

Original Articles

Relationship-Focused Early Intervention With Children With Pervasive Developmental Disorders and Other Disabilities: A Comparative Study

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ABSTRACT. This study compares the effects of relationship-focused early intervention on toddlers and preschool-age children who were classified as having either pervasive developmental disorders (PDDs) (N = 20) or developmental disabilities (DDs) (N = 30). The intervention was conducted over a 1-year period through weekly individual parent-child sessions. It focused on helping parents use responsive teaching strategies to encourage their children to acquire and use pivotal developmental behaviors that addressed their individualized developmental needs. Before and after comparisons indicated significant increases in parents' responsiveness and children's pivotal behavior. Both groups of children made significant improvements in their cognitive, communication, and socioemotional functioning. However, children with PDDs made statistically greater improvements on the developmental measures than children with DDs. On several developmental measures, children's improvements were related to increases in both their parents' responsiveness and their own pivotal behavior. *J Dev Behav Pediatr* 26:77-85, 2005. Index terms: *early intervention, pervasive developmental disorders, relationship focused intervention.*

Relationship-focused (RF) early intervention addresses the socioemotional and developmental needs of young children by encouraging parents to use strategies that are designed to help them interact more responsively with their children. There is increasing evidence that RF interventions are effective at promoting the cognitive and communication functioning of young children with a variety of developmental risks or disabilities. More than 15 published studies indicate that parents can be encouraged to engage in responsive interactions with their children through the use of interactive strategies such as "take one turn and wait," "follow the child's lead," or "imitate your child."¹⁻³ In addition, RF interventions that are implemented for 6 months or longer often result in significant improvements in children's development.

Several authors have proposed that RF intervention could be an effective treatment for children with pervasive developmental disorders (PDDs).⁴⁻⁷ Enthusiasm for this approach is related to at least two factors. First, research conducted with a range of parents and children over the past 30 years indicates a moderate relationship between

maternal responsiveness and many of the developmental features that are problematic for children with PDDs, including cognition,⁸ language,^{9,10} and socioemotional behavior.¹¹ Second, recent reports indicate that the same features of parental interaction that affect the development of typically developing children and children with developmental disabilities (DDs) also influence the development of children with PDDs. Siller and Sigmund¹² reported data on 25 children with PDDs that indicated that early measures of maternal responsiveness predicted these children's language development during the preschool-age period and up through late adolescence.

Despite the promise of RF intervention, there is insufficient empirical evidence to recommend this approach for children with PDDs. To date, only one investigation of RF intervention has been published with this group of children. Greenspan and Wieder¹³ reported a chart study of 200 children. Comparisons of before and after data as well as anecdotal reports suggested that several children made remarkable improvements in developmental functioning and reduced many of their atypical behaviors. However, the procedures of this study precluded definitive conclusions. In addition to lacking a control group, there were inadequate documentation of the intervention and no record of how parents and families followed through with intervention and how outcomes were assessed by informal procedures.

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In this study, we compare the effects of RF intervention for a 1-year period on the developmental and socioemotional functioning of two developmentally matched groups: children with PDDs and children with other types of DDs. The design of this study enables us to both replicate previous findings that RF intervention is effective at promoting the developmental functioning of young children with disabilities (DDs) and to determine whether comparable effects can be accomplished with children with PDDs. The comparison of these two groups allows us to examine a prevailing assumption of contemporary early intervention practice that children with PDDs require more highly structured and intensive developmental intervention than children with other disabilities.¹⁴ Dawson and Osterling⁴ maintain that children with PDDs require structured intervention methods because of their severe information-processing deficits, yet there is little empirical support for this assumption, particularly for children younger than 5 years of age.

The RF intervention used in this investigation is responsive teaching (RT).¹⁵ RT is a newly developed, manual-based curriculum that incorporates the instructional strategies and intervention methods of two previous curricula that had been reported to be effective with children with DDs: the Transactional Intervention Program¹⁶ and the ECO model.¹⁷ RT differs from previous RF interventions insofar as it is based on a logic model (Fig. 1) that asserts that the effects of responsive interaction strategies on children's development are mediated by the impact that they have on children's "pivotal developmental behaviors"¹⁸ (i.e., attention, persistence, interest, initiation, cooperation, joint attention, and affect). Consequently, the RT curriculum is organized around 19 pivotal intervention objectives, which are behaviors that (a) have been described as core processes for cognitive, communication, and socioemotional development and (b) have been reported to be influenced by maternal responsiveness.¹⁹

