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Comparing cognitive outcomes among children with autism spectrum disorders receiving community-based early intervention in one of three placements

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Abstract

Little comparative research examines which community-based preschool intervention placements produce the best outcomes for which children with autism spectrum disorders (ASD). Autism-specific placements can provide intensive evidence-based care; however, inclusion settings provide interaction with typically developing peers, the importance of which is increasingly recognized. This study examined the association between early intervention (EI) placement in three settings (autism-only, mixed disabilities or inclusive) and cognitive outcomes upon entry into elementary school in an urban school district for 98 preschool-aged children with ASD. Initial child and demographic characteristics were similar among the three placements. Controlling for initial cognitive scores and other covariates, cognitive outcomes for children in inclusive placements were better than those of children in mixed disabilities settings. A consistent pattern emerged that suggested the particular importance of inclusive placements for children with initially greater social impairments, greater adaptive behavior impairments, and for those with at least a baseline level of language skills. Opportunities to interact with typically developing peers may be particularly beneficial for certain subgroups of young children with ASD. The results provide preliminary insight into important child characteristics to consider when parents and providers make preschool EI placement decisions.

Keywords

Autism spectrum disorders (ASD); early intervention; preschool; inclusion; community practices

Introduction

Despite the requirement of the Individuals with Disabilities Educational Act (PL-108-446) to provide free and appropriate public education for young children with autism spectrum disorders (ASD) in the least restrictive environment suitable for their needs, as well as the

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potential importance of experiences with typical peers for children with ASD, little research has investigated the relative benefits of various intervention environments for young children with autism spectrum disorders. Although consistent opportunities to interact with typically developing peers are often part of recommended practices for young children with ASD (e.g. Koegel et al., 2009; National Research Council, 2001; Strain et al., 1998; Tsai, 1998), most research to date has evaluated interventions implemented in more restrictive settings that do not routinely offer such opportunities for preschoolers with ASD (such as individual services provided in homes or clinics, or in classrooms consisting only children with ASD). For example, of the ten comprehensive early intervention programs for children with ASD identified by the National Research Council (2001) as having some empirical support, only two incorporated systematic, daily interactions with peers without disabilities. In a recent review of 30 comprehensive treatment models for children with ASD, only four were identified as inclusive (Odom et al., 2010). The studies of inclusive preschool programs for children with ASD suggest that preschoolers with ASD can make gains in cognitive, academic, language, functional and social skills when placed in settings with their typically developing peers (e.g. Schwartz et al., 2004; Strain and Bovey, 2011; for reviews see Ferraioli and Harris, 2011; Harrower and Dunlap, 2001; Odom et al., 2004). However, the internal validity and generalizability of many of these studies have been limited by their lack of control groups and small samples sizes. There is also debate as to the appropriateness of inclusive settings for children with ASD. Some researchers have argued that certain effective educational strategies for teaching children with ASD, such as specialized instructional techniques and environmental modifications, are not feasible in inclusion classrooms (Mesibov and Shea, 1996), and that children with ASD encounter peer rejection (Lowenthal, 1999; Odom et al., 2006). These mixed findings have led some to call for additional study of the importance of inclusion for young children with ASD (Rogers and Vismara, 2008).

Beyond the lack of consensus on the benefit of different preschool intervention settings, there is also little research on outcomes for young children with ASD treated by community providers. Although there have been a few studies investigating community-based early intervention services conducted in Europe (Eldevik et al., 2012; Fernell et al., 2011; Magiati et al., 2007, 2011) and Canada (Perry et al., 2008, 2011), to our knowledge to date there have not been any such studies in urban school districts in the United States. The small body of research in this area suggests that although preschoolers with ASD make gains in cognitive ability, adaptive behavior, and language, and experience reductions in autism severity when receiving intervention in the community, community practices often do not result in the large gains observed in research trials (Magiati et al., 2007; Perry et al., 2008; but see Eldevik et al., 2012).

There is even less work comparing the impact of the various settings in which interventions are delivered (Parsons et al., 2011). The few studies in this area have been largely inconclusive, finding no differences between children receiving home-based early intensive behavioral intervention and those receiving care in autism-specific preschools (Magiati et al., 2007), or among a 1) 1:1 home-based program, 2) “generalist special nursery placement for children with all types of learning difficulty” and 3) an autism-only special nursery placement (Reed et al., 2010).

Parents and professional teams often must decide between components of comprehensive EI programs recommended for children with ASD (Koegel et al., 2009), such as placements in which staff have specific training in evidence based practices for working with children with ASD (e.g. providers of Applied Behavior Analysis (ABA) in restricted settings), and placements in which structured interaction with typically developing peers are available (e.g. inclusion settings). However, there is a dearth of empirical information on which to base these decisions, particularly when trying use initial child characteristics to determine the most appropriate placement. Language, social-communication, adaptive behavior, IQ, object exploration, age, and autism severity have emerged as potential moderators of outcomes for preschool children with ASD in some studies of various treatment programs (e.g. Kasari et al., 2008; Gordon et al., 2011; Harris and Handelman, 2000; and Perry et al., 2011; Remington et al., 2007; and Yoder and Stone, 2006a, 2006b), however their interaction with preschool settings in predicting outcomes has not been examined.

