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Developmental Changes in Pretend Play from 22- to 34-months in Younger Siblings of Children with Autism Spectrum Disorder

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Abstract

Developmental trajectories of children's pretend play and social engagement, as well as parent sensitivity and stimulation, were examined in toddlers with an older sibling with autism spectrum disorder (ASD, high risk; HR) and toddlers with typically-developing older siblings (low risk; LR). Children (N=168, 97 boys, 71 girls) were observed at 22, 28, and 34 months during free play with a parent and elicited pretend play with an examiner. At 28 and 34 months, children were asked to imagine the consequences of actions pantomimed by the examiner on a pretend transformation task. At 36 months children were assessed for ASD, yielding 3 groups for comparison: HR children with ASD, HR children without ASD (HR-noASD), and LR children. Children in all 3 groups showed developmental changes, engaging in more bouts of pretend play and obtaining higher scores on the elicited pretend and transformation tasks with age, but children with ASD lagged behind the other 2 groups on most measures. Children with ASD were also less engaged with their parents or the examiner during play interactions than either LR or HR-noASD children, with minimal developmental change evident. Parents, regardless of group, were highly engaged with their children, but parents of HR-noASD children received somewhat higher ratings on stimulation than parents of LR children. Most group differences were not accounted for by cognitive functioning. Instead, lower social engagement appears to be an important correlate of less advanced pretend skills, with implications for understanding the early development of children with ASD and for early intervention.

Keywords

High risk siblings; Autism Spectrum Disorder; trajectories of pretend play; social engagement

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Compliance with Ethical Standards

Ethical Approval

All procedures performed in studies involving human participants were in accordance with the ethical standards of the of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Informed Consent

Informed consent was obtained from all participating parents at each study visit.

Conflict of Interest

The authors declare that they have no conflict of interest.

Typically-developing toddlers spend much of their time engaged in exploratory play with toys and other objects as a way of practicing routines and learning about the world (Lillard 2007; McCune-Nicolich 1981; Piaget 1962). By the middle of the second year, play becomes increasingly complex as toddlers move from reliance on sensorimotor exploration and functional activities with toys to also engage in pretend play, reflecting the ability to imbue objects with imaginary characteristics and functions (Fein 1981; Garvey 1990). Pretend play becomes more frequent and elaborated across the third and fourth years of life as children engage in pretend play scenarios that involve role playing, scripted themes, and object transformations (Garvey 1990; Howes, Unger, & Seider 1989). Importantly, early pretend play lays the groundwork for other key aspects of social and cognitive development, including perspective taking, emotion regulation, executive functioning, peer interaction, language, and narrative skills (Brownell & Kopp 2007; Lillard 2007; Sutherland & Friedman 2013; Weisberg 2015).

In contrast to typically-developing children, children with autism spectrum disorder (ASD) show deficits in pretend play by preschool age (Charman et al.1997; Hobson, Hobson, Malik, Bargiota, & Calo 2013; Rutherford, Young, Hepburn, & Rogers 2007; Sigman & Ungerer 1984) and a delay in the emergence of pretend play appears to be one early sign of ASD. However, until recently, ASD was rarely diagnosed prior to preschool age, and thus, the play behavior of very young children with ASD was largely unexplored. Over the past decade, research has focused on the younger siblings of children with ASD who are at heightened genetic risk to develop autism themselves, thereby allowing for the prospective assessment of social and communicative development in children, some of whom will receive a diagnosis of ASD (Rogers 2009; Zwaigenbaum et al. 2007). Indeed, one large-scale study found that almost one in five high risk infants received a diagnosis of ASD by 36 months (Ozonoff et al. 2011). The goal of these prospective studies is to identify early signs of emerging ASD in infancy and toddlerhood in high risk (HR) siblings (Rogers 2009) and to trace the early development of specific aspects of social and cognitive functioning that are known to differentiate between typically-developing children and those with an ASD diagnosis (Christensen et al. 2010; Szatmari et al. 2016). Recent studies indicate that signs of emerging ASD are evident early in the second year (e.g., Gangi, Ibañez, & Messinger 2014; Hutman et al. 2010), and that HR siblings who do not receive a diagnosis by 36 months often show more variable patterns of development (Gangi et al. 2014; Hutman et al. 2010; Ozonoff et al. 2014) and, sometimes, but not always, differ from low risk (LR) children with typically-developing older siblings. The reasons for differences between LR and HR children without a diagnosis are far from clear and are likely to reflect both genetic and environmental factors.

Using this research strategy, we examined the development of pretend play in HR and LR siblings, most recruited in infancy, and followed through 36 months. The current report is a follow-up to an earlier paper (reference removed for blind review) that examined play at 22 months. Measures of pretend play at 28 and 34 months in 3 different contexts, varying in degree of structure and play partner are now added, allowing us to investigate trajectories of play behavior across these 3 age points (22, 28, and 34 months) for 3 groups of children: LR children, HR children without a diagnosis of ASD (HR-noASD), and HR children with a

diagnosis of ASD. The aim is to examine patterns of developmental change in pretend play measures to determine whether HR children with and without a diagnosis of ASD by 36 months differ from LR children and from each other at each age and in the magnitude of change over time. To explore potential mechanisms, we also examine whether group differences in patterns of pretend play development are explained by differences in general cognitive abilities or differences in social engagement with play partners.

Play in Typical Development

Numerous studies have characterized the play behavior of typically-developing children, emphasizing the functions of play (Lillard 2007; McCune-Nicolich 1981; Piaget 1962) and the increasingly sophisticated sequence of activities that characterizes spontaneous play from infancy and toddlerhood (Belsky & Most 1981; Lillard 2007; McCune-Nicholich 1981) to the preschool years (Fein 1981; Garvey 1990). Play in early infancy involves sensorimotor exploration, primarily mouthing and simple manipulation (Belsky & Most 1981; Piaget 1962), as infants learn about the properties of objects. By the end of the first year and beginning of the second, play becomes more elaborated and functional, as toddlers use toys in routine ways consistent with their intended uses, for example, stacking blocks or rolling a toy car along the floor. In the second year, pretend play emerges, first primarily at a basic level with simple acts directed to the self, a doll, or a social partner, such as pretending to feed oneself or a doll in the absence of real food (Fein 1981; Lillard 2007). More complex symbolic play, such as role-playing, builds on these basic pretend skills, and language also becomes more symbolic, thereby supporting more complicated and more social pretend play scenarios. In the current study we examine developmental changes from 22 to 34 months of age in children's ability to produce increasingly sophisticated play sequences when modeled by an examiner (after Brownell & Carriger 1990). We also include a novel task (after Kavanaugh & Harris 1994) at 28 and 34 months, during which children observe an examiner making pretend transformations to a toy animal, and we assess their ability to represent imaginary actions instead of producing them.

As articulated by Lillard (2007), parental scaffolding, joint attention, and social referencing are critical to facilitating advances in pretend play in toddlers. Thus, more sophisticated play is often evident when young children have a social partner to scaffold their play either by following the child's lead or suggesting play activities or themes. In addition, observations of parent-child interaction during play provide a window into levels of reciprocity and social engagement for both parents and children. In the current study we assess developmental changes in children's levels of play while playing with a parent, and also obtain ratings of child engagement and parental sensitivity and scaffolding.

Play in Children with ASD and in High Risk Siblings

It is well-documented that children with a diagnosis of ASD are less likely to engage in either spontaneous or scaffolded pretend play by the preschool years (Charman et al. 1997; Jarrold 2003; Sigman & Ungerer 1984) than either developmentally-delayed or mental-age matched typically developing children. Indeed delays and/or deficits in pretending are a defining characteristic of ASD and are closely linked to cognitive and social deficits

(Hobson et al. 2013; Manning & Wainright 2010; Rutherford et al. 2007), including delays in language development and imitation (Charman et al. 1997; Sigman & Ungerer 1984). These studies indicate that young children with ASD engage in fewer spontaneous pretend play acts than developmentally delayed or typical children, although some children with ASD respond more readily with pretend play acts when provided with direct suggestions or modeling than when they are expected to play on their own (Jarrold 2003). In their classic study, Sigman and Ungerer (1984) found that children with autism spent less time engaged in object-directed, self-directed, and doll-directed acts than children in the comparison groups during both structured and unstructured conditions. In the current study, following Belsky and Most (1981), we distinguish between early non-pretend play (simple manipulation; functional) and basic pretend play to enable detection of the earliest and lowest levels of pretense.

In accordance with Lillard's (2007) argument for the importance of parental scaffolding in the development of pretense in typically-developing children, Hobson et al. (2013) contend that an underlying social impairment, reflected in less social engagement with play partners, may limit opportunities for pretending in children with ASD and may partly explain their lower level of pretend play and imitation. Indeed, Rutherford et al. (2007) found that children with ASD who engaged in joint attention with the examiner showed more frequent pretend play, supporting Hobson's contention. We were able to locate only 2 earlier studies of play in high risk infant siblings; both identified deficits in play behavior during the second year in children who received a diagnosis of ASD, but with marked variability among the HR children without a diagnosis (Christensen et al. 2010; Landa, Holman, & Garrett-Mayer 2007). Christensen at al. speculate that lower levels of play acts in HR siblings who ultimately receive a diagnosis may reflect a lack of social awareness or motivation to engage with play partners, consistent with Hobson's hypothesis about the importance of social engagement for promoting pretend play in children with ASD. We examine this issue in the current study during the period when pretend play is emerging.

