Introduction

Nature of the research problem. Autism is characterized by deficits in social interaction and communication, as well as repetitive behaviors and circumscribed interests (American Psychiatric Association, 2000). The stress and burden experienced by families of children with ASD is substantial, and is estimated to exceed levels experienced by families of children with other disabilities (e.g., Baker-Ericzen, Brookman-Frazee, & Stahmer, 2005; Bouma & Schweitzer, 1990; Davis & Carter, 2008; Hoppes & Harris, 1990). The challenge of meeting the clinical needs of this population is considered a significant public health issue (Mandell et al., 2006). Due to improved public awareness of the early signs of ASD, there is an increasing demand for Part C Early Intervention services for toddlers at high risk for ASD (Feinberg & Vacca, 2007). The importance of intervention for toddlers with ASD is considerable, given the role that early experience plays in the establishment of early neuronal networks and of appropriate connectivity (Johnson, Grossmann, & Kadosh, 2009). At present, however, there is a lack of empirically-based information to guide intervention decision-making for minority and underserved toddlers with ASD. Most early intervention for young children with ASD is provided in the home or child care setting using a transdisciplinary model. In addition, curricula are rarely used to guide selection of treatment targets for children. Oftentimes, intervention is completely child-focused without systematic training of the caregivers in the use of development-enhancing strategies. This state of the service delivery system of care and state of the science contributes to disparity in quality and availability of services for young children with ASD.

Purpose, scope, and methods of the investigation. Our aims were to examine issues pertaining to (1) the impact of specially designed intervention content and instructional strategies on social, communication and cognitive functioning in underserved populations. Through examining these issues, we gathered preliminary data that will inform a future study focused on service delivery models for toddlers with ASD. (2) We also examined predictors of positive outcomes for toddlers with ASD.

To address Aim 1, we developed a new parent-mediated intervention curriculum and manual that paralleled the center-based interpersonal synchrony curriculum developed through NIH STAART funding. In the present study, change in children's cognitive, communication, and social functioning were assessed at pre- and post-intervention. Comparisons were made between and within groups. Children were randomized to one of two active intervention conditions. In both conditions, the new 'Parent-Mediated Early Achievements' manualized program was implemented with parents, training them to use child-responsive strategies paired with developmentally-based principles of applied behavior analysis. The two conditions were distinguished in two major ways. In the 'Home-Based' (HB) condition, children received direct intervention from an interventionist in a 1:1 context for about 45 minutes per week. During this time, the instructional strategies and intervention content was described by the interventionist while modeling those strategies and describing and interpreting the child's behavioral responses. In the contrasting 'Center-Based' (CB) condition, children also attended the Early Achievements classroom-based therapeutic nursery school program with five age-peers having ASD; intervention was provided by a special educator and two assistants.

To examine questions associated with Aim 2, we used pre-treatment child measures of autism symptomatology, cognitive functioning, and communicative behavior as well as a measure of parent stress to predict whether children made clinically significant gains in at least two developmental domains.

Nature of the findings. We found that toddlers with ASD improved with early intervention that strategically targeted core deficits of ASD, regardless of whether they were enrolled in the Home-Based or Classroom-based condition. However, children in the Classroom-Based intervention showed more comprehensive gain than those in the Home-Based intervention.

Review of the Literature

Although autism is a neurobiological disorder, behavioral and educational interventions are currently the primary treatments for children with this disorder (United States Surgeon General, 1999). Interventions are most efficacious when they begin early and are provided on an intensive basis (Filipek, Accardo, Baranek, Cook, Dawson, & Gordon, 1999; Handleman & Harris, 2001). Studies on early intervention, which mostly include children age 3 years and older, have yielded impressive outcomes, particularly in the area of cognitive

skills. Average IQ gains of approximately 20 points have been reported in children with autism who receive intensive intervention (see review by Rogers & Vismara, 2008). Likewise, the core deficits of ASD involving joint attention, play, language, and affect sharing can also be ameliorated in many children through early intervention that specifically targets such deficits (Kasari, Freeman, & Paparella, 2006; Landa & Homan, 2009). Improvement in these core deficits has the potential to fundamentally alter outcomes for children with ASD. Early joint attention, affect sharing and imitation abilities are the platform for the development of insights into others' intentions and emotional states, and the ability to anticipate, appreciate, and share these states with others (Trevarthen, 1979). These abilities also are thought to undergird later-developing 'theory of mind' abilities and the ability to attribute mental states (e.g., beliefs, intents, desires, pretending) to oneself and others (Baron-Cohen, 1995, Mundy & Hogan, 1994). Early joint attention abilities are predictive of later language functioning in children with ASD (Bono, Daley, & Sigman, 2004; Toth, Munson, Meltzoff, & Dawson, 2006) and in children with typical development (Adamson & Bakeman, 1991; Carpenter, Nagell, Tomasello, Butterworth, & Moore, 1998). If not addressed in early intervention, the cascading effect of these core deficits in early social communication abilities can lead to continued and further disruption in development of later social cognitive skills (Mundy, Sullivan & Mastergeorge, 2009). In the proposed study, the primary child outcomes will focus on these core deficits of ASD.

