the beginning of the assessment, the mother sat on the couch and allowed the child to explore the environment but did not interact with the child. After 5 min of free exploration, the mother attempted to elicit language from her child using any method that she desired (e.g., pointing to body parts and asking "What's this?" or singing songs). Next, the mother was asked to spend 5 min attempting to have her child comply with requests (e.g., "Bring mommy the ball."), although no specific requests were given for the mother to use. Lastly, the mother played with her child. The total assessment lasted 20 min and was performed twice for each child (on different days) to assess the reliability of the observed behavior. We videotaped the assessment, and we scored the child's behavior for the presence of the five profile behaviors using occurrence–nonoccurrence scoring per 30-s intervals. Each videotape was scored by two researchers independently. Profile behaviors assessed during screenings were as follows:

1. Toy contact/object manipulation. The child interacted with a toy in the room appropriately for 5 consecutive seconds or more.

2. Approach behaviors. The child moved to within arms reach of the adult or closer (only those intervals in which the child physically moved closer). These behaviors also included spontaneous looking at the adult's face or reaching to the adult (with or without looking at the adult) and approaching to take a toy.

3. Avoidant behaviors. The child moved away from the adult out of arm's reach (only those intervals in which the child physically moved away). These behaviors included instances in which the child pulled part of his or her body away from the adult's touch, resisted looking at the adult's face when the adult initiated a look, crawled under a table, and covered his or her ears or eyes in response to the adult speaking.

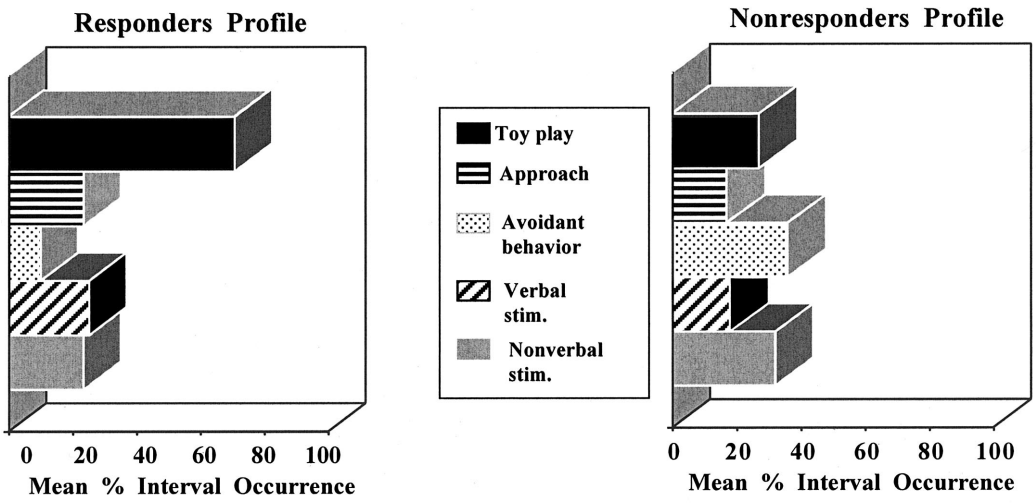
4. Verbal self-stimulatory behaviors. These behaviors were defined as nonsensical sounding utterances that were not associated with a tantrum, including repetitive sounds.

5. Nonverbal self-stimulatory behaviors. These varied from child to child; some examples included (but were not limited to) hand flapping, rocking, facial grimacing, head shaking, jumping up and down, and body posturing.

Six participants were selected on the basis of this assessment: 3 whose results matched the responders profile and 3 whose results predicted nonresponders. These participants' profiles were within one standard deviation of each characteristic for the respective composite profile. Because teaching language was a primary goal of the intervention, there was no minimum language requirement and there were no IQ cutoffs.

Responders

The 3 responders were labeled Responder 1 (R1), Responder 2 (R2), and Responder 3 (R3)—R1 was a girl; R2 and R3 were boys. They had a mean



Responders

Category	Mean Percentage of Interval Occurrence	Standard Deviation	Cutoff Ranges
Toy Play	70.8	9.56	61-80
Avoidant	10.0	2.88	7-13
Approach	23.3	8.49	15-32
Nonverbal Stim.	23.3	10.74	13-34
Verbal Stim.	25.0	8.16	17-33

Nonresponders

Category	Mean Percentage of Interval Occurrence	Standard Deviation	Cutoff Ranges
Toy Play	27	10.29	17-37
Avoidant	36	10.67	25-47
Approach	17	9.27	8-26
Nonverbal Stim.	32	12.88	19-49
Verbal Stim.	18	4.0	14-22

Figure 1. Behavioral profiles of predicted responders and nonresponders to pivotal response training. Stim. = self-stimulation.

chronological age of 3 years, 3 months (range was from 3 years, 0 months to 3 years, 5 months). Both R1 and R2 had very limited communication skills. Parents of both children reported that they had heard their children say single words previously, but the frequency of their usage was very low. Both engaged in verbal self-stimulatory behavior that consisted of repetitive sounds, including squeals and shrieks. R1 displayed few social behaviors toward her mother or twin sister (fraternal). She displayed no eye contact, would not respond to her name, and generally had a flat affect. R2 displayed similar behaviors of disengagement in addition to frequent self-stimulation.

R3 was able to communicate verbally; however, his rate of language use was also very low for his age, and he engaged in verbal self-stimulatory behaviors. Most of his communication occurred when he wanted something, but he did not make requests often. He also hoarded small figurines, developed obsessions with particular toys (e.g., a school bus), and had great difficulty transitioning between settings and activities.

Nonresponders

The 3 nonresponders were labeled Nonresponder 1 (NR1), Nonresponder 2 (NR2), and Nonresponder 3 (NR3)—NR1 and NR2 were boys; NR3 was a girl. Their mean chronological age was 4 years, 2 months (range was from 3 years, 1 month to 5 years, 10 months). NR1 and NR2 did not use functional speech, and their parents reported hearing words very infrequently.

NR1 engaged in verbal and nonverbal self-stimulation (e.g., hand flapping). He frequently dropped to the floor or went to a corner of the room when approached.

NR2 also displayed nonverbal self-stimulatory behaviors (e.g., staring at lights) and avoided interactions. He enjoyed sitting in a beanbag chair, but when approached he would roll over with his face down and start whining or crying. Although he frequently engaged in spontaneous eye contact, he had flattened affect and rarely displayed positive emotions.

NR3 could make requests and answer questions verbally, although she usually spoke very quickly (with her head down or while walking away), which made her difficult to understand. She became upset when someone tried to interact with her and consistently chose to occupy the part of the room furthest from others. She showed unusual attachments to objects and had difficulty deviating from her routine.