The Current Study

In this study we build on this existing research and extend the findings from a recent paper from our research group, in which HR and LR toddlers were studied at 22 months during free play with a parent and during a structured task meant to elicit children's pretending (Campbell, Leezenbaum, Mahoney, Moore, & Brownell 2016). Children's engagement with their parents during play and with the examiner during the structured pretend play task was also assessed. Toddlers with a diagnosis of ASD by 36 months engaged in less pretend play with their parent and received lower scores on the elicited pretend task at 22 months than either the LR toddlers or the HR toddlers without an ASD diagnosis (HR-noASD). Children with a diagnosis were also less engaged with their parents and with the examiner at 22 months than children in the other 2 groups. Nevertheless, parents of children in all 3 groups were sensitive and responsive, although parents of children in the HR-noASD group received somewhat higher ratings than parents of LR children.

The current study presents data on a somewhat larger sample of HR and LR toddlers assessed longitudinally at 22, 28, and 34 months. We include multiple measures of

spontaneous and elicited pretense, using both structured and unstructured tasks, to index developmentally appropriate and differentiated advances in pretend play. We also include a task to assess children's ability to represent, rather than produce, pretend actions. Finally, we considered both cognitive and social correlates of developmental changes in early pretend in children at risk for ASD.

It was expected that LR children and HR-noASD children would show significant decreases over time in functional play and increases in pretending while playing with a parent and would imitate more complex pretend scenarios during the elicited play task. In contrast, we expected that children who received a diagnosis of ASD would show only minimal developmental changes on these measures (functional play, pretend play, elicited pretend) from 22 to 34 months. It was also predicted that those with an ASD diagnosis would continue to differ from the LR and HR-noASD toddlers over time by showing more functional play, less pretend play with a parent, and less ability (or interest in) imitating the pretend play scenarios modeled by the examiner than comparison children. Children with a diagnosis of ASD were also expected to have more difficulty than LR and HR-noASD children on a third task assessing the ability to imagine transformations pantomimed by an examiner; this task was administered only at 28 and 34 months because prior research indicated that it was too difficult for 22- month-olds (Kavanaugh & Harris 1994). Finally, it was expected that children with a diagnosis of ASD would be less engaged with either their parent during free play or the examiner during the structured pretend task across these 3 time points than children in the other 2 groups. Although developmental changes in play behavior were expected in the HR-noASD group, it was unclear whether they would or would not differ from the LR group in either level of play or magnitude of developmental change. Parental sensitivity and support for cognitive development were rated as well, but no hypotheses were advanced about group differences or developmental changes in parent behavior from 22 to 34 months.

Method

Participants

The 168 children included in this report are participants in a prospective study of children at risk for ASD. Infants with an older sibling with ASD and comparison infants with a typically-developing older sibling, most recruited in infancy, were seen at 22, 28, and 34 months for a play-based assessment of social behavior that included the measures described below. Most were seen again at 36 months for a follow-up diagnostic assessment (details below). Groups did not differ in age at any assessment (See Table 1). Parents signed informed consents prior to participation and at each study visit; the research protocol was approved by the University Institutional Review Board.

HR toddlers (n=78, 46 males) were recruited between 6 and 16 months for a study of cognitive and social development, through the Autism Center at the University of Pittsburgh, with the exception of four HR children who joined the study between 18 and 22 months. To be eligible for inclusion in the HR group, children had to be born full-term after an uncomplicated pregnancy and delivery, and have an older sibling diagnosed with autism spectrum disorder according to research criteria. The older sibling's diagnosis was

confirmed by research reliable staff at the Autism Center who administered the Autism Diagnostic Observation Schedule (ADOS; Lord et al. 2000) under the supervision of a licensed psychologist, prior to the younger sibling's enrollment in the study. Infants whose older siblings had known genetic or other anomalies, such as Fragile X, were excluded. Four HR toddlers were half-siblings of the child with ASD.

LR control participants (n=90, 51 males) were recruited from the local obstetrics hospital, community groups, pediatric offices, and word of mouth. Full-term healthy children with a typically-developing older sibling and negative family history of ASD in first and second degree relatives comprised the LR group, most of whom were also recruited in infancy. Parents of LR children completed the Social Communication Questionnaire (Rutter, Bailey, & Lord 2003) on the older sibling prior to study enrollment; all scored well below the ASD cut-off of 15.

Participant characteristics are summarized in Table 1, including comparisons between the LR toddlers, the HR toddlers without a diagnosis (HR-noASD), and the toddlers with a later ASD diagnosis (see below). Participating children are predominantly Caucasian and non-Hispanic (80%) and all but 6 children live in 2-parent families. Parent education was scored according to the Hollingshead Scale (Hollingshead, 1957) and averaged when data for both parents were available. Although the majority of parents in both groups had at least a college degree, the LR parents were more highly educated than the parents of toddlers with ASD; parents of HR-noASD toddlers fell between these 2 groups. The sample included in this report overlaps with participants in several prior publications (Campbell et al. 2016; Campbell, Leezenbaum, Mahoney, Day, & Schmidt 2015; Campbell, Leezenbaum, Schmidt, Day, & Brownell 2015; Campbell, Moore, Northrup, & Brownell, 2017).

Data are available for 145 toddlers at 22 months (80 LR, 48 HR-noASD, 17 ASD), 157 at 28 months (85 LR, 52 HR-noASD, 20 ASD) and 159 at 34 months (84 LR, 58 HR-noASD, 17 ASD). A total of 136 children were seen for all 3 visits (75 LR, 47 HR-noASD, 14 ASD). Data at 22 and 28 months are missing because although most HR and LR toddlers were recruited in infancy for another study, the toddler study did not begin until after some children's second birthdays. Missed appointments and scheduling difficulties accounted for the remainder. Only 12 children (5 LR, 7 HR-noASD) were seen only once, most (n=10) because they reached 22 and 28 months before the toddler study began. In addition, while the majority of assessments were conducted in the university playroom, some data were collected during home visits in order to minimize data loss. Finally, most visits were conducted with children and their mothers, but 14 fathers participated at 22 and 28 months and 21 participated at 34 months. The distributions of fathers did not differ significantly by group. Participating parent and visit location are discussed further under preliminary analyses.

Procedure

Toddlers' Free Play with a Parent—As part of a longer assessment of social development in toddlerhood, children were observed during free play with a parent using a standard set of toys selected to elicit functional and pretend play. These included a dump truck filled with blocks, a school bus with small removable figures, a series of colored

shapes and pegs, a farm with animals, a kitchen set, a xylophone, a teddy bear, and a toy airplane with moving parts. Children were given 5 minutes to explore the toys on their own and then parents were asked to play with their child as they normally would. Because children varied widely in how willing they were to engage with the toys on their own, coding focused on the 10-minutes of children's play with their parent. Children's social engagement with the parent and parent support for the child's play were also assessed during this play interaction.

Children's Levels of Play: ELAN for Windows, a computer-based time-locked system, was used to code children's levels of play (Lausberg & Sloetjes 2009). The play period was divided into 30-second bouts, during which the highest level of play was coded. This resulted in 20 bouts across the 10-minute observation. Three levels of play were coded, based on Belsky and Most (1981): 1) simple manipulation or exploration of objects (e.g., mouthing, banging, throwing, fingering, shaking, visually inspecting) at the lowest level; 2) functional play (the use of objects in an appropriate manner such as pushing the school bus, stacking blocks or putting them into the dump truck, and playing the xylophone), at an intermediate level; and 3) pretend play, at the highest level. To be coded as pretend play, the child had to attribute pretend properties to the toys by acting out a sequence or play scenario (for example, pretending to cook by stirring and "tasting"; feeding themselves or their parent while playing with the kitchen set; moving the school bus or other vehicles while making sounds suggesting driving or flying). Although we also included categories reflecting limited engagement in play with the toys, these occurred rarely and are not considered further. Scores were mutually exclusive and hierarchical such that only one play type (the highest level reached) was scored for each 30-second bout. The number of play bouts (out of 20 possible) during which children exhibited each play type as the highest level of play was entered into analyses.

Child engagement with the parent during play was rated on a 4-point scale adapted from the National Institute of Child Health and Human Development (NICHD) Study of Early Child Care (NICHD Early Child Care Research Network [ECCRN] 1999). The first and second 5 minutes of play were rated separately and the 2 ratings were averaged. Higher ratings indicated that the child brought the parent into his/her play and/or responded positively to parent suggestions or initiations. Lower ratings indicated that the child ignored the parent, actively rejected the parent by turning away or moving away, or showed a clear preference for solitary play that excluded the parent.

Two independent coders, blind to group assignment and later diagnostic status, coded at least 20% of the video records at each age to determine inter-rater reliability. Intraclass correlation coefficients (ICC) were .80 or above for all behaviors across the 3 assessment points (22, 28, 34 months). They averaged .84 for simple manipulation, .93 for functional play, .92 for pretend play, and .84 for child engagement with parent.

