

Replicating Lovaas' Treatment and Findings: Preliminary Results¹

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Abstract

Twenty-four autistic children completed the first year of a three-year replication study of the 1987 research published by Lovaas. Changes in pre-post test scores showed an average gain of 22 IQ points. Nineteen of the children matched those in Lovaas' study. Eight children showed a gain of 45 IQ points, raising them into the average range. Gains in adaptive/social skills rose to the low average range. These "best outcome" children represented 42% of the matched group. Several factors related to outcome and its prediction are discussed.

Behavioral methods for addressing the deficits common in autism have been recognized as the most effective treatment approaches to date (Rimland, 1994; Schreibman, 1988; Smith, 1993). Ivar Lovaas has researched behavioral treatment strategies with autistic children since the early 1960's, and in the past 25 years has focused on treating children under four years of age. Using an intensive behavioral treatment regimen (40 hours per week of one-to-one contact), emphasizing language development and social skills, he reported in 1987 that 47% of the experimental group (9 of 19 children), achieved "normal functioning" after two to three years of treatment, compared with 2% of the control group (Lovaas, 1987). In 1993, he published a follow-up on those children at age 12 and found that of the nine "best outcome" children, eight remained essentially normal (McEachin, Smith, & Lovaas, 1993). More recently Lovaas has followed up these same children as young adults and again their gains continue to be maintained without intervening treatment (Smith, Wynn, & Lovaas, 1997). Lovaas is the first researcher to document such marked improvement in such a large proportion of treated children.

These findings have created considerable controversy and the above studies have been criticized on methodological grounds (Gresham & MacMillan, 1998; Schopler, Short, & Mesibov, 1989). One criticism has been that assignment of subjects to treatment and control groups was not random. Although an analysis of pretreatment test scores showed that the groups were not statistically different

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(Lovaas, 1987), the lack of random assignment allowed the possibility that some unmeasured important variable may have been left uncontrolled. A second criticism has been that the pre and post treatment measures that were used to document improvement were not the same for all children. A third criticism has focused on the fact that these early studies have not been replicated, nor has the more recently developed non-aversive version of Lovaas' treatment been shown to be effective. Finally, some doubted that a non-university-affiliated site would be able to carry out such an intensive treatment successfully.

Lovaas' Multi-Site Young Autism Project was intended to address many of these concerns. Several sites would be involved to test the replicability of Lovaas' treatment. The children were to be randomly assigned to an intensive treatment group, which would have 40 hours per week of treatment, and to a "parent directed" group, where the number of hours of treatment would not be prescribed and would likely be lower, thereby constituting a non-intensive control group. Pre and post measures were to be the same for all children. The project would evaluate the effectiveness of the non-aversive treatment regimen, and attempt to identify pre-treatment variables related to outcome.

Method

Subjects

Children were recruited through local physicians and Birth to Three programs. All children referred were screened for eligibility according to the following criteria: age at intake between 24-42 months; ratio estimate of Mental Development Index of 35 or higher (mental age divided by chronological age) from the Bayley Scales of Infant Development: Second Edition (Bayley, 1993); normal neurological functioning as determined by a pediatric neurologist; diagnosis of autism by an independent child psychiatrist. All children met the criteria for autism outlined in the Diagnostic and Statistical Manual of Mental Disorders: Fourth Edition (APA, 1994), and the Autism Diagnostic Interview-Revised (Lord, Rutter, & Le Couteur, 1994).

Pre-treatment testing included two IQ measures: The Bayley Scales of Infant Development: Second Edition (Bayley II), and the Merrill-Palmer Scale of Mental Tests (Stutsman, 1948), an older test of nonverbal intelligence which is useful for children with low mental ages. The Reynell Developmental Language Scales (Reynell & Gruber, 1990), was used to measure language functioning, and the Vineland Adaptive Behavior Scales (Sparrow, Balla, & Cichetti, 1984), was used to measure adaptive ability. Post-treatment testing utilized the same tests except that children who had become too old for the Bayley II (its norms extend to 42 months), were given the Wechsler Preschool and Primary Scale of Intelligence-Revised (WPPSI-R; Wechsler, 1989). After meeting quality control standards (achieving a score within one month developmental level of Dr. Lovaas' evaluator with three children tested within three weeks), testing was done by the second

author, using the procedures outlined by Freeman (1976) to maintain child attention and motivation.

One experimental assessment procedure, the Early Learning Measure, was also administered. Developed by Lovaas (Buch, 1995), the ELM assesses rate of learning during the initial months of treatment. It consists of ten items in each of four skill areas or scales. The specific items used with each child are taken in order from a larger list until the child's list contains ten that he cannot perform correctly. This then comprises that child's ELM, and it is administered every three weeks prior to the start of treatment, and for up to six months into treatment. Only the evaluator knows the content of each child's ELM, so that the items cannot be taught. Two sets of scores can be obtained from the ELM. The first consists of the number of items the child can perform correctly prior to treatment. The second is the number of weeks the child requires to learn 90% of the items once treatment has begun, providing a measure of rate of acquisition.

Twelve children were admitted each year for three years. Twenty-four of these children have completed one year of treatment. The group was made up of twenty boys and four girls. Average pre-treatment MDI (Bayley II) was 49 (range 35 to 65). Average age was 33 months (range 25 to 42 months). The average age equivalent for the Adaptive Behavior Composite on the Vineland was 15 months. Pre-treatment and one year test scores are shown in Table 1.

