Effect of Parent Training on Adaptive Behavior in Children With Autism Spectrum Disorder and Disruptive Behavior: Results of a Randomized Trial

RH: Parent Training for Daily Living in ASD

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ABSTRACT

Objective: This study examined the impact of Parent Training on adaptive behavior in children with autism spectrum disorder (ASD) and disruptive behavior.

Methods: This was a 24-week, six-site, randomized trial of parent training versus parent education in 180 children with ASD (age 3 to 7 years; 158 boys, 22 girls) and moderate or greater behavioral problems. Parent training included specific strategies to manage disruptive behavior over 11 to 13 sessions, 2 telephone boosters, and 2 home visits. Parent education provided useful information about autism, but no behavior management strategies over 12 core sessions and 1 home visit. In a previous report, we showed that parent training was superior to parent education in reducing disruptive behavior in young children with ASD. Here, we test whether parent training is superior to parent education in improving daily living skills as measured by the parent-rated Vineland Adaptive Behavior Scales II. The long-term impact of parent training on adaptive functioning is also presented.

Results: At week 24, the parent training group showed a 5.7-point improvement from baseline on the Daily Living domain compared to no change in parent education (p=.004; effect size = 0.36). On the Socialization domain, there was a 5.9-point improvement in parent training versus a 3.1-point improvement in parent education (p=.11; effect size =0.29). Gains in the Communication domain were similar across treatment groups. The gain in Daily Living was greater in children with IQ > 70. But the interaction of treatment-by-IQ was not significant. Gains in Daily Living at week 24 were maintained upon re-evaluation at 24 weeks posttreatment.

Conclusion: These results support the model that reduction in disruptive behavior can lead to improvement in activities of daily living. By contrast, the expected trajectory for adaptive behavior in children with ASD is often flat and predictably declines in children with intellectual disability. In the parent training group, higher-functioning children achieved significant gains in daily living skills. Children with intellectual disability kept pace with time.

Clinical trial registration information—Randomized Trial of Parent Training for Young Children With Autism (RUBI); http://clinicaltrials.gov/; NCT01233414.

Key words: autism spectrum disorder, disruptive behavior, parent training, adaptive behavior

INTRODUCTION

Autism spectrum disorder (ASD) is characterized by social communication impairment, repetitive behavior, and restricted interests that begin in early childhood.[1] Current prevalence estimates of ASD range from 6.2 to 14.7 per 1,000 children, with 30 to 40% in the intellectually disabled range.[2,3] Young children with ASD consistently show deficits in activities of daily living (toileting, dressing, use of utensils and play skills). Adaptive functioning in children with ASD as measured on the Vineland Adaptive Behavior Scales is lower than predicted by IQ.[4,5] This gap between IQ and adaptive functioning tends to be wider in children with ASD and average IQ compared to those with intellectual disability.[6] Over time, many children with ASD do not keep pace with age mates on the Vineland, and standard scores may actually decline.[5,7]

A high percentage of children with ASD also exhibit disruptive behavior, including tantrums, aggression, self-injury, hyperactivity, impulsiveness, and noncompliance.[8,9] These co-occurring behavioral problems pose enormous challenges to parents, may result in restrictive school placement, and undermine interventions in the home and community.[10] Disruptive behavior may actually contribute to adaptive skill deficits. A child's active protest in response to parental efforts to promote daily living skills may compel parents to complete the task to avoid conflict. The child's escape from the routine demand hinders acquisition of new skills, interferes with performance of current skills, and reinforces the tantrum. In two previous studies we reported that reduction in disruptive behavior is associated with improvement in adaptive functioning.[11,12] More recently, we showed that parent training was superior to parent education in reducing disruptive and noncompliant behavior in young children with ASD.[13] Here, we test whether parent training is superior to parent education in improving daily living skills as

measured by the Parent/Caregiver Rating Form of the Vineland Adaptive Behavior Scales II.[14] In addition to testing the effect of parent training on daily living skills, we also evaluate the effects of parent training on communication and social interaction.

METHOD

Design

This was a multicenter trial of 180 children between ages 3 and 6 years, 11 months with ASD and moderate or greater behavioral problems. The methods and disruptive behavior outcomes were described in Bearss et al.[13] Eligible children were randomly assigned in a 1:1 ratio to parent training (PT) or a structured parent education program (PEP) for 24 weeks. Parents completed a series of ratings throughout the trial. At endpoint, a treatment-blind independent evaluator at each site classified each participant's treatment response as positive or not (see below). All participants and families in the PT group were invited to return for assessment at weeks 36 and 48 to evaluate longer-term outcomes. Parents of children in the PEP group were allowed to cross over to PT, and most parents elected to do so (see Table S1, available online). Thus, PEP participants were not informative for long-term outcome assessment and are not included in this report.

Setting and Participants

The multisite consortium included: Emory University, Indiana University, Ohio State University, University of Pittsburgh, University of Rochester, and Yale University. Coordinating center activities, data management, and analysis were performed at Emory and Yale. Institutional review boards at each site approved the trial, and parents provided informed consent before collecting study data. An external data and safety monitoring board reviewed the conduct and study results every 6 months during the trial.

Eligible participants were children with an ASD (*DSM-IV-TR* autistic disorder, pervasive developmental disorder-not otherwise specified [PDD-NOS], or Asperger's disorder) based on clinical judgment and supported by the Autism Diagnostic Observation Schedule (ADOS) and

the Autism Diagnostic Interview-Revised.[15-17] Participants had to have moderate or greater behavioral problems as measured by a pretreatment score of ≥ 15 on the Aberrant Behavior Checklist–Irritability subscale[18,19] and a rating of moderate or higher on the Clinical Global Impression Severity (CGI-S). This 7-point scale ranges from 1 (normal) through 4 (moderate) to 7 (extreme).[20] To assign the CGI-S score, independent evaluators considered the child's disruptive behavior, overall impairment, and the impact of the child's behavior on the family.

