**Appendix F. Characteristics and Outcomes of Studies of Early Intensive Behavioral and Developmental Interventions**

**Table F-1. Characteristics and outcomes of early intensive behavioral and developmental intervention studies**

| **Author, Year, Country**  **Groups, N Enrollment/N Final**  **Study Quality** | **Age, Mean Months ± SD**  **IQ, Mean ± SD** | **Intervention Provider**  **Intervention Setting** | **Intervention Manualized?** | **Intervention Intensity, Duration, And Focus** | **Key Outcomes** |
| --- | --- | --- | --- | --- | --- |
| **ABA-Based Approaches** |  |  |  |  |  |
| Peters-Scheffer et al. 2013[1](#_ENREF_1)  Netherlands  **G1:** Low intensity Lovaas-based intervention+specialized preschool, 20/20  **G2:** Specialized preschool, 20/20  Quality: Good | **G1+G2:** 62.52 ± 16.96 (median)  **G1:** 40.66 ± 20.1  **G2:** 40.14 ± 18.3 | **G1:** Master’s trained special education or psychology therapists  **G2:** Preschool teachers (no additional information reported)  **G1+G2:** Specialized preschools | **G1:** Yes  **G2:** NR | **G1:** Mean 4.98±1.45 hours/week one-to-one treatment plus standard specialized preschool for 24 months; intervention included programs focused on compliance/attention, imitation, matching, categorization, PECS, motor skills, language, memory, play, adaptive behavior, academic skills, social interaction/communication  **G2:** Hours not reported; standard preschool incorporating TEACCH, PECS, individualized speech therapy, sensory integration, language, play, sensory-motor | * 9/20 participants in G1 received 1 year of treatment vs. 2 years * Developmental age in both groups improved over time, but increase was greater in G1 vs. G2 (p=.001); effect size for change=1.09 * IQ improved significantly from baseline to 12 months (mean 40.66 to 48.17, P<.001) in G1 and remained stable from 12-24 months; no significant change over time in G2 (baseline mean=40.14, 24-month mean=39.42); effect size for change=0.40 * Total Vineland and subscale scores improved in both groups with greater improvements in G1 vs. G2 (p values<.001); effect size for change in total score=1.74 * Receptive language improved at 24 months in G1 vs. G2 (p=.04); expressive language improve over time in both groups but between group differences at 24 months were not significant (effect size for change=0.40) * Both groups generally improved over time on Early Social Communication Scales domains but between group differences were not significant at 24 months * Severity ratings (CARS, ADOS) decreased significantly over time for G1 but not G2; effect size for change in ADOS=1.51, CARS=1.50) * Differences between groups in measures of emotional and behavioral problems and behavioral flexibility were not significant * More G1 participants achieved clinical and reliable significant on developmental age, adaptive behavior, interpersonal relationships, play and leisure time, receptive and expressive language, ASD severity, and responding to social interaction vs. G2 * More G2 vs. G1 participants obtained clinical and reliable significance on measures of problem behavior and maternal stress; equal numbers of G1 and G2 participants obtained clinical and reliable significance on IQ, behavioral flexibility, joint attention, behavioral requests, and initiating social interaction * Diagnoses changes from autism to PDD-NOS in 45% of G1 and 20% of G2; 10% in G1 classified as non-autistic at 24 months (0 in G2); level of intellectual disability declined in 55% of G1 and 5% of G2 * Baseline hours of treatment, developmental age, IQ, level of adaptive behavior, play skills , receptive language significant predictors of progress |
| Dawson et al. 2012[22](#_ENREF_22), [23](#_ENREF_23)  US  **G1:** ESDM, 24/24  **G2:** Community-based interventions, 24/21  Quality: Good | **G1:** 23.9 ± 4.0  **G2:** 23.1 ± 3.9  **G1:** 61.0 ± 9.2  **G2:** 59.4 ± 8.6 | **G1:** Trained therapists, clinical psychologist, speech language pathologist, developmental behavioral pediatrician, parents  **G2:** Community-based therapists | **G1:** Yes  **G2:** NR | **G1:** Mean 15.2 ± 1.4 therapist-delivered hours/week + mean 16.3 ± 6.2 parent-delivered hours/week for 24 months, intervention focused on interpersonal exchange, positive affect, shared engagement with real life materials/activities, communication, and adult responsiveness to child cues  **G2:** Mean 9.1 hours/week of individual therapy and 9.3 of group delivered interventions, potentially including speech language and occupational therapy, developmental preschool | 1 year outcomes:   * Significantly greater improvement in IQ for G1 (154 vs. 22 points) compared with G2 * No adaptive behavior differences   2 year outcomes:   * Significantly more improvement in G1 vs. G2 on IQ; receptive language, and expressive language * Adaptive behavior improvements in both groups (all domains except socialization); significantly greater improvements in G1 * No change in ADOS severity scores or repetitive behavior * Diagnostic shift toward milder diagnosis (PDD-NOS) greater for ESDM group * No differences between groups in EEG measurements of perceptual face processing * EEG measures of engagement/cognitive processing comparable to those of typically developing children for G1 children with usable EEG data; 11/15 G1 participants and 4/14 G2 showed faster neural response to faces vs. objects |