The purpose of this study was to provide preliminary evidence as to the effectiveness of inclusive, mixed disabilities, and autism-only preschool early intervention placements in an urban community in the United States, as well as to investigate which placements were best for different subgroups of children with ASD.

Methods

Participants

Subjects were drawn from an intervention study for children with ASD in kindergarten-through-second-grade autism support classrooms in a predominately African American public school district in an urban east coast American city. Ninety-eight (19.9%) of the 492 enrolled children with ASD met the following inclusion criteria: a) had parental consent to review their educational records; b) had accessible records in the early intervention system; c) received three- to-five early intervention services primarily in a classroom setting c) participated in the research trial directly after transitioning out of the early intervention system; d) had complete cognitive assessment data available from their initial early intervention eligibility assessment (Time 1) and at the beginning of their first year of elementary school (Time 2); and e) had a community diagnosis of an autism spectrum disorder or met ASD criteria on the Autism Diagnostic Observation Schedule (ADOS; Lord et al., 1999) during the first year of the research trial.

Procedures

Preschool educational records, which included evaluation reports, individualized education plans (IEPs), notices of recommended educational placements and additional screening and diagnostic reports were reviewed, and child, family and intervention characteristics were coded by two independent coders blind to study outcomes. The Differential Abilities Scales, Second Edition (DAS; Elliot, 2007) was administered by trained psychologists and research assistants as part of the elementary school intervention trial.

Dependent variable of interest

Outcomes at entry into elementary school (Time 2) were measured using the Differential Abilities Scales, Second Edition (DAS; Elliot, 2007) administered by trained research staff who were blind to early intervention placement. The DAS is designed to assess cognitive abilities in children ages 2 years 6 months through 17 years 11 months across a broad range of developmental levels. Age normed standard scores ($mean = 100$, $SD = 15$) of General Conceptual Ability (GCA) were used for analysis.

Independent variables of interest

Early intervention placement was the primary independent variable of interest. Placement was determined based on the decisions of service coordination teams, provider availability and parent preference. It was coded based on the most recent intervention information available in the child's file. If information from the year before the child transitioned to elementary school was not available, it was assumed that the service provider did not change. Changes in preschool intervention placement noted in the child's file were coded dichotomously (yes/no). Based on information reported in the files and provided by the director of the three to five early intervention system as to the nature and type of settings served by specific providers, participants were classified as receiving one of three types of placement: inclusive, mixed disabilities, and autism-only.

1) Inclusive.—The child received intervention services in center-based programs run by a special education teacher for typically developing children that includes children with ASD (reverse mainstream), Head Start preschools or in community-based typical preschool or daycare settings. Opportunities for interactions with typical peers were noted on the IEP. According to program administrators, reverse mainstream and Head Start classrooms used the High/Scope (Hohmann et al., 2008) curriculum. Children typically attended for three hours a day, three days a week, but could attend up six hours a day or five days a week. All lead teachers were certified or had degrees in Early Childhood Education or Special Education; some had Master's degrees. Associate teachers had associate's degrees. Reported student-teacher ratios ranged from six-to-one (six teachers and up to 18 kids) to ten-to-one (with at least two teachers per classroom). For the children in our sample, speech therapy provided at the programs ranged from thirty minutes per month to one hour per week. Children received up to an hour-and-a-half a week of occupational therapy and up to a half-an-hour week of physical therapy. Some children received up to two hours of special instruction a week in their typical preschool or daycare.

2) Mixed disabilities (MD).—The child received intervention services at a center-based preschool in a setting that included children with developmental or other disabilities that qualified them for preschool early intervention services. According to program administrators, the mixed disabilities classrooms used the Creative Curriculum[®] (Trister Dodge et al., 2002) based on Early Learning Standards. Children commonly attended mixed disabilities programs between two and three hours a day for three days a week, but the number of days per week varied between two and five. The reported student-staff ratio in all mixed disabilities programs was at least eleven to two. Some programs required lead teachers to have a bachelor's degree in Special Education or Early Childhood Special

Education; others required certification in Early Childhood Education or Special Education or Certificate of Competency. Children in our sample received between 30 minutes and one hour of speech therapy a week at their mixed disabilities program. They also received up to an hour a week of occupational therapy and up to a half-an-hour a week of physical therapy.

3) Autism-only.—The child received services in a center-based autism support preschool program. There were three programs that had autism-support classrooms. According to program administrators, two programs used the Creative Curriculum® (Trister Dodge et al., 2002) paired with applied behavior analysis (ABA) instructional and behavior management strategies. In one of these programs, some students were pulled out of the classroom and received one-to-one ABA for half of the program day. The third program reported that they incorporated a variety of treatment methods including ABA, T.E.A.C.C.H., DIR/Floortime, visual supports, sensory integration, and creative art therapies. Children in one of these classrooms commonly attended for five hours a day, five days a week. The reported student-to-staff ratio ranged from two-to-one to five-to-one. At their autism-only program children received up to two hours a week of speech therapy, up to an hour a week of occupational therapy, and up to a half an hour a week of physical therapy.