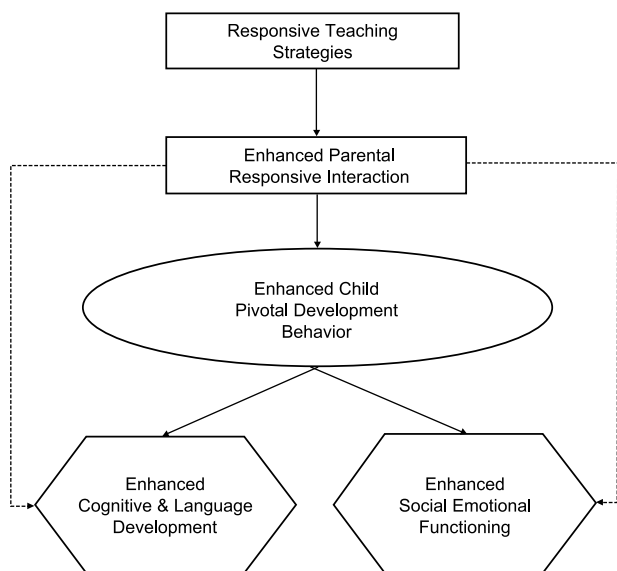


FIGURE 1. Model showing how responsive teaching strategies affect child development.

In this study, the effects of RF intervention are analyzed in relation to the logic model of RT. That is, this analysis will examine the relationships between RT intervention, parental responsiveness, children's pivotal developmental behavior, and children's developmental and socioemotional outcomes. This procedure minimizes the likelihood that observed intervention effects can be attributed to extraneous factors such as subject selection bias, maturation, or children's history of alternative treatments.²⁰

METHODS

Subjects

Subjects included 50 mother-child dyads in which each of the children had either pervasive developmental disorders (PDDs) or other developmental disabilities (DDs). Age range was 12 to 54 months, with 85% of the children younger than 36 months of age when they enrolled.

Table 1 presents the demographics of the subjects. The average age of the mothers was 32.6 years and most were white (89.1%) and married (92.7%). Mothers had 14.8 years of education, and almost one half were working (47.3%). The children were approximately 2 years old at the start of the study (26.4 months), and almost two thirds (62%) were boys. The only significant demographic difference between the two groups was that children were significantly older in the PDD group (mean = 32.4 months) than in the DD group (mean = 23.3 months).

Children in the PDD group had been diagnosed by their physicians with autism ($n = 10$), autism with mental retardation ($n = 3$), or PDDs ($n = 7$). In addition, these children's scores on our developmental and socioemotional measures indicated they met the DSM-IV criteria for PDD at entry into this study. As indicated in Table 1, each of the children had substantial delays in cognitive, symbolic, and communication functioning and also had severe problems in social interaction and self-regulation as indicated by their scores on both the Temperament and Atypical Behavior Scale (TABS)²¹ and Infant Toddler Social Emotional Assessment (ITSEA) (Table 1).²²

The overall scores for children in the PDD group on the TABS were 3 SD below the mean, which met the criteria for regulatory disorder.²¹ Research indicates that severe regulatory problems accompanied by deficits in communication and cognitive development are highly predictive of a later diagnosis of autism.²³ A retrospective study of 65 parents of children with diagnosed autism found that 86% of their children met the TABS criteria for regulatory disorder when they were 1 year old.²⁴

Each of the children with DDs had significant delays in cognitive and/or communication development (Table 1). Only three of the children in this group had diagnosed medical conditions (cerebral palsy ($n = 1$), Down syndrome ($n = 1$), and neurofibromatosis ($n = 1$)). The remainder of the children were identified by their parents as having speech and language problems ($n = 14$) or developmental delays ($n = 13$).

As indicated on Table 1, although children with DDs were younger than children with PDDs, the two groups had equivalent developmental age (DA) scores for the four

Table 1. Demographic Characteristics of Parents and Children at Start of Intervention