Children on medication or those receiving behavioral intervention were eligible if treatments were stable with no planned changes for the six-month study duration. To be eligible, children had to have a receptive language age equivalent of at least 18 months (e.g., on the Mullen Receptive Language subtest), be enrolled in a school program, and live in a household with at least one English-speaking caregiver who could participate in the trial. Exclusion criteria were: a *DSM-IV-TR* diagnosis of Rett's disorder, childhood disintegrative disorder, another psychiatric diagnosis requiring immediate treatment, or a known serious medical condition that could interfere with participation. Concomitant psychiatric disorders were assessed by clinical interview aided by the parent-rated Early Childhood Inventory.[21] Children whose parents participated in a structured parent training program in the past 2 years were also excluded.

Randomization and Blinding

Children were randomly assigned within site by the data center using permuted blocks with concealed allocation. The randomization was stratified by high and low educational intensity to ensure equal numbers of participants in high intensity school programs (≥15 hours/week of 1:1 or 1:2 specialized ASD instruction) across treatment groups. Parents and therapists were aware of the treatment assignment, but independent evaluators were not. Parents were instructed not to discuss treatment assignment in assessment sessions with independent evaluators.

Measures in this Report

Results of the co-primary outcomes (the Irritability subscale of the Aberrant Behavior Checklist and the Home Situations Questionnaire-Autism Spectrum Disorder) as well as the key secondary outcome (Improvement item of the Clinical Global Impressions scale rated by the independent evaluator) have been reported elsewhere.[13] This report examines the Parent/Caregiver Rating Form of the Vinland Adaptive Behavior Scales-Second Edition (Vineland II). Our focus on the Vineland II follows from the model that disruptive behavior interferes with the acquisition and regular performance of daily living skills.

Vineland II provides standard scores for four domains: Daily Living, Communication, Socialization and Motor, as well as an Adaptive Behavior Composite. The Motor domain and the Adaptive Behavior Composite are not useful for children over the age of 6 years. Because our sample included children 3 to 7 years old, we did not analyze the Motor or Adaptive Behavior Composite scores. Research coordinators followed a semi-structured script to show parents how to score the Vineland II. The Vineland II asks parents to consider the child's acquired skills and actual independent performance of the behavior (0 =behavior not performed; 1= performed sometimes or partially; 2=performed on a regular basis). Higher scores indicate better adaptive functioning. Standard scores have a population mean of 100 $\pm$ 15 for each domain (Daily Living, Communication, Socialization). In addition to standard scores, the Vineland II provides scaled scores (mean of 15 $\pm$ 3) for three subdomains within each major domain. The Vineland II was completed at baseline, week 24 (or early termination), and at the week 48 posttreatment follow-up visit.

Cognitive Ability Two tests were used to evaluate cognitive ability: the Stanford-Binet-5 (SB-5) or Mullen Scales of Early Learning.[22,23] Examiners started with the abbreviated form of the SB-5, which includes tests of verbal and nonverbal intelligence and yields a valid estimate of IQ (normative mean =100 $\pm$ 15). If the child was unable to complete the SB 5, the examiner administered the Mullen, which includes four subtests (Visual Reception, Fine Motor, Receptive Language, and Expressive Language). Each Mullen subtest yields a T score (normative mean

=50±10) for children under 68 months of age. If a child completed all four subtests, the Early Learning Composite yields a standard score (normative mean =100±15) that can be used as an estimate of intellectual functioning.

Improvement item of the *Clinical Global Impressions* (CGI-I)[20] is a 7-point scale designed to measure overall improvement from baseline that has been used in numerous clinical trials in ASD.[24,25] Scores on the CGI-I range from 1 (very much improved) through 4 (unchanged) to 7 (very much worse). Scores of "much improved" or "very much improved" defined positive response; all other scores indicated negative response. In this study, the independent evaluator, who was blind to treatment assignment, rated the CGI-I monthly during the randomized trial and at weeks 36 and 48 posttreatment.[13] In this report, we explore change in Vineland II scores with children having positive versus negative response on the CGI-I.

Treatments

Parent Training PT included 11 (60-90 minute) core sessions, up to 2 optional sessions, and a home visit over 16 weeks, as well as a home visit and two telephone booster sessions between weeks 16 and 24.[13] Spreading PT sessions over 16 weeks provided scheduling flexibility and promoted delivery of the full dose of the PT program within the 24-week randomized trial (see Table S2, available online).

The structured PT sessions were administered individually to the primary caregiver using direct instruction, video examples, role-play with therapists, handouts, and regular homework assignments. The homework assignments between sessions encouraged parents to apply newly acquired techniques. To identify the purpose (i.e., the function) of a behavior, parents were taught to consider events occurring before the disruptive behavior (antecedent) and the events following the behavior (consequences). Other sessions covered specific strategies: the use of visual schedules, positive reinforcement for appropriate behavior, planned ignoring of inappropriate behavior, and techniques to promote compliance. The last few sessions focused

on how to maintain improvements over time. The sequence of sessions was intended to reduce disruptive behaviors and foster skill acquisition in the child.[26]

Parent Education Program (PEP) was an active intervention that was designed to control for therapist attention and time. It included 12 60-to-90- minute individually administered sessions and one home visit over 24 weeks. The PEP manual also included therapist scripts and handouts for parents at each session. Although PEP sessions provided useful information for parents of young children with ASD, these sessions did not include any instruction on behavior management (see Table S3, available online).

Therapists (master's-level or higher education) were trained to reliability on each treatment manual. Within each site, therapists participated in weekly supervision. Senior therapists also convened monthly cross-site teleconferences to identify and resolve problems of treatment implementation. In addition, a 10% randomly selected sample of video-recorded PT and PEP sessions were independently reviewed to rate fidelity with the manuals.

