

## Review Article

# Changing Developmental Trajectories of Toddlers With Autism Spectrum Disorder: Strategies for Bridging Research to Community Practice

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**Purpose:** The need for community-viable, evidence-based intervention strategies for toddlers with autism spectrum disorder (ASD) is a national priority. The purpose of this research forum article is to identify gaps in intervention research and needs in community practice for toddlers with ASD, incorporate published findings from a randomized controlled trial (RCT) of the Early Social Interaction (ESI) model (Wetherby et al., 2014) to illustrate community-based intervention, report new findings on child active engagement from the ESI RCT, and offer solutions to bridge the research-to-community practice gap.

**Method:** Research findings were reviewed to identify gaps in the evidence base for toddlers with ASD. Published and new findings from the multisite ESI RCT compared the effects of two different ESI conditions for 82 toddlers with ASD to teach parents how to support active engagement in natural environments.

**Results:** The RCT of the ESI model was the only parent-implemented intervention that reported differential treatment

effects on standardized measures of child outcomes, including social communication, developmental level, and adaptive behavior. A new measure of active engagement in the natural environment was found to be sensitive to change in 3 months for young toddlers with ASD and to predict outcomes on the standardized measures of child outcomes. Strategies for utilizing the Autism Navigator collection of web-based courses and tools using extensive video footage for families and professional development are offered for scaling up in community settings to change developmental trajectories of toddlers with ASD.

**Conclusions:** Current health care and education systems are challenged to provide intervention of adequate intensity for toddlers with ASD. The use of innovative technology can increase acceleration of access to evidence-based early intervention for toddlers with ASD that addresses health disparities, enables immediate response as soon as ASD is suspected, and rapidly bridges the research-to-practice gap.

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Early diagnosis and intervention have lifetime consequences for children with autism spectrum disorder (ASD) and their families, and yet, most children are not diagnosed until ages of 3.5–5 years (Baio et al., 2018), which means missing the opportunity for early intervention (EI). EI significantly improves children's outcomes (Dawson et al., 2010; National Research Council

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[NRC], 2001; Wetherby et al., 2014) and is the greatest tool available to reduce the societal cost of treating ASD. ASD is one of the most costly developmental disabilities, with an estimated lifetime societal cost ranging from \$1.4 to \$2.4 million per child (Buescher, Cidav, Knapp, & Mandell, 2014). Limitations of current research identify a critical need for efficient, efficacious, and community-viable EI for infants and toddlers with ASD and their families that could be implemented by public Individuals With Disabilities Education Act (IDEA) Part C service delivery programs. EI is particularly critical for children with ASD because, without intervention, early social attention deficits associated with ASD can lead to cascading effects on learning and developmental outcomes (Dawson, Bernier, & Ring, 2012; Mundy & Burnette, 2005; Wetherby, Watt, Morgan, & Shumway, 2007). Although the spirit of IDEA is collaboration with families and interprofessional partnerships, delays in diagnosis and referral to services are common (Crais et al., 2014). EI providers are positioned to play a pivotal role in reducing the age of detection and entry into intervention.

In spite of substantial investments and scientific advances in autism research over the past decade, there continues to be an urgent need to bridge the science-to-service gap and address disparities in access to evidence-based EI for young children with ASD. The purpose of this research forum article is to (a) identify gaps in intervention research and needs in community practice for toddlers with ASD, (b) incorporate published findings from a randomized controlled trial (RCT) of the Early Social Interaction (ESI) model (Wetherby et al., 2014) as an illustration of community-based intervention, (c) report new findings on child active engagement from the ESI RCT, and (d) offer solutions to bridge the research-to-community practice gap.

## **Gaps in Intervention Research and Needs in Community Practice for Toddlers With ASD**

### ***Evidence Base From RCTs of Interventions for Toddlers With ASD***

There is now a sizeable number of RCTs that include toddlers with ASD with divergent results (e.g., see Bradshaw, Steiner, Gengoux, & Koegel, 2015; Landa, 2018, for systematic reviews of the ASD EI literature for thorough analyses and summaries). In a clinician-delivered, 2-year trial of the Early Start Denver Model (ESDM; Rogers & Dawson, 2010) beginning at a mean age of 23 months, significant differences were reported in child outcomes on standardized measures of developmental level (Mullen Scales of Early Learning; Mullen, 1995) and adaptive behavior (Vineland Adaptive Behavior Scales; Sparrow, Cicchetti, & Balla, 2005) for toddlers in the ESDM compared with a community treatment control, but not on autism symptoms in social affect (SA) and restricted and repetitive behavior (RRB; Dawson et al., 2010). This hallmark study of the ESDM is promising, but offering a clinician-delivered intervention of this intensity (20 hr/week of scheduled sessions for 2 years)

is not viable in most state-funded EI systems. In a 6-month RCT of a comprehensive center-based group intervention for 10 hr a week compared with the same comprehensive center-based group intervention plus an interpersonal synchrony (IS) supplement (Landa, Holman, O'Neill, & Stuart, 2011), the group receiving the IS supplement demonstrated greater short-term effects on only one primary outcome variable—socially engaged imitation—and did not find between-groups differences on standardized measures of developmental level on expressive language and visual reception at posttest. However, they did find differential effects on growth rate at follow-up 6 months later, with the IS group showing significant growth on all three primary outcome variables and both standardized measures and the non-IS group showing significant growth on only expressive language. The authors note that this study shows promise for a developmentally based social curriculum, leading to similar treatment effect sizes on measures of developmental level on expressive language and visual reception as found with the ESDM, but with less intensity and in a briefer time.

In contrast, large RCTs of parent-implemented interventions of lower intensity have reported medium to large effects with respect to increasing parent responsivity, synchronization, or interaction skills but have not reported main effects on standardized assessments of child outcomes, including the Joint Attention, Symbolic Play, and Emotional Regulation (JASPER; Kasari, Gulsrud, Paparella, Helleman, & Berry, 2015), the ESDM parent intervention (Rogers et al., 2012), the Hanen More Than Words (Carter et al., 2011), the Preschool Autism Communication Trial (PACT; Green et al., 2010), and the Social ABCs (Brian, Smith, Zwaigenbaum, & Bryson, 2017). The RCTs with the youngest toddlers did not find significant effects on child outcomes but had very limited sessions (11–12) and were brief in duration (3 months; Brian et al., 2017; Carter et al., 2011; Rogers et al., 2012). JASPER parent-implemented intervention offered 24 sessions with more promising findings, including significant proximal effects on joint engagement, but did not report effects on standardized measures (Kasari, Gulsrud, Wong, Kwon, & Locke, 2010; Kasari, Paparella, Freeman, & Jahromi, 2008).