| Peters-Scheffer et al. 2010[2](#_ENREF_2)  Netherlands  **G1:** Specialized preschool + UCLA/Lovaas-based intervention, 12/12  **G2:** Specialized preschool, 22/22  Quality: Fair | **G1:** 53.5 ± 5.52  **G2:** 52.95 ± 11.14  **G1:** 47.00 ± 10.33  **G2:** 45.73 ± 15.99 | **G1:** Psychologist, special educator, preschool teachers and parents with workshop training in ABA techniques  **G2:** Psychologist, special educator, preschool teachers  **G1+ G2:** Preschool for children with intellectual disabilities | **G1:** Yes  **G2:** NR | **G1:** Mean 28.38 hours intervention/week for 8 months using elements of TEACCH, incidental and structured teaching, individualized speech, occupational, music therapy plus mean 6.29 hours/week 1:1 Lovaas-based intervention focused on developmental age and adaptive skills  **G2:** Mean 23.38 hours intervention/week using elements of TEACCH, incidental and structured teaching, individualized speech, occupational, music therapy | * Both groups improved over time on cognitive and adaptive measures; G1 improved significantly compared with G2 on IQ/developmental age and Vineland composite, communication, daily living, and socialization domains (all p≤.02) * G2 had greater emotional and behavioral problem scores at baseline vs. G1 (p<.05), changes in scores not significant for either group over time * Decreases in symptom severity not significant between groups |
| Itzchak et al. 2011[3](#_ENREF_3), [4](#_ENREF_4)  Israel  **G1:** ABA-based approach, 45/45  **G2:** Eclectic approach, 33/33  Quality: Fair | **G1:** 25.1 ± 3.9  **G2:** 26.0 ± 4.6  **G1:** 72.2 ± 19.2  **G2:** 73.3 ± 22.2 | **G1:** Psychology or special education master’s trained board certified behavior analysts, trained therapists, speech language pathologists, occupational therapists, preschool teachers  **G2:** Clinical psychologist, special education preschool teacher, speech language pathologist, occupational therapist, cognitive trainer, music therapist, teacher’s aids  **G1+G2:** Autism-specific preschools | **G1:** NR  **G2:** NR | **G1:** 20 hours/week for 12 months, 1:1 intervention with focus on language, play, social, emotional, academic, adaptive skills, and reducing inappropriate behavior  **G2:**19 hours/week for 12 months, 1:1 intervention and parental involvement in intervention 1 day/week; overall treatment integrated developmental approaches | * Overall high level of diagnostic stability from baseline to end of 12-month intervention: 91% of children retained autism diagnosis. Classification improved for 3 G1 and 2 G2 participants and deteriorated for 2 children in G1 * Cognitive abilities (Mullen Scales) and overall Vineland raw scores improved in both groups (p<.001) over time; no significant differences between groups at followup; overall Vineland standard scores improved for both groups (p<.05) * Vineland motor skills domain decreased over time for both groups (p<.001) * Children in G1+G2 with lower severity (ADOS) improved significantly more than those with higher severity on cognitive and adaptive measures; both groups declined on measures of motor skills, with greater decline for those with higher severity * G2 participants with lower severity improved significantly on Vineland communication and socialization measures compared with G1 (p<.001) * In analyses combining G1 and G2, higher cognitive abilities at baseline, particularly verbal abilities, and older maternal age were associated with greater adaptive skills at followup (p<.05) * Among those with greater severity, greater verbal ability was associated with better adaptive skills at followup (r=.672, p<.001) * Cognitive gains were greater for those with lower severity (p<.01) and older, more educated mothers (p values <.001, .05); younger children had a better chance of cognitive improvement with intervention (p=NS) |
| Strain et al. 2011[5](#_ENREF_5)  US  **G1**: LEAP program with coaching and training, 28 classrooms (27 analyzed)/177 children  **G2**: LEAP intervention manuals only, 28 classrooms (23 analyzed)/117 children  Quality: Fair | **G1:** 50.1 ± 4.6  **G2:** 50.7 ± 4.2  **G1:** 59.6 ± 6.9  **G2:**  63.2 ± 6.6 | **G1+G2:** Preschool teachers  **G1+G2:** Preschool | **G1+G2:** Yes | **G1:**2 years intervention, mean 17 hours/week (teachers received 23 full days coaching/training), peer mediated social skills, incidental teaching, pivotal response training, PECS, positive behavior support  **G2:** 2 years intervention, mean 17 hours/week, intervention as above, no specific training for teachers beyond provision of LEAP manual | * Significant gains on CARS, language, cognitive, and social skills measures for G1 vs. G2 (p<.05) * G1 improved by 18.5 points compared with 9.4 for G2 on the Preschool Language Scale (effect size difference=0.92, p<.01) * G1 improved by 28.6 points compared with 12 for G2 on socials skills rating (effect size difference=1.22, p<.01) * Greater intervention fidelity associated with better outcomes on all measures |
