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# Home-based behavioral intervention for young children with autism/pervasive developmental disorder

*A preliminary evaluation of outcome in relation to child age and intensity of service delivery*

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**ABSTRACT** Sixteen children with diagnoses of autism and pervasive developmental disorder who participated in home-based behavioral intervention were evaluated retrospectively to determine whether the 'intensity' of service delivery (hours per week, duration in months, total hours) and the age at which intervention was introduced (before and after 3 years of age) influenced developmental rating scale assessments of progress. Children who were involved in services before and after 3 years of age all demonstrated significant changes on six developmental domains when assessed before and following intervention but there were no significant differences between these groups. Overall improvement in the areas of communication, cognitive and social-emotional functioning was predicted by the duration of time (months) that a child spent in home-based intervention. These findings are discussed in light of recommendations for the 'intensive' behavioral treatment of young children with autism.

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Children with autism who receive intensive instruction and treatment, before the age of 5 years, using methods derived from applied behavior analysis, can evince dramatic improvements in intellectual functioning, language skills, socialization and self-care competencies (Anderson et al., 1987; Birnbrauer and Leach, 1993; Lovaas, 1987; McEachin et al., 1993). In summarizing the research on early behavioral intervention for autism, Green (1996) concluded that optimal results occur when services are initiated with children at an age of 2–3 years, are provided for a minimum of 30 hours per week, and are maintained for at least 2 consecutive years. Although center-based and home-based programs that include these components often are described as being ‘intensive’ (Anderson et al., 1987; Lovaas and Smith, 1988), it is unclear what ‘intensity’ means relative to service delivery. One dimension in this regard would be the number of hours per week that a child receives treatment. The number of learning opportunities that are made available would also be a relevant measure. Finally, the amount of time a child participates in discrete trial instruction versus incidental teaching interactions should be considered.

Another question pertaining to the intensity of early behavioral intervention for young children with autism concerns the relationship of child characteristics to outcome. Variables such as a child’s IQ, developmental status and language abilities have been identified as meaningful predictors (Green, 1996). These factors, of course, would be expected to interact with features of service delivery. As an example, is the outcome from intensive behavioral intervention influenced by the age of a child when he or she begins treatment?

With regard to the number of hours of service delivery as a measure of ‘intensity’, only Lovaas (1987) provided a comparative analysis of this component relative to outcome. In that study, the comparison was between children who received 40 hours per week versus 10 hours per week of intensive behavioral intervention. Only the group that participated in 40 hours of intervention per week showed significant improvement. More recently, Weiss (1999) reported positive outcomes for 20 children with autism (mean age = 41.5 months) who had 40 hours per week of intensive home-based behavioral intervention for a 2 year period. That study, however, was a retrospective analysis that did not include a control group and, therefore, it was not possible to interpret findings in relation to children who did not receive treatment. Also, different ‘intensities’ of intervention could not be contrasted because the home-based program of 40 hours per week was the same for all children.

Other studies have evaluated the outcome from in-home early intensive behavioral intervention that was delivered for less than 30–40 hours per week. Anderson et al. (1987) reported on 14 children with autism

(mean age = 43.0 months) who showed improvement on mental age and social age indices following one year of home-based services that were provided for 15–25 hours per week. Birnbrauer and Leach (1993) documented gains in intellectual, language and adaptive behavior measures for nine children (mean age = 39.0 months) who received an average of 18.7 hours of individualized, behaviorally oriented instruction for a duration of 2 years. Neither of these studies evaluated child progress as a function of different amounts (hours per week) of intervention.

Although 30–40 hours per week of intensive behavioral intervention has been proposed as the treatment standard for young children with autism (Green, 1996), the work by Anderson et al. (1987) and Birnbrauer and Leach (1993) indicate that, frequently, fewer hours are delivered and yet such programming can produce meaningful results. This situation might be attributed, in part, to the enormous financial costs that are required to support a comprehensive program of in-home intervention which replicates the Lovaas (1987) model (Mulick, 1999). That is, funding sources such as a local public school district or state agency usually have limited financial resources to pay for professional services. Where fewer hours per week of intervention are provided, it still would be valuable to compare outcome in relation to the 'intensity' of service delivery. Also, the influence of child age when intervention was initiated should be examined because this variable may be critical in predicting success (Green, 1996).