Matching

In addition to meeting the requirements of the profile, each responder (R1, R2, R3) was matched on IQ, language age, and symptom severity to a nonresponder (NR1 to R1, NR2 to R2, and NR3 to R3) to minimize the effects that these variables would have on differential treatment outcome. Language, age, and IQ were used as matching variables—as these are known to be the best predictors of treatment outcome in autism.

None of the children received any other autism treatment during this study, although all of the children, with the exception of R1, were in special education classrooms. R1 began preschool toward the end of the investigation.

Settings

Baseline and Treatment Settings

Baseline and treatment sessions were conducted in two small play rooms located within a university autism research laboratory. The rooms were identical and consisted of a large one-way mirror, two small chairs, a child-size table, and a cabinet with a wide variety of age-appropriate toys. All sessions were videotaped through the one-way mirror.

One child (NR1) was unable to come into the laboratory setting; as a result, baseline and treatment sessions were conducted in an enclosed area of his classroom that was approximately the same size as those in the laboratory. The area was carpeted, had a small table and chair, and contained bookshelves that held the toys. We videotaped his sessions using a camera mounted on a tripod.

Generalization Settings

A large room within the university research laboratory that resembled a living room served as one of the generalization settings. The room was carpeted and contained a couch, coffee table, a child-size table and chairs, and age-appropriate toys. Video cameras were mounted near the ceiling in two corners of the room, and a large one-way observation mirror occupied one wall. A room in the child's home served as a second generalization setting

Experimental Design

A multiple baseline design across participants was implemented. Baselines ranged from 4 to 16 weeks and pretreatment measures were administered within the first 2 weeks of baseline. For one child (R3), all assessments were readministered just prior to the treatment phase because his behavior showed some improvement during an extended baseline phase. Responders and nonresponders were in treatment concurrently to minimize any potential order effects.

Intervention

PRT

The following is a brief description of PRT. A thorough explanation of the methods and procedures used in this intervention are detailed in an instructional manual (R. L. Koegel et al., 1989) and is available from Michelle R. Sherer and Laura Schreibman.

During PRT, the environment is structured to include items and activities that the child prefers and that can be used to meet the goals of the intervention (e.g., communication, imaginative play). The components of PRT are as follows: child's choice, focusing of attention, turn taking (to model appropriate play and language), reinforcement of goal directed attempts, the interspersal of maintenance tasks, and a direct relationship between the response and the reinforcer with reinforcement contingent on appropriate behavior.

A learning interaction begins when the therapist presents or offers the child choices, and the child directs the training by choosing and requesting desired items and activities. Motivation is further enhanced through the incorporation of previously mastered tasks (i.e., maintenance tasks) and reinforcing attempts at correct responding.

Each time the child indicates a preference, the therapist requires a response from him or her to gain access to the item/activity. Appropriate responses can include, but are not limited to, single word labeling, eye contact, or a sentence requesting the item or activity. A very simple example would be when a child shows interest in a toy, the therapist holds it and then has the child name the object (e.g., "train") before giving it to him or her.

The complexity of the required responses increases as training progresses to meet the specific goals for that child, whether it is to develop language, augment play skills, or teach reciprocal interactions. In the previous example, after the child has mastered object naming, the difficulty level could be increased by requiring the child to choose between several trains and use more elaborate speech or model a variation in play (e.g., putting the train through the tunnel) before getting unrestricted access to the train.

There are no predetermined correct responses for each interaction. A child with emerging language could be reinforced for saying "train" or "choo-choo" or for smiling while looking at the therapist holding the train. If the goal were to increase the variety of play, then a child could be reinforced for any number of appropriate play sequences that deviated from their typically ritualistic play or for appropriate turn taking.

During the baseline and treatment sessions in our study, inappropriate behaviors (e.g., self-stimulatory behaviors, tantrums) were either ignored or received a consequence (e.g., response cost), whichever was appropriate for the child at the time.

Therapists

Advanced psychology students served as therapists during all phases of the study. They were trained a minimum of 8 weeks in the intervention. Their training included classroom type instruction with a written manual, video modeling of others performing the intervention with participants from different studies, role playing with trained therapists, and direct feedback during hands-on training. They received training in all modalities from a variety of instructors. All therapists were blind to the hypotheses of the investigation, and each worked with responders and nonresponders. Therapists stayed with the investigation a minimum of 6 months, and each child had a minimum of four therapists. Fidelity of implementation measures (see below) evaluated each therapist's proficiency and maintained the integrity of the independent variable.

Experimental Conditions

Baseline

During the baseline phase, toys were placed within reach of the children, and they were given free access to them. Once each minute the therapist made an attempt to elicit language or direct play (e.g., "Is that Pooh Bear? Can you say Pooh?" or "Look, I'm putting the people in the bus."). The child was not required to respond to the therapist's initiations, and the

therapist did not physically disrupt the child's activity during the interactions. Baseline sessions lasted approximately 30 min. Three sessions were conducted daily (90 min each visit) 4–5 times per week, and children were given 10-min breaks between sessions.

Treatment

Following the baseline phase, children received 90 min of one-on-one PRT 4–5 times a week. These 90 min were broken into three 30-min sessions that alternated between two different play rooms. Children received brief breaks between sessions.

Treatment Duration

Three children, R1, R2, and R3, received PRT for 6 months (approximately 190 total number of hours). Treatment was discontinued after 5 weeks for the nonresponders because of failure to demonstrate any improvement (see the Results section). These children were referred to alternate treatment programs.

Generalization

Setting and stimulus generalization were assessed via a structured laboratory assessment (described below), and home visits were conducted for each child prior to and following treatment.

Setting Generalization

Each mother participated in a structured laboratory assessment with her child in the living room (described above). Training was never conducted in this setting. The protocol was the same as described in the Screenings subsection. The same instructions were used during home visits.

Stimulus Generalization

A different set of play items from those used in training sessions was used in the generalization settings (i.e., laboratory living room and child's home).

Generalization to Other Adults

Generalization of child behaviors to adults (other than the child's therapists) was also assessed during the home and the structured laboratory living room assessment. Measures of generalization were obtained with parents who had not been trained in PRT, in addition to a 10-min PRT session conducted with a novel therapist in this same setting.

Follow-Up

Two of the children (R1 and R3) were evaluated 6 months after completing the study. NR2 was followed up 9 months later. Standardized assessments were readministered to all 3 children to measure language, cognitive, and adaptive skills, and they also were evaluated during PRT sessions. Three families moved out of the area, and only limited follow-up data were available for two children (R2 and NR1). NR3 moved out of state, and no follow-up data were available for her.