Variable	Children with PDD (n = 20)		Children with DD (n = 30)		Total Sample (n = 50)		STATS
	Mean	SD	Mean	SD	Mean	SD	
Parents							
Mother's age (yr)	32.1	7.1	31.7	5.5	32.6	5.2	0.33 ^a
Mother's education (yr)	15.5	2.6	14.3	1.9	14.8	2.2	0.01 ^a
Marital status (% married)	100.		88.2		92.7		0.21 ^a
Race (% White)	95.2		85.3		89.1		2.17 ^b
Employed (%)	52.1		44.1		47.3		0.28 ^b
Part time (%)	28.6		14.7		20.0		
Full time (%)	23.8		29.4		27.3		
Father's age (yr)	35.6	6.0	33.7	5.5	34.5	5.8	0.07 ^a
Father's education (yr)	15.9	2.6	14.7	2.6	15.2	2.6	0.16 ^a
Children							
Chronological age (mo)	32.4	7.3	23.3	6.1	26.9	7.9	21.35 ^{a*}
% Males	65.0		67.0		66.0		0.35 ^a
Socioemotional characteristics, (TABS)^c							
Detached ^c	22.1	21.7	47.3	11.2	37.0	20.4	35.68 ^{a*}
Hypersensitivity/hyperactivity ^c	41.0	14.8	46.2	16.4	44.1	15.8	1.72 ^a
Underreactive ^c	34.3	12.4	47.3	12.4	42.0	13.9	13.46 ^{a*}
Dysregulated ^c	35.3	16.1	46.8	10.3	42.1	14.1	11.75 ^{a*}
Overall atypical behavior ^d	58.0	37.0	91.2	24.8	77.6	34.2	17.32 ^{a*}
Child development (TPBA)^e							
Object abilities ^f	16.5	6.0	17.8	6.5	17.3	6.3	0.57 ^a
Symbolic behavior ^f	15.2	5.3	15.1	5.5	15.1	5.4	0.01 ^a
Expressive language ^f	13.8	6.7	12.6	5.5	13.1	6.0	0.45 ^a
Receptive language ^f	12.1	7.2	15.3	6.1	14.0	6.7	2.94 ^a

PDD, pervasive developmental disorder; DD, developmental disability.

^aAnalysis of variance.

^bChi-square.

^cTemperament and Atypical Behavior Scale (TABS).²¹ *T* score (mean = 50, SD = 10).

^dStandard score (mean = 100, SD = 15).

^eTransdisciplinary Play-based Assessment (TPBA).²⁵

^fDevelopmental age (months).

**p* < .001.

domains measured by the Transdisciplinary Play Based Assessment.²⁵ Group differences in children's socioemotional functioning as measured by the TABS were significant. Children with PDDs had significantly more problems in detachment (*p* = .000), underreactivity (*p* = .001), and dysregulation (*p* = .004) than children with DDs.

Procedures

Children received RT during weekly 1-hour parent-child sessions that were conducted either at a center-based facility or in parents' homes by one of six early intervention specialists. Subjects participated in this study for approximately 1 year (mean = 11.3 months, SD = 2.1). While subjects were scheduled for one session each week, they received an average of 32.6 (SD = 12.9) sessions. At the completion of intervention, parents reported spending an average of 15.1 (SD = 2.4) hours each week carrying out intervention activities with their children at home.

Data Collection. Child and family assessment data were collected at the beginning and end of intervention. Three instruments were used to assess children's development and socioemotional functioning.

The Transdisciplinary Play Based Assessment²⁵ is a play-based assessment for children up to 6 years of

age. This instrument meets the developmental assessment criteria recommended by *Zero to Three*.²⁶ It is especially useful for children who are underrepresented in the normative samples of standardized tests, such as children with DDs and PDDs. It provides these children opportunities to engage in play activities in a manner that is compatible with their behavioral style and developmental level.

Each of the play and social behaviors that children produced during the observation were transcribed from videotape recordings and coded according to their DA level as reported in the Developmental Rainbow.²⁷ DAs were computed for two cognitive domains, object use and symbolic behavior, and two language domains, expressive and receptive language. DAs were estimated by independent raters based on the highest age level of developmental behaviors that children consistently demonstrated (i.e., more than ten times) during the observation for each of the four developmental domains. Interrater reliability was calculated on 20% of the observations. A *t* test indicated no significant differences between the DA ratings for the two observers (*t* = 0.84, *p* > .05), and a Pearson correlation indicated that their ratings were highly correlated (*r* = .92, *p* < .001).

The Developmental Rainbow²⁷ is a child development profile designed to be used to guide developmental observations and play-based assessments of children from birth through 5 years of age. This observational tool includes a detailed listing of the skills and behaviors that young children are likely to manifest across five developmental domains: cognition, communication, socioemotional functioning, motor development, and self-help skills. Items included in this profile were compiled from several standardized developmental assessment instruments and pre-school curricula and organized according to DA ranges.