Adverse Events

Adverse events were systematically monitored and documented at each assessment visit whether considered related to study treatments or not. There were no group differences on the frequency of adverse events. A detailed description of adverse events recording and results was included in a prior publication.[13]

Statistical Analyses

Descriptive statistics were calculated for all variables of interest and included means and standard deviations, medians and interquartile ranges, or counts and percentages, as appropriate. To minimize the effects of attrition, we invited parents and children who stopped treatment to return for assessments. If necessary, we conducted an early termination visit. Fourteen of 180 participants had no post-randomization Vineland II. There were no baseline differences in mean age, Vineland II scores, percentage of males, percentage of participants with IQ < 70, family income levels, or racial distribution in the 14 participants who dropped out

and those with post-randomization Vineland II scores (see Table S4, available online). Thus, measured variables at baseline did not appear to predict premature study withdrawal, which supports the assumption that data are missing at random.[27]

To estimate treatment effects, we conducted a mixed model using baseline and all post-randomization Vineland standard scores. To deal with the 14 participants with no post-randomization Vineland II data, the model was conditioned on all baseline values.[27] This conditional joint response model is more tolerant of missing data than analysis of covariance (ANCOVA) and is less biased than carrying baseline data forward to endpoint. Given our proposed model that disruptive behavior contributes to deficits in activities of daily living, we focused first on change in Vineland II Daily Living domain and then compared PT to PEP on Vineland II Communication and Socialization domains. Effect sizes were computed by subtracting the change from baseline to week 24 (or early termination) in the mean Vineland standard scores in PT minus the change in PEP divided by the standard deviation at baseline for the entire study sample (N=180). To evaluate the long-term effect of PT on Vineland II Daily Living, Communication and Socialization scores, we conducted a mixed model that included baseline, week 24, and week 48. Post hoc multiple comparisons used the Tukey-Kramer multiple comparisons procedure. Statistical significance was assessed at the .05 level unless otherwise noted.

Based on the prognostic importance of IQ in children with ASD, we compared the effect sizes of PT versus PEP on the three Vineland domains in children < IQ 70 to those with IQ $\geq$ 70. In a second exploratory analysis, we compared the change in Vineland II scores in PT participants blindly rated as “much improved” or “very much improved” at week 24. All analyses were conducted using SAS/STAT® software, Version 9.4 of the SAS System for Windows (Cary, NC, USA).

RESULTS

Table 1 summarizes baseline demographic and clinical characteristics. It was not possible to estimate IQ in 17 children who did not complete the SB-5 or the four Mullen subtests. Of these, 15 children did complete the Mullen Receptive Language subtest to confirm the ≥ 18-month receptive language entry criterion. Based on their Receptive Language T-scores, a panel of psychologists classified these participants as IQ < 70 (n=10 in PT; n=5 in PEP) for analytic purposes. The remaining two children could not be tested. These participants were allowed to enter the study following individual case reviews by senior investigators and were not classified as above or below 70.

Overall, the rate of attrition was 10%, and attendance was over 90%, with no differences for PT and PEP. On the Vineland II Daily Living domain, the PT group showed a 5.7-point improvement from baseline to Week 24 compared to no change in the PEP group (p=.004; effect size = 0.36). On the Socialization domain, there was a 5.9-point improvement in the PT group compared to a 3.1-point improvement in PEP (p=.11; effect size =0.29). Both groups achieved some improvement on the Communication domain, but there was no difference between groups (see Table 2).

Table 3 shows pre- and posttreatment Vineland II scores by IQ classification. In PT, improvements on all three Vineland II domains were smaller in children with IQ < 70 than those with IQ ≥ 70. This pattern was not observed in the PEP group, where the change scores from baseline to Week 24 were modest and similar across IQ groups. The significant difference between PT and PEP on the Daily Living domain was driven by the 6.6-point improvement in the children ≥ 70 and the slight decline in Daily Living in the higher-functioning participants in PEP. In children with IQ < 70, however, the Daily Living score did not show the expected decline (see Figure 1). When conditioned on baseline values, however, the interaction between treatment and IQ on Daily Living scores at week 24 was not significant.

Examination of the Vineland II subdomains (e.g., Receptive, Expressive and Written subdomains in Communication; Interpersonal, Play/Leisure and Coping subdomains in

Socialization; Personal, Domestic and Community subdomains in Daily Living) revealed no group differences in any Communication or Socialization subdomains (see Table S5, available online). In Daily Living, the Domestic subdomain (PT =12.03± 2.31 to 13.19 ± 2.50 versus PEP =12.55 ± 2.57 to 12.70 ± 2.45; *p*= .007; effect size= 0.33) and Community subdomain (PT =11.82 ± 2.74 to 12.75 ± 3.47 versus PEP =12.35 ± 3.04 to 12.33± 2.92; *p*= .022; effect size= 0.29) were significantly better in the PT group compared to PEP (see Figure 2). The Domestic subdomain includes items such as "puts away personal possessions (books or toys)" and "cleans up play area," suggesting improved compliance, skill level, or both. The Community subdomain includes following family rules, appropriate behavior in the car (e.g., staying in car seat). Gains observed in Personal subdomain (e.g., uses a spoon or fork, dressing, toileting) were not significant.

Analyses within the PT group Table 4 presents the results of the mixed model in Vineland II scores in children (n=61) who showed a positive response on PT at week 24 (CGI-I of "much improved" or "very much improved" from the blinded independent evaluator) compared to children who did not show a positive response. For this analysis, children who dropped out of the study were included with those who did not show a positive response (n=28). Across all three Vineland II domains, children rated "much improved" or "very much improved" at week 24 showed greater gains. in line with the overall results, the only significant difference in this within group analysis was in the Daily Living domain.