| Eldevik et al. 2012[6](#_ENREF_6)  Norway  **G1:** Preschool-based EIBI, 31/31  **G2:** Usual care preschool, 12/12  Quality: Fair | **G1:** 42.2 ± 9.0  **G2:** 46.2 ± 12.4  **G1:** 51.6 ± 16.9  **G2:** 51.7 ± 18.1 | **G1:** Board certified behavior analyst and psychologist, bachelor’s trained therapists with ABA-training  **G2:** Special education teacher, trained therapists  **G1+G2:** Preschool | **G1:** Yes  **G2:** NR | **G1:** Mean 13.6 hours/week over 24 months, ABA-based EIBI intervention using discrete trial training, operant conditioning to promote communication, gross and fine motor skills, play and social skills, adaptive behavior  **G2:** Mean 5+ hours/week over 24 months, intervention including elements of alternative communication, ABA-based approaches, sensory motor skills, TEACCH, adaptive and communication skills | * Greater gains in cognitive outcomes (p=.004) and overall adaptive behavior (p=.036) , Vineland communication (p=.034) and socialization (p=.008) for G1 vs. G2; no significant differences in Vineland daily living skills between groups * Effect size for change in IQ=1.03 (95% CI: .34 to 1.72) and for change in overall adaptive behavior=.73 (95% CI: .05 to 1.36) * Baseline age and PDD-NOS or Asperger diagnosis correlated with larger gains in overall adaptive behavior, communication, and daily living skills; baseline IQ positively correlated with Vineland socialization gains |
| Eikeseth et al.  2012 [7](#_ENREF_7)  Norway/Sweden  **G1:** EIBI, 35/13-15 depending on outcome  **G2:** Standard care, 24 / NR  Quality: Fair | **G1:** 3.9 ± 0.9 years  **G2:** 4.4 ± 1.2 years  Vineland age equivalent:  **G1:** 1.9 ± 0.9  **G2:** 2.1 ± 0.8 | **G1**: Therapist, parents, Supervisor from Banyan Center, school staff  **G2**: Special education teacher, teacher assistant  **G1**+**G2**: Mainstream public preschools or kindergartens, and home | **G1**:Yes  **G2**:NR | **G1**: One year of 15 to 37 hours-per-week, with an estimated mean of  23 hours ± 5.3 comprehensive intervention focused on adapative behavior, ASD severity  **G2**: individual special education program | * G1 scored significantly higher on all Vineland scales as compared to G2 (p<0.05) with an effect size of Total (composite)=0.92, Communication=1.08, ADL=0.71, Socialization=0.75,Motor=0.70, and Learning rate=0.97 * G1: CARS scores continued to decrease significantly during the second year of treatment (from 31.8 (SD=8.5) to 27.2 (SD=6.2), p<.05), effect size of 0.59 * Children receiving G1 scored significantly higher on standard scores of adaptive behavior * Significant improvements were found in maladaptive behaviors and excess and deficit behaviors as compared to G2 * Largest gains were observed during the first year. Effect size on all measures at year one were moderate to large |
| Flanangan et al. 2012[8-13](#_ENREF_8)  Canada  **G1:** Intensive behavioral intervention, 61/61  **G2:** Wait list control (matched by age), 61/61  Quality: Fair | **G1:** 42.93 ± 11.53  **G2:** 42.79 ± 10.51  NR | **G1:** Trained instructor therapists, masters-degreed or certified behavior analyst supervisors, psychologists  **G2:** Community-based interventionists  **G1:** Specialized centers, preschools, home  **G2:** Community-based with multiple settings | **G1:** No  **G2:** NR | **G1:**Mean 25.81 ± 3.44 hours intervention/week for varied time period depending on age at enrollment, ABA-based, center- and home-based, publicly funded intervention incorporating discrete trial training and naturalistic approaches and curricula focusing on impairments of a specific child  **G2:** Mean 17.9 ± 12.3 hours/week of school based services and <10 hours/week of behavioral intervention; community based interventions including low intensity ABA, speech therapy, occupational therapy, behavioral consultation | * In 2008 retrospective case series (Perry 2008) reporting on ~30% of G1 participants ASD severity (CARS), cognitive level, adaptive behavior, and rate of development improved significantly (all p<.001); outcomes varied across children: approximately 25% showed substantial improvements, 30% showed clinically significant improvement, 19% showed some/modest improvement, 25% showed no improvement or worsening of outcome. Analyses of a subset of the total participants (n=89) showed similar improvements (Freeman 2010) * Age (younger at baseline), IQ, adaptive behavior, and ASD severity were correlated with outcome; IQ was strongest predictor, accounting for 5-12% of the variance in outcomes (Perry 2011); in sub-set analysis (Shine 2010), duration of intervention also associated with better outcomes * In 151 participants with parental stress data available, higher maternal stress at baseline was correlated with lower child adaptive behavior skills at end of intervention (p<.01) (Shine 2010) * ASD severity improved for G1 vs. G2 as did Vineland composite standard and ratio scores and IQ estimates (p values ≤ .033, effect sizes ranging from 0.53 to 0.83); 19 point difference in IQ at end of intervention in favor of G1 * Younger age at intervention and higher adaptive skills associated with better outcomes; adaptive skills also associated with better outcomes for G2. Duration of intervention became nonsignificant after intervention type was entered into statistical models (Flanagan 2012) * In retrospective analyses (Perry 2013), higher baseline IQ predicted gains in IQ, and children starting early intervention at younger ages (2-5 yrs) gained significantly more IQ points (mean 17 points vs. mean 2 points) than children entering intervention at older ages (6-13 yrs); differences in adaptive behavior gains were not significant |