Parent Behavior during Play: Coders rated parent behavior using 1–4 point rating scales developed by the NICHD ECCRN (1999). Ratings included "warmth" (affectionate behavior; enjoyment of the interaction), "sensitivity" (following the child's lead; tuning into the child's interests), "intrusiveness" (directing or controlling the interaction, following their

own agenda rather than the child's lead), and "stimulates cognitive development" (teaching and scaffolding play). ICCs, calculated on at least 20% of the records and averaged across time were satisfactory: warmth (.81), sensitivity (.79), intrusiveness (.82), and stimulates cognitive development (.78). As in the NICHD Study, ratings of warmth and sensitivity were highly correlated with each other and negatively correlated with intrusiveness, so a sensitivity composite score was derived by adding the averaged warmth and sensitivity ratings and subtracting the averaged rating of intrusiveness. Stimulation of cognitive development was considered separately because it specifically captures scaffolding play.

Elicited Pretend Play—Measures of children's ability to imitate structured, examiner-administered pretend scenarios with a doll and toy props were obtained (Brownell & Carriger 1990), along with a measure of children's engagement with the task and examiner. Children were seated at a small table with the examiner who modeled four scenarios at four levels of complexity. The examiner modeled each story twice and then asked the child to repeat the story. At level 1, the self is the recipient of the actions (e.g., the examiner pretends to feed herself with a spoon). At level 2, the self is the agent and a doll is the recipient (e.g., the examiner pretends to feed the doll with a spoon). At level 3, the doll is both the agent and the recipient (the examiner has the doll feed herself). At level 4, the doll is the agent and a toy teddy bear is the recipient (the examiner has the doll feed the teddy bear). Boy and girl dolls were used to match the child's gender. Each story (making breakfast; getting ready for bed; making tea; getting ready for school) included 3 actions in fixed order, but the order of presentation of each scenario and the level of difficulty were counterbalanced, with the exception that the easiest level (self as recipient) was always presented first.

Coders blind to group membership scored the child's responses from the video records. For each pretend scenario the number of different actions imitated was scored (0–3), regardless of the sequence in which they were imitated. The focus was on actions imitated; children did not need to use language to receive points on this task. In addition, the level of complexity was scored. For example, if the examiner modeled a level 3 scenario (the doll is making breakfast by pouring cereal, stirring it, and feeding herself), but the child imitated these actions by acting on the doll (i.e., the child feeds the doll), the child would be credited with a level 2 response. If the child acted on himself, he would be credited with a level 1 response. For the purposes of data analysis, a weighted composite score was calculated that included the number of actions imitated for each scenario multiplied by the level (self, doll, doll to self, doll to bear) for each action. In the scenario above, the child who imitated 3 actions at level 2 would receive a score of 6. Inter-observer agreement for the total score, calculated on over 50% of the video records at each age, and averaged over time was .96.

In addition to coding the child's performance on this task, behavior during task presentation was rated, as children's interest and cooperation with the examiner might vary widely, especially in toddlers with autism. Children were rated on 4-point scales for interest (engagement, attention, enthusiasm vs. disengaged, inattentive, bored), compliance (cooperative, waiting for turn vs. grabbing toys, throwing toys, not awaiting turn), and activity level (able to sit at the table or on floor, even if moving around between stories vs. running around the room, frequently on the move). Higher scores reflected better attention, interest and compliance, and less inappropriate activity. Inter-rater agreement (ICC)

averaged across the 3 assessment points was as follows: .72 for interest, .82 for compliance, and .81 for activity level. These 3 ratings were composited into an overall engagement score (range: 3–12).

Pretend Transformations—At 28 and 34 months, children were assessed on their ability to imagine pretend actions, based on earlier work by Kavanaugh and Harris (1994). This procedure was first administered at the 28 month visit because it was considered too difficult for 22 month olds to comprehend. In addition, this assessment was added to the protocol after the study began; thus data are available on 127 28-month olds and 136 34-month olds.

The task was introduced to the child as a game of pretend in which the child would hear stories about 6 stuffed animals. After securing the child's attention the examiner presented the child with a stuffed animal, a story-specific prop, and a choice of 3 pictures. For example, the examiner presented the child with a toy dog and a can of red paint and then pretended to pour paint on the dog. She said “This is my dog. I am going to pretend to put paint on my dog. See. I am putting paint all over him. What does he look like after I do this to him?” The child was prompted to point to the picture that showed the animal after the transformation, from an array of 3: the dog as he appeared; the dog with streaks of red paint, and the dog after an irrelevant transformation (purple spots). There were 6 trials presented in randomized order (dog streaked with red paint; cat with spilled coffee; duck with spilled milk; elephant sprinkled with talcum powder; pig with grape juice; lion with blue ink) and the order of the 3 pictures was also randomized. The proportion of correct responses out of a possible 6 was used in the data analyses.

Developmental and Autism Assessments

Mullen Scales of Early Learning—The Mullen Scales of Early Learning (MSEL; Mullen 1995), a standardized measure of cognitive development, was administered at 24 months. An Early Learning Composite (ELC) score was derived from performance on the Receptive Language and Expressive Language scales and on the Visual Reception and Fine Motor scales. Six children were missing Mullen scores at 24 months because of missed appointments, so their 36-month score was substituted. Another 4 children (2 HR-noASD, 2 ASD) were missing Mullen scores at both ages because of scheduling difficulties or the child’s refusal. One child was missing an ELC score because only a partial Mullen could be administered at both 24 and 36 months. As can be seen in Table 1, the children with ASD had lower scores on the Mullen, differing significantly from the LR and HR-noASD children on the Verbal, Non-Verbal, and Early Learning Composite scores. Because the HR-noASD children also differed from the LR children on the Non-Verbal scale, the ELC was used as a covariate, as it includes both the verbal and non-verbal measures.

Evaluations for Autism—Both HR and LR toddlers were evaluated for an ASD diagnosis at follow-up, using the Autism Diagnostic Observation Schedule (ADOS, Lord et al. 2000). The ADOS, a semi-structured observational assessment, includes play-based activities that are meant to elicit reciprocal social interaction, communication, and stereotyped behaviors and provides scoring rules for a diagnosis of ASD. All children received either Module 1 or 2. Evaluations were conducted by a research-reliable tester from

the Autism Center under the supervision of a licensed clinical psychologist with extensive experience assessing children with ASD; different examiners conducted the diagnostic assessments and the play visits. Diagnostic decisions were based on the 36- month assessment or later for all HR-noASD children. Two children with a diagnosis of ASD were seen at 24, but not 36 months, so their 24-month ADOS scores were used. One HR child with a diagnosis was seen at a local developmental clinic specializing in autism, but the ADOS score was not available. All but 3 LR children were assessed at 36 months; the 24-month ADOS scores for these 3 children were substituted.

Children were classified as ASD if they met cut-off scores on the ADOS (Lord et al. 2000) and also met DSM-IV criteria for an autism spectrum disorder (American Psychiatric Association 2000), as determined by interview and observation. Parents of children with elevated ADOS scores and/or serious clinical concerns were interviewed using the Autism Diagnostic Interview-Revised (ADI-R, Lord, Rutter, & LeCouteur 1994) to provide further information. Final diagnoses were based on a combination of structured diagnostic measures, DSM-IV criteria, and clinical judgment and made by a licensed clinical psychologist; 19 HR toddlers (13 boys) received a diagnosis of ASD. One LR boy with an early language delay and social concerns received a diagnosis of ASD and is included in the ASD group in the analyses.

In addition, ADOS scores were converted to severity scores using the algorithm provided by Gotham, Pickles, and Lord (2009) to allow for comparability across age. As can be seen in Table 1, there was a main effect of group status. The children with a diagnosis (ASD) had substantially higher severity scores than the LR children and the HR-noASD children. LR and HR-noASD children did not differ from one another.

Data Analysis Plan

Hierarchical Linear Modeling (HLM, Bryk & Raudenbush 1992) was used to test differences between groups in growth trajectories of the play, social engagement, and parent variables from 22 to 34 months. HLM is an appropriate analytic tool for data consisting of multiple time points nested within individuals and assesses the data at 2 levels. First, HLM assesses variation within individuals over time (i.e., growth trajectories; level 1), and second, it assesses variation between individuals in growth trajectories (level 2). HLM can also accommodate missing data (Willett et al. 1998), thereby allowing for the inclusion of all participants with at least one visit.

The intercept for all models was centered at 22 months; thus, at level 1 (within individuals), HLM estimated linear growth trajectories in each variable as a function of VISIT (coded 0, 1, 2, to represent the 3 equally spaced visits at 22, 28, and 34 months). The coefficients on the intercept and linear growth terms were modeled as random effects in all models, except for the model of Parent Sensitivity for which the linear growth term did not have significant variability and was therefore fixed. In cases where a variable differed based on visit location or participating parent, the variable was included as a fixed-effect time-varying covariate at level 1 (see Preliminary Analyses below).