Treatment Groups

Children were assigned to one of two treatment conditions by matched pair random assignment, using age and ratio MDI as the matching variables. The Clinic Directed treatment group was a replication of Lovaas' original treatment (see Lovaas et al., 1981), but without the use of aversives. This consisted of 40 hours of treatment per week, with heavy supervision (6 to 10 hours per week) by experienced staff (one-year experience as a therapist with two children plus another year as a supervisor overseeing the programs of five more children). Children were also seen for weekly progress reviews by the senior author or by a UCLA-trained Clinic Supervisor, both of whom met Lovaas' criteria for Level 2 therapist. The senior author had run an inpatient unit for autistic children for 14 years, and had trained with Dr. Lovaas for two summers. The Clinic Supervisor had a B.A. in psychology, two years full time experience as a Senior Therapist with the Wisconsin Early Autism Project, and had completed a nine-month internship at Dr. Lovaas' UCLA clinic.

The Parent Directed treatment group allowed parents to determine the number of hours per week of intensive behavioral treatment, which also meant that parents had more discretion in deciding what other treatments they might want to use because they could arrange their child's schedule as they liked. Supervision for this group was 6 hours per month by experienced staff, with unlimited phone consultation. The senior author or Clinic Supervisor reviewed these children at

least every two months. In both groups, parents were offered the same advice regarding the best treatment practice (e.g., initially emphasizing intensive one-to-one treatment instead of school placement), and both groups had access to consultation by the senior author upon request. All services were provided free of charge for both groups.

Treatment for both treatment groups began with a six-hour workshop led by the senior author and Clinic Supervisor. During the workshop, which was held in the child's home, the child's parents and four to six staff were trained to implement the first steps of the program. The staff were at least 18 years old, had completed one year of college, and were screened for prior police contacts. Most were college undergraduates in psychology, education or related fields without prior experience with autism. Each staff member was required to work at least six hours per week (usually three, two hour shifts), and to attend weekly or bi-weekly team meetings. These guidelines were more strictly enforced in Clinic Directed teams. Clinic Directed therapists also received weekly individual supervision. Although children in the Clinic Directed group were required to have 40 hours per week of treatment, they began at 15 to 20 hours, and built up to 40 hours over several weeks to allow them time to acclimate to the structure. Children who began treatment under 36 months of age received fewer hours, so as not to over tax them, 20 to 30 hours per week for children under 30 months old, and 30 to 35 hours per week for children between 30 and 36 months of age.

Treatment fidelity (the degree to which the treatment provided was the same as that described by Lovaas) was addressed by having all supervisors and all treatment staff in the Clinic Directed group pass quality control criteria set by Lovaas. This involved passing two tests, the first being a written test which assessed knowledge of basic behavioral principles and treatment procedures covered in *The Me Book* (Lovaas et al., 1981). Staff were also required to pass a videotaped review of their work by Dr. Tristram Smith (research director of the Multi-Site Project) at Washington State University using the protocol initially described by Koegel (Koegel, Russo, & Rincover, 1977), and expanded by Smith (Smith, Parker, Taubman, & Lovaas, 1992).

Alternate Treatment Group

We requested permission from parents to examine school test scores of all autistic children enrolled in a local public school district during the previous ten years. There were 130 such children, and parents of 43 gave permission. These children had received a combination of special education, occupational therapy, and speech therapy. Several of the children were those we were already working with in our non-research clinic caseload. Many more lacked repeated testing either because they were new to the school system or because the tests used were so different that comparisons could not be easily interpreted (e.g., initial testing consisted of a language test or test of adaptive skill or a parent checklist, and later testing was an IQ test). Using the decision rule that pre and

post tests must have been administered at least one year apart, and that both tests must either be standardized IQ tests, or if not IQ tests they must be the same test, 19 children had acceptable pre and post tests. Most of the resulting repeated test scores were IQ tests or measures of cognitive functioning, eg., Psychoeducational Profile-Revised (PEP-R; Schopler, Reichler, Bashford, Lansing, & Marcus, 1990) or the Batelle Developmental Inventory-Cognitive (Newborg, Stock, & Wnek, 1984). One child had a repeated Peabody Picture Vocabulary Test (PPVT; Dunn & Dunn, 1981) and another had a repeated Vineland (Sparrow et al., 1984). The average test-retest period was three years, corresponding with the federally mandated frequency of reevaluation of special needs children.

Results

One-Year Treatment Results

Pre-treatment and first year IQ scores for all 24 children are presented in Figure 1. Their average IQ increased from 49 to 71, a 22 point increase. The mean pre-treatment IQ of 49 was much lower than that of Lovaas' 1987 study, which had a mean pre-treatment IQ of 62, and whose children increased from 62 to 83, a 21 point increase. Eight of the children in the current study achieved IQ's of 90 or higher after one year of treatment. As a group, their IQ's increased from 52 prior to treatment to 97 after one year of treatment, a 45 point increase. This represented 33% of all 24 children, Clinic Directed and Parent Directed combined. However, two Parent Directed children received 13 hours per week or less, and previous research has shown that children receiving 20 to 25 hours per week evidence large improvements but do not achieve average IQs (Anderson, Avery, Di Pietro, Edwards, & Christain, 1987; Birnbrauer & Leach, 1993; Sheinkopf & Siegel, 1998). Further, four children had pre-treatment IQ's at or below the cut-off used in Lovaas' 1987 study (IQ=37). If data from children receiving less than 25 hours of treatment per week and who had IQ's of 37 or below were removed, the resulting N would be 19. The percent of children who achieved average IQ after one year of treatment would then be eight of nineteen or 42%.