In a recent study, Sheinkopf and Siegel (1998) had parents report retrospectively on their experiences with 'intensive', in-home behavioral intervention that was based on a 'Lovaas model' and compared pre-treatment and post-treatment IQ scores for children receiving these services with those in a control group. As emphasized by the authors, this study differed from that of Lovaas (1987) because intervention was (a) provided outside an academic setting, (b) conducted for a shorter period of time (mean = 15.7 months), and (c) delivered for fewer hours per week (mean = 19.4 hours). Children who had 'intensive' home-based intervention scored significantly higher on the post-treatment IQ measure in contrast to the control group and they also were rated as having reduced symptom severity. Another finding of interest was that the IQ score differences for children in the treatment group did not correlate with the number of hours of intervention per week, leading to the conclusion 'that variation in treatment intensity did not relate to therapeutic response' (Sheinkopf and Siegel, 1998, p. 21).

Similar to the study by Sheinkopf and Siegel (1998), the purpose of this report is to describe a retrospective analysis of young children with autism or pervasive developmental disorder who received 'abbreviated' home-based behavioral intervention (less than 20 hours per week) and

represents a preliminary evaluation of service delivery relative to outcome. Data were analyzed and are presented to determine whether differences in learning, as measured by a developmental rating scale, were a function of child age when treatment was started (defined broadly as before or after a child was 3 years old) and how long it was provided (defined broadly as the number of hours per week, the number of months, and the total number of hours of service delivery).

## Method

### Participants

The participants were 16 children who received home-based services from The May Center for Early Childhood Education, a private program located in Massachusetts (described below). All children had been diagnosed as having autism or pervasive developmental disorder by evaluators who were not associated with the center. For the purpose of this analysis, participants were selected randomly from the population of children who had received home-based services. Selections were made for eight children who initiated treatment when they were under 3 years of age (mean = 2.63 years) and eight children who initiated treatment when they were over 3 years of age (mean = 3.98 years). Table 1 presents each child's diagnosis and age at the onset of treatment.

### Overview of home-based intervention

The May Center for Early Childhood Education is one program within The May Institute Inc., a private human services and behavioral health care organization concerned with the education, treatment and habilitation of children, adolescents and adults with developmental disabilities, psychiatric disorders, acquired brain injuries and medically compromised conditions. Children and families were referred to The May Center through public school districts, early intervention programs supervised by the state's Department of Public Health, and other service providers. An initial screening was performed by a representative from the center and if the child were judged to be an appropriate candidate for treatment, he or she was admitted to the program. Home-based services included the following components:

- 1 Pre-treatment assessment was administered to each child and included standardized instruments (described below), direct observations, parent interviews and videotape segments. These assessments and observations were completed by center staff and were implemented with all children who were enrolled in the home-based program.

**Table 1** Diagnosis and age of children when home-based services were initiated

<i>Child</i>	<i>Diagnosis</i>	<i>Age when services were initiated (years : months)</i>
<i>Under 3 years</i>		
Hank	Global developmental delay	2 : 2
Issac	PDD	2 : 4
Owen	PDD-NOS	2 : 4
Ron	PDD	2 : 6
Zeb	Autistic disorder	2 : 7
Juan	PDD/autistic disorder	2 : 8
Jacob	PDD-NOS	2 : 9
George	PDD-NOS	2 : 11
<i>Over 3 years</i>		
Ned	Developmental delay	3 : 1
Adam	PDD	3 : 3
Carlos	Autistic disorder	3 : 9
Johnny	PDD	4 : 1
Roland	PDD	4 : 2
Trent	PDD	4 : 3
Elaine	PDD	4 : 7
David	PDD	4 : 9

- 2 A service plan was developed for each child based on the consensus of center staff and other professionals who were involved with the family. The plan specified the number of hours of home-based services that would be provided by The May Center.
- 3 A home-based therapist was assigned to each child and family and this person was responsible for implementing the respective procedures detailed on the service plan. Therapists were individuals with BA and MA degrees who had specializations in psychology, early childhood education or special education. They were trained in the implementation of assessment and intervention procedures before initiating treatment with children. In addition, they received weekly supervision and case consultation from the director of the home-based services program.
- 4 All services were delivered in each child's home during multiple weekly visits conducted by the assigned therapist. The treatment model was based on methods developed by Lovaas and colleagues (Lovaas, 1987; Lovaas, et al., 1981) and described by Anderson et al. (1987). Briefly, children received discrete trial instruction and incidental teaching opportunities that were based on criterion-referenced

and behavior-specific learning objectives. The instructional methodology featured empirically documented procedures such as task-analyzed skill sequences, modeling, prompting, prompt fading and positive reinforcement. Data were gathered by therapists during home visits for the skill acquisition objectives identified for each child. Following each visit, these data were summarized and reviewed to determine progress and the requirement to revise approaches accordingly.