Baseline measures of children's abilities.

The Developmental Assessment for Young Children (DAYC; Voress and Maddox, 1998) was administered at Time 1 by a multi-disciplinary evaluation team as part of standard community practice to determine eligibility for early intervention services. The DAYC is designed for use with children from birth through age 5 years, 11 months. It measures a child's abilities in five developmental areas (cognition, communication, social-emotional development, physical development and adaptive behavior) through direct item administration, observation, and parent interview. Each of these assessment areas comprises a subtest with a standard score ($mean = 100$, $SD = 15$). The DAYC was normed on a geographically diverse sample of 1,269 children from the United States and Canada. The DAYC has adequate reliability and validity. Each of the subtests had excellent internal consistency (Cronbach's α .95) and test-retest reliability (r .94). Construct validity was documented by significant correlations between the DAYC subsets at the total score of the Battelle Developmental Inventory: Screening Test (Newborg et al., 1988) (r .47, $p < .05$).

The primary DAYC subtests of interest were the cognitive, communication, social-emotional, and adaptive behavior subtests. The cognitive subtest consists of 78 items that measure conceptual skills and abilities such as attention, memory, planning, decision making and visual discrimination. Sample items from this subtest include: "matches objects by color shape and size" (Item 34), "counts up to 5 objects" (Item 39) and "identifies 'first,' 'last,' and 'middle'" (Item 51). The communication subtest consists of 78 items that measure expressive and receptive language and verbal and nonverbal communication. Sample items from this subtest include: "briefly stops activity when told 'no'" (Item 15), "uses at least 5 words" (Item 30) and "carries out 2-step unrelated commands" (Item 44). The social-emotional subtest consists of 58 items that measure a child's social awareness, relationships, social competence and expression of emotions. Sample items include: "plays well for brief time in groups of two or three children" (Item 26), "separates from parent in familiar

surroundings without crying” and “talks about own feelings” (Item 42). The adaptive behavior subtest consists of 62 items that measure a child’s independent functioning and self-help skills. Sample items from this subtest include: “washes and dries face without assistance” (Item 33) and “uses all eating utensils” (Item 41).

Cognitive ability was measured at Time 1 using the cognitive subtest from the DAYC. While it is less than ideal to use different cognitive measures at different time points (such as the DAYC at Time 1 and the DAS at Time 2), this practice is relatively common when clinical research is conducted with children with ASD (see Perry et al., 2008) and there is some precedent for utilizing both the DAS and DAYC as measures of cognitive skills in children with ASD (see Howard et al., 2005).

Additional covariates of interest.

Children’s socio-demographic characteristics included sex, ethnicity and household composition. Ethnicity was coded into five categories (i.e., Asian-Pacific Islander, Black-non-Hispanic, Hispanic, White-non-Hispanic, and other/unknown). The number of parents or guardians in the child’s household at baseline (i.e. two parent/guardian household, one parent/guardian, or unclear/other) was also coded based on the early intervention records. In addition, we coded for whether children participated in birth to three early intervention programs prior to entering the three-to-five early intervention system. In the school district of interest, children can transition to kindergarten if they turn five years old before the start of classes in September. Parents also can elect to have their child attend preschool for another year before transitioning to elementary school. We therefore coded for whether children transitioned to elementary school in kindergarten or waited until first grade. Also, as previously mentioned, whether children changed settings during the course of three-to-five early intervention was coded. Since children sometimes changed settings multiple times throughout their course of early intervention there were more than 18 possible placement combinations (e.g. 1) ASD-only; 2) ASD-only, then MD; 3) first ASD-only, then MD, then inclusion; 4) first ASD-only, then MD, then ASD-only). The small sample size precluded coding and investigating these changes more specifically. The Autism Diagnostic Observation Schedule (ADOS; Lord et al., 1999), the “gold standard” semi-structured observational assessment measure that uses a variety of social presses to assess symptoms of ASD, was administered at Time 2 by trained research staff in order to characterize the sample.

Analysis

Preliminary analyses included bivariate inspection of the data for undue influence. Analyses of variance (ANOVA) and chi-square analyses were used to test for differences among the three placement groups on all variables at Time 1. Linear regression was used to test for associations between each variable of interest and cognition at Time 2. Because of concerns regarding statistical power, only covariates that were associated with the outcome variable at $p < .20$ were included in the final models. All continuous variables included as covariates were grand-mean centered to facilitate intercept interpretability. The final model used linear regression to compare cognitive outcomes among EI placements. We also tested interactions between EI placement and the baseline communication, social-emotional and adaptive

behavior DAYC subtests to determine whether some settings resulted in better outcomes for subgroups of children. To facilitate the interpretability of the findings, these interaction analyses were conducted using dichotomized variables. DAYC communication scores were dichotomized based on receiving a floor score (standard score < 50, the lowest possible standard score on the DAYC) as compared to not (standard score ≥ 50), which approximated a median split. DAYC social-emotional and adaptive behavior subtest scores were dichotomized based on a median split.