| Boyd et al. 2013[14](#_ENREF_14)  US  **G1:** TEACCH preschools, 85/81  **G2:** LEAP preschools, 54/48  **G3:** Non-model specific preschools, 59/56  Quality: Fair | **G1:** 48 ± 6.84  **G2:** 47.52 ± 8.4  **G3:** 48.84 ± 7.68  NR | **G1:** Teachers in high fidelity TEACCH programs  **G2:** Teachers in high fidelity LEAP programs  **G3:** Teachers in inclusive or special education preschools  **G1+G2+G3:** Preschools | **G1:** Yes  **G2:** Yes  **G3:** No | **G1:** Half or full school day for 6 months of cognitive social learning based intervention that uses visual schedules and other modifications to the environment to promote learning and engagement  **G2:** Half day for 6 months of interventions blending ABA and early childhood education techniques and peer mediation and focused on reducing ASD characteristics to promote learning  **G3:** Half or full day for 6 months, inclusive or special education preschool | * Groups differed at baseline on autism characteristics and severity (p=.0013), communication (p<.001), parent-rated reciprocal social interaction (p=.0241) and fine motor (p=.0066) composite scores * All groups showed significant change over time on the autism characteristics and severity, fine motor, and communication composites (p values ≤.05); G1 and G2 improved on teacher-rated reciprocal social interaction (p≤.05). G1 improved on parent-rated reciprocal social interaction (p<.05) * No significant differences among groups on any measure at followup * Children with higher Mullen scores made fewer gains in G1; children with high Preschool Language Scale scores at baseline had higher communication and autism characteristics and severity composite scores in G1 * Females in G2 had smaller communication gains, although few females in study overall (n=33) |
| Kovshoff et al. 2011[15](#_ENREF_15), [16](#_ENREF_16)  UK  **G1:** EIBI (publicly-funded or privately purchased), 23/23  **G2:** Usual care, 21/18  Quality: Poor | **G1:** 35.7 ± 4.0  **G2:** 38.4 ± 4.4  **G1:** 61.43 ± 16.43  **G2:** 62.33 ± 16.64 | **G1:** Trained behavior analysts and special educators  **G2:** NR  **G1:** Home  **G2:** Community-based interventions | **G1:** NR  **G2:** NR | **G1:** Mean 25.6 hours/week 1:1 teaching for 24 months, ABA-based intervention using discrete trial training in natural environment to improve, language, social skills, behavior  **G2:** Hours of intervention over 24 months NR, intervention included speech therapy, PECS, TEACCH, medications, and other approaches as provided in the community | * Groups differed significantly on age at baseline (p<.05) * IQ, mental age, and language comprehension improved significantly for G1 vs. G2 after 24 months of intervention (p≤.05); effect size for IQ change=0.77 * Vineland daily living and motor skills scores improved for G1 vs. G2 (p<.05) but composite, communication, severity, and socialization scores did not differ significantly between groups at the 24 month followup * Parents noted more positive social behavior for G1 vs. G2 at the 24 month followup * Intervention responders had higher IQ, higher mental age, higher Vineland composite, communication, and socialization scores, lower motor skills, more behavior problems, and more autistic symptoms and fewer hours of intervention in Year 2 * At followup of 41 participants 2 years after the end of the 24-month intervention, 14/23 G1 and 4/18 G2 children in mainstream education settings (p=.013), most receiving some 1:1 support * At 2-year followup no significant group differences in IQ, adaptive behavior, communication, socialization, or behavior; more G1 participants achieved standard score on receptive language measure vs. G2 (p=.048) * In analyses of G1 participants in privately purchased vs. publicly funded EIBI programs, IQ declined for the publicly funded group compared with the control or privately purchased participants (p<.0001); privately purchased participants maintained IQ and adaptive behavior gains from end of intervention to the 2 year followup. Publicly funded group had more severe ASD symptoms, lower adaptive behavior, and received less intensive intervention than the privately purchased group |
| **Parent Training** |  |  |  |  |  |
| Schreibman et al. 2013[17](#_ENREF_17)  US  **G1:** Pivotal Response Training (PRT), 20/20  **G2:** PECS, 19/19  Quality: Good | **G1:** 29.5 ± 6.9  **G2:** 28.9 ± 4.2  NR | **G1+G2:** Trained therapists, parents  **G1+G2:** Home | **G1:** Yes  **G2:** Yes | **G1+G2:** Mean 247 hrs treatment over 23 weeks, G1 focused on motivational techniques delivered by parents to facilitate communication. G2 focused on motivational techniques to facilitate augmented communication | * Children in both G1 and G2 showed gains in language from baseline to followup 3 months after the end of treatment but no between group differences reported; effect sizes for change ranged from .001 to .486 * In the PECS group 12/19 children mastered requesting and were learning to comment using pictures * Mean number of spoken words gained across groups=80; individual progress varied widely , with 78% of children using at least 10 spoken words at final followup |