The ITSEA²² is a parent respondent instrument that assesses the socioemotional behavior of children up to 3 years DA. The scale measures four components of socioemotional functioning including internalizing (e.g., depression-withdrawal), externalizing (e.g., aggression, activity), regulatory problems (sleep and eating difficulties), and social competencies (e.g., empathy).

The TABS²¹ is a standardized instrument for assessing problem behavior of children between 1 and 6 years of age. It is a parent respondent instrument with 55 items that assess four factors: detached, hypersensitive/active, under-reactive, and dysregulated. The TABS has been described as a sensitive tool for the early diagnosis of autism.²⁸ A study reported by the developers of the TABS showed that young children diagnosed with autism meet the regulatory disorder criteria on the TABS.²⁹

Pivotal Behavior

Children and their parents were recorded on videotape while playing together for 7 minutes with a set of developmentally appropriate toys. Parents were instructed to play with their children as they typically do. The Child Behavior Rating Scale (CBRS)³⁰ was used to rate these observations to assess children's pivotal behavior. The CBRS has seven items that characterize children's engagement: persistence, attention, involvement/interest, initiation, cooperation, joint attention, and affect. Trained observers rated each of the items on a 5-point Likert scale, ranging from 1 (very low) to 5 (very high), after watching the videotaped observations.

Interactive Style

Parents' style of interacting was assessed with the Maternal Behavior Rating Scale (MBRS)³¹ from the videotapes of parent-child play described above. The MBRS is a 12-item scale that assesses four dimensions of interactive style: responsiveness, affect, achievement orientation, and directiveness. Research indicates that the MBRS assesses parenting characteristics associated with children's developmental growth and that it is sensitive to changes in interaction promoted through parent-mediated interventions.^{16,32}

Coding and Reliability of Parent-Child Observation

Observations of mother-child play were coded by raters who had received at least 40 hours of training on each

scale and who had attained at least 80% agreement within 1 point on a 5-point Likert scale. To minimize rater bias, observations were randomly sorted so that before and after observations for each subject would not be coded consecutively and would be counterbalanced.

A second rater coded a random selection of 30% of all observations to assess reliability. For the MBRS, interrater reliability using the Spearman correlation was $r = .73$ ($p < .000$). Raters attained 60% exact agreement and 99% agreement within one scale point. Cohen's kappa was .43 ($p < .000$). For the CBRS, interrater reliability using the Spearman correlation was $r = .77$ ($p < .000$). Raters attained 56% exact agreement and 100% agreement within one scale point. Cohen's kappa was .48 ($p < .000$). The level of reliability attained for these two scales is consistent the levels of reliability reported for previous studies in which these scales were used.³²

RESULTS

Effects of Responsive Teaching on Parents' Interaction and Children's Pivotal Behavior

Results from the Maternal Behavior Rating Scale (MBRS) are presented in Table 2. A repeated-measures multivariate analysis of variance (MANOVA) indicated significant intervention changes in mothers' style of interaction. Univariate analyses indicated significant increases in responsiveness and affect. While the intervention \times group interaction was not significant, univariate analyses showed significant interactions for two MBRS subscales. Mothers of children with pervasive developmental disorders (PDDs) made greater increases in responsiveness and affect than mothers of children with developmental disabilities (DDs).

Each of the behaviors measured by the Child Behavior Rating Scale (CBRS) increased during intervention (Table 2). A MANOVA indicated significant effects for intervention and intervention \times treatment. Univariate analyses indicated significant intervention effects on all seven CBRS items. Children with PDDs made greater improvements on all items than children with DDs.

Responsive Teaching Effects on Children's Development and Socioemotional Functioning

Pre- and post-developmental age (DA) scores are reported in Table 3. To assess intervention effects on children's cognitive and language development, we first compared the level of developmental functioning children attained at post-intervention with the level of development that they were expected to attain based on assessments of their developmental functioning at pre-intervention. Expected DAs were calculated using the formula $[DA1 + (DA1/chronological\ age1 \times months\ of\ intervention)]$. A repeated-measures MANOVA indicated that the effects of intervention and intervention \times group were both significant at $p < .01$. Univariate analyses indicated that DA scores at post-intervention were significantly greater than expected DAs for all four developmental domains. Children with PDDs made significantly greater improvements