For each of the primary analyses Hedges' g and its 95% confidence interval were calculated as a measures of effect size and precision, based on the adjusted mean difference, t value and sample size using Comprehensive Meta-analysis Version 2 (Borenstein et al., 2005).

Hedges' g is a variation of Cohen's d (Cohen, 1988), correcting for potential bias due to small sample sizes (Hedges & Olkin, 1985). According to Cohen's effect size conventions (Cohen, 1992), the magnitude of Hedges' g can be expressed as small (.20), medium (.50), and large (.80).

Results

Participants

Children in the sample were on average 38.1 months old ($SD = 7.0$) when they were assessed for eligibility for three to five early intervention services and received intervention for an average of 2.1 years ($SD = 0.6$). Of the 98 participants (79 male), 37 received three-to-five year old early intervention in autism-only settings, 25 were in mixed disabilities settings and 36 were in inclusive settings. Consistent with the urban public school district in which this study was conducted, 52 children identified as Black-non-Hispanic, 16 as White-non-Hispanic, 12 as Hispanic, 11 as other or were missing this information, and seven as Asian-Pacific Islander. A measure of autism severity was unavailable at Time 1, at Time 2 average ADOS calibrated severity scores (Gotham et al., 2009) fell in the autism range ($mean = 6.4$, $SD = 1.8$). Participant characteristics are reported in Table 1.

As seen in Table 1, the sex of the participants, type of household they lived in, whether they participated in the birth-to-three early intervention system and the average number of years they received intervention as part of the three-to-five early intervention system did not statistically significantly differ among the three EI placement groups ($p = .10$). The number of participants that had remained in preschool for an extra year instead of transitioning to kindergarten also did not statistically significantly differ among the three groups ($p = .07$). The children in three EI placement groups did not have statistically significant differences in their average baseline DAYC cognitive ($p = .98$), social-emotional ($p = .51$) or adaptive behavior standard scores ($p = .18$), nor did they differ in the number that fell above or below the median on their social-emotional, adaptive behavior, and communication scores ($p = .07$). The three EI placement groups did differ, however, in the ethnicity ($p = .04$), age ($p = .02$) and DAYC communication standard scores ($p = .04$) of the participants at Time 1. The number children who changed EI placement settings also differed among the three groups ($p = .05$).

Main effects of early intervention placement

As presented in Table 2, children who attended inclusive preschool placements had significantly higher Time 2 DAS GCA scores than those in mixed disability placements ($p = .02$, $g = 0.63$, $CI = 0.12 - 1.15$), controlling for ethnicity and Time 1 DAYC cognitive, social-emotional, adaptive behavior and communication scores (i.e. the covariates whose unadjusted association with the outcome had a p -value $< .20$). Children in inclusive placements made on average an 11.3 point greater cognitive gain than children in mixed disability placements. Children in inclusive settings also made on average an 6.5 point greater cognitive gain than children in autism-only placements; this difference was not statistically significant ($p = .17$, $g = .35$, $CI = -0.15 - 0.86$). Time 2 cognitive scores of children in autism-only placements and mixed disabilities placements did not significantly differ ($p = .23$, $g = .28$, $CI = -0.18 - 0.74$). Time 1 cognitive scores were also a statistically significant predictor of outcomes ($p = .04$).

Moderators of Intervention Placement Effects

Early intervention placement and social-emotional ability.—As presented in Figure 1, among children with low social-emotional scores at Time 1, children who attended inclusive placements had higher Time 2 DAS GCA scores than those in autism-only ($p = .03$, $g = 0.79$, $CI = 0.06 - 1.52$) or mixed disabilities ($p < .05$, $g = 0.74$, $0.00 < CI < 1.49$) placements, controlling for ethnicity and for Time 1 DAYC cognitive, adaptive behavior and communication scores. In the low Time 1 social-emotional subgroup, children who attended inclusive placements had on average 13.9 point and 13.4 point higher scores on the DAS GCA at Time 2 than children in autism-specific and mixed disability placements, respectively. Time 2 DAS GCA scores for autism-only and mixed disabilities placements did not significantly differ from one another in the low social-emotional subgroup ($p = .93$, $g = 0.03$, $CI = -0.61 - 0.67$). Among children with high social-emotional scores at Time 1, Time 2 DAS GCA scores did not significantly differ among the three placements ($p > .07$, $g < 0.58$, $-1.22 < CI < 0.75$).

Early intervention placement and communication ability.—As presented in Figure 2, among children with higher communication scores at baseline, those who attended an inclusive early intervention placement had significantly higher Time 2 DAS GCA scores than those who attended a mixed disabilities EI placement ($p = .02$, $g = 0.82$, $CI = 0.12 - 1.51$), controlling for ethnicity and for Time 1 DAYC cognitive, social-emotional and adaptive behavior scores. Children who attended inclusive settings had on average a 16.4 point higher Time 2 DAS GCA scores than those in the mixed disability placements. The cognitive outcomes of children in this subgroup who attended autism-only placements did not significantly differ from those that attended the other settings ($p > 0.15$, $g < 0.47$, $-1.10 < CI < 0.31$). Among children who floored on the DAYC communication subtest at Time 1, Time 2 DAS GCA scores did not significantly differ among the three placements ($p > .26$, $g < 0.45$, $-1.24 < CI < 0.70$).