Dependent Measures

Standardized Assessments

The Differential Abilities Scales (DAS; Elliott, 1990) or the Bayley Scales of Infant Development, Second Edition (Bayley, 1993)—when participants were unable to meet basal levels of performance on the DAS—were used to obtain measures of general cognitive abilities. The Leiter International Performance Scale (Leiter, 1979) was also used to obtain a measure of nonverbal IQ. We assessed language abilities using the Peabody Picture Vocabulary Test—Revised (PPVT–R; Dunn & Dunn, 1981), the Expressive One-Word Picture Vocabulary Test (EOWPVT; Gardner, 1990), and the MacArthur Communicative Development Inventory (CDI; Fenson et al., 1993). The Vineland Adaptive Behavior Scales (Sparrow, Balla, & Cicchetti, 1984) provided a measure of daily functioning abilities for each participant.

The CARS served to supplement diagnostic instruments and as a dependent measure of how autistic symptomology may have changed in response to treatment. Children were rated by graduate students in psychology who were blind to the investigation but familiar with the participant.

All of these assessments were conducted both prior to and following the treatment phase of the investigation. Three of the children (2 responders and 1 nonresponder) were also available for follow-up approximately 6 months after treatment concluded, and these assessments were readministered.

Behavioral Data Collection

All baseline, training, and generalization sessions were videotaped. Data were collected across three categories: language, play, and social skills. These behaviors were chosen because they are the behaviors that are often of most concern when treating children with autism. Behaviors were scored in 30-s intervals for occurrence and nonoccurrence. Four segments were scored for behaviors listed and described below from each of the daily 90-min sessions. The sampled segments were 5 min in length and were preselected to be evenly distributed across the 90 min (i.e., beginning at Minutes 15:00, 35:00, 55:00, 1:10).

Language

Data were collected on immediate echolalia, verbally cued speech, nonverbally cued speech, and spontaneous utterances. Data on individual behaviors for each participant are not presented here because of space constraints. Instead, the summation of these categories is presented as total appropriate communication and, as a result, sometimes exceeds 100%.

Play Behavioral Definitions

Functional play. The child used an object as it was intended (e.g., rolling a toy car), either following a therapist's prompt or spontaneously.

Symbolic play. The child used a toy as a placeholder (e.g., using a block as a bar of soap to wash a baby doll) with or without a therapist's prompt.

Varied play. The child began to play with a different toy or changed the nature of play with the same object (e.g., switched from rolling a ball to putting it down a chute). This may have been spontaneous or may have followed a verbal or nonverbal prompt.

Social Behavioral Definitions (Adapted From Kohler, Strain, Maretsky, & DeCesare's, 1990, Study)

Maintaining interactions. The child displayed a continued engagement with the therapist in a verbal or nonverbal interaction. Complying with a request would be scored as maintaining an interaction, whereas turning away from the therapist (even when the child remained engaged with a toy) would not. During baseline, responses to the therapist's probes (e.g., "Are you holding Tigger?") were scored as maintaining interactions. Nonverbal responses included showing or sharing the object or engaging in spontaneous eye contact (not in response to a command for eye contact).

Social initiations (combined play and language initiations). The child made a verbal or nonverbal request directed to the therapist to engage in a different play activity or a variation of the current activity. The request had

to be for the therapist's involvement and not just for the object. Or, the child made an appropriate spontaneous verbalization (i.e., not in response to a prompt) that could not be characterized as requesting but rather as commenting or sharing. For example, "the bus is broken" during a play sequence with the bus.

Fidelity of Implementation

One third of each participants' sessions were scored for accurate implementation of the treatment protocol. A 10-min segment was randomly selected from each 3rd day of treatment and scored in 1-min intervals by therapists with a minimum of 4 months experience in PRT. Therapists were not familiar with the therapist being rated in the segment. The segments were scored for correct use of prompting procedures, choice offerings, turn taking, and delivery of reinforcement. Percentage correct for each category was calculated by dividing the number of correctly implemented behaviors by the total number of behaviors for that category and multiplying by 100. The accuracy score for the segment was the mean of the percentage scores across the categories. Maintenance tasks and reinforcement of attempts were scored separately. These categories were scored as correct if the maintenance tasks composed a minimum of 20% of the total number of tasks during the 10 min, and a minimum of 20% of the responses reinforced had to be attempts (e.g., partially correct responses) to be considered correct. Fidelity of implementation for responders and nonresponders across categories ranged from 92% to 97% correct.

Reliability

Eight therapists (of a total of 35) working on this research were trained as observers. These therapists did not score tapes for children with whom they worked, and all were naïve as to the experimental hypothesis. Two observers independently collected data across all behavioral categories (e.g., language, play, and social skills) on approximately 33% of each child's videotaped sessions across baseline, treatment, and generalization. Kappa coefficients were calculated across participants for language behaviors and yielded .87 for immediate echolalia, .82 for verbally cued speech, .82 for nonverbally cued speech, and .79 for spontaneous speech. For social behaviors, the coefficients yielded .80 for maintaining interactions and .77 for initiations. For play behaviors, the coefficients yielded .84 for functional play, .82 for symbolic play, and .77 for variations in play.

Results

The results of this experiment are presented in two sections: standardized measure assessments and behavioral measure assessments. Each of these sections is further subdivided by responders and nonresponders.

Standardized Measures

Results for standardized measures of cognitive functioning can be seen in Table 1. Responders were not reassessed on these measures at 5 weeks (as were the nonresponders) because readministration of these tests so soon is not advised and might have made posttreatment assessment invalid.

Intellectual Functioning: Responders

R1's Bayley Scales of Infant Development age equivalent score increased from baseline to posttreatment and at follow-up. R2's scores reflected the greatest gains in cognitive functioning. R2's nonverbal IQ, however, decreased during the same period. R3's IQ score on the DAS also showed improvement from pretreatment.

Intellectual Functioning: Nonresponders

NR1 and NR2's scores on the Bayley Scales of Infant Development were unchanged from baseline to posttreatment and had

Table 1
Age, Cognitive Functioning, Language, Severity, and Adaptive Functioning Scores for Responders and Nonresponders

Participant type	Age (years-months)	DAS (IQ)			Bayley (age equivalent)			Leiter (nonverbal IQ)			Vineland (age equivalent)			CARS (severity score)		
		pre	post	f/up	pre	post	f/up	pre	post	f/up	pre	post	f/up	pre	post	f/up
R1	3-0	UT	UT	65	0-11	2-0	2-8	UT	UT	UT	1-0	2-4	3-3	37	40	32
R2	3-4	UT	UT	—	0-9	1-11	—	124	120	—	0-11	1-8	—	40	40	—
R3	3-5	78	88	83	NA			93	98	—	2-7	3-6	4-2	32.5	29	30
NR1	3-1	UT	UT	—	1-3	1-3	—	118	120	—	1-11	1-10	—	35	37	—
NR2	3-8	UT	UT	UT	0-9	0-8	0-6	UT	UT	UT	0-10	0-10	0-9	43	43	48
NR3	5-10	70	68	—	NA			110	110	—	3-11	3-11	—	37	38	40