Factors that may contribute to lack of effects of parent-implemented interventions on child outcomes include limited number of sessions (11–24), length of intervention (3 months or less), and sessions offered in a clinic setting only, which may not support generalization to natural environments. Green et al. (2010) reported a systematic attenuation of treatment effect as measurement moved from proximal (e.g., change in parent behavior) to more distal (e.g., clinician-implemented assessment) in an RCT examining PACT, a parent-mediated individual intervention for 2- to 4-year-old children and their families, compared with a treatment-as-usual condition. A 5-year follow-up demonstrated reductions in autism symptoms and greater initiation of social communication for children of families in PACT, which shows the continued long-term impact of teaching parents how to be responsive and support social

communication in young children with ASD (Pickles et al., 2016). Further research is needed to study dosage, format, and approach of parent education and parent-implemented interventions, as well as family and child characteristics of treatment responders.

### ***Gaps in the Evidence Base of Interventions for Toddlers With ASD***

These findings raise three significant needs in toddler treatment studies. First, the level of intensity needed to change developmental trajectories is not known for toddlers with ASD. The NRC (2001) recommended that children with ASD receive 25 hr per week of active engagement in systematically planned, developmentally appropriate educational activities. This recommendation is supported by recent systematic reviews (Bradshaw et al., 2015; Landa, 2018; Maglione, Gans, Das, Timbie, & Kasari, 2012; Warren et al., 2011; Zwaigenbaum et al., 2015) but is based on treatment studies that included predominantly preschool-age children. Furthermore, the intensity of clinician time required in the ESDM study ( $M = 15.2$  hr/week for 2 years) is not feasible for most community-based EI systems. This is a critical concern based on evidence that efficacious treatments are rarely adopted or successfully implemented by public systems (Dingfelder & Mandell, 2011). It is important to determine whether comparable treatment effects can be achieved with reduced professional time.

Second, the results of most recent studies raise questions about potential limitations of parent training. For most studies, the time spent teaching parents was so limited (11–54 sessions) that it was not surprising that child change (i.e., change in child outcomes) was not achieved. Specific strategies for teaching or coaching parents were not delineated clearly enough to determine if instructional methods used were either sufficient or effective. Thus, it is important to evaluate innovative ways to increase dosage and intensity of parent-implemented interventions to lead to stronger treatment effects on children's outcomes. If we can improve earlier access to intervention and start parent-implemented intervention earlier, when symptoms are not yet as obvious or as severe, we may be able to prevent the need for more intensive clinician-implemented intervention.

Third, there is a need for meaningful outcome measures for toddlers with ASD, particularly to document change in the natural environment. The NRC recommendation of 25 hr of active engagement has implications for priority treatment targets and the way in which a variety of evidence-based teaching strategies and supports can be incorporated to foster active engagement. The core features of ASD seem to converge to impede the child's availability for learning. Targeting active engagement in infants and toddlers with ASD can capitalize on the potential for change that may at least partly reflect neural plasticity. Utilizing parents to implement teaching strategies and supports to promote active engagement as early as possible may have the greatest potential to change children's developmental trajectories.

### ***Need for Community-Viable EIs for Toddlers With ASD***

Research reviews have highlighted several challenges that underscore the current gap between Part C policies and practices and the evidence base for interventions specifically targeted to infants and toddlers with ASD (Schreibman et al., 2015; Siller et al., 2013). Four gaps of significance include (a) the goodness of fit between the ASD intervention and the Part C service delivery approach, (b) professional development (PD), (c) accessibility for community providers, and (d) supports for family education. In addition, personnel shortages persist, especially in areas serving rural and low-resource families (Hebbeler, Spiker, & Kahn, 2012), resulting in later rather than earlier identification and fewer services and supports consistently available.

Based on the Part C legislation (IDEA, 2004) and recommendations from national professional organizations (American Speech-Language-Hearing Association, 2008; Copple & Bredekamp, 2009; Division for Early Childhood, 2014), four EI principles are key to policy and practice: (a) family-centered and capacity-building practices; (b) meaningful intervention in the child's natural environment; (c) active child engagement and learning; and (d) functional, systematic instructional practices. As noted previously in the review of research on experimental treatments, while emerging, there are still limited options for toddler treatments and even fewer that address the recommended EI principles. Schertz and colleagues, for example, in their review, found that only five of 27 reviewed studies addressed all four principles (Schertz, Baker, Hurwitz, & Benner, 2011).

In addition to these four principles, Part C stipulates that services should "enhance the family's capacity to meet the developmental needs of the family's infant or toddler" (IDEA, 2004, Section 1436). Therefore, interventionists are faced with the task of providing EI services that not only meet the child's targeted outcomes but also enhance the family's capacity to meet their children's developmental needs (American Speech-Language-Hearing Association, 2008; IDEA, 2004). This stipulation underscores the importance of engaging the parent to take an active role in the planning, decision making, and participation process by coaching the parent to implement the intervention competently and confidently (Dunst & Espe-Sherwindt, 2016; Kemp & Turnbull, 2014). The research literature is limited with regard to which coaching practices should be leveraged to build the capacity of parents so that they can more consistently and competently enhance their child's learning (Brown & Woods, 2015). Over 88% of children, birth to age of 3 years, receive Part C services in home-based settings most appropriate for a parent-implemented model (U.S. Department of Education, Office of Special Education and Rehabilitative Services, 2016) from interdisciplinary team members with limited training in coaching (Bruder, 2016) and evidence-based approaches for toddlers with ASD (Snyder, Rakap, et al., 2015). Taken together, these details illustrate the enormity of the gap in personnel preparation for coaching caregivers and the importance of easily accessible



and cost-effective PD so that interdisciplinary team members can ensure coordinated program implementation.

## **Findings From an RCT of the ESI Model**

ESI is a comprehensive EI model for toddlers with ASD and their families that incorporates evidence-based active ingredients designed to impact across domains and be consistent with requirements of the IDEA Part C EI program (Wetherby & Woods, 2006), which meets all four principles of IDEA Part C (Schertz et al., 2011). The multiple components of ESI are drawn from autism research and IDEA Part C policies and practices, each of which will be described next.