The Part C early intervention service system is designed to provide family-centered services that are individually planned to meet children's and families' needs, with a focus on developmental skills that are precursors for later school success. One of the fundamental tenets of early intervention is that families and homes are considered to be the primary nurturing contexts, and that an essential outcome of early intervention is to strengthen parent-child relationships (Odom & Wolery, 2003). Thus, most early intervention is provided within the home (Bailey, Aytch, Odom, Symons, & Wolery, 1999), based on a conceptual model of providing social supports that enhance family well-being and empowering parents to engage in responsive interactions with their child (Dunst, 2000). The goal is to influence a large proportion of the child's experiences throughout the day (McWilliam, 2000), implementing intervention strategies that have been adapted for use by family members (Rule, Losardo, Dinnebeil, Kaiser, & Rowland, 1998). The majority of intervention provided through Part C, then, is parent-mediated.

A few studies, all with very small numbers of subjects, have indicated that very young children with ASD receiving parent-mediated intervention show improvements in social and communication functioning These few descriptive or quasi-experimental studies (Aldred et al., 2004; Chandler et al., 2002; Drew et al., 2002; Jocelyn et al., 1998; Schertz & Odom, 2007) indicate that improvement in social (Aldred et al, 2004; Chandler et al., 2002) and communication development is possible (Chandler et al., 2002; Drew et al., 2002; Jocelyn et al., 1998; Schertz & Odom, 2007). In their parent-training intervention model, Chandler and colleagues (2002) reported improved social interest in all 18 participants, but details were not provided about the magnitude of change nor how this gain was measured. Using a single subject design, Shertz and Odom (2007) reported that two of three children with ASD learned to respond to others' joint attention bids and to initiate joint (shared) attention with others through the parent-mediated intervention approach. Similarly, Aldred et al. (2004) reported a reduction in autism symptoms involving social interaction in 12 of 14 children enrolled in a parent-mediated intervention. Impact of the parent training on parental interaction strategies has been positive, when reported (Mahoney & Perales, 2003; but see Fey et al., 2006 in a study involving parents of non-ASD developmentally disabled children). The one study including a measure of parent stress reported no improvement in parents' stress level after the intervention (Drew et al., 2002). These studies either reported no information on the inclusion of minorities or involved 80% or more Caucasian families. Thus, the generalizability of the findings to minority and underserved children and their parents is unknown. We propose the first experimental study of outcomes for minority and underserved parents and children involving a parent-mediated intervention.

An alternative intervention approach would be to supplement the parent-mediated intervention that typifies Part C services with intervention that is provided directly to the child by the interventionist within a center-based program, where children are afforded the opportunity to learn alongside and through peers. Center-based interventions for 2-year-olds with ASD provided within a nursery school classroom have been studied by three investigators. One of these studies, descriptive in nature, involved 20 2-year-olds with ASD enrolled in a classroom-based program that utilized multiple instructional methods (Stahmer & Ingersoll, 2004). Statistically significant gains in developmental quotient and adaptive behavior were reported. In addition, gains in functional communication and social engagement with peers were documented (Stahmer & Ingersoll, 2004).

In another descriptive study, McGee, Morrier and Daly (1999) examined social and language gains in 28 2-year-olds enrolled in a classroom-based intervention. This program focused primarily on implementing the strategies of incidental teaching (Hart & Risley, 1975). Gains were reported in percentage of children with meaningful verbalizations as well as improvements in peer proximity for most children following intervention. Similar results were obtained in the applicant's study of a comprehensive intervention for 2-year-olds with ASD that involved 10 hours per week of classroom-based instruction paired with parent education and parent training (see Preliminary Results). Long-term follow-up of these children two to five years after the termination of the intervention indicates that early gains in cognitive and language functioning are sustained (Landa & Kalb, 2012).

Study Design and Methods

Study design. Randomized Clinical Trial. Children were assessed prior to, and at the completion of, the intervention.

Population studied. 22- to 33-month-olds with autism spectrum disorders and their caregivers who were trained to use the Early Achievements strategies.