Table 2. Before and After Data on Parental Style and Children’s Behavior

Variables	Time 1				Time 2				F (Intervention)	F (Intervention × Group)
	PDDs		DDs		PDDs		DDs			
	Mean	SD	Mean	SD	Mean	SD	Mean	SD		
MBRS ^a									8.66***	2.74
Responsiveness	2.7	0.7	3.1	0.7	3.8	0.5	3.4	0.5	34.05***	8.11**
Affect	2.8	0.6	2.9	0.5	3.5	0.5	3.1	0.5	26.48***	10.19**
Achievement orientation	3.0	0.6	2.9	0.7	2.9	0.4	2.7	0.5	3.87	0.01
Directiveness	3.2	0.5	3.2	0.7	3.1	0.3	3.0	0.5	2.86	0.00
CBRS ^b									11.28***	3.10**
Attention	2.9	1.2	3.4	1.0	4.1	0.7	3.6	0.8	14.66	8.38**
Persistence	2.9	1.3	3.2	0.9	4.5	0.8	3.3	1.0	20.30***	14.38***
Interest	2.2	1.1	3.0	0.7	3.8	0.8	3.3	1.0	41.44***	19.86***
Cooperation	2.1	0.9	3.2	0.9	3.5	0.9	3.3	0.8	14.84***	13.49***
Initiation	2.7	1.5	2.8	0.9	4.2	0.7	3.5	0.9	44.94***	5.47*
Joint attention	1.9	1.0	2.9	0.8	3.6	1.0	3.5	0.8	64.18***	12.90***
Affect	3.3	0.8	3.4	0.6	4.1	0.7	3.5	0.6	15.38***	7.50**

PDDs, pervasive developmental disorders; DDs, developmental disabilities.

^aMaternal Behavior Rating Scale (MBRS).³¹

^bChild Behavior Rating Scale (CBRS).³⁰

p* < .05; *p* < .01; ****p* < .001.

than children with DDs in object relations and receptive language.

Proportional change indices (PCIs)³³ were computed to delineate the magnitude of children’s developmental improvements. PCIs compare children’s rate of development during intervention with their rate of development before intervention. Scores of 1.0 indicate no change in rate of development; scores of greater or less than 1.0 indicate proportional increases or decreases in children’s developmental rates. The PCIs reported in Table 3 indicate that children made dramatic improvements in their rate of development ranging from 20% to 259%. They also show that children with PDDs made greater improvements on all four developmental measures than children with DDs.

Table 4 reports pre- and post-intervention measures of children’s socioemotional functioning as measured by the Infant Toddler Social Emotional Assessment (ITSEA) and the Temperament and Atypical Behavior Scale (TABs). A MANOVA indicated significant intervention and intervention × group effects on the ITSEA. Univariate analyses indicated that children made significant improvements on three of the ITSEA subscales: internalizing, self-regulation, and social competence. As evidenced by the mean scores

for the two groups of children, the significant intervention × group interaction reflected the fact that only the children with PDDs made improvements in self-regulation.

Results for the TABs indicated significant improvements for the entire sample of children. However, the significant intervention × group interaction indicated that this effect was attributable to the fact that only children with PDDs made improvements on their TABs scores. This improvement was evident on three subscales, detached, underreactivity, and self-regulation, as well as on their overall scores, which increased by an average of 1.5 SD.

Responsive Teaching Logic Model

Three analyses were conducted to determine whether findings from this study were consistent with the logic model of responsive teaching (RT). First, analyses were conducted to examine how increases in maternal responsiveness were associated with changes in children’s pivotal behavior. Changes in pivotal behavior were the difference between the averages of children’s CBRS scores at pre-intervention and their average CBRS scores at post-intervention. A hierarchical regression was conducted

Table 3. Intervention Changes in Children’s Cognitive and Communication Functioning

Variables	Pre		Expected				Observed				Stats Expected/Observed					
	PDDs		DDs		PDDs		DDs		PDDs		DDs		PCI PDDs	PCI DDs	F (Intervention × Group)	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD				
Play-Based Assessment ^a															17.51***	3.86**
Object relations	16.5	6.0	17.8	6.5	22.1	7.4	26.4	8.6	27.5	8.2	27.3	7.4	2.20	1.19	28.00***	15.26***
Symbolic behavior	15.2	5.3	15.1	5.5	20.3	6.6	22.4	7.2	24.9	10.0	24.8	8.0	2.03	1.44	18.44***	1.60
Expressive language	13.8	6.7	12.6	5.5	18.4	8.6	18.7	7.1	24.1	10.2	24.6	7.6	3.36	2.22	33.27***	0.02
Receptive language	12.1	7.2	15.3	6.1	16.1	9.1	22.7	8.3	22.9	8.4	25.8	7.8	3.59	1.58	47.70***	6.52**

PDDs, pervasive developmental disorders; DDs, developmental disabilities; PCI, proportional change index.