### ***Family-Centered Capacity-Building Approach***

The use of family-centered capacity-building practices has been associated with positive outcomes for children and families (Bruder, 2010; Dunst, Bruder, & Espe-Sherwindt, 2014). The family-centered capacity-building approach, which is the foundation of ESI, engages families throughout the assessment and intervention process and facilitates active participation and decision making while systematically increasing awareness and encouraging reflection on their own actions. Family members' active participation as the implementer of the intervention strengthens their relationships and increases responsiveness to their child. Building partnerships and trust with EI professionals by sharing information on typical developmental milestones and how ASD impacts child development supports the family to make informed decisions regarding the intervention plan and achievement of goals (Dunst & Espe-Sherwindt, 2016; Lane & Brown, 2016).

### ***Learning in Natural Environments***

Natural environments are defined in IDEA Part C as everyday activities, routines, and settings typical for any family, including home, child care, and community locations, which naturally support acquisition and generalization of skills. Rather than using a specified set of play materials, the ESI model uses activities individualized to the child and his or her family. For example, a family may identify morning activities, such as dressing, eating, washing up, and playing outdoors as priorities, whereas another adds books and music as family favorites to their typical meal and nap schedule. Incorporating intervention into the child and his or her family's unique and preferred routines disperses intervention throughout the day, expands opportunities for repetition, and increases the family's ownership of the intervention.

### ***Collaborative Coaching to Support Parent Learning and Generalization***

ESI builds capacity by coaching caregivers to embed intervention strategies targeting their child's goals within everyday activities as they occur. A four-step collaborative coaching model based on adult learning and cognitive

behavioral research is used (Wetherby & Woods, 2006). The interventionist and parent collaboratively (1) identify what works for each parent-child dyad with the interventionist using observation, direct teaching, and demonstration/modeling with explanation as needed to increase the parent's understanding; (2) guide the parent's practice embedding intervention, provide feedback, and engage the parent in problem solving about the practice; (3) repeat with parent-led practice and reflection on the child and parent's participation; and (4) decide when the interventionist should back out for caregiver independence. The interventionist coaches the parent in each new activity at the first step and moves to Step 4 as quickly as possible to promote parent competence, confidence, and independence. Coaching in multiple (three to five) and varied everyday activities promotes generalization of parent learning so the parent can deliberately embed intervention throughout the day as planned and as opportunities arise incidentally (Brown & Woods, 2016; Woods & Brown, 2011).

### ***Naturalistic Developmental Behavioral Intervention Framework to Prioritize Child Outcomes***

ESI uses SCERTS, a manualized curricular-based assessment and naturalistic developmental behavioral intervention (NDBI) framework to identify goals and objectives and monitor progress (Prizant, Wetherby, Rubin, Laurent, & Rydell, 2006). *SCERTS* refers to Social Communication (SC), Emotional Regulation (ER), and Transactional Support (TS), which are three primary dimensions targeted to support the development of children with ASD and their families. The SC and ER domains delineate specific, measurable outcomes for the child and are organized by communication stage, beginning with the Social Partner Stage, before the development of any words. The TS domain delineates outcomes for the parent or other communicative partners and includes teaching strategies and learning supports that are selected to help the child meet individualized outcomes. SC targets for toddlers with ASD include expanding the use of gestures, sounds, and words, initiating spontaneous verbal and nonverbal communication, understanding the meaning of words, initiating and responding to joint attention, increasing functional object use and pretend play, and extending reciprocity in interaction. ER targets for toddlers with ASD include being available for learning and expressing emotion, expanding self-regulatory strategies to calm self when dysregulated, using communication to help regulate emotion when frustrated or help is needed, and using regulatory strategies to stay engaged in activities and handle new and changing situations. SC and ER targets are integrated to prevent the development of problem behavior, consistent with tenets of positive behavior support.

### ***Systematic Instruction Using Evidence-Based Strategies***

Children with ASD learn when structured learning opportunities and systematic techniques are embedded to

foster active engagement (Schreibman et al., 2015). ESI incorporates deliberate instruction using evidence-based naturalistic behavioral strategies that are developmentally sensible for toddlers. ESI is intentionally embedded throughout the daily activities of the family with consideration of the sequence, ease of strategy use, frequency of repetition, and sufficiency of opportunity within various activities (Wetherby et al., 2014). Ongoing monitoring with corresponding adjustments in programming is based on observational data. Parents learn to use intervention strategies matched to the priority learning targets dispersed throughout daily activities to increase opportunities for teaching and learning when the activity occurs.

### ***Intensity Needed for Children With ASD***

The intensity of intervention needed for children with ASD is achieved through the integration of the core features of ESI. Interventionists coach parents on how to competently and systematically use intervention strategies throughout the day in typical activities and collaboratively develop a plan to monitor implementation adherence that supports 25 hr per week of active child engagement. Parents complete a daily log of the minutes they embed intervention strategies within the activity category to tally the hours per week and review it with the interventionist as a measure of adherence. Although it is not possible to verify the hours reported by parents in the daily log, the recording of the daily log by the parent and the weekly review with the interventionist may serve as an important reminder about embedding intervention strategies across a variety of activities for many hours each day. The intensity of intervention needed to provide optimal outcomes is not yet determined for infants and toddlers at risk for ASD; however, research suggests that more time spent in active, positive engagement results in better outcomes for preschoolers. A toddler's time spent participating with a caregiver in typical caregiving, play, and family activities each day adds up quickly. We believe that embedding intervention strategies in activities and play that are preferred and occur naturally provides a way to maximize intensity of intervention and reduce professional time, making the model feasible within community settings and Part C EI programs.

### ***Findings From Our RCT of ESI With Toddlers With ASD***

Wetherby and colleagues (2014) reported findings from a multisite RCT of ESI with 82 toddlers with ASD and their families to compare two parent-implemented intervention conditions for 9 months each: (a) individual-ESI offered in two to three weekly sessions at home to teach parents how to embed strategies to support social communication skills for 25 hr a week within everyday routines, activities, and places and (b) group-ESI with an information, education, and a support group offered once a week. Toddlers with ASD were recruited at 18 months of age and randomly assigned to individual or group and then, using a

cross-over design, received the other condition. Implementation fidelity of ESI by the EI provider was monitored for 20% of intervention sessions, with an average of 81% fidelity (80%–82%) for individual-ESI and 88% (86%–90%) for group-ESI. See Wetherby et al. for a detailed participant description.