	PPVT–R			EOWPVT			MacArthur CDI: Comprehension			MacArthur CDI: Gestures			MacArthur CDI: Production		
R1	UT	>1-9	2-4	UT	2-8	3-0	0-8	>1-4	>1-4	>1-4	>1-4	—	1-2	2-6	2-11
R2	UT	2-0	—	UT	2-3	—	0-11	>1-4	—	0-9	>1-4	3.0	1-2	1-8	—
R3	2-2	2-6	2-10	2-10	3-8	3-4	NA			NA			2-4	>3-0	>3-0
NR1	UT	UT	—	UT	UT	—	0-10	0-10	—	0-11	1-0	—	1-4	1-4	—
NR2	UT	UT	UT	UT	UT	UT	0-8	0-8	0-9	0-10	0-9	0-9	1-0	1-0	1-0
NR3	5-0	5-3	—	3-9	3-9	—	NA			NA			NA		

Note. Dashes in the table refer to no data obtained. Hyphenated values indicate years-months. DAS = Differential Abilities Scale; CARS = Childhood Autism Rating Scale; pre = pretreatment; post = posttreatment; f/up = follow-up; R1 = Responder 1; UT = untestable; R2 = Responder 2; R3 = Responder 3; NA = not applicable; NR1 = Nonresponder 1; NR2 = Nonresponder 2; NR3 = Nonresponder 3; PPVT–R = Peabody Picture Vocabulary Test—Revised; EOWPVT = Expressive One-Word Picture Vocabulary Test; CDI = Communicative Development Inventory.

not improved at follow-up. NR1's nonverbal IQ increased by 2 points as measured by the Leiter International Performance Scale between baseline and posttreatment. NR3's nonverbal IQ remained unchanged from baseline, and her scores on the DAS indicated a 2-point decrease from baseline to posttreatment. The results for standardized measures of language, autism severity, and adaptive functioning are also presented in Table 1.

Standardized Language Measures: Responders

Scores on the MacArthur CDI placed R1 between 8 months (comprehension) and 16 months (gestural abilities) at baseline. At posttreatment, R1's language abilities were measured to be an age equivalent between 16 months and 30 months on this measure, and they increased further at follow-up. At follow-up, R1's receptive language level had also improved to 2 years, 4 months. In addition, her expressive language age was equivalent to 3 years as measured by the PPVT–R and EOWPVT, respectively.

R2's comprehension ability measured by the MacArthur CDI at baseline was 11 months, and his production capability was 14 months. Gestural ability was measured at a 9-month age equivalent. At posttreatment, R2's comprehension and gestural abilities exceeded 16 months, and his vocabulary production scores increased by 6 months. PPVT–R and EOWPVT scores placed his age equivalent at 2 years for receptive language and 2 years, 3 months for expressive abilities at posttreatment. At 1-year follow-up, R2's scores on the MacArthur CDI exceeded the 36-month norms. Additional standardized language measures were not assessed at follow-up because he had moved out of state.

R3's language abilities at baseline indicated a receptive ability of 2 years, 2 months. Following treatment, his scores increased by 4 months, and at follow-up, his scores placed him at 2 years, 10 months as measured by the PPVT–R. Expressively, R3's language abilities were assessed at an age equivalent of 2 years, 10 months at baseline; 3 years, 8 months at posttreatment; and 3 years, 4 months at follow-up. Results from the MacArthur CDI also showed an increase in language abilities following treatment.

Standardized Language Measures: Nonresponders

MacArthur CDI scores for NR1 at baseline placed his abilities between 10 and 16 months. These were unchanged at posttreatment. NR2's language functioning as measured by the MacArthur CDI was between 8 and 12 months at baseline, posttreatment, and follow-up.

NR3's level of receptive vocabulary at baseline placed her abilities at 5 years, and following treatment, her abilities were at 5 years, 3 months. Her verbal abilities exceeded the upper limit for the MacArthur CDI. Her performance on the EOWPVT placed her expressive ability at 3 years, 9 months at baseline, which remained unchanged at posttreatment.

Autism Severity: Responders

CARS scores in the range of 15–30 are categorized as nonautistic, in the range of 30–37 as mild autism, and in the range of 37–60 as severely autistic. The scores in this investigation evidenced little change from baseline to posttreatment for any of the responders, although follow-up scores for R1 indicated a 5-point decrease in autistic symptoms relative to baseline levels.

Autism Severity: Nonresponders

Scores from the CARS changed very little for nonresponders from baseline to posttreatment.

Adaptive Functioning: Responders

All 3 responders' scores on this measure increased from baseline to posttreatment. R1's Vineland Adaptive Behavior Scales age equivalent score increased by 16 months, R2's by 9 months, and R3's increased 11 months at posttreatment and another 8 months at follow-up.

Adaptive Functioning: Nonresponders

There were no increases in the Vineland Adaptive Behavior Scales age equivalent scores for these participants.

Behavioral Measures

Data were collected from videotapes of baseline, training, and generalization sessions and scored for the targeted behaviors (i.e., language use, play skills, and social behaviors). These data are presented below for responders and nonresponders. Shaded bars on the figures indicate performance at the 5-week mark, when nonresponders ended treatment.

For all participants, data for total appropriate communication are presented as the percentage of intervals in which the behavior occurred, and changes reported from baseline to treatment are given as means derived from the last 10 days of baseline and last 10 days of treatment.

Language: Responders

Total appropriate communication for R1, R2, and R3 during baseline and treatment are presented in Figure 2. These data are a summation of data collected across four individual communication behaviors exhibited by each participant and frequently total greater than 100%.

The mean percentage of intervals engaged in total appropriate communication for R1 and R2 increased from zero at baseline to 61.85% and 64.96%, respectively. Total appropriate communication also generalized to novel settings, stimuli, and therapist for both children. Percent engagement in total appropriate communication for R1 at follow-up averaged 127.50%. R3's baseline rate of total appropriate communication was 67.45%. The percentage of intervals during which he displayed appropriate communication rose to 118.80% during treatment and 153.75% at follow-up.

Language: Nonresponders

The percentage of intervals during which NR1, NR2, and NR3 engaged in total appropriate communication are also presented in Figure 2.