To examine long-term effects of PT on Vineland II domains, we used a mixed model that included baseline, week 24 and week 48. Table 5 shows steady improvement on all three Vineland II domains across the three time points and maintained improvement from week 24 to week 48.

DISCUSSION

In a previous publication from this randomized trial we reported that PT was superior to PEP for reducing disruptive behavior in children with ASD.[13] Here we examined the impact of PT on adaptive functioning in children with ASD and disruptive behavior compared to PEP using the parent-reported Vineland II. PEP was an active comparator that controlled for time and attention. Our interest in adaptive functioning follows from the replicated observation that children with ASD have lower Vineland scores than predicted by IQ.[5-7] We also advanced the organizing principle that disruptive behavior hinders the acquisition and regular performance of daily living skills.[11,12] Thus, our primary focus was on the Vineland II Daily Living domain and, secondarily, on the Communication and Socialization.

Compared to PEP, children in the PT group showed greater gains in all three Vineland II domains. The only statistically significant group difference was in the Daily Living domain. Children in the PT group with IQ < 70 showed modest gains with wide variability in all three Vineland II domains. By contrast, children in the PT group with IQ $\geq$ 70 achieved 5- to 6-point gains in all three Vineland domains. Our results are especially encouraging when contrasted with the results of the Canadian longitudinal study of young children with ASD not selected for disruptive behavior. In that study, Szatmari et al. followed approximately 400 children with ASD for three years. At Time 1, participants were 40 months of age. At the 6- and 12-month follow-up visits, children with IQ < 70 showed a two-point decline in adaptive skills as measured on the Vineland Composite standard score; children with IQ $\geq$ 70 showed a three-point improvement (Szatmari et al., 2015).[7] Our trial followed a similar time frame (24-week randomized phase and 24-week posttreatment follow-up). Within the PT group as a whole, the 5.7-point gain in Vineland II Daily Living domain observed at Week 24 was also evident at Week 48. The flat trajectory of Vineland scores is the expected pattern. The average gain of 5.7 points in the PT group is unexpected.

Although children with IQ < 70 achieved only modest gain in Vineland II Daily Living domain, the treatment-by-IQ interaction was not significant. In a separate analysis, IQ did not

moderate the treatment effect of PT on the primary disruptive behavior outcomes (Luc Lecavalier, personal communication, December 16, 2015). The modest benefit of PT on the Daily Living standard scores in lower-functioning children indicates that these children were keeping pace with the passage of time. Following the reduction in disruptive behavior, increased adaptive skill acquisition in lower-functioning children with ASD may require additional targeted intervention over a longer-time period. For children with ASD in the average IQ range, PT appeared to narrow the gap between IQ and adaptive functioning.

To our knowledge, this is the largest randomized trial of a behavioral intervention in children with ASD. Several limitations warrant mention when considering these results. First, the Vineland II is a standardized measure of adaptive behavior across the lifespan. The change in adaptive function in each domain for this age group of young children is based on relatively few items. In addition, the Vineland II is an age-adjusted standardized scale. Gains over time may result in the same standard score, making it difficult to show positive change on standard scores. Second, the sample was predominately white and nearly three fourths of the children had an IQ > 70. The findings may not generalize to a wider population. Third, parents, who were not blind to treatment assignment, completed the Vineland II. It is not clear, however, that parents were aware of the proposed association between disruptive behavior and daily living skill deficits. Thus, the degree of bias is unknown and perhaps negligible.

The findings of this study support, but do not prove, the model that reduction in disruptive behavior mediates improvement in daily living skills.[28] Although this model was strongly evident in young children with average IQ, those with intellectual disability did not show the expected decline.

References

1. American Psychiatric Association. *Diagnostic and statistical manual of mental disorders.* 5th ed. Washington, DC: American Psychiatric Association; 2013.

2. Elsabbagh M, Divan G, Yun-Joo Koh YJ, et al. Global Prevalence of Autism and Other Pervasive Developmental Disorders. *Autism Res.* 2012;5:160–179.

3. Centers for Disease Control and Prevention (CDC). Prevalence of autism spectrum disorder among children aged 8 years—Autism and Developmental Disabilities Monitoring Network, 11 sites, United States, 2010*. Morbidity and Mortality Weekly Report. Surveillance Summaries*. 2014;63:1–21.

4. Perry A, Flanagan HE., Geier JD, & Freeman NL. Brief report: The Vineland Adaptive Behavior Scales in young children with autism spectrum disorders at different cognitive levels. *J Autism Dev Disord*. 2009;39:1066–1078.

5. Green SA, Carter AS. Predictors and course of Daily living skils development in toddlers with autism spectrum disorders. *J Autism Dev Disord*. 2014;44:256-263.

6. Kanne SM, Gerber AJ, Quirmbach LM, Sparrow SS, Cicchetti DV, Saulnier CA. The role of adaptive behavior in autism spectrum disorders: Implications for functional outcome. *J Autism Dev Disord*. 2011;41:1007–1018.

7. Szatmari P, Georgiades S, Duku E, et al; Pathways in ASD Study Team. Developmental trajectories of symptom severity and adaptive functioning in an inception cohort of preschool children with autism spectrum disorder. *JAMA Psychiatry*. 2015;72:276-83.

8. Lecavalier L. Behavioral and emotional problems in young people with pervasive developmental disorders: relative prevalence, effects of subject characteristics, and empirical classification. *J Autism Dev Disord*. 2006;36:1101-1114.

9. Simonoff E, Pickles A, Charman T, Chandler S, Loucas T, Baird G. Psychiatric disorders in children with autism spectrum disorders: prevalence, comorbidity, and associated factors in a population-derived sample. *J Am Acad Child Adolesc Psychiatry*. 2008;47:921-929.