At Level 2 (between individuals) the 2 HR Groups (HR-noASD and ASD) were included as person-level predictors of the intercept and linear growth terms. The LR group served as the reference group; thus analyses at Level 2 examined differences in intercept and growth trajectories between LR toddlers and the 2 HR toddler groups. The coefficients (β) represent deviations from the LR group on each of these terms. In cases where a variable differed based on sex, this variable was also included at Level 2 (see Preliminary Analyses below). In addition, all models were run with and without Mullen ELC Scores included as an independent variable at Level 2 in order to control for the effect of cognitive ability on the variables of interest; the analyses that included ELC scores were conducted without data from the 5 children missing ELC scores.

For each variable, planned comparisons were run to examine intercept differences over time by systematically re-centering the VISIT variable. This determined the point at which the developmental trajectories of the 3 groups diverged or came together. Further comparisons addressed specificity by examining potential differences between the ASD and HR-NoASD groups.

Assumptions of normality and homoscedasticity were assessed through examination of residuals. All models met assumptions of homoscedasticity; however due to modest violations of normality assumptions for some variables, robust standard errors are reported throughout.

For the pretend transformation task, two one-way ANOVAs were calculated, one at 28 months and one at 34 months, to avoid subject loss. A repeated measures analysis was also conducted to examine developmental change for the children with assessments at both ages.

Results

Preliminary analyses were conducted to examine whether the play measures varied systematically as a function of child sex, participating parent (mother vs. father), or visit location (lab vs. home), using one-way ANOVAs separately by age to avoid listwise deletion. Only the LR and HR-noASD groups were included in the preliminary analyses of sex differences, as sex and ASD were confounded. Girls were more engaged with their parents during free play at 22 months (p=.049) and more engaged with the examiner during elicited pretend play at 28 months (p=.041) than boys, so child sex was controlled in the analyses of these 2 variables. Children engaged in more simple manipulation during home than laboratory visits at 22 months (p =.022); they also engaged in more functional play at home at both 22 (p =. 026) and 28 months (p=.036). Therefore, visit location was controlled as a time-varying covariate in the analyses of these 2 variables. Children were more likely to engage in pretend play at 22 months when playing with their mothers than their fathers (p = . 006) and they showed a higher level of engagement with mothers than fathers at 34 months (p=.008). In addition, fathers received lower ratings on the sensitivity composite than did mothers at 34 months (p<.001) and lower ratings on stimulates cognitive development at all 3 ages (p<.01). Thus, participating parent was included as a covariate in the analyses of these four variables. Correlations between parent education and dependent measures were low and mostly not significant, so parent education is not considered further. Scores on the

pretend transformation task were unrelated to child sex, visit location, or which parent was present during task administration.

Free Play with a Parent

Results of the HLM analyses for measures of child behavior and parent ratings during free play are summarized in Table 2, and point estimates and 95% confidence intervals based on the HLM models are summarized in Table 3. Statistics associated with the main HLM analyses and presented in Tables 2 and 4 are not included in the text, whereas *p*-values associated with planned comparisons are reported in the text. In addition, descriptive statistics for the variables included in the HLM analyses are provided in two supplemental tables.

Toddler Behavior during Free Play with a Parent—As can be seen in Table 3, simple manipulation, the lowest play level, was relatively infrequent during free play. Groups did not differ from one another in the number of play bouts spent in simple manipulation at 22 months. Furthermore, children in all 3 groups engaged in fewer bouts of simple manipulation over time. The conditional HLM model confirmed that LR children showed a significant decrease in simple manipulation from 22 to 34 months and neither of the HR groups differed significantly from the LR group in intercept or slope (i.e., the rate of decrease over time).

As expected, children in the LR and HR-noASD groups decreased the amount of time spent in functional play, the intermediate level, between 22 and 34 months. Contrary to expectations, children in the ASD group also showed a decline in the frequency of functional play. (See Figure 1 and Table 3). Group differences also emerged both in the amount of time spent in functional play and in the rate of change over time. Children with ASD engaged in significantly more functional play at 22 months than children in the LR group. Planned comparisons revealed that the ASD group continued to engage in more functional play than the LR group at 28 months ($p = .042$), but not at 34 months. A significant change in slope indicated that LR children decreased the frequency of functional play bouts significantly over time. Whereas the ASD group did not differ from the LR group in slope, the HR-noASD group showed a marginally steeper reduction in functional play over time than the LR group ($p = .076$). Because the HR-noASD group showed a somewhat steeper decline in functional play, the difference between the ASD and HR-noASD group became significant by 28 months and was maintained at 34 months (28 months: $p = .007$; 34 months: $p = .017$). That is, the ASD children engaged in more functional play than the HR-noASD children at both 28 and 34 months. Furthermore, by 34 months, the HR-noASD group was also producing significantly less functional play than the LR group ($p = .050$). With Mullen ELC scores included in the model, the marginal difference between the LR and HR-noASD group in linear slope (i.e., decrease) became significant ($p = .036$), as did the intercept difference between the HR-noASD and ASD groups at 22 months ($p = .046$), with the ASD children engaging in more functional play across age.

Figure 1 also displays the estimated growth trajectories for pretend play. Overall, children in all 3 groups increased the frequency of pretend play over time. The LR group had a

significant increasing linear slope, and neither the HR-noASD nor ASD groups differed from the LR group in growth trajectory, indicating a similar rate of change for all 3 groups. Despite an increase in pretend play, however, the ASD group produced significantly fewer pretend play bouts than the LR and HR-noASD groups at 22 months, and planned comparisons revealed that the ASD group's level of pretend play remained significantly below the other 2 groups at 28 (ASD vs. LR: $p < .001$; ASD vs. HR-noASD: $p < .001$) and 34 months (ASD vs. LR: $p = .003$; ASD vs. HR-noASD: $p = .001$). Results for pretend play were unchanged with Mullen ELC scores included in the model.

Child Engagement with Parent during Free Play—Figure 2 displays the estimated growth trajectories for ratings of children's engagement with their parents during free play. Children did not show developmental change across ages. The final conditional HLM model confirmed that the change shown by the LR group was not significantly different from zero and neither of the HR groups differed significantly from the LR group in slope. The ASD children were rated as significantly less engaged with their parents than the LR and HR-noASD ($p<.001$) children at 22 months, 28 months (ASD vs. LR: $p<.001$; ASD vs. HR-noASD: $p < .001$), and 34 months (ASD vs. LR: $p < .001$; ASD vs. HR-noASD: $p < .001$). HR-noASD and LR children did not differ from each other at any time point. Results were unchanged with Mullen ELC scores included in the model.

Parent Ratings during Free Play—As can be seen in Table 3, parents of LR children displayed slight, but non-significant increases in sensitivity over time. Consistent with our previous findings, parents of HR-noASD children were rated as somewhat more sensitive than parents of LR children at 22 months. Parents of ASD children did not differ in their level of sensitivity from parents of LR children. Furthermore, by 36 months, group differences in parent sensitivity were no longer evident. Results remained unchanged with Mullen ELC scores included in the model.

Ratings of "parent stimulates cognitive development" showed a somewhat different pattern. As can be seen in Table 3, these scores increased over time. The LR parents had a significant positive slope and there were no differences between groups in linear rate of change. At 22 months, parents of HR-noASD children were rated higher than parents of LR and ASD ($p = .003$) children. The differences were also evident at 28 (HR-noASD vs. LR: $p<.001$; HR-noASD vs. ASD: $p<.001$) and 34 months (HR-noASD vs. LR: $p=.016$; HR-noASD vs. ASD: $p=.017$). Parents of children with ASD did not differ from parents of LR children at any time point. With Mullen ELC scores included in the model, the intercept difference at 22 months between parents of children with ASD and parents of HR-noASD children was no longer significant.

Elicited Pretend Play

Results of the HLM analyses for measures of child performance and engagement during the elicited pretend play paradigm are summarized in Table 4, and point estimates and 95% confidence intervals based on the HLM models are summarized in Table 5. Figure 3 displays estimated growth trajectories for total scores on this task. As can be seen in the figure, all 3 groups showed better performance on the elicited pretend task over time. The HLM model

confirmed that the LR group displayed a significant positive linear slope, and neither HR group differed significantly from the LR group in rate of change. The ASD group obtained significantly lower total scores than the LR and HR-noASD groups at 22 months (p<.001) and at 28 months (ASD vs. LR: p<.001; ASD vs. HR-noASD: p <.001), but differed only from the LR group by 34 months (p = .017). The LR and HR-noASD groups did not differ from each other at any assessment. Results remained unchanged with Mullen ELC scores included in the model.