Early intervention placement and adaptive behavior.—As presented in Figure 3, for children with low adaptive behavior scores at Time 1, children in inclusive placements

had significantly higher Time 2 DAS GCA scores than those in mixed disabilities placements controlling for ethnicity and for Time 1 DAYC cognitive, social-emotional and communication scores ($p < .01$, $g = 1.22$, $CI = 0.39 - 2.05$). In this subgroup, children in an inclusive placement had 21.6 point higher scores than children in the MD placements and 10.3 point higher scores than children in the autism-only placements. The differences outcomes for in the autism-only as compared to the other placements were not statistically significant ($p > .09$, $g < 0.58$, $-1.35 < CI < 0.11$). Among children with higher adaptive behavior scores at Time 1, Time 2 DAS GCA scores did not significantly differ among the three placements ($p > .50$, $g < 0.23$, $-0.91 < CI < 0.58$).

Discussion

In this study, children with ASD in any of three different early intervention settings – inclusion, mixed disabilities and autism-only – did not differ significantly on the majority of baseline child and family characteristics. Children in inclusive settings, however, experienced greater average gains in cognitive scores than some children who attended placements without typically developing peers. The relative benefit of inclusive preschool placement over mixed disabilities placements on cognitive outcomes was particularly apparent among children with more severe social impairments, with lower adaptive behavior skills, and with at least some expressive or receptive communication, as indicated by medium-to-large and large effect sizes. Among children with more severe social impairments, inclusive preschool placements also had a relative benefit over autism-only settings, as indicated by a medium-to-large effect size. Consistent with most previous research (Ben-Itzhak and Zachor, 2007; Harris and Handleman, 2000; Perry et al., 2011), children's initial cognitive scores were a strong predictor of later outcomes.

This study is unique in its investigation of outcomes in elementary school of children with ASD having received three-to-five early intervention from community providers in an urban American school district. However, some study limitations are important to consider. First, the conclusions are limited by the use of one cognitive measure at Time 1 (the DAYC) and another at Time 2 (the DAS). It would be more consistent to use the same measure at both time points. It is likely, however, that the use of two different measures increases the error variance, attenuating observed results and biasing findings to the null. Second, because subjects were sampled from autism support classrooms, it is possible that the sample does not include the highest achievers in early intervention, who are more likely to be mainstreamed in elementary school. Most of the children with autism spectrum disorders in this school district, however, receive their elementary education in autism support classrooms. Perhaps more importantly, children who end up in general education classrooms are probably more likely to have come from inclusion settings, thereby again biasing the results in the opposite direction as what was found. The third study limitation is the use of retrospective chart data. Unlike in randomized trials that control for potential threats to internal validity arising from history, maturation, and selection effects, in this study it is possible that unmeasured variables contribute to both placement decisions and cognitive outcomes. For example, baseline characteristics that were not measured directly, such as autism severity, may have played a role in placement decisions. Information unavailable in the children's records, such as teacher experience, student-teacher ratios, hours of all

behavioral intervention received including interventions not coordinated by the early intervention system, receipt of medical interventions, and children having attended multiple placement settings may have impacted cognitive outcomes. In addition, the inability to measure the specific curricula and other practices used in these programs and assess the fidelity of their implementation limits our understanding of the specific mechanisms responsible for the observed outcomes. The use of a quasi-experimental design precludes us from drawing strong inferences about causality, and a randomized control trial is required to conclusively establish the relative benefits of inclusive preschool programs on cognitive outcomes for children with ASD, and the relative benefits of these programs for children of different abilities. However the minimal differences between the groups at baseline, the statistical controls included in all analyses, and the magnitude of the effect sizes serve to increase confidence in the robustness of these findings and the potential importance of inclusive programming for children with ASD.

Despite these limitations there are important research and policy implications of these findings. The observed relative benefit of the inclusive placement for some children with ASD suggests that the increased opportunities to interact with and learn from typically developing peers may be particularly important for the cognitive outcomes of some children with ASD. Peer modeling through integrated play groups has been demonstrated to improve imitation skills, social behaviors and nonsocial engagement (Garfinkle and Schwartz, 2002), as well as play skills and communication (Smith et al., 2002; Zercher et al., 2001) for children with ASD. Mixed disabilities placement may be particularly inadequate for some children with ASD because it provides the fewest opportunities either to interact with typically developing peers (as in the inclusive placements) or receive autism specific intervention (presumably available in the autism-only placements). Differences among the placements in the use of evidence-based practices, the experience and training of teachers and the quality of the classrooms are all other possible factors that may have affected outcomes and are worthy of future study.

The findings regarding the interaction of clinical profile and setting are intriguing. To obtain the benefits associated with inclusion, children may require some baseline language skills. This skill may be a necessary building block to engaging in and learning from interactions with the typically developing peers present in these settings. Inclusion settings also may be particularly beneficial for children with low social-emotional and adaptive behavior skills by enabling interactions with peer models who utilize more sophisticated social, emotional, and adaptive strategies.