10. Yianni-Coudurier C, Darrou C, Lenoir P, et al. What clinical characteristics of children with autism influence their inclusion in regular classrooms? *J Intellect Disabil Res.* 2008;52:855-863.

11. Williams SK., Scahill L, Vitiellio B., et al. Risperidone and Adaptive Behavior in Children with Autism. J Am Acad Child Adolesc Psychiatry. 2006;45:431-9.

12. Scahill L, McDougle CJ, Aman MG, et al., for the Research Units on Pediatric Psychopharmacology Autism Network. Effects of risperidone and parent training on adaptive functioning in children with a pervasive developmental disorders and serious behavioral problems. J Am Acad Child Adolesc Psychiatry. 2012;51:136-146.

13. Bearss K., Johnson C, Smith T, et al. Effect of parent training versus parent education on behavioral problems in children with autism spectrum disorder: a randomized clinical trial. JAMA. 2015;313:1524-1533.

14. Sparrow SS, Ciccetti DV, Balla DA. Vineland II: *Vineland Adaptive Behavior Scales, Second Edition: Survey Forms Manual*. Circle Pines, MN: AGS Publishing; 2005.

15. American Psychiatric Association (APA). DSM-IV-TR. Washington, DC: APA; 2000.

16. Lord C, Risi S, Lambrecht L, et al. The autism diagnostic observation schedule-generic: A standard measure of social and communication deficits associated with the spectrum of autism. *J Autism Dev Disord*. 2000;30:205-223.

17. Rutter M, LeCouteur A, Lord C. *The Autism Diagnostic Interview, Revised*. Los Angeles, CA: Western Psychological Services; 2003.

18. Aman MG, Singh NN, Stewart AW, Field CJ. The Aberrant Behavior Checklist: A behavior rating scale for the assessment of treatment effects. *Am J Ment Defic.*1985;89:485-491.

19. Kaat AJ, Lecavalier L, Aman MG. Validity of the Aberrant Behavior Checklist in children with autism spectrum disorders. *J Autism Dev Disord.* 2014;44:1103-1116.

20. Guy W. *ECDEU Assessment Manual for Psychopharmacology*. Rockville, MD: US Department of Health, Education, and Welfare Public Health Service Alcohol, Drug Abuse, and Mental Health Administration; 1976.

21. Gadow KD, Sprafkin J. *Childhood Symptom Inventory-4 screening and norms manual*. Stony Brook, NY: Checkmate Plus; 2002.

22. Roid GH. *Stanford-Binet Intelligence Scales: Fifth Edition.* Rolling Meadows, IL: Riverside; 2003.

23. Mullen EJ. *Mullen Scales of Early Learning*. Bloomington, MN: Pearson Assessments; 1995.

24. Aman MG, McDougle CJ, Scahill L, et al. Medication and parent training in children with pervasive developmental disorders and serious behavioral problems: Results from a randomized clinical trial. *J Am Acad Child Adolesc Psychiatry.* 2009;48:1143-54.

25. King BH, Hollander E, Sikich L, et al. For the STAART Psychopharmacology Network. Lack of Efficacy of Citalopram in Children with Autism Spectrum Disorders and High Levels of Repetitive Behavior. *Arch Gen Psychiatry.* 2009;66:583-590.

26. Bearss K, Johnson C, Handen B, et al. *RUBI Autism Network: Parent Training for Disruptive Behavior [A Treatment Manual]*. Publisher: Authors; 2015.

27. Carpenter JR, Kenward MG. *Missing Data in Randomised Controlled Trials: A Practical Guide*. www.missingdata.org.uk. London School of Hygiene and Tropical Medicine, 2007. Accessed December 1, 2015.

28. Kazdin AE, Nock MK. Delineating mechanisms of change in child and adolescent therapy: methodological issues and research recommendations. *J Child Psychol Psychiatry*. 2003;44:1116-29.

Figure

Figure 1. Forest plot comparing group differences on Vineland II standard scores for parent training (PT) versus parent education (PEP) overall and by IQ category (> 70 and < 70).

Figure 2. Change in Daily Living subdomains from baseline to week 24 in parent training (PT) group versus parent education (PEP).

Table 1. Baseline Demographic and Clinical Characteristics by Treatment Group

	Parent Training (n=89)		Parent Education (n=91)	
	n	%	n	%
Child demographics				
Age, mean (SD) y	4.8	1.2	4.7	1.1
Males	79	88.8	79	86.8
IQ <70	13	14.6	16	17.6
≥ 70	67	75.3	67	73.6
Missing[b]	10	11.2	7	7.7
Race				
White	78	87.6	78	85.7
Black	9	10.1	6	6.6
Asian/Pacific Islander	2	2.3	6	6.6
Other	0	0.0	1	1.1
Ethnicity				
Hispanic	13	14.6	13	14.3
Non-Hispanic	76	85.4	78	85.7
***DSM-IV* diagnosis**				
Autistic disorder	60	67.4	65	71.4
PDD-NOS	27	30.3	23	25.3
Asperger's disorder	2	2.3	3	3.3
School program				
Regular class	36	40.0	46	50.5
Special education class	38	42.7	32	35.2
Special education school	13	14.6	10	11.0
Home instruction	2	2.2	3	3.3
On medication				
Melatonin	9	10.1	9	9.9
Psychotropic	4	4.5	1	1.1
Melatonin and psychotropic[c]	4	4.5	4	4.4
2+ Psychotropics	4	4.5	1	1.1
Parent demographics				
Two parent family	77	86.5	81	89.0
Maternal education				
Advanced degree	29	32.6	23	25.3
College degree	22	24.7	37	40.7
Some college	28	31.5	26	28.6
High school graduate	9	10.1	5	5.5
Some high school	1	1.1	0	0.0
CGI-Severity				
Moderately Ill	32	36.0	32	35.2
Markedly Ill	41	46.1	49	53.9
Severely Ill	16	18.0	10	11.0
	Mean	SD	Mean	SD
Aberrant Behavior Checklist				
Irritability	23.7	6.4	23.9	6.2
Social withdrawal	13.2	8.4	12.6	8.0
Stereotypic behavior	6.2	4.8	6.6	5.1
Hyperactivity	29.5	9.8	31.4	8.7