Finally, changes in child engagement during task administration are displayed in Figure 4. The LR group had a significant positive growth trajectory, indicating an increase in engagement over time. Both the ASD group and the HR-noASD group had slightly steeper linear slopes than the LR group, although this difference was significant only for the ASD group, with a marginal difference between the LR and HR-noASD (p = .078). Children with ASD were rated as less engaged than LR and HR-noASD (p<.001) children at 22 months. The HR-noASD children were also rated as less engaged than LR children at 22 months. Given the HR-noASD group's increased engagement over time, the difference between the HR-noASD and LR groups was no longer significant by 34 months (28 months: p = .035; 34 months: p = .589). The ASD group, however, continued to be rated as significantly less engaged than both the LR and HR-noASD groups at 28 (ASD vs. LR: p<.001; ASD vs. HR-noASD: p <.001) and 34 months (ASD vs. LR: p<.001; ASD vs. HR-noASD: p <.003), despite their increase in engagement over time. With Mullen ELC scores included in the model, the intercept difference at 22 months between the LR and HR-noASD children became marginal (p = .071).

Pretend Transformations

One-way ANOVAs were conducted on the proportion of correct responses out of a possible 6 on the pretend transformation task. There was a main effect of group at 28 months, $F_{(2,126)}$ = 7.22, p = .001; post hoc tests with a Bonferroni correction indicated that the LR group scored higher than both the HR-noASD, p = .046, and ASD groups, p = .002. This analysis at 28 months included 65 LR children (M=.38, SD=.27), 44 HR-noASD children (M=.26, SD=.26), and 18 children with ASD (M=.14, SD=.24). When this analysis was run controlling for Mullen scores, the group difference at 28 months became marginal, p = .055 and the post-hoc analyses of specific group differences at this age were no longer significant. At 34 months, the group difference in transformation scores was not significant, $F_{(2,135)}$ = 1.79, p = .170, based on 74 LR children (M=.53, SD=.39), 48 HR-noASD children (M=.49, SD=.37), and 14 children with ASD (M=.32, SD=.39).

A repeated measures analysis on the 119 children with complete data at both ages (62 LR, 43 HR-noASD, 14 ASD), revealed a main effect of age, $F_{(1,116)}$ = 16.82, p < .001, with children's scores, regardless of group, increasing significantly between 28 and 34 months. There was also a main effect of group, $F_{(1,116)}$ = 5.62, p = .005. Post hoc tests with a Bonferroni correction indicated that the LR group scored significantly higher than the ASD group, p = .005. After controlling for Mullen scores, the main effects of age and group were no longer significant.

Discussion

In this short-term longitudinal study, we examined developmental changes from 22 to 34 months in the play behavior of HR and LR children. HR siblings with and without a diagnosis of ASD at 36 months were compared to LR children and to each other in situations meant to elicit imaginary play. Children's pretending during free play and structured play was assessed at all 3 time points: 22, 28, and 34 months. A third task assessing children's ability to imagine the outcome of an action pantomimed by the examiner was added at 28 months. Children with a diagnosis of ASD differed from LR children and HR-noASD children on most measures. Children in all 3 groups, however, showed increases in pretend play from 22 to 34 months during free play with a parent and on an elicited imitation task; from 28 to 34 months, they also improved on a task requiring them to imagine actions carried out by the examiner. Thus, although children with a diagnosis of ASD received lower scores than LR or HR-noASD children, they also made notable gains over time on all 3 tasks. Moreover, controls for Mullen ELC scores did not account for group differences in the ability to engage in pretend activities during 2 of the 3 play probes. However, engagement with the play partner and degree of task structure were also relevant to understanding group differences over time in pretend play.

Consistent with studies of play in typically-developing children (Belsky & Most 1981; Fein 1981), when observed during free play with a parent, children in all 3 groups decreased the amount of time spent in functional play with age and these declines in functional play were paralleled by increases in the amount of pretending. Thus, when play was scaffolded by a parent, children engaged in more frequent activities that included object substitution, make-believe scenarios, and other pretend play acts across the 22 to 34 month period (Lillard 2007). Given the age of these children, however, it is important to note that they continued to spend the bulk of their time in functional play, despite its decline between 22 and 34 months.

Similarly, as expected of typically-developing children (Brownell & Carriger 1990), during the more structured elicited pretend task in which examiners presented scripted pretend stories with props for the child to re-enact, children in all 3 groups improved with age. Growth reflected children's ability to imitate at more complex levels, for example, re-enacting the doll as an active agent feeding herself, rather than re-enacting at more basic levels on themselves or on the doll alone (Watson & Fischer 1977). It should also be noted that scoring on this task was based on the child's actions, not on language production. Also noteworthy is that group differences were not accounted for by cognitive ability as indexed by Mullen ELC performance. Instead, group differences in children's pretending are likely a product of differences in their social interests and engagement, as discussed further below.

The third pretend task, introduced at 28 months, required children to imagine changes to a stuffed animal that were pantomimed, but not actually enacted by the experimenter and thus, required children to visualize the consequences of a pretend action. This structured task merely required the child to choose 1 of 3 pictures. Because it required children to represent a hypothetical outcome, however, it also appears to be cognitively more difficult than the elicited pretend task. Importantly all groups, including the children with ASD, showed significant improvement on this task from 28 to 34 months. By 34 months, children with

ASD were able to correctly identify one third of the pretend outcomes, which was not significantly different from the 50% identified by the LR and HR-noASD children. Thus, children with ASD were able to represent pretend actions at levels similar to children in the other 2 groups, even though they differed in the ability to reproduce pretend acts.

In sum, across these 3 very different pretend play probes, children generally showed increasing skills over time and the magnitude of change from their initial levels varied by group only slightly. Although it was expected that the LR and HR-noASD children would demonstrate increases in pretend play skills over time, it was also expected that children with ASD would show much slower growth in play relative to these other 2 groups than they did. Despite similar growth trajectories, however, children with ASD were consistently poorer at pretending than were the children in the LR and HR-noASD groups.

Thus, significant group differences on all 3 pretend play measures were also evident. As expected from prior research (e.g., Charman et al. 1997; Sigman & Ungerer 1984), children with an ASD diagnosis remained significantly below the LR children in the production of pretend at each age. Thus, as can be seen in Figure 1, despite developmental increases in the number of bouts of pretending, the children with ASD showed about the same number of pretend play bouts at 34 months as the HR-noASD and LR children showed at 22 months, indicating continued delays in play skills despite improvements with age. A similar pattern was evident on the elicited pretend play measure, as children with a diagnosis performed consistently more poorly than the LR children at each time point and more poorly than the HR-noASD children at both 22 and 28 months. As was the case with pretending with a parent, 34-month scores for children with ASD were at about the same level as the 22-month scores obtained by the LR and HR-noASD children, as illustrated in Figure 3. These lower scores partly reflect the fact that more children with ASD had difficulty imitating play scenarios at levels higher than pretend to self (level 1) and pretend to doll (level 2), especially at 22 and 28 months. Indeed, at 22 months none of the children with a diagnosis of ASD were able to pretend to have the doll act on herself (level 3) and by 28 months only 5% did, although this figure rose to 27% by 34 months. In contrast, by 34 months, 51% of the LR children were able to imitate at level 3 (doll acting on self) or 4 (doll acting on teddy bear). Thus, the children with ASD were able to pretend at a very basic level on this highly structured task, but they had difficulty pretending that the doll was an active agent, possibly because of limitations in self-other differentiation (Brownell & Carriger, 1990; Watson & Fischer, 1977).

Whereas differences between the children with ASD and both the LR and HR-noASD groups were evident over time on both pretend during free play and the elicited pretend task, 2 very different measures, the HR-noASD and LR children did not differ from one another at any time point. This is important because there is some uncertainty about whether HR children without a diagnosis will show more subtle subclinical symptoms or look more similar to LR children (Ozonoff et al. 2014). On these measures and in this sample, consistent with some other reports about HR siblings who do not go on to receive an ASD diagnosis (Hutman et al. 2010; Malesa et al. 2012), these children were generally showing typical development. The one exception was their poorer performance, relative to LR

children, on the more advanced pretend transformation task at 28 months, but this difference disappeared by 34 months.

It is important to emphasize that group differences in pretend both during free play and the elicited pretend task were unchanged with Mullen ELC scores controlled. In contrast, our results suggest that lower levels of social interest and engagement are likely to underlie some of the problems that children with ASD have engaging in pretend play (Hobson et al. 2013; Rutherford et al. 2007). Children in the ASD group showed lower levels of engagement with their parent during play than children in either of the other 2 groups across the 3 time points. Similarly, during the elicited pretend task, the children with ASD were less engaged with the examiner and less interested in the task than children in the other 2 groups, despite an increase in interest and engagement from 22 to 34 months. Indeed when supplemental analyses (not reported) were conducted, controlling for engagement with parent during free play and engagement with the task and examiner during elicited play, group differences on both pretend measures were greatly attenuated. Thus, the lower levels of social engagement observed among the children with a diagnosis of ASD at all 3 assessments across these 2 play situations are consistent with the possibility that an underlying social impairment may partly explain delays in the development of pretending (Hobson et al. 2013; Rutherford et al. 2007). This pattern may also suggest that the children with ASD experience less shared enjoyment during play with parents, despite parental efforts to engage their children in shared play activities. Given the importance of parental scaffolding, joint attention, and reciprocal engagement in promoting the growth of pretend play (Lillard 2007; Weisberg, Zosh, Pasek, & Golinkoff 2013), this could forecast continued or even increasing deficits in pretend play over time. In addition, on the elicited pretend task, the more advanced scenarios modeled by the examiner required role-playing and perspective-taking. Thus the group performance differences not only suggest that the children with ASD may have difficulties with these demands at the end of the third year of life, but also that their reluctance or inability to engage in socially-supported pretend play may contribute to continuing problems with these components of social competence going forward.