- 5 Home-based services continued weekly with each child and family until a termination criterion was achieved. The decision to discontinue services was made by the team of professionals and was based on several factors: (a) a child reached an age that required him or her to make the transition to another program (e.g. a public preschool classroom), (b) funding sources no longer permitted the continuation of services, and (c) a child accomplished learning objectives sufficiently to warrant alternative supports. The termination of services was based on the unique circumstances of each child and family.

## Measurement

**Service delivery** For each child, three measures of service delivery were documented. First, *hours per week of treatment* was defined as the number of hours of home-based services delivered to the child and family each week. These data were recorded by the home-based therapists routinely during the course of service delivery. Second, the *duration of treatment* was defined as the cumulative number of months that home-based services were provided. And third, the *total hours of treatment* was defined as the number of hours of home-based services per week summed for the duration of treatment.

**Outcome** Children were administered either the Early Learning Accomplishments Profile (ELAP) (Glover et al., 1988) or the Learning Accomplishments Profile (LAP) (Sanford and Zelman, 1981) before they were enrolled in, and when they were discharged from, home-based services. The ELAP and LAP are developmental rating checklists that assess a child's skill level within six domains: communication, cognition, fine motor, gross motor, social-emotional and self-care. They are constructed as criterion-referenced instruments for skills assessment of both typically developing children and those with a handicapping condition. The ELAP is geared to assessment of children with a chronological age of birth to 36 months and the LAP is geared to assessment of children with a chronological age of 36–72 months.

For each domain in the ELAP and LAP, criteria are designated for the

skills comprising the domain. A child is given the opportunity to perform the skill and is scored as either achieving or not achieving the criterion. For the ELAP each domain includes from 31 to 105 skills (mean = 68), and for the LAP each domain includes from 40 to 90 skills (mean = 57). Basal and ceiling levels of performance are established for each domain. A total numerical score is computed per domain, which represents the child's developmental age equivalent. The ELAP and LAP assessments were completed by the home-based therapist and, as noted previously, were scheduled upon admission to (pre-assessment) and discharge from (post-assessment), home-based services.

### **Reliability**

Inter-rater agreement for the administration of the ELAP and LAP was determined for 43.7 percent (7/16) of the participant sample by comparing the independent scoring of a second rater to the scoring completed by the home-based therapist. Reliability was calculated by dividing the scale items on which both raters agreed that the child did or did not perform at criterion, by the total items that were scored (agreements plus disagreements), and multiplying by 100. For the seven children who were assessed by two raters, agreement averaged 98.5 percent (range 85.7–100 percent).

### **Results**

The hours of treatment per week, the duration of treatment, and the total hours of treatment for each child are presented in Table 2 and the averages for these measures for the two groups of children are shown in Table 3. Children who initiated home-based services when they were over 3 years of age averaged significantly more hours of treatment per week ( $F = 6.6$ ,  $p < 0.02$ ). By contrast, children who started home-based services when they were under 3 years of age had a longer duration of treatment and were exposed to more total hours of treatment on average, but these measures did not differ significantly from children who started services when they were over 3 years of age.

For the six domains comprising the ELAP and LAP, change scores were computed for each child by recording the difference in pre-assessment and post-assessment measures. The average change scores, per domain, for children who initiated home-based services when they were under and over 3 years of age are shown in Table 4. Both groups demonstrated significant changes from pre-assessment to post-assessment for all six domains. However, there were no significant differences in the pre-assessment and post-assessment measures between the two groups of children for any of the six domains.