Table 1. Baseline Demographic and Clinical Characteristics by Treatment Group

	Parent Training (n=89)		Parent Education (n=91)	
Inappropriate Speech	5.3	3.1	6.1	3.2
Home Situations Questionnaire-ASD				
Demand-specific	3.6	1.7	3.2	1.7
Socially-inflexible	4.3	1.7	4.3	1.7
Total	4.0	1.6	3.8	1.5
Vineland II Adaptive Scales[d]				
Communication	80.4	15.1	82.2	15.6
Daily Living Skills	76.7	12.7	79.5	14.3
Socialization	70.5	11.3	73.5	10.5

Note: ASD = autism spectrum disorder; CGI = Clinical Global Impression; PDD-NOS = pervasive developmental disorder-not otherwise specified.
[a]Principal Investigator and therapy supervisor moved from Yale to Emory during study.
[b]17 children missing IQ were unable to complete Mullen; 15 of 17 completed the Mullen Receptive Language (RL) scale to confirm RL >18 months. The remaining 2 children were deemed eligible by study case panel.
[c]5 of 8 children were taking melatonin and $\geq$2 psychotropic drugs.
[d]The Vineland II asks parents to score the child's adaptive skills on a 0-2 scale with higher scores reflecting better adaptive function. It provides age and gender standard scores (population mean of 100 $\pm$ 15) for Communication, Socialization, Daily Living Skills domains.

Table 2. Vineland Scores Using All Observed Data With Response Conditioned on Baseline (N = 180)

Domain[a]	PT (n = 89)		PEP (n = 91)		Adjusted Mean Difference (SE)[b]	95% CI for Adjusted Mean Difference (Lower, Upper)	*p*-value[c] (effect size)[d]
	Baseline	Week 24	Baseline	Week 24			
Communication	80.36 (15.11)	84.75 (15.68)	82.31 (15.54)	85.78 (14.50)	0.45 (1.49)	(-2.49 -3.40)	.76 (0.03)
Daily Living	76.65 (12.72)	82.39 (14.61)	79.51 (14.33)	79.60 (15.39)	4.95 (1.68)	(1.63 – 8.26)	.004 (0.36)
Socialization	70.54 (11.26)	76.46 (13.51)	73.53 (10.45)	76.63 (12.28)	2.28 (1.42)	(-0.52 – 5.08)	.11 (0.29)

Note: PEP = parent education; PT = parent training; SE = standard error.
[a] Data are presented as least squares means (SD) from the mixed model.
[b] Adjusted mean difference = difference of least squares means from mixed model conditioned on baseline score.
[c] *p*-value from mixed model conditioned on baseline score. P < .05 is statistically significant.
[d] Effect size calculated from the absolute value of the adjusted mean difference divided by pooled standard deviation at baseline.

Table 3. Vineland Scores in IQ Groups Using All Observed Data With Response Conditioned on Baseline (N = 180)

Vineland Domain[a]	IQ Category	PT (n = 89)		PEP (n = 91)		Adjusted Mean Difference (SE)[b]	95% CI for Adjusted Mean Difference (Lower, Upper)	*p*-value[c] (effect size)[d]
		Baseline	Week 24	Baseline	Week 24			
Communication	< 70	67.56 (26.53)	70.59 (27.84)	70.23 (28.32)	74.41 (24.71)	-2.01 (2.92)	(-7.78 – 3.76)	.49 (0.15)
	≥ 70	84.57 (15.20)	89.37 (15.31)	86.01 (16.23)	89.04 (14.97)	1.32 (1.68)	(-2.01 – 4.64)	.44 (0.10)
Daily Living	< 70	69.14 (24.05)	71.78 (27.54)	71.45 (27.58)	73.05 (29.05)	0.40 (3.36)	(-6.23 – 7.03)	.91 (0.03)
	≥ 70	79.12 (13.78)	85.77 (15.10)	82.03 (15.80)	81.83 (17.62)	6.01 (1.93)	(2.19 – 9.82)	.002 (0.47)
Socialization	< 70	65.50 (21.88)	68.54 (26.37)	66.45 (19.46)	69.74 (23.06)	-0.45 (2.87)	(-6.13 – 5.23)	.88 (0.05)
	≥ 70	72.19 (12.54)	78.97 (14.48)	75.72 (11.15)	78.88 (13.66)	2.83 (1.64)	(-0.40 – 6.07)	.09 (0.27)

Note: PEP = parent education; PT = parent training; SE = standard error.

[a] Data are presented as least squares means (SD) from the mixed model stratified by IQ status (<70 vs. ≥ 70)

[b] Adjusted mean difference = difference of least squares means from mixed model conditioned on baseline score.