The increase in one-year IQ for each pre-treatment IQ cohort is presented in Table 2. As can be seen, the median IQ increase was highest for children with higher pre-treatment IQs (22 points for children with IQs between 55 and 64, versus 12 points for children with IQs between 35 and 44). Children with higher pre-treatment IQ's were also more likely to reach one-year IQ's in the normal range (50% for children with IQs between 55 and 64 versus 14% for children with IQs between 35 and 44). However, these "best outcome" children represented all IQ cohorts.

The average one-year Vineland composite score for all 24 children increased from 15 to 31 months, an increase of 16 months. The "best outcome" children

showed an average increase from 16 months to 43 months, an increase of 27 months. Their average composite standard score increased from 63 to 85, which is in the low average range.

The average gain in language scores for all 24 children was 13 months in comprehension and 8 months in expressive skills. The “best outcome” children showed gains of 21 months in comprehension, and 17 months in expressive language skills. Figure 2 shows changes in language use. Prior to treatment, 46% of the children were mute, 46% had single words, and 8% (n=2) had three-word phrases. After one year of treatment, 17% remained mute, 12.5% had single words, and 71% had three-word or longer phrases. The following examples are from different children, recorded during the one-year administration of the Reynell: “No, stop! Don’t cut hair!, “I want my cards”, “This is delicious bread”, “I went to the kitchen”, “I got a lolly pop”, “They’re watering the flowers”, “Emily got a fish party”.

Alternate Treatment Group

The pre- and post-test scores of the 19 children comprising the alternate treatment group are presented in Figure 3. These scores represent a wider range of pre-treatment IQs than were present in the experimental group, and the pre-treatment IQs for the alternate group were on

Post-test scores for the alternate treatment group averaged 59, representing a drop of 8 points from pre-treatment testing. As noted above this sample was not matched with the experimental sample. However, seven of the children were under 42 months at initial testing as were the experimental children. Their scores changed from an average of 59 when first tested to 52 when re-tested after an average of three years of special education. This trend, for children in special education classes to show declining IQ over time, has been noted by other researchers (Gresham & MacMillan, 1998; Guralnick, 1997; Lord & Schopler 1989).

Children in the alternate treatment group were in Early Childhood classes, and typically received ten hours per week of special education. This included two to three sessions per week of speech therapy and another two to three sessions per week of occupational therapy. Many also received additional speech and occupational therapy from community professionals, resulting in a total of perhaps 12 hours per week of intervention. While most children in the experimental treatment groups received many more hours than this, two Parent Directed children received an average of 12 and 13 hours per week respectively. While these children did not achieve IQs in the average range, their IQs did increase by 11 and 16 points (to 46 and 54).

Clinic Directed versus Parent Directed

Of the 24 children, 22 were matched pairs within our sample. The other two children were matched with children from other replication sites. Although it was anticipated that if given the choice parents would elect to offer a relatively low number of hours, upon being advised that children in Dr. Lovaas' 1987 study had received an average of 40 hours of therapy per week, many parents in the Parent Directed group chose to provide higher numbers of hours. Looking just at our eleven pairs of children, the hours of treatment averaged 39 per week for Clinic Directed children, and 29 per week for Parent Directed children. These figures do not include hours of therapy provided by parents which were substantial in some cases. Pre-treatment and first year scores are presented in Table 3. As can be seen, there was a difference of four points in IQ at post treatment that favored the Parent Directed group.

Although the two groups were quite similar in pre-treatment Bayley IQ (mean IQ was 49 for both groups), the Parent Directed group had a higher pre-treatment non-verbal IQ (80 for Parent Directed versus 69 for Clinic Directed). At one year, the Clinic Directed group had closed this gap (Clinic Directed non-verbal IQ was 94 versus 92 for Parent Directed). If the two types of IQ's are averaged, the Clinic Directed group started off six points lower and gained 23 points versus 18 points for the Parent Directed group, narrowing the gap to only one point. In most other areas, both groups showed similar improvements, although the Clinic Directed group showed slightly more improvement in Communication as measured by the Vineland (25 months versus 16 months for Parent Directed).

In addition to having a higher pre-treatment non-verbal IQ, there may have been another reason that the Parent Directed children did so well. In some cases there was a difference in how involved parents were in the two groups. In the Parent Directed group, some parents became very involved, became quite skilled therapists, supervised their teams extensively, and carried out treatment and generalization activities many hours beyond the officially recorded time in therapy. Parent Directed families with other children often involved the child's siblings as informal therapists. When asked to estimate the number of hours the family had provided outside those provided by the program, most were unable to do so, saying such things as "It was all the time. We had the other kids doing it too. When he was on the toilet, I was rehearsing maintenance items". On a seven point scale applied to each parent (range 3 to 12, $sd=2.5$), treatment supervisors rated the parents of Parent Directed "best outcome" children as a nine versus a six for non "best outcome" children in both groups and for Clinic Directed "best outcome". That Clinic Directed parents may have been somewhat less involved may have reflected their feeling frustrated by our supervisors' desire to run the program exactly right, resulting in parental suggestions, which initially were often ill-informed, not being integrated into the treatment plan.

While Parent Directed parents were more involved in treatment, they also found their role to be more stressful. On a five-point scale, 50% of the Parent Directed families rated their experience with the program as a 4 or 5 (“pretty stressful/disruptive” or “very stressful/disruptive”), whereas only 18% of Clinic Directed families rated their experience this way. The source of the stress was not the treatment per se, but was instead related to issues as “having people constantly in the house”, scheduling and turnover of therapists. It seemed then that Parent Directed families may have felt burdened by having to be largely responsible for the administrative aspects of treatment.