While we believe these findings to be robust and provocative, the retrospective nature of the study warrants cautious interpretation of the findings. Prospective research, including careful measurement of potential active intervention ingredients and randomized allocation to treatment groups, is critically needed to determine which mix of peer interaction and autism specific programming will maximize outcomes for which children in community settings.

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References

- Ben-Itzhak E and Zachor DA (2007) The effects of intellectual functioning and autism severity on outcome of early behavioral intervention for children with autism. *Research in Developmental Disabilities* 28(3): 287–303. [PubMed: 16730944]
- Borenstein M, Hedges L, Higgins J and Rothstein H (2005) *Comprehensive Meta-analysis Version 2*. Englewood, NJ: Biostat.
- Cohen J (1992) A power primer. *Quantitative Methods in Psychology* 112(1): 155–159.
- Cohen J (1988) *Statistical Power Analysis for the Behavioral Sciences* (Second Edition). Hillsdale, NJ: Erlbaum.
- Eldevik S, Hastings R, Jahr E and Hughes J (2012) Outcomes of behavioral intervention for children with autism in mainstream pre-school settings. *Journal of Autism and Developmental Disorders* 42(2): 210–220. [PubMed: 21472360]
- Elliott CD (2007) *Differential Abilities Scales-Second Edition*. San Antonio, TX: Harcourt Assessment, Inc.
- Fernell E, Hedvall Å, Westerlund J, et al. (2011) Early intervention in 208 Swedish preschoolers with autism spectrum disorder. A prospective naturalistic study. *Research in Developmental Disabilities* 32(6): 2092–2101. [PubMed: 21985993]
- Ferraioli SJ and Harris SL (2011) Effective educational inclusion of students on the autism spectrum. *Journal of Contemporary Psychotherapy* 41(1): 19–28.
- Garfinkle AN and Schwartz IS (2002) Peer imitation: Increasing social interactions in children with autism and other developmental disabilities in inclusive preschool classrooms. *Topics in Early Childhood Special Education* 22(1): 26–38.
- Gordon K, Pasco G, McElduff F et al. (2011) A communication-based intervention for nonverbal children with autism: What changes? Who benefits? *Journal of Consulting and Clinical Psychology* 79(4): 447–457. [PubMed: 21787048]
- Gotham K, Pickles A and Lord C (2009) Standardizing ADOS scores for a measure of severity in autism spectrum disorders. *Journal of Autism and Developmental Disorders* 39(5): 693–705. [PubMed: 19082876]
- Harris SL and Handleman JS (2000) Age and IQ at intake as predictors of placement for young children with autism: A four- to six-year follow-up. *Journal of Autism and Developmental Disorders* 30(20): 137–142. [PubMed: 10832778]
- Harrower JK and Dunlap G (2001) Including children with autism in general education classrooms: A review of effective strategies. *Behavior Modification* 25(5): 762–784. [PubMed: 11573339]
- Hedges LV and Olkin I (1985) *Statistical methods for meta-analysis*. New York, NY: Academic Press.
- Hohmann M, Weikart D P and Epstein AS (2008) *Educating young children: The complete guide to the High/Scope Preschool Curriculum*. Ypsilanti, MI: High/Scope Press.
- Howard JS, Sparkman CR, Cohen HG, et al. (2005). A comparison of intensive behavior analytic and eclectic treatments for young children with autism. *Research in Developmental Disabilities* 26(4): 359–83. [PubMed: 15766629]
- Kasari C, Paparella T, Freeman S and Jahromi LB (2008) Language outcome in autism: Randomized comparison of joint attention and play interventions. *Journal of Consulting and Clinical Psychology* 76(1): 125–137. [PubMed: 18229990]
- Koegel LK, Robinson S and Koegel RL (2009) Empirically supported intervention practices for autism spectrum disorders in school and community settings: Issues and practices In: Sailor W, Dunlap G,