| Strauss et al, 2012 [18](#_ENREF_18), [19](#_ENREF_19)  Italy  **G1**: Staff and parent mediated EIBI, 24/24  **G2**: Eclectic, 20/20  Quality: Good | **G1**: 55.67 ± 17.63  **G2**: 41.94 ± 13.07  GMDS-ER GQ  **G1**: 55.65 ± 20.06  **G2**: 74.29 ± 29.37 | **G1**+**G2**: Staff and parents  **G2**: Parents  **G1**: Treatment center and home  **G2**: Home | **G1**: No  **G2**: No | **G1:** For 12 months, alternated between one week of 25 hours of therapist-led center-based intervention and 3 weeks of an average of 14 hours/week parent-led home intervention. Focus on individual skills, problem behaviors, and facilitated play and social interaction  **G2**: In-home developmental intervention and cognitive behavioral treatment for  approximately 12 hours/week. Focus determined by staff expertise and preferences. | * Compared to G2, children in G1 showed significant decrease in autism symptom severity, increases in language production and mental development * Compared to G1, children in G2 had improved parent-reported socialization and motor skills * In G1, older children achieved better adaptive behavior outcomes; younger children made more gains in early language comprehension and production. Children who gained more language comprehension had higher adaptive behavior scores pre-treatment. Pre-treatment language comprehension predicted post-treatment language production * In G2, higher pre-treatment mental development state and early language skills predicted better outcome on adaptive behaviors. Initial higher adaptive behaviors predicted better post-treatment early language comprehension. * In both groups, child outcomes on early language skills, mental developmental state and adaptive behaviors were significantly influenced by parental stress, child ability to respond correctly to prompts, number and difficulty of treatment targets, and child problem behaviors in sessions. The predictive power of parental stress on outcome autism severity was modified by perception of difficult child, with higher perceptions of difficulty associated with lower decreases in autism severity * Less parent inclusion in treatment provision resulted in decreased perceptions of a difficult child and less parental stress |
| Landa et al. 2012[20](#_ENREF_20), [21](#_ENREF_21)  US  **G1:** Assessment Evaluation and Programming System for Infants and Children (AEPS) curriculum+additional joint attention and social interaction opportunities, 25/24  **G2:** AEPS curriculum, 25/24  Quality: Good | **G1:** 28.6 ± 2.6  **G2:** 28.8 ± 2.8  **G1+G2:** 60.1 ± 11.9 | **G1:** Trained interventionist + parent  **G2:** Trained interventionist + parent  **G1+G2:** Specialized clinic classroom | **G1:** Yes (AEPS), NR (additional joint attention)  **G2:** Yes | **G1:** Mean 205.66 ± 18.63 hours of intervention over 6 months, intervention included elements of discrete trial training, pivotal response training, routines-based interaction, augmented communication, and visual cues and structure + orchestrated opportunities for initiation of joint attention(IJA), shared positive affect (SPA), and socially engaged imitation (SEI)  **G2:** Mean 196±21 hoursintervention over 6 months,intervention included elements of discrete trial training, pivotal response training, routines-based interaction, augmented communication, and visual cues and structure | * Greater socially engaged imitation in G1 compared with G2 at end of intervention and at 6-month followup (effect size=0.86, p.01); growth occurred during intervention period vs. followup period * Initiations of joint attention did not differ significantly between groups at the 6-month followup, though each group improved over time * Measures of expressive language and nonverbal cognition did not differ between groups at the 6-month followup * At long-term followup of G1+G2 (n=34) at mean 37.6 months after end of intervention (mean age=72.6 ± 17.5 months), IQ and Vineland communication scores increased from baseline (mean change 21.4 ± 22.9, effect size=1.02, p<.001 and 12.7 ± 19.4, effect size=0.81, p<.001, respectively) * No change in symptom severity (ADOS) at the long-term followup |
| Roberts et al.  2011[24](#_ENREF_24)  Australia  **G1**: Individualized home-based program, 34/27  **G2**: Small group center-based program combined with parent training and support group, 33/29  **G3:** Waitlist, 28/28  Quality: Good | **Age:**  **G1**: 41.5  **G2**: 43.1  **G3:** 43.7  **IQ:**  **G1**: 57 ± 11.7  **G2**: 66 ± 17.7  **G3:** 63.3 ± 15.5 | **G1**+**G2**+**G3**: Multidisciplinary teams of teachers, speech pathologists, occupational therapists and psychologists  **G1**:Home  **G2**:Center  **G3:** home/center | **G1**: NR  **G2**: Yes  **G3:** NA | **G1**: 2 hour visit every 2 weeks, 20 sessions max, 40 weeks duration, focused on communication, social skills, adaptive  functioning and psychopathology, parent stress  **G2**: weekly 2 hour sessions, 40 weeks duration, six  playgroups of 4–6 children, with six concurrent parent support and training groups, focused on communication, social skills, adaptive  functioning and psychopathology, parent stress  **G3:** Waiting list | * Significant greater improvement in Reynell comprehension standard score for G2 compared to G1 (-7.3; 95% CI: -13.9 to - 0.7, p=0.02) * Greater improvement for expression standard score of the Reynell for the G2 compared to G1 (-3.0; 95% CI: -9.0, to 2.9, p=0.31 * Reynell standard comprehension and expression scores **G3** performed better than G1, but not significantly * For the Reynell standard comprehension and expression scores G2 performed better than **G3** but not significantly. * **G3** improved significantly more G1 on the Vineland socialization scale * There were no statistically significant differences among the three groups for other child outcomes. When analyses were limited only to children with autism spectrum diagnoses, the magnitude of the effects increased but the presence or absence of statistical significance did not. * Parent outcomes: Parenting: statistically significant differences favoring G2 vs. G1 * No significant difference between groups for stress |