Sample selection.
Inclusion criteria: Age 22-33 months; meet criteria for ASD or autism on the ADOS (Lord et al., 2000) + clinical judgment of PDD-NOS or autism; nonverbal mental age $\geq$8 months (MSEL [Mullen, 1995] Visual Reception); parents agree to participate in the study and commit to having their child participate in the 6-month intervention to which they are randomized; primary caregiver in the Parent-Mediated condition agrees to attend training sessions; parent agrees to bring their child in for testing at pre- and post-treatment; parents' age is between 16 and 50 years; prioritize entry for families who qualify for medical assistance and/or have racial/ethnic minority backgrounds. It is not required that English be their primary language, but parents must be fluent in English (or if the child is nonverbal he/she must hear English most of the time at home).
Exclusion criteria: Head injury or a fall resulting in a loss of consciousness or other severe head injury prior to enrollment in the study; major hearing or visual impairment after correction; non-febrile seizures; PKU (Phenylketonuria); congenital rubella (German measles); neurofibromatosis; tuberous sclerosis; fragile X; velo-cardio facial syndrome; any other known genetic syndrome; being a foster child; being adopted.

Subject characteristics as assessed prior to the onset of treatment are presented in Table 1. As shown, there were significantly more bilingual families in the Center-Based than in the Home-Based condition. Significantly more children in the Home-Based condition than in the Center-Based condition were enrolled in early intervention prior to the start of the HRSA R40 intervention (Table 2).

Table 1. Subject characteristics.

Subject Characteristics	Home-Based N=25	Center-Based N=32	*p*
%Male	88.0	81.3	.48
Age, mean(sd)	28.4 (3.1)	27.2 (3.1)	.16
SES, mean(sd)	52.5 (11.1)	53.4 (10.5)	.77
%Bilingual homes	8.0	28.0	<.001
%Minority	40.0	43.8	.77

Table 2. Outside receipt of treatment at entry into the HRSA R40 intervention study.

Service Type	Home-Based %	Center-Based %	*p*
School	33.0	10.0	.000
Intervention	83.3	65.5	.006

Instruments used. The primary dependent measures were obtained using direct child assessments (listed below). The aspects of development examined by each instrument are summarized in Table 3.

Child measures:

- Autism Diagnostic Observation Schedule-Generic (ADOS)
- Mullen Scales of Early Learning (MSEL)
- Communication and Symbolic Behavior Scales Developmental Profile (CSBS DP)
- Treatment History Questionnaire (completed by primary caregiver)

Table 3. Domains examined by the dependent variables.

Social Measures	Language Measures	NV Cognitive Measure
ADOS Social + Communication Algorithm Score	MSEL Expressive Language age equivalency score	MSEL Visual Reception age equivalency score
CSBS DP frequency of Initiation of joint attention (IJA)	MSEL Receptive Language age equivalency score	
	CSBS DP word inventory	

As shown in Table 4, there were no differences between the groups at the pre-treatment assessment.

Table 4. No significant differences in groups' functioning prior to start of treatment.

Measure	Home-Based	Center-Based	
	Mean(SD)	Mean(SD)	*p*
MSEL Visual Reception Age Equivalent	20.54 (5.5)	19.63 (4.9)	.51
MSEL Receptive Language Age Equiv	12.24 (8.8)	12.72 (8.6)	.83
MSEL Expressive Language Age Equiv	13.40 (5.5)	14.16 (8.0)	.68
ADOS Social+Communication alg score	15.28 (3.9)	15.66 (3.5)	.70
CSBS DP frequency of IJA	3.29 (3.5)	3.90 (7.0)	.69
CSBS DP Word Inventory	3.25 (5.2)	1.97 (3.7)	.29

Parent measures:

- Parent Stress Inventory
- Parent Child Play sample
- Parent Expectancies Scale
- Parent Self-Efficacy Scale

Statistical techniques employed. Repeated Measures ANOVA, Paired t-tests, Chi-Squares, Logistic Regression

Detailed Findings

Hypothesis 1: *Children in the Center-Based intervention will show greater gains in cognitive and language functioning compared with children in the Home-Based intervention.* The professional-mediated center-based (CB) intervention was expected to provide, to a greater extent than Home-Based (HB) intervention, a strategically designed learning milieu (toys, intervention activities, instructional strategies, curriculum) and consistent application of therapeutic principles that promote cognitive and language development (Smith et al., 2000; Casto & Lewis, 1984; Wasik et al., 1990; Scarr & McCartney, 1988).

Hypothesis 2: *Children in the two intervention conditions will show comparable gains in frequency of initiation of joint attention and other aspects of social functioning (e.g., social reciprocity).* The justification for this hypothesis was that children in both intervention conditions would receive the same Interpersonal Synchrony curriculum targeting joint attention. Joint attention, imitation, and shared positive affect improved after six months of intervention provided within a CB classroom for 10 hours per week (Landa et al., 2011) in a group of

children receiving this intervention in the past. Given that the children in the parent-mediated component of both conditions were expected to receive at least 10 hours per week of engagement with a parent trained to integrate opportunities for joint attention, affect sharing, and imitation (which are part of social reciprocity) into daily living routines, children in both conditions were expected to exhibit similar improvement in social functioning. As reviewed above in studies with very small numbers and little or no representation of minorities, children receiving either type of intervention usually show gain in social and communication functioning (Landa & Holman, 2009; Stahmer & Ingersoll, 2004; McGee & Morrier, 1999; Aldred et al., 2004; Chandler et al., 2002; Drew et al., 2002; Jocelyn et al., 1998; Schertz & Odom, 2007).