- Sugai G, Horner R and Roberts MC (eds) Handbook of Positive Behavior Support (pp. 149–176). New York: Springer.
- Lord C, Rutter M, DiLavore PC and Risi S (1999) Autism Diagnostic Observation Schedule. Los Angeles, CA: Western Psychological Services.
- Lowenthal B (1999) Early childhood inclusion in the United States. *Early Child Development and Care* 150(1): 17–32.
- Magiati I, Charman T and Howlin P (2007) A two-year prospective follow-up study of community-based early intensive behavioural intervention and specialist nursery provision for children with autism spectrum disorders. *Journal of Child Psychology and Psychiatry* 48(8): 803–812. [PubMed: 17683452]
- Magiati I, Moss J, Charman T and Howlin P (2011) Patterns of change in children with autism spectrum Disorders who received community based comprehensive interventions in their pre-school years: A seven year follow-up study. *Research in Autism Spectrum Disorders* 5(3): 1016–1027.
- Mesibov GB and Shea V (1996) Full inclusion and students with autism. *Journal of Autism and Developmental Disorders* 26(3): 337–346. [PubMed: 8792264]
- National Research Council (2001) Educating Children with Autism Lord C and McGee JP (eds) Washington DC: National Academy Press, Division of Behavioral and Social Sciences and Education.
- Newborg J, Stock JR and Wnek L (1988) Manual for the Battelle Developmental Inventory Boston: Houghton Mifflin.
- Odom SL, Boyd BA, Hall LJ and Hume K (2010) Evaluation of comprehensive treatment models for individuals with autism spectrum disorders. *Journal of Autism and Developmental Disorders* 40(4): 425–436. [PubMed: 19633939]
- Odom SL, Vitztum J, Wolery R, et al. (2004) Preschool inclusion in the United States: A review of research from an ecological systems perspective. *Journal of Research in Special Educational Needs* 4(1): 17–49.
- Odom SL, Zercher C, Li S, et al. (2006) Social acceptance and rejection of preschool children with disabilities: A mixed-method analysis. *Journal of Educational Psychology* 98(4): 807–823.
- Parsons S, Guldberg K, MacLeod A, et al. (2011) International review of the evidence on best practice in educational provision for children on the autism spectrum. *European Journal of Special Needs Education* 26(1): 47–63.
- Perry A, Cummings A, Geier JD, et al. (2008) Effectiveness of intensive behavioral intervention in a large, community-based program. *Research in Autism Spectrum Disorders* 2(4): 621–642.
- Perry A, Cummings A, Geier JD, et al. (2011) Predictors of outcome for children receiving intensive behavioral intervention in a large, community-based program. *Research in Autism Spectrum Disorders* 5(1): 592–603.
- Reed P, Osborne LA and Corness M (2007) The real-world effectiveness of early teaching interventions for children with autism spectrum disorder. *Exceptional Children* 73(4): 417–433.
- Remington B, Hastings RP, Kovshoff H, et al. (2007) Early intensive behavioral intervention: outcomes for children with autism and their parents after two years. *American Journal on Mental Retardation* 112(6): 418–438. [PubMed: 17963434]
- Rogers SJ and Vismara LA (2008) Evidence-based comprehensive treatments for early autism. *Journal of Clinical Child & Adolescent Psychology* 37(1): 8–38. [PubMed: 18444052]
- Schwartz IS, Sandall SR, McBride BJ and Boulware G-L (2004) Project DATA (Developmentally Appropriate Treatment for Autism): An inclusive school-based approach to educating young children with autism. *Topics in Early Childhood Special Education* 24(3): 156–168.
- Smith T, Lovaas NW and Lovaas OI (2002) Behaviors of children with high-functioning autism when paired with typically developing versus delayed peers: A preliminary study. *Behavioral Interventions* 17(3): 129–143.
- Strain PS and Bovey EH (2011) Randomized, controlled trial of the LEAP model of early intervention from young children with autism spectrum disorders. *Topics in Early Childhood Special Education* 31(3): 133–154.

- Strain PS, Wolery W and Izeman (1998) Considerations for administrator in the design of service options for young children with autism and their families. *Young Exceptional Children* 1(2): 8–16.
- Trister Dodge D, Colker LJ and Heroman C (2002) *The Creative Curriculum for Preschool- Fourth Edition*. Bethesda, MD: Teaching Strategies Inc.
- Tsai LY (1998) Pervasive developmental disorders briefing paper. Washington, DC: NICHCY.
- Voress J and Maddox T (1996) *Developmental Assessment of Young Children (DAYC)*. Austin, TX: PRO-ED.
- Yoder P and Stone WL (2006a) A randomized comparison of the effect of two prelinguistic communication interventions on the acquisition of spoken communication in preschoolers with ASD. *Journal of Speech, Language and Hearing Research* 49(3): 698–711.
- Yoder P and Stone WL (2006b) Randomized comparison of two communication interventions for preschoolers with autism spectrum disorders. *Journal of Consulting and Clinical Psychology* 74(3): 426–435. [PubMed: 16822100]
- Zercher C, Hunt P, Schuler A and Webster J (2001) Increasing joint attention, play, and language through peer supported play. *Autism* 5(4): 374–398. [PubMed: 11777255]

Figure 1.
Time 2 adjusted cognitive scores regressed onto early intervention placement and Time 1 social-emotional level.
Adjusted for Time 1 DAYC cognitive, communication and adaptive behavior standard scores and for ethnicity.
* = $p < .05$; Low social-emotional: Standard score < 70 ; High social-emotional: Standard score ≥ 70 ; MD: Mixed disabilities; DAYC: Developmental Assessment of Young Children.

Figure 2.

Time 2 adjusted cognitive scores regressed onto early intervention placement and Time 1 communication level.

Adjusted for Time 1 DAYC cognitive, adaptive behavior and social-emotional standard scores and for ethnicity.

* = $p < .05$; Floor Communication: Standard score < 50 ; Not floor Communication: Standard score ≥ 50 ; MD: Mixed disabilities; DAYC: Developmental Assessment of Young Children.

Figure 3.