Although children with ASD were consistently less engaged with their parents over time, ratings of parents' sensitivity indicated that parents were sensitive and tuned in to their children's needs, with only limited change over time. Parents in all 3 groups received high ratings on sensitivity, although parents of children in the HR-noASD group were rated as somewhat more sensitive at 22 months (reference removed for blind review), possibly because they were especially tuned into their toddlers who were likely to be more responsive to them than the older sibling with a diagnosis had been at the same age. This pattern was even more pronounced on the parental ratings of "stimulates cognitive development." Although parents of children in all 3 groups received higher ratings on stimulating and scaffolding play as their children got older, the parents of the HR-noASD children continued to score higher than the parents of both the ASD and LR children at 28 and 34 months. With Mullen scores controlled, the difference between parents of LR and HR-noASD children was maintained, suggesting that parents of children with an older child with ASD and a more typically-developing younger child were especially invested in scaffolding learning and providing emotional support. In a recent paper examining mothers' use of gestures and children's later language acquisition in HR and LR infant siblings, Talbott, Nelson, and

Tager-Flusberg (2015) reported that mothers of HR infants who did not receive a later diagnosis used more gestures to scaffold language development at 12 months than mothers of LR infants. These authors also suggest that the mothers of the HR-noASD infants were especially attuned to the developmental functioning of their infants, an observation consistent with the current results. This may reflect the rewards these parents feel while engaging with their younger child during reciprocal play and their experience with interventions provided to their older child.

Only the differences on the more cognitively demanding pretend transformation task became non-significant with Mullen ELC scores controlled. On this task, the children with ASD performed more poorly than the LR group at 28 months, but not at 34 months, and differences were accounted for by differences in cognitive functioning. It is important to note that not all children were able to comprehend this task and a larger proportion of children with a diagnosis scored 0 at 34 months (50%) than children in either the HR-noASD (21%) or LR (18%) groups. These results indicate that improvement on this task was evident among only half of the ASD group, and remained too difficult for others. This also explains why group differences were no longer significant with Mullen scores controlled. In addition, because four children with ASD were not administered this task at 34 months, missing data from more poorly functioning children may partly explain the lack of group differences at 34 months on this measure.

The strengths of this study include the carefully selected and reasonably large sample of high risk and low risk children; multiple distinct measures of pretense varying in structure and response format; the collection of longitudinal data obtained at 6-month intervals across the second and third years of life; and, the use of HLM to examine developmental trajectories of both pretend play and social engagement across situations and play partners. The inclusion of measures of social engagement with parent and examiner, as well as parent sensitivity and scaffolding measured over time also provide important information on the links between social engagement and pretend play in children with an ASD diagnosis, as well as high risk toddlers without a diagnosis.

Study limitations include missing data at different ages, the fact that some high risk children were not seen at 22 months because they had already aged out of that assessment, and the potential bias in the ASD group data, as not all children in this group were able to complete both the Mullen and the structured play tasks. It will be important for future research to examine pretend play using a more fine-grained analysis at 28 and 34 months as play becomes more complex. The use of global ratings of parent behavior also precluded a more detailed and time-linked assessment of parent-child interaction and parental scaffolding of children’s specific play acts.

Findings from this study allow for several conclusions. First, HR toddlers without a diagnosis were generally indistinguishable from LR toddlers by 34 months, even when they showed slight differences earlier. Second, the children with an ASD diagnosis differed from both the LR and HR-noASD children on most measures and at most ages. Most of these differences reflected their lower levels of social engagement with adults, although several were partly a function of cognitive differences. In any case, the results clearly demonstrate a

delay in the emergence of pretend play skills in high risk toddlers who ultimately receive a diagnosis of ASD. Third, all 3 groups showed growth in pretend play skills from their initial levels at 22 months, across the 3 different play situations. Despite a delay, then, most of the children with ASD showed improvements in these skills with age. Fourth, parents of children in all 3 groups were rated as sensitive and stimulating, but the particular experience of having an older child with ASD and a younger child without a diagnosis seemed especially conducive to high ratings in these areas.

These results have clear implications for intervention. The finding that children with ASD showed delayed play skills, but still improved over time, provides support for developmentally-informed intervention programs that use our understanding of typical development to guide intervention targets. Recent intervention strategies for young children with ASD are derived from well-established findings from typical development that emphasize parent responsiveness and shared positive affect (e.g., Dawson et al. 2010; Kasari, Paparella, Freeman, & Jahromi 2008). At the same time, prior research as well as the data from the present study suggest that a lack of social engagement makes it difficult for children with ASD to benefit from parental scaffolding of pretense during play based interactions. However, Shire, Gulsrud, and Kasari (2016) recently reported that helping parents of toddlers with ASD respond positively and contingently to their children's social and communicative bids resulted in more time spent in joint engagement, which in turn would be expected to support spontaneous social interaction and play. The Early Start Denver Model (Dawson et al. 2010) is likewise based on the premise that children with ASD will more readily learn social and communicative skills within the context of positive social exchanges and that joint engagement with parents and shared positive affect will support spontaneous learning. For this reason, interventions for young children with ASD that focus on enhancing joint engagement and positive interpersonal exchanges with parents and preschool teachers may be especially important, leading to more advanced play, social skills, and language development.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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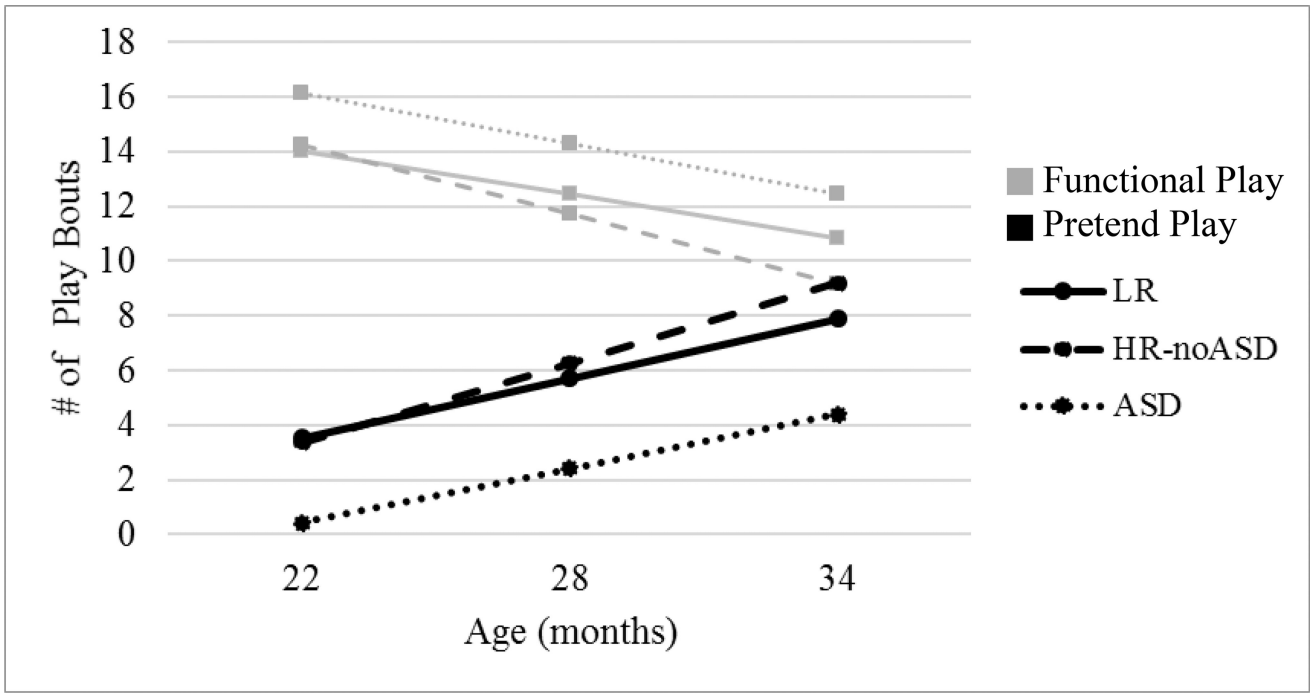

Figure 1.
Estimated growth trajectories for bouts of functional and pretend play by LR, HR noASD, and ASD groups from 22 to 34 months.