**Note: We were not able to address our original Hypotheses 3 and 4 because reviewers requested that we provide parents in both conditions with the same training such that the parent-mediated component would be the same across both conditions.*

**Note: We acknowledged in the application that we would have insufficient power to examine effects of moderators and mediators in our study. However, as promised, we did collect data on possible moderators and mediators for combination with data acquired in a subsequent, larger study powered to properly examine this issue. We gathered data on: number of hours of intervention received through Part C or private sources (Treatment History Questionnaire), degree of parental responsiveness in interaction with the child prior to onset of our intervention using the Parent Child Play Sample that we developed (Yoder & Warren 2002), parent buy-in (Parental Expectancies Scale; Nock & Kazdin, 2001), level of parent stress (Parent Stress Inventory) and nonverbal cognitive level (MSEL Visual Reception scale).*

Repeated measures ANOVA was used to examine between-group differences on cognitive and language functioning. No between-group differences were detected. Paired t-tests revealed that children within both groups made significant gains in both nonverbal cognitive and language domains (see Tables 5 and 6).

Table 5. Within-group comparison of pre- and post-treatment scores (Home-Based group)

Home-Based		Pre	Post		
	N	Mean(SD)	Mean(SD)	*t*	*p*
VR Age Equivalent	22	20.68(5.57)	28.14(11.64)	3.48	.002
RL Age Equivalent	23	12.57(9.07)	23.26(13.50)	6.09	<.001
EL Age Equivalent	23	13.57(5.66)	23.30(12.41)	4.88	<.001
CSBS Word Inv	22	3.45(5.37)	6.45(6.46)	3.05	.006

Table 6. Within-group comparison of pre- and post-treatment scores (Center-Based group)

Classroom-Based		Pre	Post		
	N	Mean(SD)	Mean(SD)	*t*	*p*
VR Age Equivalent	32	19.63(4.90)	28.22(9.24)	8.14	<.001
RL Age Equivalent	32	12.72(8.58)	21.75(12.36)	6.41	<.001
EL Age Equivalent	32	14.16(8.05)	21.97(11.73)	6.74	<.001
CSBS Word Inv	28	2.11(3.79)	5.50(6.24)	3.52	.002

There were no significant between-group differences in amount of gain in social functioning as determined by pre- to post-intervention change in frequency of initiation of joint attention (IJA) or decrease in total ADOS algorithm score (Reciprocal Social Interaction + Communication). Using paired t-tests to examine within group differences, we found no significant change from pre- to post-intervention in either group.

Subgroup with decline in frequency of IJA from pre- to post-treatment. Nine (41%) children in the HB and seven (25%) in the CB conditions exhibited a decrease in frequency of IJA from pre- to post-intervention. More children in the HB condition than in the CB condition displayed this decrease in IJA (p=.016). This decrease in frequency of IJA from pre- to post-intervention was unexpected given the results of our prior study (Landa et al., 2011). Thus, we examined changes within this sub-group of children from pre- to post-intervention in nonverbal cognitive, communication, and social functioning to determine whether the

decline in frequency of IJA was an isolated phenomenon or whether these children were exhibiting a comprehensive decline in performance. For MSEL measures of Visual Reception (nonverbal cognition), Expressive Language, and Receptive Language, gain was defined as improvement of at least 5 months in age equivalency score during the 6-month intervention. For most children, the decline in IJA was not indicative of overall change in developmental trajectory during the intervention period. However, more children in the CB than in the HB condition (82% vs 6%, respectively) improved on least two of the above four measures (p=.001). Improvement in social functioning was defined as a decrease of 4 or more on the ADOS Social+Communication algorithm score. Only one (11%) child in the HB condition compared to five (71%) in the CB condition (p=.013) met this criterion for social gain. Given the robust improvement in nonverbal cognitive, communication, and social functioning within the CB group, and cognitive and communication gain within more than half of the HB group who showed declining frequency of IJA from pre- to post-intervention, we hypothesize that the production of IJA by toddlers with ASD may susceptible to perturbations such as novelty of context, stress, and so forth. Our use of distal measures of our dependent variables may have reduced our ability to detect gain, particularly in IJA, so in future studies of toddlers with ASD it will be important to include proximal measures as well. The distal measures provide a stringent test of gain, yet detection of gain with distal measures provides strong evidence of generalized learning and an indication of robust treatment response.