### ***Main Effects on Standardized Measures of Child Outcomes***

Wetherby et al. (2014) found that, after 9 months of intervention, children in both conditions showed significant improvement on all three composites of the Communication and Symbolic Behavior Scales Behavior Sample (Wetherby & Prizant, 2002), but children in individual-ESI made significantly greater gains on the social composite ( $\text{Time} \times \text{Condition}: F(1, 71.79) = 4.14, p = .04$ , Hedge's  $g = 0.48$ ). On the Mullen Scales of Early Learning, children in both group and individual conditions showed significant improvements on receptive and expressive language scales, but children in individual ESI showed significantly greater gains in receptive language,  $F(1, 74.45) = 7.46, p = .008$ , Hedge's  $g = 0.58$ . On the Vineland Adaptive Behavior Scales, children in both conditions showed significant improvements in communication, but children in individual-ESI showed significantly greater gains,  $F(1, 75.72) = 8.76, p = .004$ , Hedge's  $g = 0.69$ . On the Autism Diagnostic Observation Schedule (Lord, Rutter, DiLavore, & Risi, 1999), children in both conditions showed a significant decrease in symptom severity on SA and no significant change in RRB. The lack of change in RRB may reflect improvement in that symptoms in this domain unfold in the first few years and the intervention gains in social communication may have slowed this unfolding. Taken together, these findings support the effectiveness of ESI as a community-viable intervention and are particularly important in light of the lack of main effects on standardized assessments of child outcomes in other parent-implemented interventions for toddlers with ASD.

Our multisite RCT of the ESI model was the only parent-implemented intervention that reported differential treatment effects on standardized measures of child outcomes, including social communication, developmental level, and adaptive behavior. The magnitude of the change in child outcomes after 9 months of ESI was comparable with that of clinician-implemented ESDM after 12 months. A direct comparison study would need to be done to determine whether these comparable results are due to the treatments themselves or are an artifact of differences in the study samples, but the published findings suggest that ESI parent-implemented intervention may have comparable effects to ESDM clinician-implemented intervention, offering support for the impact of ESI parent-implemented intervention. The hours of clinician time in the ESI RCT was an average of 2.46 hr per week ( $SD = 0.93$ ), compared with 15.2 hr per week, capturing potential cost-saving benefits for parent-implemented intervention.

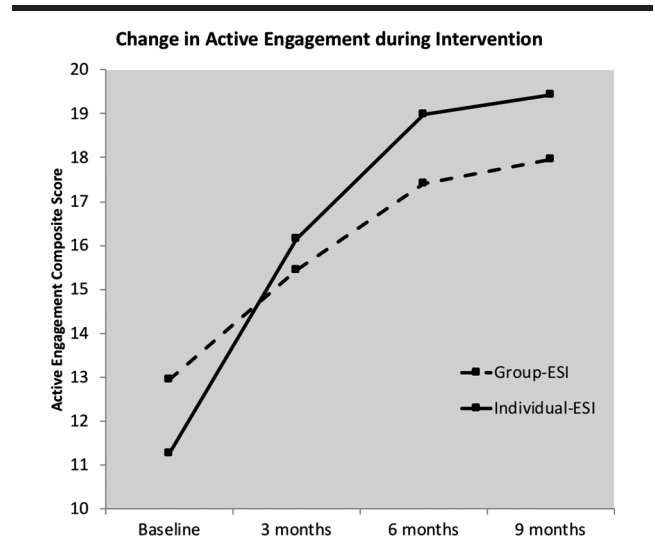
## New Findings on Child Active Engagement From the ESI RCT

The notion of generalization across interaction and context needs to be considered when measuring treatment effects from targeted proximal outcomes of parent–child interaction to downstream effects on more distal measures of child outcomes for parent-implemented intervention that occurs in the natural environment (Green et al., 2010). The child outcome measures of social communication, autism symptoms, adaptive behavior, and developmental level reported in the ESI RCT were distal to the treatment targets supported by parents as they were measured during child interaction with an assessor in a different setting. We developed the Measure of Active Engagement (MAE; Wetherby, Morgan, & Holland, 2013) to quantify a more proximal measure of targeted treatment outcomes based on child interaction with the parent during everyday activities in the natural environment that goes beyond parent synchrony and child initiation. The MAE operationalized active engagement into eight components (see definitions in the Appendix), which correspond to the ESI framework for child outcomes targeted by parents. The MAE is rated from videos of home observations when the clinician was not present lasting approximately 1 hr, collected at baseline and 3, 6, and 9 months later during the 9-month treatment condition. Two 10-min intervals at the beginning and end of each home observation were coded using a 3-point rating scale for the eight components. A composite score was derived by summing the ratings of the eight components for the two intervals. Interobserver reliability for the MAE was calculated using generalizability (*g*) coefficients for pairs of two independent raters on randomly selected video recordings for at least 10% of the samples scored by each rater. All *g* coefficients were over .73, which is considered substantial for demonstrating interrater reliability (Mitchell, 1979) with an average of .83 for the components and .94 for the composite, indicating high interrater reliability.

### Main Effects on MAE

The mean MAE composite scores at four time points (baseline and 3, 6, and 9 months later) for children in individual-ESI and group-ESI conditions are presented in Figure 1. The MAE offers a proximal treatment outcome measured from a naturalistic home observation to expand upon the distal outcome measured from standardized assessments in clinical settings reported in Wetherby et al. (2014). As would be expected given the random assignment of children to treatment conditions, those randomized to group- and individual-ESI did not differ on MAE at baseline ( $p = .19$ ). Refer to the original report of the ESI RCT for details on participants and research method (Wetherby et al., 2014). A linear mixed model with a fixed effect of time revealed a main effect of time on MAE composite scores. That is, MAE scores increased significantly from baseline to the end of the treatment

**Figure 1.** Mean active engagement composite scores at baseline and 3, 6, and 9 months later by Early Social Interaction (ESI) treatment condition.



condition,  $F(3, 224.64) = 39.52, p < .001, d = 1.03$ . Follow-up analyses revealed that increases in MAE scores were significant from baseline to 3 months of intervention,  $F(1, 80.19) = 31.08, p < .001, d = 0.55$ , and from 3 to 6 months,  $F(1, 76.18) = 13.38, p < .001, d = 0.35$ , but not between 6 and 9 months,  $F(1, 69.99) = 0.80, p = .38, d = 0.09$ . Stability from 6 to 9 months may reflect the maintenance and generalization phase of ESI when sessions were reduced from three to two times per week, with one session in a community setting (e.g., playground, grocery store, or restaurant).