^aTransdisciplinary Play-based Assessment (TPBA).²⁵

p* < .05; *p* < .01; ****p* < .001.

Table 4. Before and After Data on Children's Socioemotional Functioning

Variables	Time 1				Time 2				F (Intervention)	F (Intervention × Group)
	PDDs		DDs		PDDs		DDs			
	Mean	SD	Mean	SD	Mean	SD	Mean	SD		
ITSEA ^a									6.36***	2.88*
Internalizing ^b	49.5	8.1	46.6	7.6	52.9	8.8	48.2	7.7	3.92*	0.48
Externalizing ^b	47.9	8.6	50.7	11.6	49.0	9.0	49.0	11.0	0.44	1.00
Self-regulation ^b	41.3	8.6	49.1	8.0	47.2	7.8	49.3	10.0	6.69**	5.85*
Social competence ^b	30.2	15.8	42.2	12.5	36.6	11.4	46.8	10.3	6.74**	0.21
TABS ^c									4.02**	5.46***
Detached ^b	21.0	21.1	47.3	11.2	35.2	22.0	48.6	11.2	11.85***	8.18**
Hypersensitivity/hyperactivity	39.7	15.0	46.3	16.5	43.6	13.7	49.2	11.7	2.68	0.07
Under reactivity ^b	34.7	16.3	47.7	12.1	47.1	13.6	50.1	10.7	13.31***	6.12**
Self-regulation ^b	33.8	16.3	47.7	9.8	43.6	11.5	44.3	12.1	3.09	12.86***
Overall ^d	55.1	37.3	91.8	24.9	75.4	38.5	95.4	22.2	9.88**	4.78*

PDDs, pervasive developmental disorders; DDs, developmental disabilities.

^aInfant Toddler Social Emotional Assessment (ITSEA).²²

^bT Score (mean = 50, SD = 10).

^cTemperament and Atypical Behavior Scale (TABS).²¹

^dStandard Score (mean = 100, SD = 15).

* $p < .05$; ** $p < .01$; *** $p < .001$.

in which responsiveness at T1 and global pivotal behavior at T1 were entered in the first block and change in responsiveness was entered in the second block. Results indicated that change in responsiveness accounted for 20% of the variance in changes in children's pivotal behavior, controlling for children's pivotal behavior and parents' responsiveness at the beginning of intervention (Table 5). Increases in children's pivotal behavior during intervention were highly associated with increases in their parents' responsiveness.

Second, hierarchical multiple regressions were conducted to examine the contribution of children's pivotal behavior to the PCIs for each developmental domain, controlling for the effects of children's development at the beginning of intervention. As reported in Table 6, children's pivotal behavior (i.e., pivotal behavior at time 1 + change in pivotal behavior) accounted for an average of 9.5% of the variance in children's PCIs across the four developmental measures.

We also conducted hierarchical regression analyses to examine how children's pivotal behavior contributed to changes in their socioemotional functioning as measured by the ITSEA and TABS. Neither children's pivotal behav-

ior at the start of intervention nor changes in their pivotal behavior during intervention contributed significantly to these socioemotional measures.

DISCUSSION

In this study, we have reported data regarding the impact of an relationship-focused (RF) intervention model, responsive teaching (RT), on the development and socioemotional functioning of young children with pervasive developmental disorders (PDDs) or developmental disabilities (DDs). Results indicated that RT procedures were effective at encouraging two thirds of the parents to engage in more responsive interactions with their children during intervention. In addition, nearly three fourths of the children increased their pivotal developmental behaviors, and this was highly related to how responsive their parents became during intervention.

RT also appeared to be highly effective at promoting children's development. The PCIs that were used to assess children's developmental improvement during intervention indicated that the entire sample of children made more than a 60% increase in their rate of cognitive development and even more dramatic increases in their communication development. Their rate of expressive language development increased by an average of 167%, and their rate of receptive language development increased by 138%. Seventy percent of the children made expressive language improvements and 80% made receptive language improvements.