NR1 and NR2 did not use spoken communication during baseline and did not develop communication skills during the treatment phase. NR3's mean percentage interval occurrence of total appro-

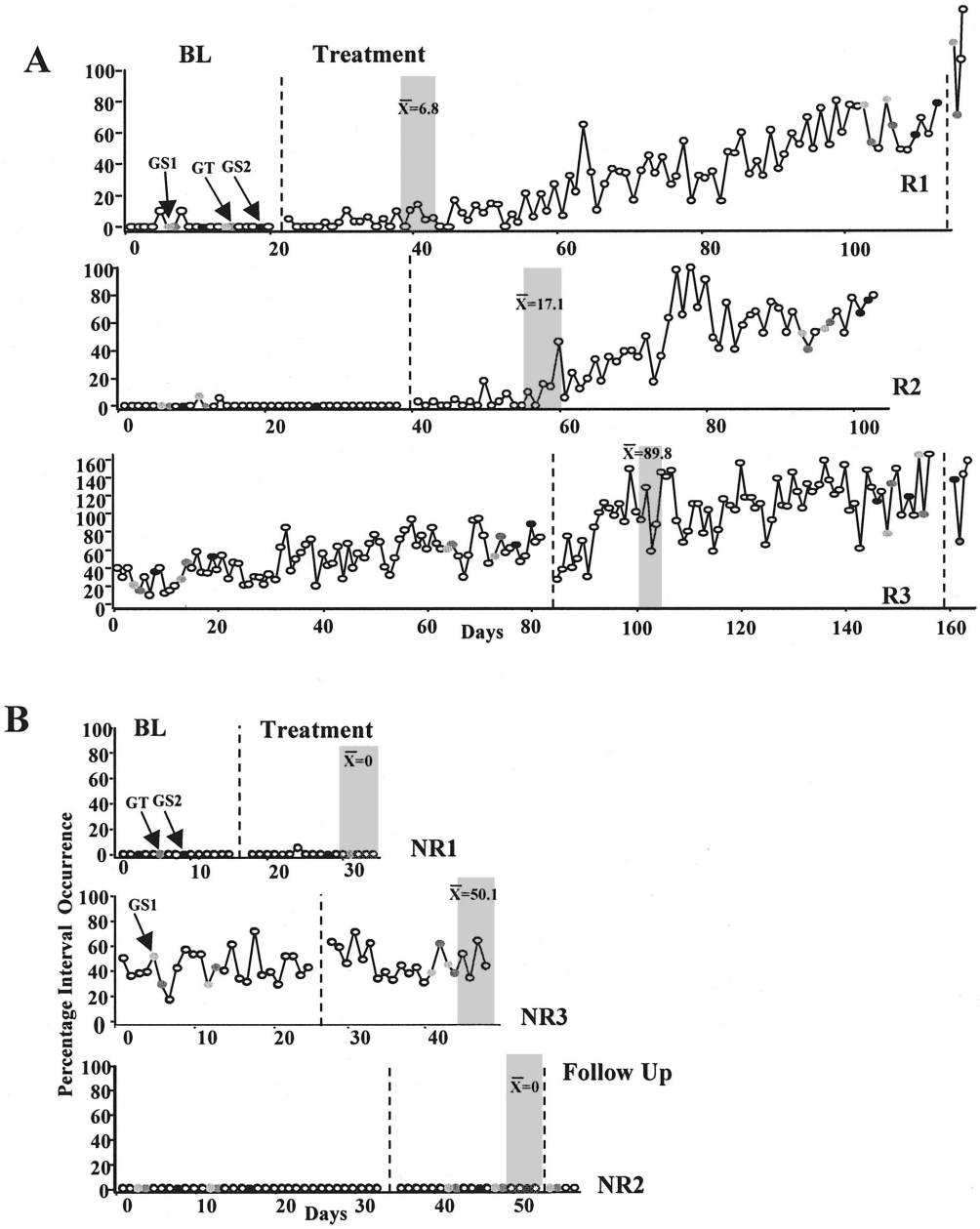


Figure 2. The percentage of 30-s intervals that contained appropriate communication for responders (Rs) and nonresponders (NRs) during baseline, treatment, and generalization sessions. Shading indicates 5th week of treatment and mean appropriate communication. BL = baseline; GS = generalization settings; GT = generalization to novel therapist.

priate communication during baseline was 43.4% and was 42.8% across the last 10 days of treatment.

Play

Play data are presented as the percentage of 30-s intervals in which play occurred and are categorized as either functional or symbolic. Varied play is also presented. Changes in behavior from baseline to treatment are given in means derived from the last 10 days of baseline and last 10 days of treatment.

Play Behaviors: Responders

Data for R1, R2, and R3 are presented in Figure 3. During baseline, all three children engaged in functional play in more than half of the intervals observed. Baseline rates for each were as follows: R1, 80.0%; R2, 72.3%; and R3, 65.3%. Initially, functional play decreased for all children during treatment and then rebounded to 74.6% for R1, 74.0% for R2, and 70.4% for R3. At follow-up, R1 and R3's mean percentages of engagement in functional play were 82.5% and 72.5%, respectively.