Next, treatment condition as a between-subjects variable and an interaction term were added to the mixed model to examine whether improvement in MAE scores during treatment differed for those in individual-ESI and group-ESI conditions. The significant interaction term,  $F(3, 224.63) = 2.64, p = .05, d = 0.40$ , indicates that, although both treatment groups showed improvement, those in individual-ESI demonstrated significantly greater improvement in MAE scores than those in group-ESI. Additional analyses that included time as a within-subjects variable revealed that this differential effect of treatment condition on MAE scores was significant from baseline to 3 months,  $F(1, 80.19) = 4.40, p = .04, d = 0.39$ . However, improvement did not differ by treatment condition from 3 to 6 months,  $F(1, 76.12) = 0.42, p = .52, d = 0.14$ , and as indicated above, significant improvement was not observed for either condition from 6 to 9 months,  $F(1, 69.91) = 0.31, p = .58, d = 0.08$ .

Finally, the relationship between change in active engagement during the treatment condition and distal child outcome measures measured at the end of treatment (9 months after baseline) was tested. Separate mixed models were conducted for each of the standardized outcomes (i.e., measures of social communication, autism symptoms, adaptive



behavior, and developmental level), where time (baseline and 3, 6, and 9 months later) was included as a within-subject factor and the outcome measure was included as a between-subjects factor. Results of these analyses revealed that the change in MAE composite score from baseline to the end of treatment significantly predicted outcomes on the Communication and Symbolic Behavior Scales Social,  $F(3, 203.46) = 5.00, p = .002$ , Speech,  $F(3, 201.15) = 3.85, p = .01$ , and Symbolic,  $F(3, 207.14) = 6.19, p < .001$ ; Mullen Scales of Early Learning Visual Reception,  $F(3, 208.28) = 6.24, p < .001$ , Fine Motor,  $F(3, 208.35) = 3.54, p = .02$ , Receptive Language,  $F(3, 208.36) = 6.65, p < .001$ , and Expressive Language,  $F(3, 208.38) = 4.95, p = .002$ ; Vineland Adaptive Behavior Scales Social,  $F(3, 210.64) = 5.06, p = .002$ , Daily Living,  $F(3, 209.68) = 4.23, p = .006$ , and Communication,  $F(3, 210.87) = 5.04, p = .002$ , including Receptive,  $F(3, 210.70) = 5.35, p = .001$ , and Expressive,  $F(3, 210.31) = 5.41, p = .001$ ; and Autism Diagnostic Observation Schedule SA,  $F(3, 209.79) = 3.05, p = .03$ , as evidenced by a statistically significant interaction term of outcome by time on active engagement. Thus, greater change in MAE scores was related to higher scores in those distal outcome measures at the end of the 9-month treatment condition.

### ***The Lens of Active Engagement***

The NRC (2001) recommended progress monitoring for children with ASD at least every 3 months to inform programmatic decisions and guide intervention refinements if the child is not improving. The lens of active engagement is a guidepost for parent support within everyday activities to monitor proximal treatment outcomes and inform decisions about child progress. Our findings suggest that treatment responders, as measured by changes in active engagement, may be identified by the end of the first 3 months of treatment, thus informing the team of the effect of ESI for the child and his or her family. The MAE offers a new measure in the natural environment with good psychometric features that is sensitive to change after 3 months of treatment for young toddlers with ASD and that predicts outcomes on standardized measures of social communication, developmental level, adaptive behavior, and autism symptoms.

### **Solutions to Bridge the Research-to-Community Practice Gap**

A review of parent-implemented interventions by the Autism Speaks Toddler Treatment Network (ASTTN) of eight parent-mediated interventions involving 389 toddlers identified specific research needs (Siller et al., 2013). Paramount was the importance of community-viable interventions encompassing the entire EI team, for example, primary care, EI providers, early care and education, and the family, especially for children under 24 months when parents may be less ready to seek a diagnosis or participate in services. Parents who are not ready or are initially

unwilling to participate in Part C practices can inadvertently delay and decrease the potential effectiveness of the EI during critical developmental phases. ASTTN recommendations also emphasized the importance of offering information and emotional support that were immediately useful and tangible for parents, while engaging them in the collaborative process, and learning more about factors that moderate treatment efficacy (Siller et al., 2013).

The ASTTN brought together a workgroup of autism researchers to form a consensus statement that operationalizes the common features in evidence-based treatments for young children with ASD (Schreibman et al., 2015). The group coined the term *naturalistic developmental behavioral interventions* (NDBIs) to capture the finding that most studies of toddler interventions are based on naturalistic approaches to promote generalization of learning within a developmental framework rather than traditional applied behavior analysis but are rooted in principles of behavior learning and developmental sciences. Evidence is emerging for the efficacy of NDBIs for toddlers with ASD, which blend behavioral learning and developmental science fields. Among these empirically supported interventions is ESI, which is designed to achieve the necessary intensity for toddlers with ASD using parent-implemented intervention within natural environments.

### ***Coaching to Build Caregiver Independence***

A critical ingredient to achieve the intensity of active engagement needed for very young children with ASD used in ESI is coaching parents to intentionally embed intervention strategies during everyday activities. The ESI coaching model was developed from the broader EI research on coaching families to address the intensity needed to support learning for children with ASD. The effectiveness of parent-implemented interventions for children with developmental disabilities has been well established; however, fewer studies have included or focused on younger children with ASD using a collaborative coaching approach (Kaiser, Hancock, & Nietfeld, 2000; Kashinath, Woods, & Goldstein, 2006; Landa et al., 2011; Rogers et al., 2014; Schertz et al., 2011; Wetherby et al., 2014). Empirical evidence suggests that parents can learn a variety of specific intervention techniques, even within a relatively brief window of time; however, they may not always maintain strategy use or implement intervention with sufficient intensity to change children's long-term outcomes (Siller et al., 2013). An important distinction among parent-implemented interventions is the coaching or training method used to teach parents and the specific coaching strategies that support caregivers to generalize and sustain their fidelity and dosage of strategy use. On one end, parents can be passive recipients of prescriptive lessons to complete with their child; on the other end, parents can be active learners who are partners with the interventionist by contributing to the planning and decision making. To change developmental trajectories of children with ASD, a coaching approach is needed that moves beyond a direct transfer of knowledge

and prescriptive application to one that empowers parents by increasing their self-efficacy to plan, implement, problem-solve, adapt, reflect, and refine strategies and supports based on priority targets, child change, and activity demands.