Children with PDDs and DDs were matched at the beginning of this study in their level of language and cognitive development. Nonetheless, children with PDDs made greater improvements both in communication and cognitive functioning than children with DDs. However, these group differences were related to the fact that parents of children with PDDs made greater changes in responsiveness during intervention than parents of children

Table 5. Multiple Regression Analyses for Changes in Children's Pivotal Behavior

Model	Beta	T Value	Significance	R ²	R ² Change
Responsiveness T1	.04	0.33	.740	.57*	
Global pivotal behavior T1	-.78	-7.12	.000		
Change in responsiveness	.70	6.81	.000	.77*	.20*
Responsiveness T1	.56	5.03	.000		
Global pivotal behavior T1	-.75	-9.35	.000		

* $p < .001$.

with DDs and appeared to have had little to do with the different diagnoses of the two groups of children.

RT also appeared to be effective at reducing children’s socioemotional problems, but these effects occurred primarily for children with PDDs. Children with DDs did not have socioemotional problems at the beginning of intervention and showed little improvement in this domain. However, children with PDDs, who had several socioemotional problems at the onset of intervention, made marked improvement in this area. Although many professionals have speculated that interventions that encourage parents to become more responsive can be effective at promoting children’s socioemotional well-being,³⁴ this is the first long-term intervention study to actually demonstrate this effect.

One of the most notable aspects of these results is that they occurred even though professionals had modest levels of contact with parents and children, averaging only 32 sessions in 1 year. Yet despite the limited professional involvement in the intervention, reports from parents indicated that this may still have been a relatively intensive intervention for children. Parents reported spending more than 15 hours per week, or more than 2 hours a day, using RT strategies with their children. This level of intervention intensity is comparable with the amount of time that many model intervention programs have worked directly with children with PDDs.⁴

In the following, we discuss several issues that are crucial for interpreting the results of this study.

The quasi-experimental design used in this investigation is susceptible to threats to validity associated with history, maturation, and subject selection bias. However, two design features mitigate the likelihood that our results were seriously compromised by these threats. First, the instruments used to assess children’s outcomes provide a normalized comparison contrast that lessens the likelihood that changes in functioning can be attributed to maturation. Both the Infant Toddler Social Emotional Assessment (ITSEA) and Temperament and Atypical Behavior Scale (TABS) are

standardized tests. The standard scores from these tests should be stable over time unless there are changes in functioning that are not caused by normal maturational factors. Slight variations in scores from one age to the next could be caused by factors such as normal deviations in developmental growth, measurement error, or inadequate standardization of these instruments. However, substantial changes, such as the 1.5 SD increase in the overall TABS scores observed for children with PDDs, greatly exceed the level of change that should occur due to developmental variation or test error and thus likely reflect legitimate changes in their socioemotional functioning.

Zero to Three has published developmental assessment guidelines²⁶ that recommend that structured, standardized testing procedures *not be used* with children with limited capabilities to conform to these testing procedures, such as children with PDDs or DDs. To comply with these recommendations, we used a nonstandardized play-based observation procedure to assess children’s cognitive and communication functioning, and norm-referenced criteria (e.g., developmental age [DA]) to evaluate their development. Play-based assessment provides a reliable method for assessing children who have conditions such as PDDs who require more opportunities and flexibility to demonstrate their developmental capabilities than other children. This procedure yields DA estimates that have been reported to be consistent with those obtained from standardized tests.³⁵

Although the scores attained with this procedure may not be equivalent to scores attained with traditional tests, such as the Bayley Scales of Mental Development, the developmental changes that children made were very dramatic. While the level of this effect can be debated, it is unlikely that developmental changes of this magnitude could simply be an artifact of our procedures.

Second, to mitigate the validity threats associated with a history of alternative treatments that children were receiving as well as subject selection bias, we analyzed intervention effects in relationship to the logic model for

Table 6. The Impact of Changes in Children’s Pivotal Behavior on Intervention Effects for the Four Developmental Domains

Dependent Variable	Model	Beta	T Value	Significance	R ²	R ² Change
Object Use PCI	Object use T1	-.50	-4.15	.000	.23**	
	Change in pivotal behavior	.47	2.70	.010	.34**	.11*
	Pivotal behavior T1	.56	3.06	.004		
Symbolic behavior PCI	Object use T1	-.60	-4.57	.000		
	Symbolic behavior T1	-.40	-3.14	.003	.14**	
	Change in pivotal behavior	.45	2.57	.013	.31**	.17**
Expressive language PCI	Pivotal behavior T1	.69	3.79	.000		
	Symbolic behavior T1	-.54	-4.30	.000		
	Expressive language T1	-.48	-3.90	.000	.21**	
Receptive language at PCI	Change in pivotal behavior	.38	2.08	.043	.26**	.05*
	Pivotal behavior T1	.44	2.28	.027		
	Expressive language T1	-.56	-4.07	.000		
Receptive language at PCI	Receptive language T1	-.61	-5.61	.000	.37**	
	Change in pivotal behavior	.39	2.42	.019	.42**	.05*
	Pivotal behavior T1	.41	2.37	.022		
	Receptive language T1	.82	-5.41	.000		

PCI, proportional change index.
*p < .01; **p < .001.