Early Learning Measure

Of the 24 children who completed one year of treatment, 13 passed the ELM. Table 4 shows the relationship between one year IQ and rate of learning new material as measured by the ELM. As can be seen, all eight children who achieved one year IQs of 90 or higher passed the ELM at or before 12 weeks of treatment (n=6) or before reaching 42 months of age (n=2). Of the latter group, one child passed the ELM after 18 weeks of treatment at age 38 months, and the other passed it after 23 weeks of treatment at age 32 months. Using the above criteria (passing the ELM after 12 weeks of treatment or by 42 months of age), the ELM correctly predicted a one-year IQ in the average range for eight of ten children. The ELM was accurate for five of five Clinic Directed children but only for three of five Parent Directed children. The parents of the two children who passed the ELM, but who did not achieve average IQs at one year, were for personal reasons less involved in treatment, leaving their teams without much direction or consistency among therapists.

Predicting Outcome

Correlations between pretreatment test scores including pretreatment ELM and ADI-R and one-year IQ were computed using standard scores (Vineland), ratio IQ scores (Bayley II and Merrill-Palmer), and raw scores for the Reynell, since many children initially scored below the norm tables. The number of hours per week of supplemental treatments such as special education, speech and other therapies, and use of vitamins, diets and medications during treatment was also included. The results are shown in Table 5. Pretreatment IQ correlated .52 with one year IQ, and the Vineland ABC correlated almost as highly (.50). The variable with the highest correlation with one year IQ was the child’s ability to imitate, especially to imitate sounds ($r = .64$). Combining verbal imitation and pretreatment IQ yielded a correlation with one-year IQ of .72, accounting for approximately half of the variance. Seven of eight children (88%) who could imitate 2 of 20 sounds or words went on to achieve IQs in the average range. If they could not do this, the likelihood of achieving an average IQ at one year was 6% (one of 16 children).

Some aspects of the “severity” of symptoms were correlated with outcome. On the ADI-R, the degree of Repetitive Behaviors and Stereotyped Patterns was not related to outcome (Lord, 1999, notes that very young autistic children often do not show obvious self stimulation), but the degree of delay in communication (spoken or gestural) and imaginative or imitative play (both subsumed under Communication) was significantly correlated with outcome ($r = -.425$, or $-.549$ if extreme scores were omitted and only nonverbal items were scored). Similarly, the ability to speak as measured on the Reynell was also correlated with outcome. While Qualitative Impairments in Reciprocal Social Interaction as measured by the ADI-R was not significantly related to outcome, socialization as measured on the Vineland was almost significant ($r = .399$, $p = .054$). Although significantly correlated with outcome, results of a step-wise linear regression analysis showed that none of these variables contributed more to the prediction of one year outcome than the combination of pretreatment ELM and IQ.

Most of the children received some type of supplemental treatment prior to (23 of 24), or during treatment (19 of 24). These services consisted of special education (21), preschool (2), and private therapies beyond what was offered in school – speech (5), sensory integration (7), Auditory Integration Training (2), music and horseback riding (1). Hours per week ranged from 0 to 14 hours prior to and 0 to 15 during treatment (average 6 and 7 hours respectively). In addition, several children received megavitamins with DMG (4), diets plus homeopathic remedies (1), Immune Globulin (1), SSRIs (2) or anticonvulsants in the absence of overt seizures (1). Neither the hours of supplemental treatment nor the use of vitamins, etc. were correlated with one year outcome. Since children were not randomly assigned to these treatments, their intensity was not controlled, and the number of children receiving some treatments was too small to analyze their effects separately, these results should not be interpreted as a test of the effectiveness of these treatments. The purpose of this analysis was to determine whether one year outcome results could be explained by the children’s involvement with supplemental treatments which they received, and it appears that they were unrelated.

Discussion

The present study demonstrated that Lovaas’ treatment could be implemented in a clinical setting outside a university, and that his earlier findings regarding outcome could in large part be replicated without the use of aversives. Eight of 24 children achieved IQs in the average range after one year of treatment. Correcting for differences in the current sample and Lovaas’, these eight children represented 42% of those treated. Given the lower average pre-treatment IQ of the present sample, this figure compares favorably with Lovaas’ finding of 47% achieving average IQs. The “best outcome” children also showed dramatic improvements in adaptive skills, increasing to the low average range. Language skills, while still delayed after one year of treatment, nevertheless improved 21

months in comprehension and 17 months in expressive skill. Children who were able to speak in phrases increased from 8% to 71%.

An unanticipated finding in the study was the very positive outcome of children in the Parent Directed group. When this occurred, it may have been due to greater parental involvement. Although these parents did initially make ill advised decisions regarding treatment, resulting in their children becoming more frustrated and occasionally “shutting down”, many then sought input and learned rapidly to avoid making the same mistake twice, becoming quite skilful after a few months. Sheinkopf and Siegel (1998) similarly hypothesized that parental involvement may explain the positive outcomes for children who do not receive high levels of treatment hours from the program itself. Whether or not children whose treatment programs are run similarly to the Parent Directed model, but are supervised by less qualified supervisors and consultants, would do as well as those in this study remains an unanswered question.

Outcome was somewhat predicted by pre-treatment IQ. Children with pre-treatment IQs below 40 showed limited progress. While the progress of children with pre-treatment IQ's between 45 and 60 was more pronounced, the relationship between IQ and one-year outcome was only moderate ($r=.52$). For example, one child with an IQ of 44 showed an increase to the average range, while another child with an IQ of 45 increased only five points. While all IQ bands produced children whose IQs increased to the average range, this trend was stronger for children in higher IQ bands. In contrast to pre-treatment IQ, which was only a rough predictor of outcome, both pretreatment ability to imitate, especially verbally, and rate of learning as measured by the Early Learning Measure during the first three months of treatment, were much more accurate predictors. These findings are similar to those of Lovaas (McEachin et al., 1993).