The active partnership role of parents within the ESI coaching model differentiates it from other parent-implemented ASD interventions. In a meta-analysis of 58 RCTs, Dunst and Trivette (2012) identified six critical characteristics of evidence-based adult learning practices: (1) introduction (e.g., sharing information in written, oral, and/or activity formats, planning for learning), (2) illustration (e.g., demonstration or role play), (3) application practicing (e.g., real-life application, problem solving within the active practice), (4) evaluation (e.g., instructor feedback and review, learner self-assessment), (5) reflection (e.g., review performance improvement, guided self-reflection), and (6) mastery (e.g., standards-based self-assessment, learner-completed fidelity of implementation checklists). The ESI coaching model not only systematically represents these effective adult learning characteristics as specific practices within the graduated coaching sequence but also equips the parents as decision makers and problem solvers. The ESI coaching approach moves systematically across the following steps: (1) building consensus on the session targets, activities, and strategies; (2) deliberate practice with coaching supports matched to the caregiver's support needs; (3) opportunities for repetition to increase competence of the caregiver and child; and (4) reflection and problem solving to increase a deeper understanding and interpretation of actions combined with planning led by the parent.

The intentional focus on extending adult learning through deliberate practice, which is woven into the coaching model, is a unique feature of ESI that may make it particularly feasible and effective in supporting parents to bring about child change. Deliberate practice is a theoretical framework that incorporates training activities designed by a coach or teacher to bring participants to an expert or refined, sophisticated level through repetition with detailed feedback (Ericsson, 2015; Ericsson, Krampe, & Tesch-Römer, 1993). To build caregiver independence, participants in ESI are given detailed in vivo or technology-supported feedback by professionals. Caregivers also actively evaluate their own performance as they embed intervention intentionally with their child between coaching sessions and reflect on these experiences with the interventionist at the start of the next session. Self-assessment and reflection lead to deeper understanding and generalization of learning for adults (Bransford, Brown, & Cocking, 1999). Detailed measures of fidelity ensure that all participants consciously monitor their targets and build upon successes, thus increasing engagement and maintenance in practice, all of which are key features of the theoretical framework (Ericsson, 2015). All of these are also incorporated into the training model of ESI, in which coaches themselves are taught by master coaches to develop, accurately measure, self-evaluate, and monitor their own practice goals, independently refining their practice to enable reproducible performance—so that

they can themselves become teachers (Dunst & Trivette, 2012; Ericsson, 2015).

Connecting with the family and building their capacity by closely monitoring progress across activities and always pushing to advance to the next target, level, or new activity is a linchpin of ESI. Without caregiver competence and the confidence that their growing understanding and capacity to support their child's learning provides, the child's program stays dependent on the input of the interventionist, which may limit the impact on the child. In ESI, the intervention for the child is directly related to the support provided to the parent to implement embedded intervention between sessions with the provider. As the parent learns, so does the child, necessitating that the parent's learning be individualized and planned carefully, just as it is for the child. This model of parent-implemented intervention is not merely cost-saving by decreasing hours of provider-delivered implementation; a priority goal in ESI is that the caregiver gains independence as a decision maker and problem solver to expand generalization and ensure maintenance of learning.

### ***Technology Solutions for PD to Scale Up for Community-Based Dissemination***

The need for high-quality PD that influences provider practice change is essential for the delivery of evidence-based intervention with fidelity. This need is particularly great for serving toddlers with ASD, given that many providers have not had relevant or extensive preservice education (Rakap, Jones, & Emery, 2015). Traditional workshop models of PD have not been associated with significant learner behavior changes (Snyder, Hemmeter, & McLaughlin, 2011); therefore, their utility should be limited to increasing awareness or transmitting introductory knowledge. Systems of PD, as opposed to episodic one-time approaches, that incorporate components of implementation science and innovative delivery mechanisms are increasingly being recommended and supported to increase effectiveness (Dunst, 2015; O'Keefe, Henderson, & Chick, 2017; Schachter, 2015).

Research on PD identifies the importance of manualization with explicit procedures illustrating the intervention, supported by coaching and feedback of the personnel, to improve fidelity (Dunst, 2017). PD using job-embedded strategies such as frameworks that support individualized treatment goals and checklists or rating scales for progress monitoring also result in improved fidelity (Snyder, Hemmeter, & Fox, 2015). Although the availability of online training has increased overall (Curtiss et al., 2016), focus on toddler treatments is limited, and PD in coaching to support parent-implemented intervention is both rare and costly. Availability of online learning objects is increasing, providing opportunities for professionals, parents, and the general public to expand awareness, knowledge, and practices. Online resources including Ohio Center for Autism and Low Incidence (OCALI; <https://ocali.org>) and the National Professional Development Center on Autism Spectrum Disorders (<http://autismpdc.fpg.unc.edu>) offer



PD modules at no cost. These self-directed learning resources are valuable for professionals; however, they often lack the depth of content focused directly on toddlers and caregiver coaching.

Online learning technology can be expanded beyond self-directed resources and modules to complete systems of PD with adequate dosage and duration when a multiple-component, learner-oriented approach is used. There is a need for varying delivery formats, resources, and tools—including interactive videos, webinars, just-in-time resource guides, rubrics, and a system for building and maintaining communities of practice. The intentional inclusion of these learning components within technology-supported PD models provides the foundation for a systematic approach and prevents them from becoming the next “workshop-only” model of ineffective PD. Furthermore, technology-supported PD can decrease personnel and access barriers, particularly in rural and resource-limited areas, by providing scheduling flexibility and removing the need for travel. Interventionists can access technology-supported PD on their own time, without time away from service delivery to children and families. Technology-supported PD also serves as a reference for providers at any time to review, explore resources, and problem-solve options for intervention via review of videos online.