**Table 2** Hours of treatment per week, duration of treatment in months, and total hours of treatment provided to each child

<i>Child</i>	<i>Hours per week</i>	<i>Duration in months</i>	<i>Total hours</i>
<i>Under 3 years</i>			
Hank	6	10	240
Issac	15	6	360
Owen	15	14	840
Ron	15	22	1320
Zeb	9	5	180
Juan	8	6	192
Jacob	12	12	1056
George	15	8	480
<i>Over 3 years</i>			
Ned	20	11	880
Adam	15	6	360
Carlos	15	6	360
Johnny	15	6	360
Roland	15	11	660
Trent	15	6	360
Elaine	15	6	360
David	15	5	300

**Table 3** Average hours of treatment per week, duration of treatment in months, and total hours of treatment for children who initiated home-based services under and over 3 years of age

<i>Group</i>	<i>Hours per week</i>	<i>Duration in months</i>	<i>Total hours</i>
Under 3 years	11.8 (3.72) <sup>a</sup>	11.6 (7.00)	583.50 (435.27)
Over 3 years	15.6 (1.76)	7.12 (2.41)	455.00 (204.17)

<sup>a</sup> Numbers in parentheses are standard deviations.

Each of the domains comprising the ELAP/LAP pre-assessment to post-assessment change scores was subjected to a stepwise regression analysis utilizing age, hours of treatment per week, duration of treatment in months, and total hours of treatment as predictors. Using the Bonferroni correction to control for type I error for the six regression analyses, a  $p$ -value of 0.008 was required for significance. Only duration of treatment was a predictor of change and was statistically significant for the communication domain ( $F = 14.66$ ,  $p < 0.002$ ), cognition domain ( $F = 17.96$ ,  $p < 0.001$ ) and social-emotional domain ( $F = 15.66$ ,  $p < 0.001$ ). Results

**Table 4** Average change score measures on the ELAP/LAP from pre-assessment to post-assessment for children who initiated home-based services under and over 3 years of age

<i>Domain</i>	<i>Change score</i>	<i>t-score</i>	<i>p-value</i>
<i>Under 3 years</i>			
Communication	21.00 (18.42) <sup>a</sup>	3.22	0.015
Cognitive	21.00 (15.38)	3.86	0.006
Fine motor	20.75 (21.88)	2.68	0.031
Gross motor	16.85 (16.15)	2.59	0.036
Self-care	15.00 (12.82)	3.30	0.013
Social-emotional	24.00 (21.98)	3.08	0.018
<i>Over 3 years</i>			
Communication	8.25 (10.11)	2.30	0.054
Cognitive	11.25 (6.75)	4.71	0.002
Fine motor	13.50 (12.31)	3.10	0.017
Gross motor	10.50 (11.89)	2.49	0.041
Self-care	12.75 (11.31)	3.18	0.015
Social-emotional	17.25 (12.18)	4.00	0.005

<sup>a</sup> Numbers in parentheses are standard deviations.

were not significant for the fine motor domain ( $F = 8.18$ ,  $p < 0.01$ ), gross motor domain ( $F = 6.17$ ,  $p < 0.02$ ) and self-care domain ( $F = 7.38$ ,  $p < 0.01$ ).

## Discussion

This report evaluated several outcomes from a home-based behavioral intervention program for young children with autism to determine whether developmental rating scale measures were influenced by the age at which professional services were initiated and the 'intensity' of service delivery. There were three primary findings. First, all children in the sample demonstrated significant positive changes in the six domains that comprised the ELAP/LAP developmental ratings when assessed before the initiation of, and when terminated from, home-based services. Second, the degree of change that was recorded did not differ significantly between the two groups of children. And third, overall improvement for all children on the communication, cognitive and social-emotional domains of the developmental rating scale assessments was predicted by the duration of time (months) spent in treatment.

Although the children who initiated home-based services when they were over 3 years of age received more hours of treatment per week than

the group under 3 years of age, the younger children participated in more months and total hours of intervention. The assessment data revealed that the children under 3 years of age scored consistently lower than the children over 3 years of age on all six domains of the ELAP/LAP when assessed before intervention. Table 4 also shows that the group of children under 3 years of age had larger pre-assessment to post-assessment change scores when compared to children in the over 3 years of age group. This finding might be explained by the fact that, in contrast to their older peers, the younger age group possessed fewer abilities at the onset of treatment. Therefore, what is needed is a comparative study in which skill level preceding intervention is matched between two groups of children and both the number of hours of service delivery (e.g. 10 versus 20 hours per week) and the duration of treatment (e.g. 10 months) are controlled. Such a design would permit better interpretation of differences that might emerge between the two groups as a function of the 'intensity' of service delivery.