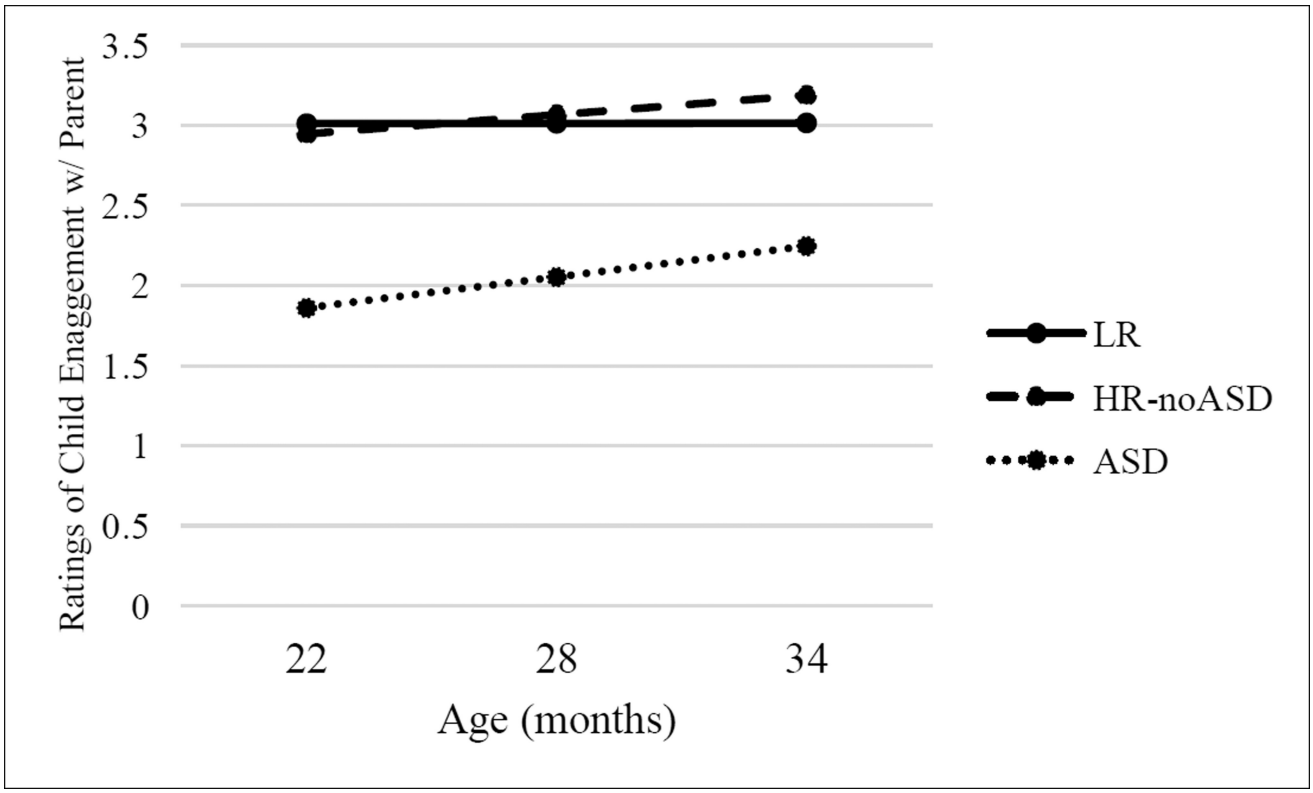

Figure 2.
Estimated growth trajectories of LR, HR-noASD, and ASD groups for ratings of child engagement with parent during free play.

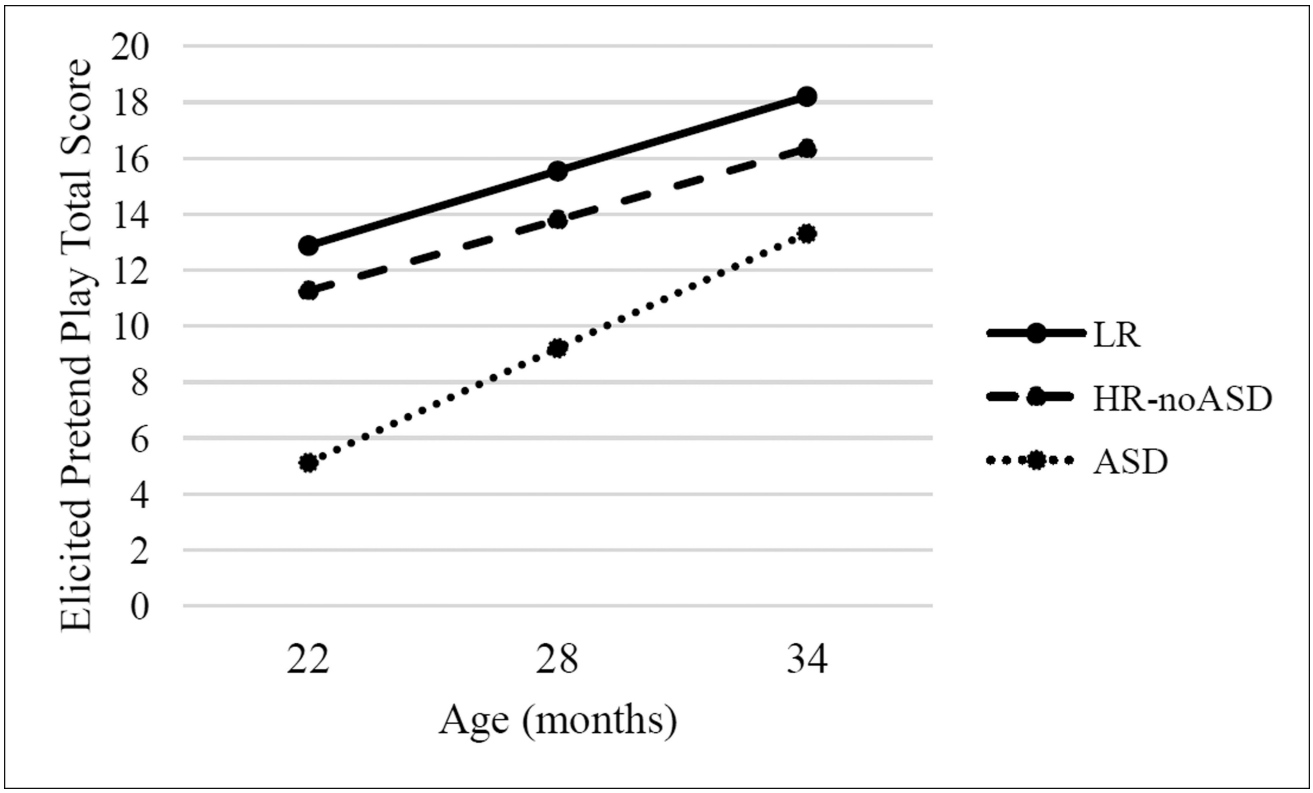

Figure 3.
Estimated growth trajectories of LR, HR-noASD, and ASD groups for total scores on the elicited pretend play task.

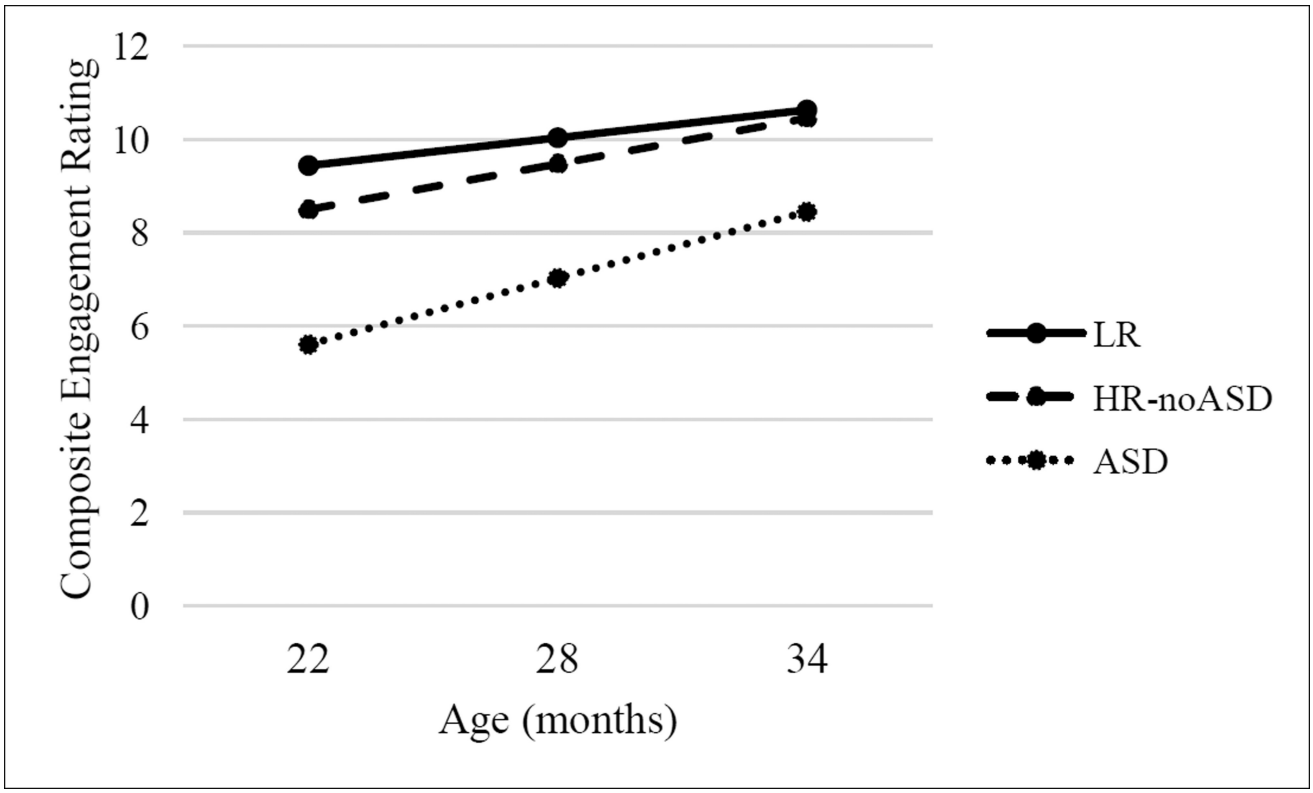

Figure 4.
Estimated growth trajectories of LR, HR-noASD, and ASD groups for composite engagement ratings during the elicited pretend play task.