Secondary Analyses

Cross-domain developmental gain. We hypothesized that children in the CB condition would display more comprehensive gain, defined as meeting our criteria for improvement in multiple developmental domains, compared to children in the HB condition. We reasoned that the consistency and highly targeted nature of the intervention stimuli and high dosage of social communicative opportunities in the CB condition may stimulate cross-domain development in toddlers with ASD to a greater degree than would the therapeutic stimulation provided in a less-well controlled environment (home). To examine this hypothesis, we established cut-offs for clinically significant gain in nonverbal cognitive, language, and social functioning, then conducted chi square analyses to determine whether the groups differed in the proportion of children who met our criteria for clinically significant gain in two or more of these domains. The cut offs and justifications for clinically significant gain in each of the domains is provided below.
Nonverbal cognition: Gain of $\geq$ 5 months from pre- to post- intervention on the MSEL Visual Reception scale. *Justification:* The intervention was 6 months duration. Improvement of at least 5 months age equivalence on a standardized measure (MSEL Visual Reception scale) would represent a developmental rate of at least 83% of the expected rate.
Language: Gain of at least 5 months from pre- to post-intervention on the MSEL Receptive or Expressive Language scales, or at least 2-word increase in word inventory (novel words produced communicatively and directed toward another person during the administration of the CSBS DP). *Justification:* For the MSEL measures, we opted to use the same threshold for clinically significant gain as we had specified for nonverbal cognitive gain. The criterion set for clinically significant change in word inventory during the 25-minute CSBS DP sampling procedure represents a major improvement for young children with ASD who are in the early stages of expressive language development, particularly given that they were in a novel context. Change on the CSBS DP word inventory is considerable, especially considering the administration conditions where stimuli change every few minutes, introducing novelty and requiring set shifting, which are major deficits in children with ASD.
Social: Gain of at least two self-generated bids for joint attention (initiation of joint attention, IJA) during the CSBS DP or at least a four-point reduction in ADOS algorithm total score (for Reciprocal Social Interaction+Communication domains). *Justification:* The rationale for the improvement in frequency of IJA bids is the same as that for improvement in word inventory- these are self-generated (not elicited) social-communicative behaviors demonstrated within a brief sampling period within an unfamiliar, dynamic context, and thus would be considered demonstrative of improving social communicative skill. The threshold set for improvement in ADOS score represents a quadrupling in ADOS score reduction compared to change observed in our longitudinal study of infant siblings of children with autism observed between 24 and 30 months, the same duration of lapsed time between assessments and nearly the same ages as the in the HRSA R40 study.

Significantly more children in the CB (81%) than in the HB (61%) condition met criteria for clinically significant change in two or more domains (p=0.002). This finding supports our hypothesis that more comprehensive developmental gain would occur in the CB condition.

Using logistic regression, we examined predictors of change in at least two of the three domains. The pre-treatment independent variables, or predictors, examined in a step-wise model, included: treatment condition (CB or HB); MSEL Expressive Language and Visual Reception age equivalent scores; ADOS algorithm total score (Social+Communication); and the Parent scale of the Parent Stress Inventory. Two variables reached our criterion for statistical significance (p<.05): Condition and Expressive Language score. The odds ratio for Condition is 34.79 (p=.016), indicating that, controlling for the other variables in the model, children in the CB condition are nearly 35 times more likely than those in the HB condition to make gains in at least 2 of the 3 domains. The odds ratio for Expressive Language is 1.48 (p=.043), indicating that, controlling for the other variables, for every one month increase in pre-treatment Mullen Expressive Language age equivalent score, there is a 1.48 likelihood of clinically significant change in two developmental domains.

Together, these findings support our hypothesis that when toddlers are exposed to a short-term early intervention, a strategically designed center-based learning context is more likely to effect cross-domain developmental gains than a home-based intervention where parents are the primary intervention agents.

***Parent expectancies*.** We hypothesized that parents whose children were in the CB condition would be more optimistic about their child's outcome compared to parents in the HB condition. We presumed that if children were attending an evidence-based center-based program, parents would expect greater change in their child as a result of the treatment than if their child's intervention consisted of community-based treatment, a small amount of 1:1 treatment from one of our trained staff, and the stimulation that parents provided to their children at home. In our analysis, we used the first item of the Parent Expectancies Scale ("How much do you believe that this treatment will help your child's development?"), which parents rated using a 5-point scale (1=Not at All; 5=Very Much). As expected, ratings by parents in the CB condition were significantly higher (p<.01) than in the HB condition, indicating a higher expectation for child improvement by parents in the CB condition (see Table 7). Unexpected, however, was the narrow spread of ratings. No parents rated this item less than 3, indicating that all parents expected the intervention to help their children, regardless of the condition to which their child was randomized.

Table 7. Proportion of parents in each condition endorsing ratings of 3-5 on the Parent Expectancies Scale item indicating expectation about potential intervention impact.