[c] *p*-value from mixed model conditioned on baseline score. P < .025 is statistically significant

[d] Effect size calculated from the absolute value of the adjusted mean difference divided by pooled standard deviation at baseline

Table 4. Vineland Scores Using All Observed Data Conditioned on All Baseline Scores Comparing Participants Who Showed a Positive Response to Parent Training (PT) (Much Improved or Very Much Improved) Compared to Those Who Did Not Show a Positive Response (n = 89)[a]

Vineland Domain[b]	Negative Response to PT (n = 28)		Positive Response to PT (n = 61)		Adjusted Mean Difference (SE)[b]	95% CI for Adjusted Mean Difference (Lower, Upper)	P-value[d] (effect size)[e]
	Baseline	Week 24	Baseline	Week 24			
Communication	77.46 (15.21)	82.02 (17.89)	81.69 (15.00)	86.09 (14.84)	0.98 (2.43)	(-3.84 – 5.81)	.69 (0.06)
Daily Living	73.46 (12.78)	76.49 (12.26)	78.11 (12.52)	84.81 (14.87)	4.89 (2.60)	(-0.28 – 10.07)	.06 (0.38)
Socialization	69.04 (13.22)	73.91 (16.12)	71.23 (10.28)	77.51 (12.43)	1.72 (2.31)	(-2.88 – 6.32)	.46 (0.15)

Note:
[a] "Much Improved" or "Very Much Improved" rated by an independent evaluator who was blind to treatment assignment.
[b] Data are presented as least squares means (SD) from the mixed model.
[c] Adjusted mean difference = difference of least squares means from mixed model conditioned on baseline score.
[d] *p*-value from mixed model conditioned on baseline score. P < .05 is statistically significant.
[e] Effect size calculated from the absolute value of the adjusted mean difference divided by pooled SD at baseline.

Table 5. Longitudinal Change in Vineland II Standard Scores Using All Observed Data for Participants in Parent Training (PT)

Vineland Domain[a]	PT (n = 89)			Mean Difference Week 48 vs. Baseline (SE)[b] [95% CI]	*p*-value[c]	Mean Difference Week 48 vs. Week 24 (SE)[b] [95% CI]	*p*-value[c]
	Baseline	Week 24	Week 48				
Communication	80.36 (15.11)	84.75 (15.68)	84.76 (17.14)	4.42 (1.46) [1.50 – 7.33]	.010	0.02 (1.56) [-3.07 – 3.12]	1.00
Daily Living	76.65 (12.72)	82.39 (14.61)	82.01 (15.72)	5.36 (1.48) [2.42 - 8.30]	.002	-0.38 (1.37) [-3.11 – 2.35]	.96
Socialization	70.54 (11.26)	76.46 (13.51)	77.58 (16.51)	7.07 (1.43) [4.20 – 9.88]	< .001	1.12 (1.31) [-1.49 – 3.72]	.67

Note:
[a] Data are presented as least squares means (SD) from the mixed model.
[b] *p*-value from mixed model and is adjusted for multiple comparisons based on a Tukey-Kramer multiple comparison procedure.

Table S1. Participants Assigned to Parent Education (PEP) Who Did or Did Not Cross Over to Parent Training (PT) by Clinical Response Status at Week 24 as Measured on Clinical Global Impressions (CGI-I)

	Crossed over to PT	Did not crossover to PT	Totals
PEP Responder	13	23	36
PEP Non-responder	44	11	55[a]
Totals	57	34	91

[a] n=49 rated as non-responders at week 24; n=6 who dropped out before week 24.

Table S2. Outline and Brief Description of Parent Training Program

Week	SESSION	CONTENTS
1	Introduction to Behavioral Principles	Introduce overall treatment goals and concepts of behavioral functions, antecedents and consequences of behavior
2	Prevention Strategies	Discuss antecedents to behavior problems and develop preventive strategies
3	Daily Schedules	Develop a daily schedule and identify points of intervention (including use of visual schedules) to decrease behavior problems
4	HOME VISIT 1 and WEEK 4 ASSESSMENT	
5	Reinforcement I	Introduce concept of reinforcers - to promote compliance, strengthen desired behaviors and teach new behaviors
6	Reinforcement II	Introduce “catching your child being good” Teach play and social skills through child-led play
7	Planned Ignoring	Explore use of extinction (via planned ignoring) to reduce behavioral problems
8	WEEK 8 ASSESSMENT	
9	Compliance Training	Introduce effective parental requests and the use of guided compliance to enhance compliance and manage noncompliant behaviors

10	Functional Communication Training	Through systematic reinforcement, teach alternative, communicative skills to replace problematic behaviors
11	Teaching Skills I	Using task analysis and chaining, provide parents with tools on how to replace problem behaviors with appropriate behaviors and how to promote new adaptive, coping and leisure skills
12	WEEK 12 ASSESSMENT	
13	Teaching Skills II	Teach various prompting procedures to use while teaching skills
14	Generalization & Maintenance	Generate strategies to consolidate positive behavior changes and generalize newly learned skills
	OPTIONAL SESSIONS (completed by Week 16)	Provide instruction on up to two sessions from the following topics: Toileting, feeding, sleep, time out, imitation skills, token economy, crisis management
16	WEEK 16 ASSESSMENT	
18	Telephone Booster I	Review implementation of intervention strategies, troubleshoot new behaviors, develop intervention for any newly emerging behaviors
20	HOME VISIT 2 and WEEK 20 ASSESSMENT	
22	Telephone Booster II	Review implementation of intervention strategies, troubleshoot new behaviors, develop intervention for any newly emerging behaviors
24	WEEK 24 ASSESSMENT	

Table S3. Outline and Brief Description of Parent Education Program

Week	SESSION	CONTENTS
1	Autism Diagnosis	Review of diagnostic labels and prevalence data
2	Interpreting Clinical Evaluations	Review the assessment process -Roles of various professionals -Interpretation of various scores provided in clinical reports
3	Developmental Issues	Discuss lifespan issues (Childhood, Adolescence, Adulthood) -What to expect based on child age and functional level
4	WEEK 4 ASSESSMENT	
5	Home Visit	
6	Family Issues	Discuss impact of diagnosis on family members
7	Genetics, Medications, Allied Interventions	Review genetics (Current information & risk for future children), common medication therapies and the role of speech, occupational and physical therapy
8	WEEK 8 ASSESSMENT	