Table 1

Sample characteristics

	ASD (n=20)	HR-noASD (n=59)	LR (n=89)		
Gender, male	70%	55.9%	56.2%		
Ethnicity, Caucasian	80%	86.4%	88.8%		
	M (SD)	M (SD)	M (SD)	*F*	*p*
Parent Education	5.61 (0.98)$_a$	6.01 (0.79)	6.18 (0.72)$_b$	4.62	.011
Age: 22 mo assessment	22.82 (0.68)	22.70 (0.73)	22.78 (0.71)	0.24	.787
Age: 28 mo assessment	28.69 (0.63)	28.68 (0.51)	28.52 (0.42)	2.24	.110
Age: 34 mo assessment	34.88 (0.88)	34.69 (0.84)	34.62 (0.61)	0.92	.402
Mullen Verbal Score	35.78 (12.95)$_a$	51.09 (8.32)$_b$	53.56 (8.50)$_b$	29.10	<.001
Mullen Non-verbal Score	43.68 (9.08)$_b$	49.68 (7.45)$_b$	53.57 (8.87)$_c$	11.24	< .001
Mullen ELC Score	79.82 (18.97)$_a$	101.49 (13.77)$_b$	107.20 (14.6)$_b$	24.52	<.001
ADOS severity score	5.79 (1.55)$_a$	1.53 (0.90)$_b$	1.42 (0.85)$_b$	167.83	<.001

Note: Means with different subscripts differ from one another at $p < .05$.

ASD = Autism spectrum disorder; HR-noASD = High risk toddlers without a diagnosis; LR= Low risk toddlers

Table 2

Final HLM models predicting growth trajectories for child behavior and parent ratings during free play.

	Child Behavior during Free Play								Parent Ratings			
	Simple Manipulation		Functional Play		Pretend Play		Engagement w/ Parent		Sensitivity Composite		Stimulates Cog Dev	
	β	SE	β	SE	β	SE	β	SE	β	SE	β	SE
Intercept												
LR, β_{00}	1.42***	0.20	14.01***	0.46	3.53***	0.43	3.00***	0.09	5.52***	0.19	2.88***	0.10
HR-NoASD, β_{01}	−0.15	0.29	0.25	0.70	−0.16	0.66	−0.08	0.14	0.53*	0.25	0.50***	0.14
ASD, β_{02}	1.19	0.87	2.16*	1.06	−3.11***	0.58	−1.01***	0.22	−0.12	0.35	−0.12	0.20
Sex, β_{03}							0.30*	0.13				
Linear Growth												
LR, β_{10}	−0.45***	0.12	−1.57***	0.33	2.17***	0.33	0.01	0.05	0.17	0.12	0.16*	0.06
HR-NoASD, β_{11}	0.09	0.18	−0.98	0.55	0.74	0.53	0.13	0.09	−0.19	0.15	−0.11	0.09
ASD, β_{12}	−0.34	0.47	−0.27	0.74	−0.19	0.69	0.14	0.15	−0.03	0.28	−0.06	0.17
Sex, β_{13}							−0.24**	0.08				
Visit Location, β_2	−0.20	0.11	1.71***	0.52								
Participating Parent, β_2					−2.07***	0.58	−0.31*	0.13	−0.78**	0.29	−0.70***	0.15

Note.

*$p < .05$,

**$p < .01$,

***$p < .001$

ASD = Autism spectrum disorder; HR-noASD = High risk toddlers without a diagnosis; LR= Low risk toddlers

Table 3

Point Estimates and 95% confidence intervals for child behavior and parent ratings during free play at 22, 28, and 34 months.

	22 months		28 months		34 months	
	Point Estimate	**95% C.I.**	**Point Estimate**	**95% C.I.**	**Point Estimate**	**95% C.I.**
Simple Manipulation						
LR	1.42	1.02–1.81	0.96	0.76–1.17	0.51	0.32–0.70
HR-noASD	1.26	0.69–1.84	0.90	0.62–1.18	0.54	0.26–0.82
ASD	2.60	0.89–4.32	1.81	0.88–2.73	1.01	0.31–1.70
Functional Play						
LR	14.01	13.10–14.91	12.43	11.81–13.06	10.86	9.96–11.77
HR-noASD	14.26	12.88–15.63	11.70	10.59–12.81	9.15	7.44–10.85
ASD	16.16	14.08–18.25	14.32	12.52–16.11	12.47	9.95–14.99
Pretend Play						
LR	3.53	2.69–4.36	5.70	5.07–6.33	7.88	6.93–8.83
HR-noASD	3.37	2.08–4.65	6.28	5.17–7.39	9.19	7.47–10.91
ASD	0.42	−0.71–1.55	2.41	1.26–3.55	4.39	2.15–6.64
Engagement w/ Parent						
LR	3.00	2.83–3.17	3.01	2.88–3.14	3.02	2.86–3.18
HR-noASD	2.92	2.65–3.19	3.05	2.86–3.24	3.18	2.95–3.42
ASD	1.99	1.55–2.43	2.08	1.80–2.37	2.21	1.82–2.60
Parent Sensitivity						
LR	5.52	5.15–5.90	5.69	5.44–5.94	5.86	5.55–6.16
HR-noASD	6.05	5.57–6.54	6.03	5.65–6.40	6.00	5.54–6.46
ASD	5.41	4.72–6.10	5.55	5.03–6.06	5.68	4.86–6.51
Parent Stimulates Cog Dev						
LR	2.88	2.69–3.08	3.04	2.91–3.17	3.20	3.04–3.36
HR-noASD	3.39	3.12–3.65	3.44	3.26–3.61	3.49	3.25–3.72
ASD	2.76	2.36–3.16	2.86	2.6–3.11	2.95	2.52–3.39

Note: Play scores (simple manipulation, functional, pretend) reflect the number of play bouts out of a possible 20 during which that was the highest level reached.

Engagement with parent and stimulates cognitive development were rated on 4-point scales (1=low to 4=high).

Parent sensitivity was a composite of sensitive responsiveness + warmth − intrusiveness, all rated on 1–4 scales, with higher scores reflecting greater sensitivity.

ASD = Autism spectrum disorder; HR-noASD = High risk toddlers without a diagnosis; LR= Low risk toddlers.

Table 4

Final HLM models predicting growth trajectories for performance and engagement during elicited pretend play

	Total Score		Engagement Composite	
	β	SE	β	SE
Intercept				
LR, β_{00}	12.88***	0.59	9.44***	0.24
HR-NoASD, β_{01}	−1.62	0.91	−0.95**	0.37
ASD, β_{02}	−7.76***	1.29	−3.84***	0.69
Sex, β_{03}			0.66*	0.33
Linear Growth				
LR, β_{10}	2.66***	0.47	0.60***	0.16
HR-NoASD, β_{11}	−0.13	0.75	0.39	0.22
ASD, β_{12}	1.43	1.23	0.83*	0.39
Sex, β_{13}			−.26	0.20

Note.

* $p < .05$,

** $p < .01$,

*** $p < .001$

ASD = Autism spectrum disorder;

HR-noASD = High risk toddlers without a diagnosis;

LR= Low risk toddlers

Table 5

Point Estimates and 95% confidence intervals for performance and engagement during elicited pretend play at 22, 28, and 34 months.

	22 months		28 months		34 months	
	Point Estimate	**95% C.I.**	**Point Estimate**	**95% C.I.**	**Point Estimate**	**95% C.I.**
Total Scores						
LR	12.88	11.72–14.03	15.54	14.47–16.61	18.20	16.58–19.82
HR-noASD	11.26	9.48–13.03	13.80	12.15–15.44	16.33	13.77–18.90
ASD	5.12	2.59–7.64	9.21	6.93–11.49	13.30	9.34–17.27
Engagement						
LR	9.44	8.97–9.91	10.21	9.93–10.49	10.70	10.32–11.08
HR-noASD	8.49	7.78–9.21	9.65	9.13–10.17	10.52	9.90–11.15
ASD	5.60	4.25–6.96	7.20	6.14–8.26	8.51	7.24–9.78

Note: Engagement was a composite of three 4-point ratings (1=low; 4= high) of children's interest, compliance, and appropriate activity level.

ASD = Autism spectrum disorder; HR-noASD = High risk toddlers without a diagnosis; LR=Low risk toddlers