RT.²⁰ By linking intervention outcomes to the processes by which RT is assumed to mediate children's development, this analysis reduces the probability that interventions or events in children's lives other than those promoted through RT accounted for the observed developmental changes.²⁰ In addition, since this procedure examines variability in intervention outcomes among this select sample, it reduces the likelihood that children's intervention improvements could be attributed to the biases associated with parents being selected for this study, such as their belief in the RF approach, motivation to help their children, or advantaged resources and supports.

Thus, our analysis yielded two significant findings that are strongly supportive of the hypothesis that RF intervention enhanced children's developmental and socioemotional functioning. First, we found that changes in parents' responsiveness were moderately associated with changes in children's pivotal behaviors ($R^2 = .20$). Second, we found that the increases in children's pivotal behavior promoted through parental responsiveness were significantly related to improvements in children's developmental functioning. The size of the relationships between changes in children's pivotal behavior with improvements in their cognitive and language development (mean $R^2 = .10$) reflect moderate level intervention effects and are comparable with relationships reported between maternal responsiveness and child development.^{36,37}

While we did not find a statistically significant relationship between children's pivotal behavior and their socioemotional functioning, this result was neither surprising nor counterevidence of the RT logic model. Parent respondent instruments were used to assess socioemotional functioning since these are the only valid procedures available for children at this age level. These instruments have acceptable test-retest reliability. However, because of the different ways respondents interpret test items, their interrater reliability is likely low, making it difficult to assess the association of children's pivotal behavior to these measures.

The apparent effectiveness of RF intervention in promoting the development of children with PDDs is a provocative finding for several reasons. First, this is a cost-effective alternative for addressing the needs of young children with PDDs. The intervention effects reported in this study are among the strongest short-term effects reported for any developmental intervention to date. Yet these effects occurred with an average of 32 one-hour early intervention sessions. The annual costs for this type of intervention are less than \$5000 (2004 dollars), a fraction of the annual costs of alternative interventions for children with PDDs.

Second, these results suggest that the same kinds of procedures that have been reported to be effective at promoting the cognitive and language development of

children with DDs are also effective at addressing these needs in children with PDDs. These findings challenge the notion that young children with PDDs need highly structured interventions. They suggest that interventions that are effective at addressing the developmental needs of all children can also be used effectively with children with PDDs despite the serious socioemotional disorders that these children have.

Third, these results indicate that the same type of RF intervention procedures that promote language and cognitive development can simultaneously promote socioemotional functioning. These findings are not surprising in light of the increasing number of child development studies reporting that parental responsiveness is associated with all aspects of early development. Findings from this study indicate that the effects of RF intervention are related to the global influence that maternal responsiveness has on children's development and are not limited to the specific developmental outcomes addressed during intervention. In this study, RT enhanced multiple domains of children's development as mothers became more responsive, regardless of what developmental goals and objectives were targeted during intervention.

Finally, the relationship that we found between children's developmental progress and increases in their pivotal behavior is consistent with the differential effects that pivotal behaviors have been reported to have on the progress made by children with PDDs in discrete trial training interventions.³⁸ They suggest that pivotal behavior may play a primary role in early developmental intervention. They raise the important question of whether intervention effectiveness depends on children (a) being taught the functional or developmental skills that typify higher levels of functioning or (b) being encouraged to learn the developmental processes, i.e., pivotal developmental behaviors, that they need to use spontaneously during their daily activities, routines, and interactions.

In conclusion, the results of this study provide support for the notion that RF intervention can be an effective procedure for enhancing the development of children with PDD. However, additional research is needed to address some of the shortcomings of this investigation to gain greater confidence in these effects. In particular, this research needs to use more acceptable procedures such as the Autism Diagnostic Observation Scale³⁹ or Childhood Autism Rating Scale⁴⁰ for establishing children's diagnoses of autism and examine how other intervention services that children receive might be contributing to the effectiveness of RF intervention. This research should not only include adequate control groups but must also examine the impact of RF intervention with more diverse parents and children over a longer period of time.

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