Time 2 adjusted cognitive scores regressed onto early intervention placement and Time 1 adaptive behavior level. Adjusted for Time 1 DAYC cognitive, communication and social-emotional standard scores and for ethnicity.

* = $p < .05$; Low Adaptive Behavior: Standard score < 76 ; High Adaptive Behavior: Standard score ≥ 76 ; MD: Mixed disabilities; DAYC: Developmental Assessment of Young Children.

Table 1.

Participant characteristics by early intervention placement.

		Autism-only (<i>n</i> = 37)	MD (<i>n</i> = 36)	Inclusive (<i>n</i> = 25)	
		<i>n</i> (%)/ Mean (<i>SD</i>)	<i>n</i> (%)/ Mean (<i>SD</i>)	<i>n</i> (%)/ Mean (<i>SD</i>)	<i>p</i>
Gender	Male	31.0 (83.8)	31.0 (86.1)	17.0 (68.0)	.18
Ethnicity	Black	18.0 (48.6)	23.0 (63.9)	11.0 (44.0)	.04 *
	White	4.0 (10.8)	5.0 (13.9)	7.0 (28.0)	
	Hispanic	5.0 (13.5)	6.0 (16.7)	1.0 (4.0)	
	Asian/Pacific Islander	2.0 (5.4)	1.0 (2.8)	4.0 (16.0)	
	Other/unknown	8.0 (21.6)	1.0 (2.8)	2.0 (8.0)	
Household	1 parent	7.0 (18.9)	11.0 (30.6)	4.0 (16.0)	.36
	2 parent	24.0 (64.9)	17.0 (47.2)	18.0 (72.0)	
	Other/unknown	6.0 (16.2)	8.0 (22.2)	3.0 (12.0)	
Birth to three EI		28.0 (75.7)	24.0 (66.7)	16.0 (64.0)	.56
Time 1 age (months)		35.7 (4.3)	38.7 (7.9)	40.7 (7.9)	.02 *
Time 1 DAYC					
Cognitive SS		64.7 (8.6)	65.3 (9.3)	64.6 (9.5)	.98
Social-emotional SS		65.0 (10.5)	67.2 (9.4)	67.9 (11.9)	.51
Median split low: SS < 70		19.0 (51.4)	17.0 (47.2)	12.0 (48.0)	.93
Adaptive behavior SS		73.4 (6.1)	77.1 (10.2)	76.4 (11.1)	.18
Median split low: SS < 76		22.0 (59.5)	12.0 (33.3)	13.0 (52.0)	.07
Communication SS		52.7 (6.4)	55.0 (8.6)	58.1 (9.8)	.04 *
Split at floor: SS < 50		17.0 (45.9)	19.0 (52.8)	9.0 (36.0)	.43
Length of time in EI (years)		2.3 (0.6)	2.1 (0.7)	1.9 (0.6)	.11
Change EI placement		17.0 (45.9)	7.0 (19.4)	9.0 (36.0)	.05
Extra year of preschool		4.0 (10.8)	0.0 (0.0)	4.0 (16.0)	.06
Time 2 age (months)		67.3 (5.6)	67.0 (5.7)	67.4 (5.8)	.96
Time 2 cognitive SS (DAS)		57.1 (19.4)	54.4 (16.7)	66.0 (21.0)	.06
Time 2 ADOS severity score		6.8 (1.6)	6.5 (1.6)	5.8 (2.3)	.12

* $p < .05$.

ADOS: Autism Diagnostic Observation Schedule; MD: Mixed disabilities; EI: Early intervention; DAYC: Developmental Assessment of Young Children; SS: Standard score; DAS: Differential Abilities Scales.

Table 2.

Unadjusted and adjusted models of Time 2 cognitive scores.

		Time 2			
		Unadjusted coefficient	<i>p</i>	Adjusted coefficient	<i>p</i>
EI Placement	Reference group: Inclusive		.06		
	Mixed disabilities	-11.5		-11.3	.02 *
	Autism-only	-8.9		-6.5	.17
Gender	Female vs. Male	5.5	.26	-	-
Ethnicity	Reference group: Black		.04 *		
	White	14.9		11.1	.04 *
	Hispanic	7.1		11.2	.05
	Asian/ Pacific Islander	-6.7		-7.2	.31
	Other/ unknown	1.0		5.8	.32
Household	Reference group: 2 parent		.27		
	1 parent	7.1		-	-
	Other/unknown	-1.6		-	-
Birth to 3 EI vs. no Birth to 3 EI		1.5	.74	-	-
Time 1 age (months)		3.2	.41	-	-
Time 1 cognitive standard score		0.9	<.01 *	0.5	.04 *
Time 1 social-emotional standard score		0.6	<.01 *	0.2	.44
Time 1 adaptive behavior standard score		0.4	<.01 *	0.3	.27
Time 1 communication standard score		1.0	<.01 *	0.4	.20
Change EI placement vs. no change		-2.7	.52	-	-
Length of time in EI (years)		-0.8	.79	-	-
Extra year of preschool vs. no extra year		-4.5	.50	-	-

* $p < .05$. EI: Early Intervention.