		Rating			
		3	4	5	
Condition	N	N(%)	N(%)	N(%)	*p*
HB	20	6 (30)	7(35)	7(35)	.023
CB	28	1(3.6)	9(32.1)	18(64.3)	

Issues related to minority groupings

As indicated in our published manuscript (Tek & Landa, 2012), communication development was significantly more delayed in minority children, regardless of the condition in which they were enrolled. This finding was robust, as it held true across different measures (parent report and direct assessment) as well as across receptive and expressive language domains. We also found that socio-economic status (SES) factors did not contribute to this finding as there were no between-group differences in SES.

Discussion and Interpretation of Findings

Conclusions to be drawn from findings (with reference to data supporting each).
There are a number of conclusions to be drawn from this study. First, toddlers with ASD respond to early intervention employing an evidence-based set of instructional strategies and where core social and communication deficits of ASD are heavily targeted using an Interpersonal Synchrony and Communication curriculum. Primary gains occur within nonverbal cognition and language domains, which were measured using distal measures. Thus, our findings indicate generalization of skills that were treated. Gains established

within children in the CB condition were more developmentally comprehensive across nonverbal cognitive, language, and social domains despite the fact that significantly more children in the HB condition were receiving community-based and/or private intervention in addition to the intervention we provided through this study and despite the fact that there were significantly more children in the CB condition from bilingual homes, posing a potential threat to our ability to measure improvement using tools standardized on English speaking children and administered in English only. Predictors of clinically significant cross-domain gains from pre to post treatment identified through logistic regression were Condition and pre-treatment expressive language level. Children in the CB condition and those with higher pre-treatment expressive language levels were more likely to show gains, controlling for non-verbal cognitive level and parent stress level (and for expressive language, controlling for Condition; for Condition, also controlling for expressive language level).

Children from minority and families (controlling for SES) entered the treatment with greater impairment in communication functioning than children from non-minority families.

Explanation of study limitations. First, conducting post-treatment assessments in a novel context, using novel tasks and unfamiliar examiners was stressful for some toddlers, interfering with our ability to detect improvement in social functioning in group comparisons. This discovery was made by examining the pre- and post-treatment scores for children who initiated joint attention less frequently at the post-treatment lab assessment than at the pre-treatment assessment. These children tended to show more robust gains in language and cognitive functioning if they were in the CB than if they were in the HB condition, and in some cases, even reduced autism symptomatology at post-treatment. Thus, if we had included a proximal measure of our participants' frequency of production of IJA, we may have found that the children did indeed improve in IJA when assessed in familiar contexts (such as environments where the treatment was delivered), but that this newfound ability is vulnerable to stress in novel contexts.

Another limitation was the higher level of attrition in the HB condition. Parents in the CB seemed to settle into a routine, carving out time in their lives for six months of a commitment to bring their child to our center. In the HB condition, many families viewed the intervention as something that could be arranged around their existing schedules, which may have enabled them to prioritize other commitments over the intervention and thus drop out of the study.

Another limitation was the difficulty associated with completing the parent questionnaires. Some parents were not able to read, or were highly distracted, or had no time to complete the questionnaires. Thus, for some parent questionnaire measures, we had insufficient data to analyze with confidence.

Another limitation arose in multi-lingual homes. Our tests are administered in English, intervention is delivered in English, and assessment tools were standardized on English speakers. Thus, our results may not reflect the true robustness of the intervention because some children were unable to obtain the maximum benefit of the intervention given the multiple languages to which they are exposed at home.

Comparison with findings of other studies. Gains in the CB condition were expected to resemble those we reported in our 2011 paper (Landa et al.) about the results of an RCT examining the Interpersonal Synchrony condition (which the CB group received). Indeed, we did find similar gains in nonverbal cognition and language but not in frequency of initiation of joint attention. The reason for this is not completely clear, but may be related to the increase in bilingual and non-Caucasian homes in this study compared to the prior study. That is, cultural differences may have resulted in less emphasis on joint attention at home in the current sample. In addition, the children in this study entered producing a higher frequency of IJA than the children in the Landa et al. (2011) report.

In addition, Gotham et al. (2012) have reported more severe autism symptomatology in minority children with ASD, which is in line with our finding of greater communication impairment in minority toddlers with ASD (Tek & Landa, 2012).

Possible application of findings to actual MCH health care delivery situations. Our findings highlight the importance of early identification and early intervention. First, we must focus a concerted public awareness campaign on recognition of early signs of communication delay and ASD in minority communities using strategies that are most likely to be accessible to these communities. Better and more accessible ASD screeners are needed. Secondly, training programs are needed to enable early intervention providers to deliver evidence-based intervention to toddlers with ASD from diverse communities. Thirdly, families of young children with ASD need intervention options. For some families, home-based (or child-care based) intervention

is preferable. For others, center-based intervention is preferable. Both options should be made available to families, and transportation is needed if families opt for the center-based option. In addition, families need encouragement and support as they strive to provide care to their children with ASD as they also deal with many other stressors. They need to be equipped with strategies for engaging their children, knowledge about what to expect from their children, knowledge about how to set limits, and knowledge about how to create optimal care environments for children in their homes.