Once a child has acquired useful communication, typically after one year of treatment, social interaction skills are targeted intensively. Building social interaction is more complex than building speech or adaptive skills, and requires more training and experience on the part of therapists and supervisors (Lovaas, 1999). We are in the process of addressing social skills for the 24 children described here, and preliminary results are promising. Several have been mainstreamed without the need for any special assistance. We will provide full information as it is available.

REFERENCES

- Anderson, S.R., Avery, D.L., Di Pietro, E.K., Edwards, G.L., & Christian, W.P. (1987). Intensive home-based intervention with autistic children. Education and Treatment of Children, 10, 352 – 366.
- American Psychiatric Association. (1994). Diagnostic and statistical manual of mental disorders (4th edition). Washington, DC: American Psychiatric Association.
- Bayley, N. (1993). Bayley Scales of Infant Development (2nd edition). San Antonio: The Psychological Corporation.
- Birnbrauer, J.S., & Leach, D.J. (1993). The Murdoch early intervention program after 2 years. Behavior Change, 10, 63 – 74.
- Buch, G.A. (1995). Teaching parents and paraprofessionals how to provide behavioral intensive early intervention for children with autism and pervasive developmental disorder. Unpublished doctoral dissertation, UCLA.
- Dunn, L.M., & Dunn L.M. (1981). Peabody Picture Vocabulary Test – Revised: Manual for forms L and M. Circle Pines, MN: American Guidance Service.
- Freeman, B.J. (1976). Evaluating autistic children. Journal of Pediatric Psychology, 1, 18-21.
- Gresham, F.M. & MacMillan, D.L. (1998). Early intervention project: Can its claims be substantiated and its effects replicated? Journal of Autism and Developmental Disorders, 28, 5-13.
- Guralnick, M. (Ed.).(1997). The effectiveness of early intervention. Baltimore, MD: Brookes.
- Koegal, R.L., Russo, D.C., & Rincover, A. (1977). Assessing and training teachers in the generalized use of behavioral modification with autistic children. Journal of Applied Behavior Analysis, 10, 197-205.
- Lord, C. (1999, September 24). Diagnostic methods and frame work for autism spectrum disorders. Presentation at the Waisman Center Mental Retardation Care Seminar Services, Madison, Wisconsin.
- Lord, C., Rutter, M., & Le Couteur, A. (1994). Autism Diagnostic Interview – Revised: A revised version of a diagnostic interview for caregivers of individuals with possible pervasive developmental disorders. Journal of Autism and Developmental Disorders, 24, 659-685.
- Lord, C. & Schopler, E. (1989). The role of age at assessment, developmental level, and test in the stability of intelligence scores in young autistic children. Journal of Autism and Developmental Disorders, 19, 483-499.

- Lovaas, O.I., Ackerman, A.B., Alexander, D., Firestone, P., Perkins, J., & Young, D. (1981). Teaching developmentally disabled children: The me book. Austin, TX: Pro-Ed.
- Lovaas, O.I. (1987). Behavioral treatment and normal educational and intellectual functioning in young autistic children. Journal of Consulting and Clinical Psychology, 55, 3-9.
- Lovaas, O.I. (1999). Different types of service delivery: Clinic-supervised versus parent-directed. Manuscript submitted for publication.
- McEachin, J.J., Smith, T., & Lovaas, O.I. (1993). Long-term outcome for children with autism who received early intensive behavioral treatment. American Journal on Mental Retardation, 97, 359-372.
- Newborg, J., Stock, J. R., & Wnek, L. (1984). Batelle Developmental Inventory. Allen, TX: DLM Teaching Resources.
- Reynell, J.K. & Gruber, G.P. (1990). Reynell Developmental Language Scales. Los Angeles, California: Western Psychological Services.
- Rimland, B. (1994). Intensive early behavioral intervention: A letter of support. Autism Research Review International, 8 (3), 3.
- Schopler, E., Reichler, R.J., Bashford, A., Lansing, M., & Marcus, L. (1990). Individualized assessment and treatment for autistic and developmentally disabled children. : Vol. 1. Psychoeducational Profile Revised (PEP-R). Austin, TX: Pro-Ed.
- Schopler, E., Short, A., & Mesibov, G. (1989). Relation of behavioral treatment to normal functioning: Comment on Lovaas. Journal of Consulting and Clinical Psychology, 57, 162-164.
- Schreibman, L. (1988). Autism. Newbury Park, CA: Sage Publications.
- Sheinkopf, S.J., & Siegel, B. (1998). Home-based treatment of young children with autism. Journal of Autism and Developmental Disorders, 28, 15-23.
- Smith, T. (1993). Autism. In T.R. Giles (Ed.), Handbook of effective psychotherapy, (pp.107-133). NY: Plenum.
- Smith, T., Parker, T., Taubman, M., & Lovaas, O.I. (1992). Transfer of staff training from workshop to group homes: A failure to generalize across settings. Research in Developmental Disabilities, 13, 57-71.
- Smith, T., Wynn, J., & Lovaas, O.I. (1997). Outcome in adulthood. Paper presented at the Early Intervention Conference, Los Angeles, CA.
- Sparrow, S.S., Balla, D.A., & Cicchetti, D.V. (1984). Vineland Adaptive Behavior Scales (Interview Edition), Circle Pines, Minn.:American Guidance Service.