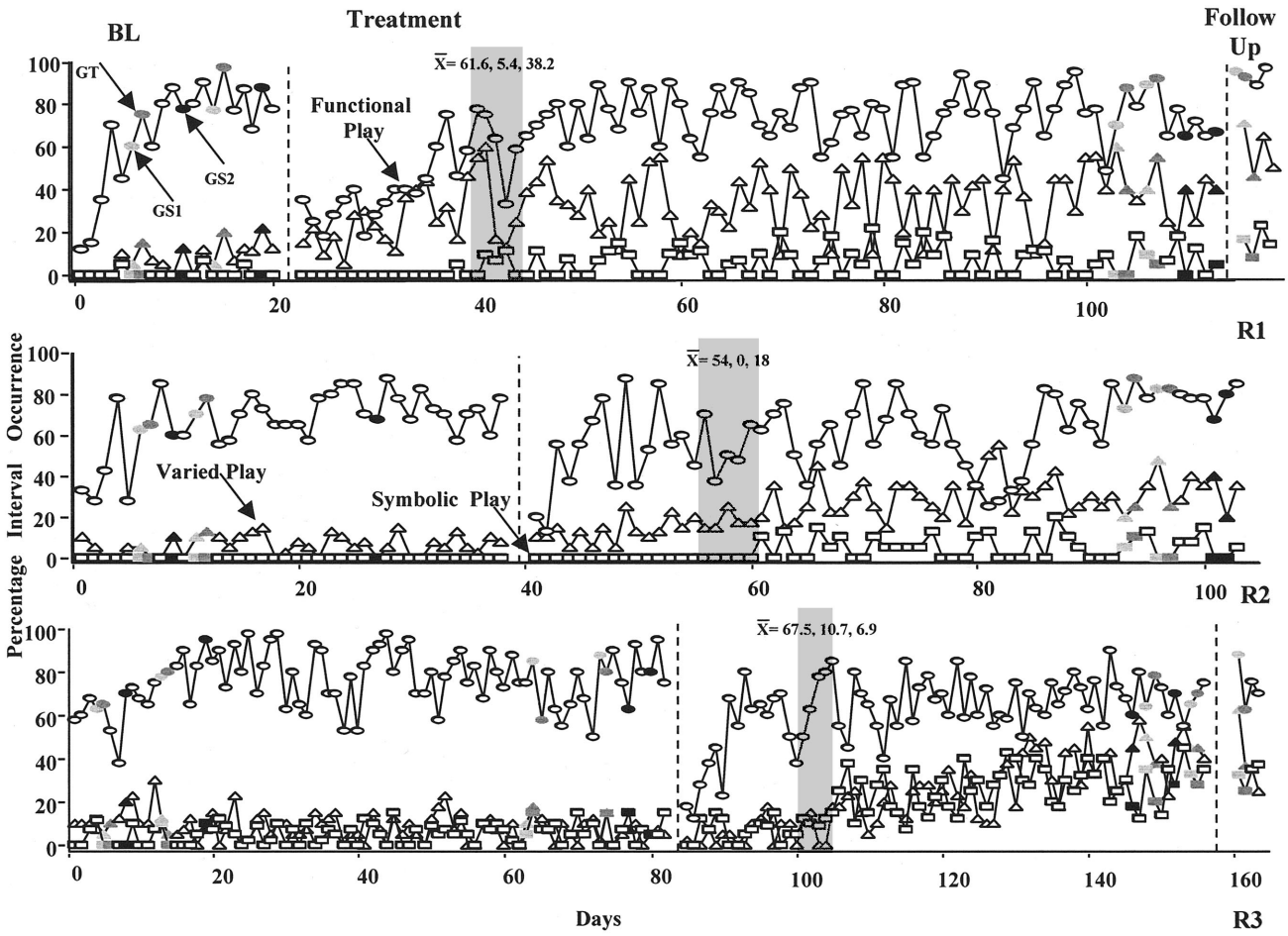


Figure 3. The percentage of 30-s intervals in which responders (Rs) engaged in play behaviors. Shading indicates 5th week of treatment. Means represent functional, symbolic, and varied play, respectively. BL = baseline.

Symbolic play rates increased from 1.2% at baseline to 7.7% for R1 and from zero occurrences at baseline to 7.8% for R2. Mean engagement in symbolic play for R1 increased further to 20.0% at follow-up. R3's mean percentage interval occurrence for symbolic play during baseline was 7.7% and increased to a mean of 28.9% at treatment and 36.3% at follow-up.

Increases in varied play were also observed for these children. All responders increased the number of intervals in which they either switched to a new object or activity or altered the way they interacted with the same object or activity.

Varied play for R1 increased from 9.8% at baseline to 37.5% during treatment and 58.8% at follow-up. R2's rate increased from 6.3% to 30.5% between baseline and treatment, and R3's varied play also showed improvement increasing from 6.3% at baseline to 38.5% during treatment and 30.0% at follow-up. These children also generalized their newly acquired skills to untrained stimuli, settings, and novel adults during treatment and at follow-up.

Play Behaviors: Nonresponders

Percentage interval occurrence for play behaviors for nonresponders is shown in the top half (A) of Figure 4. NR1 and NR2 had very low rates of functional play behavior during baseline and treatment (NR1 baseline 2.13%, treatment 3.00%; NR2 baseline 1.05%, treatment 1.25%) and exhibited no symbolic play or varied play. NR3's mean baseline rates were 27.5% for functional play, 2.0% for symbolic play, and 7.0% for varied play. During treatment, mean occurrence of functional play was 20.3%, symbolic play was 8.0%, and variation in play was 7.0%.

Social Behaviors

Data were collected on the participants' ability to initiate and/or maintain social interactions (through either language or play behaviors) during baseline, treatment, and follow-up sessions. Data are presented as the percentage of intervals in which the behavior occurred, and changes from baseline to treatment are given in means derived from the last 10 days of baseline and last 10 days of treatment.

Social Behaviors: Responders

Figure 5 presents the percentage of interval occurrence for R1, R2, and R3's social behaviors. During baseline, R1 and R2 rarely