| Aldred et al. 2011[25](#_ENREF_25), [26](#_ENREF_26)  UK  **G1:** Parent training in social communication intervention plus community intervention, 14/14  **G2:** Community intervention, 14/14  Quality: Good | **G1:** 51.4 ± 11.8  **G2:** 50.9 ± 16.3  NR | **G1:** Speech language therapists, parent  **G2:** Routine care as provided in community—speech pathologists, behavior analyst  **G1:** Clinic, home  **G2:** Community | **G1:** Yes  **G2:** NR | **G1:** Suggested 30 minutes/day parent training, parents received monthly training for 6 months followed by training ~2 months for 6 months, intervention focused on facilitating communication via parental sensitivity and responsiveness, adapted communication strategies, consolidation, elaboration + routine care  **G2:** Intensity NR, routine care including speech pathology, ABA-based treatment | * G1 showed improvements in ADOS scores, social interaction, expressive language, child communication acts during interaction * No adaptive behavior differences or differences in parenting stress between groups * Language gains particularly prominent in younger, lower functioning children * Increased parental synchrony (communication which maintained vs. redirected or controlled child responses) in G1 associated with reduction in child ADOS score (decreased impairment, p=.014); reduction in synchrony for G2 and small increase in mean ADOS scores * In tests of mediation, change in parental synchrony accounted for 34% of total treatment effect on ADOS outcome |
| Keen et al. 2010[27](#_ENREF_27)  Australia  **G1:** Professional parent intervention, 17 families/NR  **G2:** Self-directed video based parent intervention, 22 families/NR  Quality: Good | **G1:** 36.38 ± 7.54 **G2:** 35.71 ± 6.92  **G1:** 53.06 ± 9.06  **G2:** 52.86 ± 6.53 | **G1**: Doctoral students (facilitator)  **G2**: DVD-led curriculum  **G1**: Workshop / home  **G2**: Home | **G1**:NR  **G2**:NR | **G1**: 2-day parent group workshop and a series of 10 home-based consultations  10 X 1 hour home-visits which occurred twice-weekly over 5–6 weeks, focused on parental stress, child communication  **G2**: Self-directed parent intervention group received an interactive instructional DVD “Being Responsive: You and Your Child with Autism” lasting for 6 weeks, focused on parental stress, child communication | * G1 showed significantly greater improvement on social communication at follow-up than G2 regardless of values at baseline * Parents low in self-efficacy at baseline demonstrated relatively higher levels of self-efficacy if they received G1 vs. G2 * G1 reduced child-related stress relative to G2 for both mothers and fathers * Fathers reported higher levels of stress than mothers in both groups * Behavior sample scores at follow-up not affected by group condition * All outcomes are based on parent report |
| Casenhiser et al. 2013[28](#_ENREF_28)  **G1:** MEHRIT (developmental individualized relationship-based intervention), 25/25 **G2:** Community-based treatment, 26/26  Quality: Fair | **G1:** 42.5 ± 8.8 (mo.)  **G2:** 46.4 ± 8.3 (mo.)  NR | **G1:** Speech-language pathologists, occupational therapists  **G2:** Varied community-based therapists  **G1:** NR  **G2:** Community-based | **G1:** Yes  **G2:** NR | **G1:** 2 hours/week therapist training+3 hours parent interaction for 12 months; intervention focused on social interaction, communication, parental responsiveness, sensory-motor skills  **G2:** Mean 3.9 hours treatment/week; treatment included speech therapy, ABA-based approaches, occupational therapy, social skills training, and specialized day care | * At pretreatment, G2 had higher scores on investigator-rated “enjoyment in interaction” domain of the modified Child Behavior Rating Scale; at followup, G1 improved significantly more compared with G2 on the domains of attention to activity, involvement, initiation of joint attention, and enjoyment in interaction (p values <.05, effect sizes 0.63-1.02); no significant difference in compliance domain * Both groups improved from baseline to followup on language developmental quotient measure but no significant between group difference * Greater baseline language skills, initiation of joint attention, and involvement were significant predictors of language change |