Stutsman, R., (1948). Merrill Palmer Scale of Mental Tests. Wood Dale, Ill.: Stoelting.

Wechsler, D. (1989). Wechsler Preschool and Primary Scale of Intelligence – Revised.
San Antonio, TX: The Psychological Corporation.

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**Table 1
PreTreatment and One Year Test Results**

| PreTreatment | | | | | | | | | | | |
|--------------------------|------------|--------------|-----------|----------------|------------|-----------------|------------|------------|------------|------------|-----------|
| | Age | DQ/IQ | MP | Reynell | | Vineland | | | | | |
| | | | | Comp | Exp | Com | DLS | Soc | Mot | ABC | SS |
| All Children (N=24) | 33 mo | 49 | 74 | 13 mo | 16 mo | 11 mo | 17 mo | 10 mo | 24 mo | 15 mo | 59 |
| Best Outcome (N=8) | 33 mo | 52 | 80 | 13 mo | 16 mo | 12 mo | 18 mo | 12 mo | 26 mo | 16 mo | 63 |

| One Year | | | | | | | | | | | |
|------------------------|------------|--------------|-----------|----------------|------------|-----------------|------------|------------|------------|------------|-----------|
| | Age | DQ/IQ | MP | Reynell | | Vineland | | | | | |
| | | | | Comp | Exp | Com | DLS | Soc | Mot | ABC | SS |
| All Children (N=24) | 48 mo | 71 | 93 | 24 mo | 24 mo | 31 mo | 27 mo | 24 mo | 40 mo | 31 mo | 68 |
| Best Outcome (N=8) | 48 mo | 97 | 112 | 34 mo | 33 mo | 49 mo | 35 mo | 35 mo | 49 mo | 43 mo | 85 |

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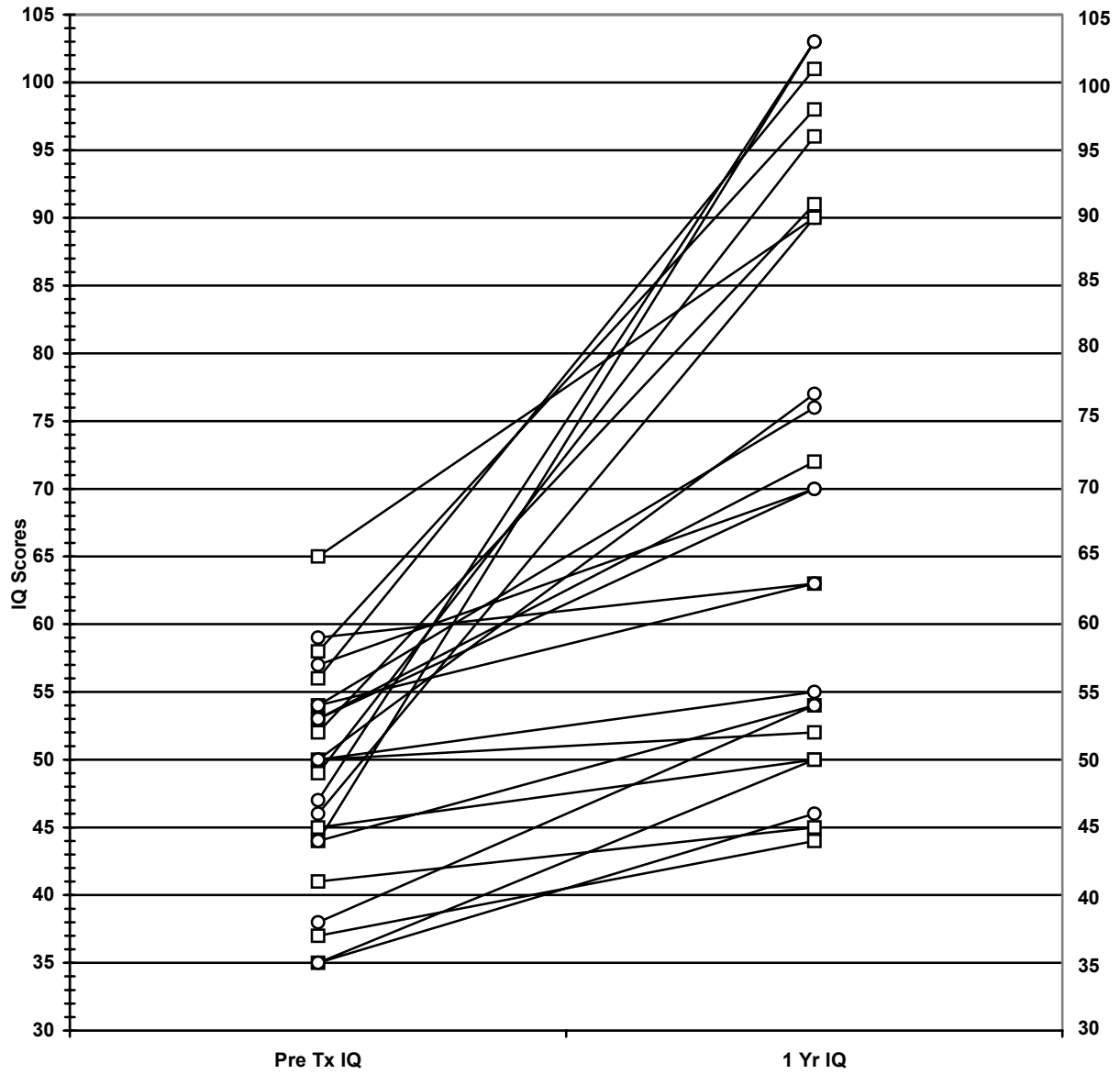