The retrospective analysis described in this report encompassed children who participated in a comprehensive program of home-based intervention. Because the evaluation was not designed as a formal study, predetermined controls over the number of hours and duration of service delivery were not imposed. Rather, the course of treatment with the children was dictated by real-world demands and exigencies. For example, the arrangement and scheduling of services was, in some cases, determined by the availability of therapists. Similarly, the decision to terminate services was dependent on factors such as the capacity of funding sources to maintain financial support, the determination by a public school district that alternative program options should be considered, and a level of improvement evinced by children so as to warrant a change in the focus of their education. These considerations, of course, are integral to human services and behavioral health care organizations whose primary objective is the development of educational and treatment programs for children and families. Our goal in preparing this report was to describe the integration of applied research within a service delivery model, in this case as it relates to a topic which is critical in better serving young children with autism and pervasive developmental disorder.

We defined the 'intensity' of home-based treatment as the number of hours and months of service delivery provided to the children. It must be recognized that these data do not necessarily correlate with the type of intervention that was received (e.g. number of discrete trials during instruction, percentage of learning opportunities spent in incidental learning, the amount of time the therapist interacted with the child), although they represent an accurate measure of the amount of time each child was exposed to instruction each week. Clearly, a more behavior-specific definition of

treatment 'intensity' will help clarify the relationship between this variable and child progress. On a similar note, the outcome measurement presented in this report was limited to pre-assessment and post-assessment recordings on a developmental rating scale. It is likely that obtaining data on multiple learning measures would yield a more comprehensive evaluation of treatment. In fact, indices such as a child's acquisition of learning readiness skills, language production, and display of challenging behaviors were recorded routinely by the home-based therapists. However, because the methods of data collection and the selection of these dependent measures were not comparable across all children, a meaningful analysis of these data was not possible for the purpose of this research. Anecdotally, it can be reported that all of the children showed positive changes in their acquisition of skills and reductions in the frequency of challenging behaviors.

In the study by Sheinkopf and Siegel (1998), children who received 'intensive' home-based intervention showed comparable gains in IQ from pre-treatment to post-treatment assessments regardless of whether services were provided for 12–27 hours per week ('low group') or for 28–43 hours per week ('high group'). Similarly, the children in our analysis all demonstrated improvement independent of the number of hours of in-home programming that occurred. On this topic, Sheinkopf and Siegel speculated that 'it is possible that Lovaas overestimated the minimum number of treatment hours per week needed for therapeutic effects' (1998, p. 21). They also commented that positive clinical outcome might occur in response to fewer hours of direct service because of the involvement of parents in the implementation of home-based programs. In effect, the role of parents as teachers and mediators beyond the time delivered by professional therapists might hasten the pace of learning, skill acquisition and cognitive development.

Despite the fact that we documented developmental progress after intervention for children in both age groups, a control group of children who did not receive home-based services was not included in this analysis. Therefore, maturation or other non-specific factors cannot be ruled out as contributing to outcome. A comparative study of this type was beyond the scope of the present project and indeed, this was not the focus of attention. Rather, the objective was to evaluate children who were actively involved in home-based behavioral intervention while qualifying particular components of service delivery.

Although preliminary in its focus, and the aforementioned limitations notwithstanding, the present findings suggest that starting home-based behavioral intervention before a child is 3 years of age may yield a larger magnitude of developmental change when contrasted to children who are older than 3 years of age when such intervention is introduced. Furthermore, a longer

duration of continuous intervention, independent of the number of hours that it is provided per week, may be associated with the best learning outcomes. Although the number of hours of treatment per week and the overall duration of service delivery that constituted our home-based program were less than the time allotment described in previous projects (Anderson et al., 1987; Birnbrauer and Leach, 1993; Lovaas, 1987), we were able to document meaningful improvement in developmental rating scale assessments. Research that features more rigorous experimental control of intervention variables, includes multiple outcome measures, and matches children on elements such as chronological age, mental age and skill repertoires, should enhance our understanding of, and guide decision-making about, the design of 'intensive' behavioral treatment programs for young children with autism.

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