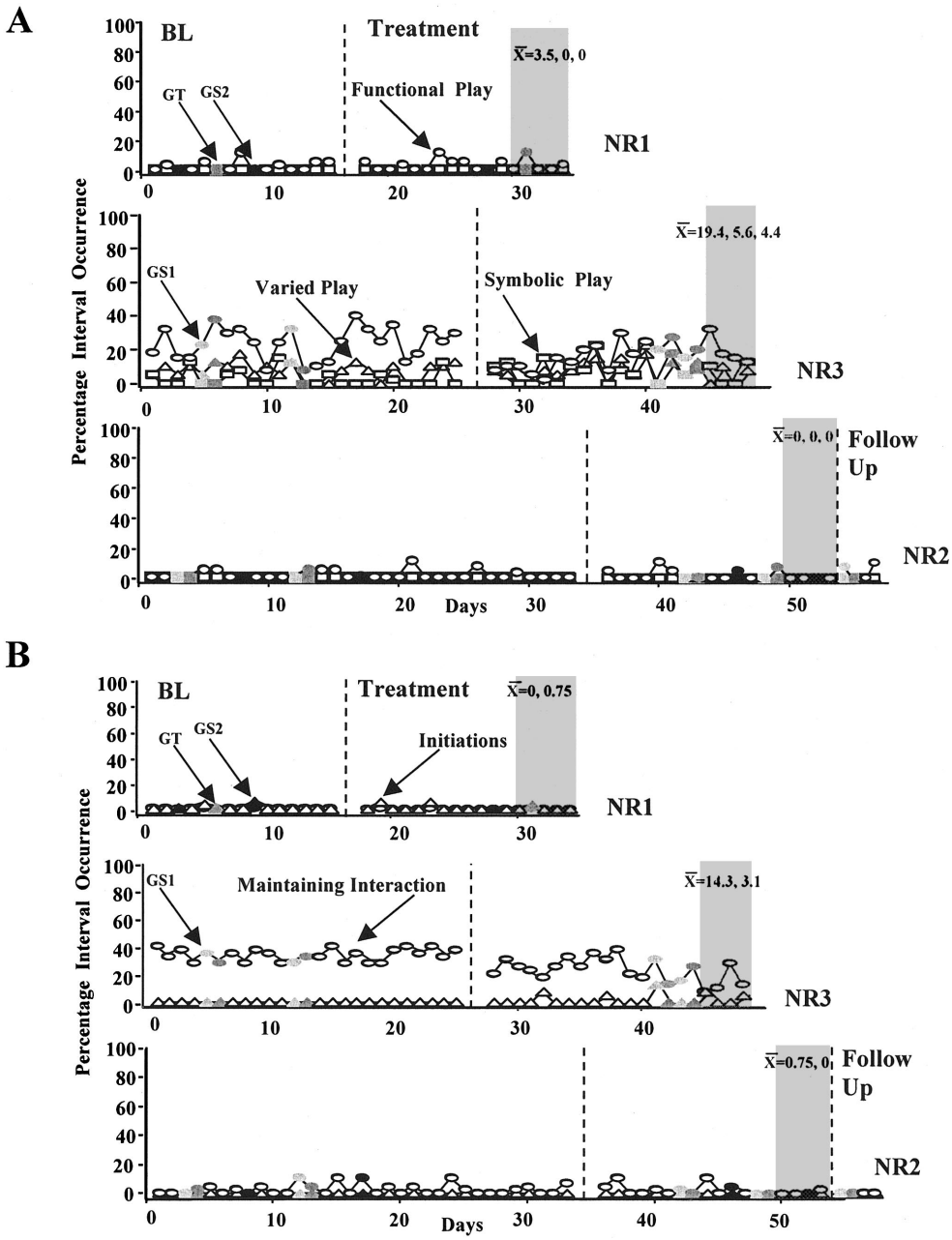


Figure 4. A: The percentage of 30-s intervals in which nonresponders (NRs) engaged in play behaviors. Shading indicates 5th week of treatment. Mean rates are for functional, symbolic, and varied play, respectively. B: The percentage of 30-s intervals in which NRs engaged in social behaviors. Shading indicates 5th week of treatment. Means are for levels of maintaining and initiating social interactions. BL = baseline; GT = generalization to novel therapist; GS = generalization settings.

engaged in any of the targeted social behaviors. Rates for maintaining interactions were below 10.0% occurrence for R1 and less than 20.0% for R2. R3's baseline mean for this behavior was 23.2%.

During treatment, all 3 participants' ability to maintain interactions increased to levels above 60.0% (R1, 80.3%; R2, 61.5%; and R3, 78.5%). At follow-up, mean percentage of engagement for R1 and R3 was 88.8% and 87.5%, respectively.

Social initiations were exhibited with even less frequency during baseline (R1, 0.0%; R2, 0.0%; and R3, 7.6%). These behaviors increased at the end of treatment with a mean of 15.9% for R1, 12.7% for R2, and 28.9% for R3. R1's mean percentage of en-

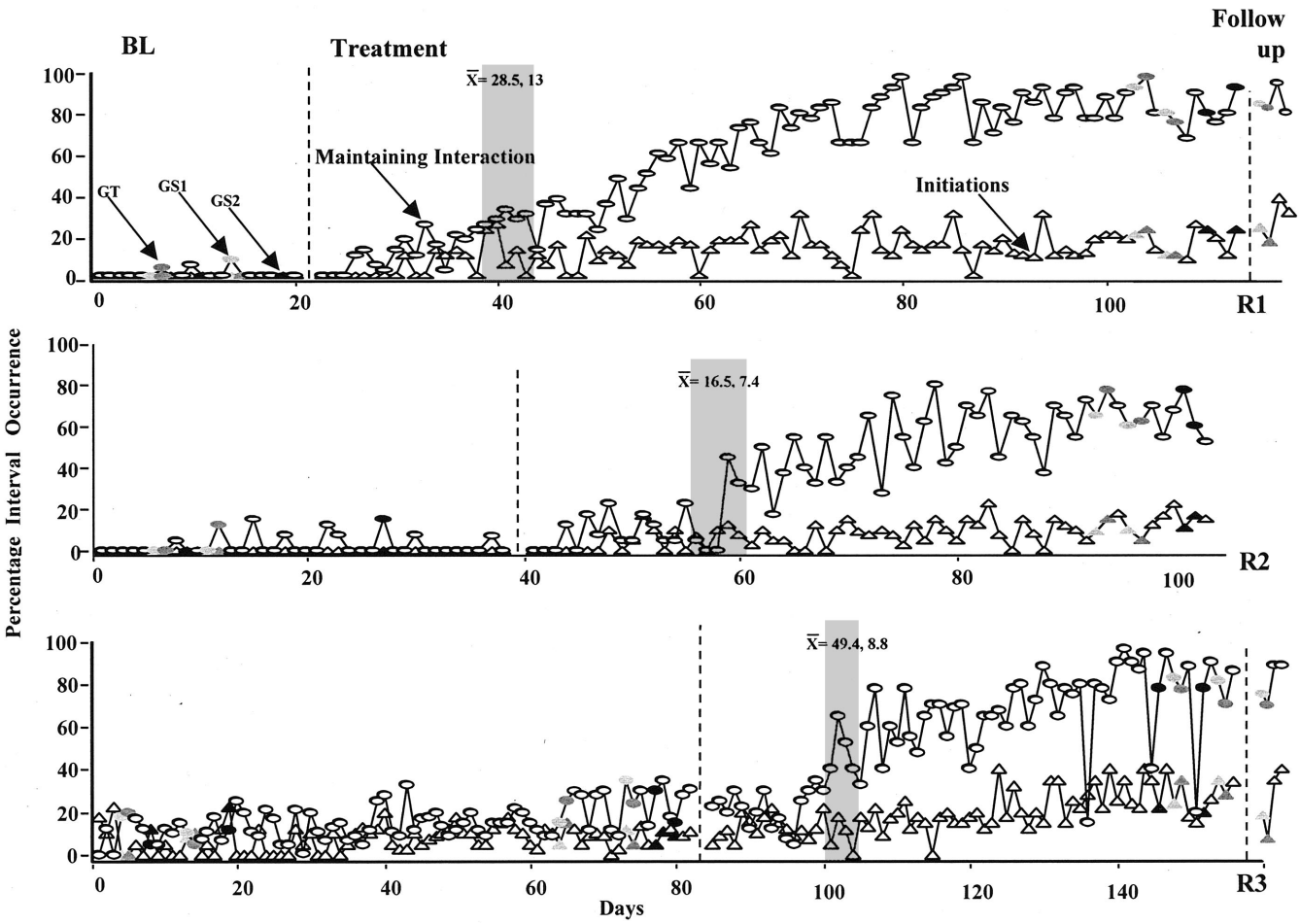


Figure 5. The percentage of 30-s intervals in which responders (Rs) engaged in social behavior. Shading indicates 5th week of treatment. Means are for levels of maintaining and initiating social interactions. BL = baseline; GT = generalization to novel therapist; GS = generalization settings.

gagement in social initiations at follow-up was 33.8%. R3 engaged in social initiations 40% of the time sampled at follow-up.

Social Behaviors: Nonresponders

Data for the same categories are presented in the bottom half of Figure 4 (B) for NR1, NR2, and NR3. NR1 and NR2's rates of maintaining interactions were below 10.0% during baseline and did not change during treatment. Rates of social initiations for NR1 and NR2 during baseline and treatment were below 5.0%. NR2's behavior at follow-up remained unchanged. NR3 maintained interactions 37.5% of the time during baseline. This behavior decreased to 17.8% during treatment. NR3's baseline percentage occurrence of initiations was 0.0% and increased to 1.5% during treatment.