Figure 1: PreTreatment and 1st Year IQ Scores for All Children Who Completed One Year of Treatment

Circle = Parent Directed
Square = Clinic Directed

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Table 2

Changes in IQ after One Year of Treatment

| Pre Tx IQ | 1 Year IQ | | | | | | Median Increase | Percent 90+ |
|-----------|-----------|-------|-------|-------|-------|-------|-----------------|-------------|
| | 35-44 | 45-54 | 55-64 | 65-74 | 75-84 | 85-94 | | |
| 65-74 | | | | | | 1 | | |
| 55-64 | | | 1 | 1 | | | 2 | 50 |
| 45-54 | | 2 | 2 | 2 | 2 | 2 | 2 | 33 |
| 35-44 | 1 | 5 | | | | | 1 | 14 |

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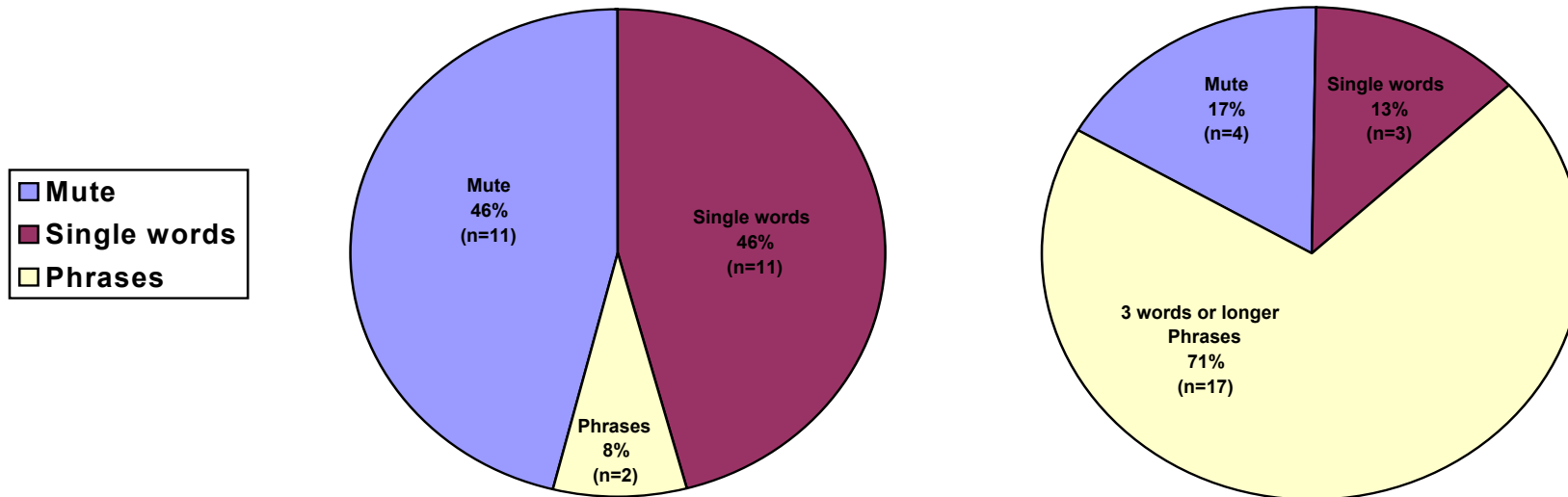
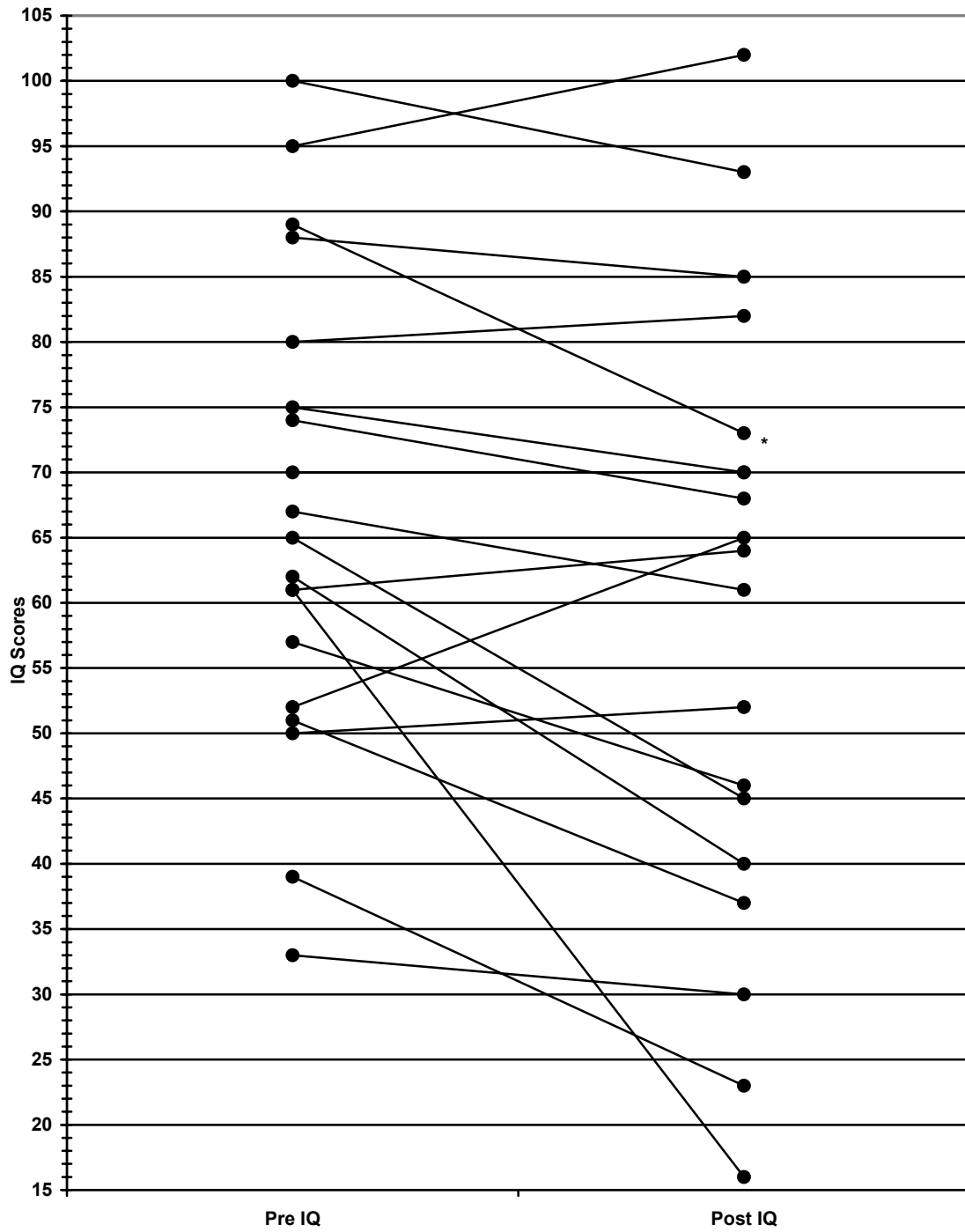