Policy implications.

1. Because the age of first diagnosis of ASD is not until around age 3-1/2 to 4 years, there is a great need for a universal developmental health program in the United States. Such a program would involve teaching families, from prenatal through early childhood periods, how to optimize the learning and emotional-health promoting environments for their children.
2. Dissemination of ASD early intervention models into community-based settings is needed on a large scale.
3. Center-based intervention options for young children with ASD are needed.
4. Training programs for early intervention providers are needed, beginning at the pre-service stage of their development.

Suggestions for further research.

1. Development and validity and usability assessment of web-based video-guided screeners for ASD and communication delays.
2. Follow-up of toddlers who received evidence-based vs community based (or no) early intervention as they enter preschool and early school-age to determine levels of school-readiness and barriers to maintenance of early intervention gains.
3. Development of feasible systems for reducing stress in parents of young children with ASD.
4. Development of effective interventionist training systems to permit widespread delivery of evidence-based interventions to young children with ASD.
5. Study of the relation between emergence of co-morbid disorders in children with ASD and environmental exposures (e.g., parent stress, parent use of child-contingent responsivity strategies, adequate treatment for child behavior challenges, accessibility of intervention for the child, etc.)

List of Products

Published papers citing HRSA R40 funding.

Landa RJ, Holman K, O'Neill A, Stuart E. (2011). Intervention targeting development of socially synchronous engagement in toddlers with autism spectrum disorder: A randomized controlled trial. *Journal of Child Psychology and Psychiatry*, *52(1),* 13-21. PMCID:21126245

Tek S, Landa R. (2012). Differences in autism symptoms between minority and non-minority toddlers. *Journal of Autism and Developmental Disorders. 42(9),* 1967-1973. doi: 10.1007/s10803-012-1445-8

Landa R, Kalb L. (2012). Long-term outcomes of toddlers with autism spectrum disorders exposed to short-term intervention. *Pediatrics, 130,* S186-S190. doi:10.1542/peds.2012-0900Q

Papers and other manuscripts in preparation or to be prepared.

1. Between-group comparisons and predictors of robust treatment response
2. Treatment response in minority versus non-minority groups
3. Parent stress, parent use of child-responsive engagement strategies, and child treatment response
4. Issues related to intervention delivery in under-resourced families
5. Measurement issues in early intervention
6. Parent training manual

Other accomplishments.

1. A Committee for Culturally Sensitive Practice was formed to help ensure culturally sensitive intervention practices and materials within both interventions. This committee provided critiques of the intervention strategies and materials and modifications were made accordingly. The committee felt that our intervention curriculum, strategies and materials were already quite appropriate for families from diverse cultural backgrounds.

2. Establishment of a community-based "Why Wait and See" campaign
   -Provided annual summer internships for minority graduate students related to above
   -Widespread community dissemination of early detection materials
   -Maryland Early Screening and Intervention Consortium
3. Helping families to understand research- Information sheet
4. Made the model available free to inner city children through a grant from the Maryland State Department of Education – partnership with Baltimore City Infants and Toddlers

Talks related to HRSA R40 grant.