9	Choosing Effective Treatments	Provide an overview of the scientific method and types of studies Review red flags for alternative treatments Discuss questions to ask when choosing treatments
10	Alternative Treatments	Discuss immunizations, alternative treatments (e.g., dietary treatments, vitamin and mineral supplements) and fads (e.g., Secretin, Hyperbaric O^2, Facilitated Communication)
11	Advocacy & Support Services	Discuss the role of parent organizations, advocacy groups and professional resources (legal, educational advocates)
12	WEEK 12 ASSESSMENT	
14	Educational Planning	Introduce IDEA/Section 504 (inclusion vs. special education placement) and the IEP Process. Review National Research Council recommendations
16	WEEK 16 ASSESSMENT	
18	Play Activities	Discuss how to choose appropriate toys/activities Review how to encourage appropriate play
20	WEEK 20 ASSESSMENT	
	Treatment Options	Review of Evidence-based/best practices: -Applied Behavior Analysis and - Developmental/Behavioral and Educational Models
22	Treatment Planning	Review materials learned in Parent Education -application to treatment planning Discuss progress, current concerns, treatment options
24	WEEK 24 ASSESSMENT	

Table S4. Completed Treatment (CT) vs. Early Termination (ET)				
Characteristic	Overall (n = 180)	CT (n = 166)	ET (n = 14)	*p*-value
Age, mean ± SD	4.7 ± 1.1	4.7 ± 1.1	4.8 ± 1.0	.78
Sex, male, n (%)	158 (87.8)	147 (88.6)	11 (78.6)	.39
Race, n (%)				.85
Caucasian	156 (86.7)	143 (86.1)	13 (92.9)	
African American	15 (8.3)	14 (8.4)	1 (7.1)	
Other	9 (5.0)	9 (5.4)	0 (0)	
Child living arrangement, n (%)				.39
With parent	174 (97.7)	161 (97.0)	13 (92.9)	
With relative	2 (1.1)	2 (1.2)	0 (0)	
Other	4 (2.2)	3 (1.8)	1 (7.1)	
Mother's age, mean ± SD (n = 179)	35.7 ± 6.3	35.9 ± 6.4	33.3 ± 4.5	.07
Father's age, mean ± SD (n = 170)	38.5 ± 7.4	38.3 ± 8.1	37.3 ± 6.3	.60
Income level (n = 179), n (%)				.65
< $20,000	15 (8.4)	13 (7.9)	2 (14.3)	
$20,001 – $40,000	36 (20.1)	33 (20.0)	3 (21.4)	
$40,001 – $60,000	36 (20.1)	32 (19.4)	4 (28.6)	
$60,001 – $90,000	36 (20.1)	33 (20.0)	3 (21.4)	
>$ 90,000	56 (31.3)	54 (32.7)	2 (14.3)	
Distance from clinic (miles), median (25th – 75th)	15 (10 – 30)	15 (10 – 30)	15 (11 – 30)	.87
Number of adults living in household median (2th – 75th)	2 (2 – 2)	2 (2- 3)	2 (2 – 2)	.39
Number of children living in household median (2th – 75th)	2 (2 – 3)	2 (2 – 3)	2 (2 – 3)	.46
IQ below 70 (n = 178), n (%)	44 (24.7)	41 (25.0)	3 (21.4)	1.00
Baseline Communication scaled score	81.3 ± 15.3	81.5 ± 15.4	79.2 ± 15.1	.59
Baseline Daily Living scaled score	78.1 ± 13.6	78.1 ± 13.3	78.2 ± 13.7	.97
Baseline Socialization scaled score	72.2 ± 10.9	72.0 ± 11.1	72.7 ± 9.6	.81

Table S5. Vineland Scaled Scores Using All Observed Data With Response Conditioned on Baseline Values (N = 180)

Vineland Domain[a] Subscale	PT (n = 89)		PEP (n = 91)		Adjusted Mean Difference (SE)[b]	95% CI for Adjusted Mean Difference (Lower, Upper)	*p*-value[c] (effect size)[d]
	Baseline	Week 24	Baseline	Week 24			
Daily Living							
Personal	10.12 (2.68)	10.74 (2.82)	10.49 (2.79)	10.71 (2.72)	0.26 (0.32)	(-0.38 – 0.90)	.42 (0.10)
Domestic	12.03 (2.31)	13.19 (2.50)	12.55 (2.57)	12.70 (2.45)	0.82 (0.30)	(0.22 – 1.42)	.007 (0.33)
Community	11.82 (2.74)	12.75 (3.47)	12.35 (3.04)	12.33 (2.92)	0.83 (0.36)	(0.12 – 1.53)	.022 (0.29)
Communication							
Receptive	10.00 (2.64)	11.35 (2.78)	9.90 (2.74)	11.60 (3.05)	-0.30 (0.35)	(-0.99 – 0.38)	.38 (0.11)
Expressive	10.93 (2.99)	11.36 (3.00)	11.58 (3.07)	11.69 (3.06)	0.17 (0.30)	(-0.42 – 0.77)	.57 (0.06)
Written	14.69 (3.60)	14.76 (3.54)	15.12 (3.56)	14.92 (3.79)	0.19 (0.33)	(-0.47 – 0.84)	.57 (0.05)
Socialization							
Interpersonal	9.31 (2.60)	10.57 (3.04)	10.07 (2.40)	10.62 (2.52)	0.49 (0.32)	(-0.13 – 1.12)	.12 (0.19)
Play	8.66 (2.18)	9.52 (2.44)	9.24 (2.35)	9.74 (2.76)	0.18 (0.32)	(-0.44 – 0.81)	.56 (0.08)
Coping	11.46 (2.05)	12.43 (2.75)	11.54 (2.18)	12.20 (2.53)	0.29 (0.33)	(-0.35 – 0.94)	.37 (0.13)

Note: PEP = parent education; PT = parent training.