Over the course of ESI, we have collected an unparalleled video library with a large number of toddlers with autism and their families embedding intervention strategies and supports in their natural environments. With permission of the families, this collection of video footage enabled the development of Autism Navigator for Early Intervention Providers, a 30-hour online self-guided PD course. Alongside extensive illustrative video clips, Autism Navigator uses interactive slides with audio narration, closed captions, and learning assessments. Participants also have links to web resources, research briefs, supporting documents for job-embedded applications, and documents to share with families. Video clips illustrate core diagnostic features, key social communication milestones and early signs of ASD, how to gather and share information with families, evidence-based EI strategies and supports used by families of toddlers with autism in everyday activities, and ways to manage challenging behavior using positive behavior support strategies. Each video player contains sets of video clips that compare and contrast features across children, families, or contexts with narration that recaps key points and highlights critical behaviors.

As evidenced in other online PD systems (Pianta, Mashburn, Downer, Hamre, & Justice, 2008), there are benefits when participants join together, physically or virtually, to share experiences and discuss implementation strategies within communities of practice. Autism Navigator convenes monthly webinars for participants enrolled in the Knowledge and Skills level and a second for those increasing their proficiency through the Mastery level. These gatherings are designed to increase learner engagement with course content and related tools and include interactive discussions based on video exemplars that address application

of the ESI practices and illustrate caregiver and child change over time. The ability to view videos of diverse children and families and engage in group discussion promotes problem solving and reflection between participants and master coaches. Each webinar also highlights additional tools and resources, reports group progress toward completing the modules, and provides research updates. This PD course supports scaling up for larger multisite research projects as well to facilitate the process of adopting evidence-based practice and sustaining its high-fidelity use in community-based EI programs designed to reduce the time between research and widespread implementation.

### ***Harnessing Technology to Change Developmental Trajectories for Toddlers With ASD***

Technology-supported intervention can provide families with information, education, and support and individual coaching. This includes online group meetings or “check ins” and individual mobile coaching delivered via video conferencing. This is a third strategy to achieve successful implementation, scalable community uptake, and sustainability of evidence-based parent-mediated interventions for children with ASD in medical, social service, and EI systems. Technology is clearly used by families for many reasons to support information needs, as evidenced by extensive website and social media networks used by family members of children with ASD (Reinke & Solheim, 2015). A Google search for “autism” yields over 37 million hits. Technology is readily available with 75% of U.S. adults owning a smartphone and 92% of younger adults aged 18–29 years owning one. Improvements such as responsive web design make it easier to access information and participate in videoconferencing. Rather than discriminating against families from lower-income homes as broadband Internet access does, smartphones and tablets are identified as the most frequently used tool to link to the Internet and to connect to others by individuals earning under \$30,000 annually (Smith, 2017).

An emerging body of literature has identified telepractice as an effective intervention tool for providing services in a cost- and time-effective manner to children with autism and their parents (National Autism Center, 2015; Vismara, McCormick, Young, Nadhan, & Monlux, 2013; Wainer & Ingersoll, 2015). Telepractice services have been perceived positively by caregivers of young children with ASD (e.g., Vismara, Young, & Rogers, 2012; Wainer & Ingersoll, 2015). Caregivers have been able to successfully embed intervention strategies when individual coaching is provided via telepractice (e.g., Meadan et al., 2016; Pickard, Wainer, Bailey, & Ingersoll, 2016; Snodgrass et al., 2017; Vismara et al., 2012; Wainer & Ingersoll, 2015). A recent pilot RCT of Project IMPACT online, a parent-mediated reciprocal imitation training, compared self-directed and therapist-assisted telehealth intervention for children with ASD (Ingersoll, Wainer, Berger, Pickard, & Bonter, 2016). Children in both groups made improvements in language, with the children in the therapist-assisted group making significant

improvements in social skills. Results suggested some benefit to online learning when professionals provided coaching, as has been found in studies of traditional NDBIs. In the therapist-assisted condition, other significant findings included increased parent fidelity of intervention and more positive parent perceptions of the child and of the programming (Pickard et al., 2016).

Ingersoll, Shannon, Berger, Pickard, and Holtz (2017) also conducted an open trial of their self-directed parent-mediated intervention modules and compared the demographics, course engagement, and knowledge survey scores of families who participated in their open and controlled trials. Although only 12% of participants in the open trial completed the program, compared with an 88% completion rate in the controlled trial, they found that program completion was significantly associated with scores on the knowledge assessment, suggesting that the content delivered by the self-directed site had the potential to contribute positively to parent education needs.

Thus, although research in this area is still in a nascent stage, results suggest that information and education may be provided by group or self-directed technology-supported platforms, whereas increased support provided by individual coaching is likely an active ingredient to promoting child change. In addition to information and social support, technology-supported ESI has multiple advantages, such as availability on demand, accessibility, cost, self-directed learning, compatibility with mobile devices, and repetition when needed (Meadan & Daczewitz, 2015; Wainer & Ingersoll, 2013) and some limitations that have yet to be explored, such as scheduling synchronous interaction (i.e., learners being online at the same time), follow-up training, maintenance of skills and strategies learned, and generalization (Vismara et al., 2012).

The next step in our research is to determine ways to make the ESI model more portable and to incorporate innovative technology to support scalability and sustained practice change in community EI systems. We have developed a “Seamless Path for Families” by maximizing technology supports—beginning with online tools that teach parents early social communication milestones. For families with a positive screen for autism, our Seamless Path offers an online introductory course, *About Autism in Toddlers*, to learn the early signs of autism with video clips of over a dozen toddlers with ASD. For families who suspect their child has ASD, the *How-To Guide for Families* is an interactive online self-paced course that has 10 hr of interactive slides and 5 hr of video libraries. It will put in the hands of families hundreds of video illustrations of evidence-based intervention techniques they can implement in everyday activities to support their child’s learning as soon as they suspect autism. This course teaches families how to embed strategies and supports into their everyday activities. These online tools and courses provide technology-supported resources that are interactive, individualized, and focused on application to ensure knowledge is applied and sustained, which was a major limitation in previous technology-supported studies (Meadan et al., 2016; Wainer & Ingersoll,

2013). This *How-To Guide for Families* is instrumental for EI providers coaching with the ESI model to help families they serve learn more efficiently so that coaching sessions can focus on changing developmental trajectories of toddlers with ASD and supporting their families. A further advantage of the ESI web platform is that it is available for use by multidisciplinary teams of EI providers to increase coordination and implementation fidelity of ESI strategies. It also provides an online screening and monitoring system, and the family tools and resources grow with the child.