1. Early Achievements: Evidence-based Early Intervention, Landa RJ. Annual Autism Conference, Sheppard Pratt, Baltimore, MD, October 29, 2010
2. The Positive Impact of Very Early Intervention for Autism Spectrum Disorders, Landa RJ. Professional Education Programs, Sheppard Pratt, Baltimore, MD November 12, 2010
3. Enhancing Parent Responsivity: Training for Parents of Toddlers with Autism, Landa RJ. ASHA Convention, Philadelphia, PA, November 18, 2010
4. Detected… Time to Treat, Landa RJ. Infants and Toddlers Providers Meeting. Doylestown, PA. December 3, 2010
5. The Positive Impact of Very Early Intervention for Autism Spectrum Disorders, Landa RJ. Sheppard Pratt Hospital, Grand Rounds, Department of Psychiatry. June 29, 2011
6. Early Detection and Intervention for 1 year olds at Risk for Autism, Landa RJ. ASHA Convention, Philadelphia, PA November 18, 2010
7. Teaching strategies for children with Autism: Language and Social Learning, Landa, RJ. The 4th Chinese Community Psychiatry Workshop (CCPW), Pingtung, Taiwan Dec. 11th -12th, 2010
8. Strategies to Improve Parent-Child Engagement at Home, Landa RJ. The 4th Chinese Community Psychiatry Workshop (CCPW), Pingtung, Taiwan, Dec. 11th -12th, 2010
9. Evidence-based Intervention for Toddlers with Autism Spectrum Disorders, Landa, RJ. A Webinar from AUCD's Early Intervention/Early Childhood Special Interest Group, January 25, 2011
10. Ecological Validity and Change Parameters in Outcome Measures, Landa, RJ. SRCD 2011 Biennial Meeting, Montreal, Canada, March 31, 2011
11. Having fun with your child while enriching development, Landa, RJ. Amazing Baby and Child Expo, Maryland State Fairgrounds, Timonium, MD, May 7, 2011
12. Cultivating Imitation Development in Young Children with Autism Spectrum Disorders, Landa, RJ. Imitation in Autism Conference, ESRC, Priory Education Services, and King's College London, London, England, June 14, 2011
13. Intervention Targeting Development of Socially Synchronous Engagement in Toddlers with ASD: A Randomized Controlled Trial, Landa, RJ. ICare4Autism International Autism Conference NYC at Albert Einstein College of Medicine, July 6, 2011
14. Barriers to Early Detection, Landa, RJ. 11th Annual Autism Conference, Baltimore, MD, October 20, 2011
15. Play as a foundation for learning in children with ASD, Landa, RJ. 11th Annual Autism Conference, Baltimore, MD, October 20, 2011
16. Early Achievements: An evidence-based intervention for toddlers with autism, Landa, RJ. DEC's 27th Annual International Conference on Young Children with Special Needs and Their Families, Gaylord National in National Harbor, Maryland, November 19, 2011
17. ROAR: Opportunity to change direction of life for individuals with autism, Landa, RJ. ROAR, Kennedy Krieger Institute, Baltimore, MD, January 31, 2012
18. Accomplishments of MCHB's Combating Autism Act Initiative: Cross-Coordination of Training, Research and Systems Implementation Programs to Advance Policy and Practice. Kavanaugh, L., **Landa, R.**, Harris, A., Autin, D. 2012 AMCHP Annual Conference, Washington, DC, February 12, 2012
19. Early Signs of Autism and Early Intervention, Center for Children, Relationships, and Culture, Landa, RJ, University of Maryland, College Park, MD, February 15, 2012
20. Intervention for the young, Landa, RJ, Universal Enrichments as a means of Optimizing Developmental Outcomes, Autism Speaks Moving the Needle Initiative, Landa, RJ. Washington DC, February 29, 2012

21. Overcoming barriers to the early detection of autism and new insights into optimizing outcomes, Landa, RJ. DEVO conference in Bethesda, MD, March 15, 2012
22. Getting the most out of your play time with your child, Landa, RJ. Autism Awareness Month, Kennedy Krieger Institute, Baltimore, MD, April 11, 2012
23. Expert Workshop on Autism Intervention Research in Underserved Communities: Research Priorities and Methodological Challenges, Landa RJ. Washington, DC, April 19-20, 2012
24. Early Achievements Approach to Early Intervention, Landa, RJ. Maryland Speech and Hearing Association annual conference, White Marsh, MD, May 4, 2012
25. Proposal: Changing tomorrow through altering early experiences for at-risk infants and toddlers, Landa, RJ. Kennedy Krieger Institute Board of Trustees, Baltimore, MD, May 9, 2012.
26. Evidence Supporting Mulit-modal Early Intervention: One Year Olds with, and at risk for, Autism Spectrum Disorder, Landa, RJ. ASTTN Conference, Toronto, Canada, May 16, 2012
27. Change lives of children with ASD through early intervention, Landa, RJ. Maryland Women Spanning the Globe, Baltimore, MD, May 31, 2012
28. Identifying children with autism early: Why it matters and how it helps families, Landa, RJ. Advocate Hope Children's Hospital, Chicago, IL, June 5, 2012
29. Early Achievements: An intervention model for improving social, language, play, and cognitive outcomes in toddlers, Landa, RJ. Vermont Summer Autism Institute, Burlington, VT, June 24-26, 2012
30. Ecologically valid treatment goals and activities, Landa, RJ. Center for Autism and Related Disorders Boot Camp, Baltimore, MD, August 28, 2012
31. Enhancing social and communication in young children with ASD learning through strategic environmental engineering, Landa, RJ. Kennedy Krieger Institute Training for Teachers, Baltimore, MD, October 4, 2012
32. Book sharing as a venue for enhancing social and communication learning in young children with ASD, Landa, RJ. Kennedy Krieger Institute Training for Teachers, Baltimore, MD, October 10, 2012
33. Early Achievements: An intervention model for improving social, language, play, and cognitive outcomes in young children with ASD, Landa, RJ. Seattle Children's Hospital Department of Psychiatry, Seattle, Washington, October 12, 2012

Poster Presentations.

1. Interventions for Toddlers with ASD: Examining Impact on Children Family and Policy, **Landa, RJ**. DEC's 27th Annual International Conference on Young Children with Special Needs and Their Families, Gaylord National in National Harbor ,Maryland
   November 18, 2011

2. The Speech-Gesture Link and Trajectory of Language Development Among Young Children At Risk for Autism, Sheperd, K. A., & **Landa, RJ**. Poster accepted at the annual meeting of the International Meeting for Autism Research. Toronto, CA.
   May 17, 2012