| Rogers et al. 2012[29](#_ENREF_29), [30](#_ENREF_30)  US  **G1**: Parent-delivered Early Start Denver mode (ESDM), 49/49  **G2**: Community treatment as usual, 49/49  Quality: Fair | **G1:** 21.02 ± 3.51  **G2:** 20.94 ± 3.42  **G1:** 64.88 ± 17.22  **G2:** 63.08 ± 15.93 | **G1:** Credentialed therapists trained in ESDM methodology  **G2:**Community-based interventionists  **G1:** University clinics  60-minute session weekly for 12 weeks  **G2:** Interventions available in community | **G1:** Yes  **G2:** NR | **G1:** 60-minute session weekly/12 weeks, ESDM intervention using parent training in increasing child attention and motivation; sensory social routines; engagement and joint activity; nonverbal communication; imitation skills; joint attention; speech development; using antecedent-behavior-consequence relationships; prompting, shaping, and fading techniques; conducting functional assessments to develop new interventions  **G2:** Community interventions as selected by parents | * At followup, G1 received mean 1.48 hours treatment/week G2 received 3.68 (p<.05) * G2 had more severe social affect symptoms at baseline, poorer imitation and nonsocial orienting scores compared with G1 (p<.05) * No significant group differences on ADOS scores or measures of development at followup * Measures of parent acquisition of parent-child interaction skills did not differ between groups at followup * Social orienting and imitation skills were not found to be moderators of outcomes; increased hours of intervention and younger child age were significantly associated with improved developmental and vocabulary scores in a pooled analysis (p≤.05). In analyses by group, age and hours of intervention associated with improvements in vocabulary for G1 (p≤.05) * Parent stress decreased in G1 compared with G2 (p<.05) |
| Pajareya et al. 2011[31](#_ENREF_31)  Thailand  **G1:** DIR/Floortime,16/15  **G2:** Usual care, 16/16  Quality: Fair | **G1:** 56.6 ± 10.1  **G2:** 51.5 ± 13.9  NR | **G1:** Clinician trained in rehabilitation medicine  **G2:** NR  **G1:** Parents (attended one day training workshop, received 3-hour DVD lecture, and had two one-hour home visits with a trainer)  **G2:** Community-based interventions | **G1:** Yes  **G2:** NR | **G1:** Parent-administered DIR/Floortime for an average of 15.2 hours/week for 3 months. Intervention focused on following child’s cues related to communication and engagement  **G2:** 3 months of usual care interventions | * G1 improved significantly on the Functional Emotional Assessment Scale compared with G2 (p=.045) * CARS scores decreased (improved) for G1 vs. G2 (mean change 2.9 vs. 0.8, p=.004) * G1 scores on parent-rated measure of emotional development significantly improved compared with G2 (mean change 7.7 vs. 0.8, p=.007) |
| Carter et al. 2011 [32](#_ENREF_32)  US  **G1**: More than Words, 32/29  **G2**: Control, 30/26  Quality: Fair | **G1:** 21.11 ± 2.71  **G2**: 21.51 ± 2.82  **G1**& **G2**: NR | **G1**+**G2**: Speech / language therapist  **G1**+**G2**: Clinic , Home | **G1**:Yes  **G2**:NR | **G1**: 8 group sessions with parents only and 3 in-home individualized parent –child sessions over 3.5 months, focused on enhancing parental responsivity and child communication  **G2**: No treatment /treatment as usual | * No treatment effect on parental responsivity * G1 showed differential effects on child communication depending on a baseline child factor * Children with lower levels of baseline object interest exhibited facilitated growth in communication * Children with higher levels of object interest exhibited growth attenuation |
| Oosterling et al. 2010[33](#_ENREF_33)  **G1:** Nonintensive parent training+specialized preschool, 40/36  **G2:** Specialized preschool, 35/31  Quality: Fair | **G1:** 35.2 ± 5.5  **G2:** 33.3 ± 6.4  **G1:** 58.4 ± 16.8  **G2:** 58.0 ± 16.9 | **G1:** Parents  **G2:** Preschool teachers  **G1:** Home  **G2:** Preschool | **G1:** NR  **G2:** NA | **G1:** Parents received 4 two-hour training sessions plus 3 hour home visits every 6 weeks for 12 months focusing on promoting joint attention and language skills; children also received standard preschool care as noted below (mean 5.2 periods in preschool/day, mean 70.9 ± 131.2 minutes of therapies in preschool/week)  **G2:** Specialized daycare or medical nursery for children with developmental issues; both provide individualized speech, motor, music, and play therapy with variable levels of parental support (mean 4.2 periods in preschool/day, mean 76.4 ± 112.8 minutes of therapies in preschool/week) | * No between group differences on language development after 12 months of intervention, though language skills within groups improved over time * No differences in CGI-Improvement scores (G1: 57% much improved, G2: 52% much improved) * No significant effects on parenting skills in either group; engagement, early social communication precursors, parental skills not found to be mediators of effects. DQ not a significant moderator |