Discussion

Investigators have properly expressed concern regarding the unexplained outcome variability associated with early intervention research (e.g., Olley et al., 1993) and have observed that pretreatment differences in child characteristics may offer some insight. The process of isolating these variables and their relationship to outcomes will enable professionals to match individual children to specific treatment programs. The exigent nature of early intervention requires that practitioners determine a priori which treatment is appropriate to a given child, thus maximizing the benefits for the entire population.

Our goal in the current investigation was to identify at intake a subset of children with autism who would respond successfully to the PRT treatment program, in addition to identifying children who were least suited to this intervention. Participants were selected on the basis of a match with either the responder or nonresponder behavioral profile and then received daily PRT to assess the validity of these predictor variables. Although both groups were similar at intake with respect to measures of intelligence, language, and autism severity, the two groups responded differently to the treatment program on all outcome measures. Furthermore, although the mean chronological age of the nonresponders was higher than that of the responders, inspection of results for individual children indicate that (a) the 1 nonresponder who was in the

age range of the responders (i.e., NR1) was among the poorest performing of the nonresponders and (b) the oldest nonresponder (NR3) performed the best of the nonresponders. This suggests that the lower mean age of the responders does not account for the positive results for this group.

Participants whose profiles matched the PRT responder profile evidenced improvements on standardized assessments and demonstrated gains in the areas of language, play, and social skills during treatment sessions and generalized these new behaviors to no-treatment environments and untrained stimuli. After 5 weeks of PRT, nonresponders had not shown any improvement across the same measures; treatment was discontinued because it was apparent that this intervention was not clinically beneficial and was therefore ethically indefensible to continue.

In this investigation, there was an effort to provide comprehensive yet detailed data beyond the standardized measures. As a supplement to traditional assessments, separate measures of language use, play, and social skills were collected during baseline, training, and generalization sessions for all participants in this investigation.

Treatment Outcome: Behavioral Measures

Language

R1 and R2 began treatment with no functional communication. By the 2nd month of treatment, both began to talk during treatment sessions and outside of the experimental setting with their parents. At the conclusion of treatment, both children communicated using spontaneous phrase speech in multiple settings and across individuals. Similar language results were achieved by R3.

The results for the nonresponders were quite different. Similar to the responders (R1 and R2), NR1 and NR2 had no functional communication prior to treatment. However, NR1 and NR2, unlike their responder counterparts, did not develop communicative skills in response to treatment. NR3's rate of speech during treatment sessions did not increase and remained primarily echoic.

Play Behaviors

Each of the responders displayed the ability to interact with toys appropriately during baseline; however, they displayed little variability in the items they chose, and their play was largely restricted to repeated patterns of interaction. Following intervention, all responders showed increases in the amount of time they spent engaged in functional play and varying their play. Symbolic play did not improve substantially for the children in this study, although R3's behaviors showed modest gains. Posttreatment language age equivalents indicated the possibility that these abilities were just emerging. Follow-up data for R1 showed an increase in both language and symbolic play behaviors.

The nonresponders, in contrast, demonstrated much greater play deficits at baseline relative to the responders (as stipulated by the profiles). Therefore, they had greater room in which to make improvements; however, none of the nonresponders developed play behaviors above their baseline levels of performance.

Social Behaviors

During baseline, all of the responders exhibited very low levels of the simple social behaviors of initiating and maintaining interactions. Levels of maintaining social interactions improved for the responders after approximately 30 hr for R1 and 40 hr for R2 and R3. Social initiations (which did not include requesting behaviors) also increased as a function of treatment; however, these gains were modest. It is possible that 8 hr a week is not enough to target initiations in this young population and that an increase in intensity would result in greater levels of responding. It may also be that these behaviors will have to be targeted separately for meaningful change to occur.

Again, the results for the nonresponders were quite different. Neither NR1 nor NR2 maintained or initiated interactions during baseline, and these skills did not develop during treatment. NR3's rate of maintaining interactions decreased.

The results from this investigation point to the need for further research. The responder and nonresponder profiles consisted of the following behaviors: functional play, approach behaviors, avoidant behaviors, and self-stimulatory behaviors. Because all four profile behaviors were considered when making the classification of responder or nonresponder, it is impossible to know to what extent any single profile behavior influenced responsiveness. Component analyses would be important.

Aside from the need for more research to identify predictor variables, there are additional questions requiring further investigation. An important question remaining unanswered is will responders to PRT respond to any treatment, and will nonresponders to PRT conversely be destined to respond poorly to all treatments? This question cannot be fully answered without further empirical investigation. Some follow-up data on NR1 and retrospective data on NR3, however, offer insight. After completing the study, NR1 began an intensive home-based DTT (Lovaas, 1987) program. Although cognitive and behavioral measures are not available, his mother reported that after 2 years, NR1 no longer required special education placement, was doing well in a classroom with typically developing peers, had developed conversational speech, and had friends. NR3, prior to her involvement with this study, had received DTT home programming and had benefited from it as well. Although anecdotal, these accounts provide some evidence that nonresponders to PRT may benefit from alternative treatment programs and underscore the point that the classification of nonresponder in this investigation refers specifically to PRT and does not classify children as nonresponders to autism treatments in general. We find it important that one empirical investigation (Schreibman, Stahmer, & Cestone, 2001) revealed that although the present profile did predict outcome with PRT, it did not predict outcome for DTT, suggesting that the profile is not predictive of improvement with treatment in general.

It remains possible that responders to PRT are responders to all interventions. As prognostic indicators for other interventions are identified, parents and professionals will have a rubric by which to choose from the available alternatives. In cases in which there may be overlap between programs, an eclectic approach to treatment that could provide them with the relative benefits of different interventions may be the best approach.

Another avenue for investigation concerns the development of the predictor behaviors themselves. In one recent study, children with autism that were predicted to have poor outcomes were taught to self-initiate and, as a result of this training, demonstrated a favorable response to treatment (L. K. Koegel, Carter, & Koegel, 2003). In preliminary data from a separate investigation, one child

who initially presented with a nonresponder profile and did not respond to PRT later presented with a responder profile, and PRT was subsequently successful (Schreibman et al., 2001).

Although the idea of modifying a child's behavior to fit a responder profile is contrary to the idea of selecting the best treatment for the child's presenting profile, this avenue would have value when the child's presenting profile does not correspond to any existing treatment. Ideally, this would only be an interim approach that would eventually be replaced by the advent of additional responder treatment pairings. Furthermore, one might assume that children's profiles change with development and learning, and changes in profiles are signposts that may indicate that one or another treatment approach should be added or changed.

Treatment Intensity

The treatment provided in this investigation was of brief duration and intensity relative to other early intervention programs. Although the gains made by the responders improved the trajectory of their development in several areas, this program is not offered as a cure for autism, and the participants cannot be described as functioning normally as a result of this brief intervention. Rather, the objective was to demonstrate the possibility of matching individual children, prior to the start of the intervention, to a particular treatment (i.e., PRT) that would be effective for them.

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