Figure 2. Language use before and after one year of intensive behavioral treatment

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* = Aspergers

Figure 3: Changes in IQ/Developmental Scores for Autistic Children Receiving Special Education Services (N = 19)

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Table 3

**PreTreatment and One Year Test Results
For 11 Paired Subjects**

| PreTreatment | | | | | | | | | | | |
|---------------------------|------------|--------------|-----------|----------------|------------|-----------------|------------|------------|------------|------------|-----------|
| | Age | DQ/IQ | MP | Reynell | | Vineland | | | | | |
| | | | | Comp | Exp | Com | DLS | Soc | Mot | ABC | SS |
| Intensive (N=11) | 33 mo | 49 | 69 | 13 mo | 15 mo | 10 mo | 17 mo | 10 mo | 24 mo | 15 mo | 60 |
| Parent Directed (N=11) | 33 mo | 49 | 80 | 13 mo | 16 mo | 12 mo | 17 mo | 11 mo | 24 mo | 16 mo | 60 |

| One Year | | | | | | | | | | | |
|---------------------------|------------|--------------|-----------|----------------|------------|-----------------|------------|------------|------------|------------|-----------|
| | Age | DQ/IQ | MP | Reynell | | Vineland | | | | | |
| | | | | Comp | Exp | Com | DLS | Soc | Mot | ABC | SS |
| Intensive (N=11) | 48 mo | 69 | 94 | 25 mo | 24 mo | 35 mo | 29 mo | 26 mo | 40 mo | 32 mo | 70 |
| Parent Directed (N=11) | 48 mo | 73 | 92 | 24 mo | 24 mo | 28 mo | 26 mo | 22 mo | 41 mo | 29 mo | 65 |

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Table 4

ELM Results and One Year IQs

| ELM Results | | | | | |
|---------------|--------------------------------------|--------------------------|-------------|----------------------------|----------------------------|
| IQ | Pass 12 Wks or by age 3-6 | Pass 24 weeks | Fail | Clinic Directed | Parent Directed |
| 90+ | 8 | --- | 0 | 5 | 3 |
| 70+ | 2 | 3 | 0 | 1 | 4 |
| <70 | 0 | 0 | 11 | 7 | 4 |

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Table 5. Zero-Order Correlations Between Predictors and IQ at 1 Year Follow-Up

| Predictor | IQ at 1 Year | p |
|--|---------------------|----------|
| Reynell Expressive | .453* | .026 |
| Reynell Comprehensive | .290 | .170 |
| ELM Nonverbal Imitation ^a | .592** | .003 |
| ELM Expressive Language ^a | .490* | .018 |
| ELM Receptive Language ^a | .448* | .032 |
| ELM Verbal Imitation ^a | .641*** | .001 |
| Vineland Communication | .287 | .174 |
| Vineland Daily Living Skills | .490* | .015 |
| Vineland Motor Skills | .339 | .105 |
| Vineland Socialization | .399 | .054 |
| Vineland Composite | .501* | .013 |
| Merrill-Palmer | .315 | .134 |
| IQ at Intake | .517** | .010 |
| Prior Supplement Treatment | .060 | .781 |
| Supplemental Treatment, Year 1 | .035 | .872 |
| ADI-R Communication ^b | -.425* | .038 |
| ADI-R Socialization | -.326 | .121 |
| ADI-R Self Stimulation | -.068 | .751 |
| Medication, Vitamin or Diet, Year 1 | -.267 | .207 |

- a) The ELM measures were not administered to one subject prior to treatment. These coefficients are based upon a sample size of 23.
- b) For ADI-R Communication, if scores of 3 are converted to 2s, and only nonverbal communication is entered, the correlation increases to $-.549$, $p=.005$.