| Reed et al. 2012[34](#_ENREF_34)  UK  **G1:** ABA, 14  **G2:** Special nursery, 21 **G3:** Portage, 18  **G4:** Local authority-developed parent training, 13  Quality: Fair | **G1:** 39.0 ± 6.9  **G2:** 41.5 ± 4.0  **G3:** 39.5 ± 6.3  **G4:** 40.2 ± 6.3  **G1:** 55.1 ± 17.3  **G2:** 52.2 ± 17.1  **G3:** 54.0 ± 15.4  **G4:** 51.7 ± 14.5 | **G1:** Board certified behavior analysts or Complete Application of Behavior Analysis to Schools-trained individuals, trained tutors  **G2:** Post-graduate special education teachers, learning support assistants  **G3:** Graduate level Portage supervisor  **G4:** Educational psychologist, trained teaching assistants  **G1:** Home  **G2:** Preschool  **G3:** Home  **G4:** Home | **G1:** Yes  **G2:** Yes  **G3:** Yes  **G4:** NR | **G1:** Mean 30.4 hours/week for 9 months, 1:1 discrete trial based intervention  **G2:** Mean 12.7 hours/week for 9 months, group-based intervention focused on social, motor, and other skills, some TEACCH elements  **G3:** Mean 8.5 hours/week for 9 months, 1:1 intervention  **G4:** Mean 12.6 hours/week for 9 months, 1:1 child training plus parent-delivered intervention | * Scores on cognitive and adaptive measures were not significantly different among groups * Scores on British Abilities Scale improved for G1 vs. G2-G4 (p<.05) * Composite change scores (mean of change scores on cognitive, adaptive, and educational measures) were not statistically significantly different across groups, although G1 vs. G2-G4 and G2 vs. G3-G4 approached significance (p<.06) * Composite change scores were inversely related to initial ASD severity for G2-G4 but positively related for G1; the strength of that relationship only differed significantly between G1 and G3 (p<.05) * As time in intervention increased, composite scores improved for G2-G4 but worsened for G1 (p<.05). No differences were found in the amount of improvement between G2-G4 |
| Reed et al. 2011[35](#_ENREF_35)  UK  **G1:** Barnet Early Autism Model (BEAM), 16/16  **G2:** Portage Treatment, 16/16  Quality: Poor | **G1:** 43.6 ± 5.8  **G2:** 40.1 ± 8.3  **G1:** 83.3 ± 23.7  **G2:** 72.3 ± 12.5 | **G1:** Trained facilitators, speech and occupational therapists, educational psychologist  **G2:** Trained Portage facilitators  **G1+G2:** Home | **G1:** Yes  **G2:** NR | **G1:** Mean 6.4±2.1 hours/week individualized therapy focused on social communication, emotion regulation, transactional support and including TEACCH, PECS, music and speech therapy, communication, sensory integration  **G2:** 8.5±6.8 hours/week delivered by parents and focused on communication, skill building based on Floortime model | * Significant gains from baseline to followup for G1 vs. G2 in investigator-and parent-rated measures of adaptive behavior and language (p values<.05) * Greater reduction in parental stress and increase in satisfaction in G1 vs. G2 (p values <.01) * Lower parent stress at baseline correlated with gains in adaptive behavior and language (p values <.05) |
| Wong et al., 2010[36](#_ENREF_36)  China  **G1**: Early intervention, 9/9 **G2**: Control, 8/8  Quality: Poor | **G1**: 25.33 ± 6 **G2**: 27.88 ± 5.57  **G1**: 17.85 ± 4.16  **G2**: 17.91 ± 4.49 | **G1**+**G2**: Trained interventionists  **G1**+**G2**: Clinic | **G1**: NR  **G2**: NR | **G1**: Ten 30-min sessions for 2 weeks with focus on communication, social interaction, parent stress  **G2**: Starting from Week 5 with the same 10-session intervention, with focus on communication, social interaction, parent stress | * No significant group difference on communication, reciprocal social interaction or symbolic play * No between group differences on parent observation on language and relationship to people * No group difference on the total parent stress scores |
| McConkey et al., 2010[37](#_ENREF_37)  UK  **G1**: Keyhole EIBI program, 36/35  **G2**: Control, 26/26  Quality: Poor | **G1**: 2.8 years **G2**:3.4 years  NR | **G1**+**G2**: Early intervention therapists  **G1**+**G2**: Home | **G1**: NR  **G2**: NR | **G1**:15–18 home visits over a nine-month period in 2 separate geographical areas, focus on child communication, parental stress  **G2**: 5 home visits (n=15) and no additional services or supports (n=11), focus on child communication, parent stress | * G1 showed significant improvements on different indices of communication than G2 * Mothers improved on measures of health G1 more than G2 but not of stress * higher percentage of parents in G2 reported the children were improving on language and imitation at Time 1 compared to G1 but the percentages were comparable at Time 2 * Only parents in G1 reported significant improvements from Time 1 to Time 2 on language, imitation and relating to others * Both groups improved on ratings of improvements in play * On all the Vineland measures, the standard deviations rose markedly at Time 2 for children in G1 but not for G2 |

ABA-applied behavior analysis; AEPS- assessment evaluation and programming system for infants and children; ADOS- autism diagnostic observation schedule; ASD- autism spectrum disorder; CARS-Childhood Autism Rating Scale; CI-confidence interval; DIR- Developmental, Individual Difference, Relationship-based (DIR®) Model; DTT- discrete trial training; DQ- developmental quotient; EEG- electroencephalogram; EIBI- early intensive behavioral intervention; ESDM- Early Start Denver Model; Z-group; IJA- initiation of joint attention; LEAP- learning experiences and alternate program for preschoolers and their parents; N-number; NR-not reported; SD- standard deviation; SEI- socially engaged imitation; SPA- shares positive affect; PECS- picture exchange communication system; PDD-NOS-Pervasive Developmental Disorder-Not Otherwise Specified; TEACCH- treatment and education of autistic and related communication-handicapped children

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