## Conclusions

Providing intervention of adequate intensity to change developmental trajectories of young children with ASD is challenging for health care and education systems. Services delivered by professionals within IDEA Part C average 2–3 hr per week (Hebbeler et al., 2007). The attractiveness of parent-implemented intervention is its potential to advance a community-viable solution for achieving the level of intensity needed to effect therapeutic change. It guides parents to maximize learning throughout the day using activities, materials, and people familiar with the family and child over the many hours of parent–child interaction occurring naturally in the home or elsewhere and to continue to use the intervention strategies after the coaching is completed (Roberts & Kaiser, 2011; Woods, Wilcox, Friedman, & Murch, 2011). Natural environments philosophy not only reflects federal legislation for Part C but is compatible with many of the contemporary behavioral and developmental approaches used for children with ASD (Schreibman et al., 2015), which have shown that embedding intervention within everyday activities promotes generalization of learning. Availability of a community-viable treatment for toddlers with ASD makes the recommendations of the Council on Children With Disabilities (Adams & Tapia, 2013) for collaboration of primary care and Part C systems possible and offers the potential for improving early detection and addressing existing health disparities in access to EI. Technology-supported ESI is pioneering, by incorporating evidence-based active ingredients while reducing professional time, to offer an efficacious treatment for implementation in natural environments that is affordable for community-based EI systems. Capitalizing on the use of innovative technology can accelerate access to evidence-based EI for toddlers with ASD, addressing health disparities, allowing for immediate response as soon as ASD is suspected, and rapidly bridging the research-to-practice gap.

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## Appendix (p. 1 of 2)

### Measure of Active Engagement (Wetherby et al., 2013)

The measure of active engagement (MAE) is an index of the proportion of time the child is actively engaged during a naturalistic home observation of everyday activities orchestrated by the parent without coaching or feedback from the intervention provider. The home observation is video-recorded for later scoring. The parent is instructed to engage and interact naturally with their child in six different activity categories (play with objects, play with people, caregiving, snacks and meals, book sharing, and family chores) during an hour of observation.

Following are the definitions for the eight components of active engagement that include benchmarks for each rating. The child must display **all** behaviors specified in that rating or should be assigned the next lower rating.

#### 1. Is the child well regulated?

- 0 = Child's emotional state interferes with availability for interaction and learning the majority of the time. Child does not actively use strategies to manage emotions.
- 1 = Child is available to interact and learn some of the time. Child may have many brief moments of dysregulation or more than one longer episode but shows at least two moments of actively trying to manage their emotions.
- 2 = Child is available to interact and learn the majority of the time despite brief moments of dysregulation. Child may have some brief moments and no more than one longer episode. Child shows at least three moments of actively trying to manage their emotions.
- 3 = Child is able to regulate and actively manage emotions and remain readily available for learning and interaction most of the time, with no more than three brief moments of dysregulation (10 s or less).

**2. Is the child productive?**

- 0 = Child is not using materials in an appropriate or conventional way. Child is unengaged or not actively attending to others or the activity.
- 1 = Child has emerging productivity with materials OR social interactions some of the time. Productivity may be incidental or very rarely occurring at other times.
- 2 = Child has productivity with materials AND social interactions within an activity that has a shared agenda some of the time.
- 3 = Child has sustained, active productivity most of the time that includes people; variations of actions or materials; AND a clear, meaningful role.

**3. Is the child socially connected?**

- 0 = Child is unaware or avoiding interactions with people.
- 1 = Child is socially oriented some of the time but lacks shared agenda with others OR there may be a shared agenda some of the time. There is little to no evidence of reciprocal interaction.
- 2 = Child is socially oriented the majority of the time AND shows awareness of a shared agenda. There are a few brief moments of reciprocal interaction.
- 3 = Child is socially oriented most of the time, shows awareness of a shared agenda, AND shows frequent reciprocal interactions.

**4. Within each activity, is the child looking at faces?**

- 0 = Child never looks at faces in social interactions. If gaze to face occurs, it appears accidental or in response to a sound and not tied to interaction.
- 1 = Child looks toward caregiver's face to get wants and needs met OR to share enjoyment or interests but not both. Gaze to face occurs one or two times.
- 2 = Child looks toward caregiver's face occasionally (at least three times) AND both to get wants and needs met AND to share enjoyment or interests OR is looking once per minute but with clear missed opportunities.
- 3 = Child regularly (average of at least once per minute) looks to faces for both instrumental and social purposes.

**5. Within each activity, is the child responding to bids for interaction?**

- 0 = Child rarely or never acknowledges or responds to bids from others.
- 1 = Child responds on occasion but inconsistently OR child responds but only with heavy support (physical guidance or direction) to follow through.
- 2 = Child responds consistently but with delay OR child responds consistently but still needs extra support (repetition, gestures, physical guidance) from caregiver some of the time and/or in certain activities.
- 3 = Child responds immediately and consistently with a sound, word, gesture, or action most of the time.

**6. Within each activity, is the child initiating directed communication?**

- 0 = Child does not initiate directed communication.
- 1 = Child only initiates directed communication to get wants and needs met (request object, request help, or protest) or for any one limited function. Initiations for other functions such as to draw attention to self, share enjoyment, or share interests are rare.
- 2 = Child shows evidence of initiated communication to get wants and needs met and at least one more social reason, but at a low rate (below two times per minute).
- 3 = Child initiates directed communication regularly (at least two times per minute) and for a variety of communicative functions including to get wants and needs met, to draw attention to self, to share enjoyment, and to share interests.

**7. Is the child demonstrating flexibility?**

- 0 = Child does not show flexibility with materials, actions, or topics AND does not show flexibility during transitions between activities.
- 1 = Child shows flexibility with two different materials, actions, or topics OR flows with one transition between activities.
- 2 = Child shows flexibility with at least three different materials, actions, or topics AND flows with at least one transition between activities or agenda suggested by others.
- 3 = Child shows flexibility with at least three different materials, actions, or topics; flows with at least one transition between activities or agenda suggested by others; AND accepts variations or changes in materials, actions, or topics most of the time. Child initiates a meaningful change at least one time.

**8. Within each activity, is the child producing generative language?**

- 0 = Child does not produce generative language.
  - 1 = Child initiates generative language occasionally (one or two clear and unique instances).
  - 2 = Child produces some generative language (at least three clear and unique instances)
  - 3 = Child regularly uses language that is generative or creative (more than three clear and unique instances).
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