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The Emergence of Triadic Attention in Infant Siblings of Children with an Autism Spectrum Disorder

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THE EMERGENCE OF TRIADIC ATTENTION IN INFANT SIBLINGS OF
CHILDREN WITH AN AUTISM SPECTRUM DISORDER

By

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Triadic attention, sharing attention with a person about an object or event, typically develops between eight and 12 months of age. This ability facilitates the development of social skills and language through shared exploration of objects and social stimuli. Two key aspects of triadic attention are initiating joint attention (IJA), the use of gaze and gestures to involve another in an experience, and behavioral requesting (IBR), the use of verbal and nonverbal communication to elicit help from another. Both aspects of triadic attention are impaired in individuals with Autism Spectrum Disorders (ASDs), which are characterized by social and communication deficits. The current study investigated the early development of triadic attention in eight- to- 12 month old infants who either have an older sibling diagnosed with an ASD (ASD-Sibs), or have older siblings with no ASD symptomatology (COMP-Sibs). This study examined age-related changes in the frequency of infant-initiated triadic attention using two measures, the Early Social Communication Scales (ESCS) and parent-administered Triadic Play Interaction (TPI). Triadic attention had modest associations between the TPI and the ESCS, with three of the six possible associations significant. At eight months of age, ASD-Sibs initiated significantly fewer IJA bids during the ESCS than COMP-Sibs. At 12 months of age, presence of IBR during the TPI differed significantly by group, with 18 percent of ASD-Sibs initiating a behavioral request, compared to 58 percent of

COMP-Sibs. This study demonstrated that infant-initiated triadic attention behaviors differed by group status in both measures used, suggesting these measures offer different and complementary information regarding triadic attention behaviors in ASD-Sibs compared to COMP-Sibs. The use of the TPI in examining triadic attention development in ASD-Sibs is discussed.

TABLE OF CONTENTS

iii

LIST OF FIGURES

LIST OF TABLES

CHAPTER ONE

INTRODUCTION

Triadic Attention Development

In the first year of life infants begin initiating interactions with people regarding objects in their environment (Bakeman & Adamson, 1984; Messinger & Fogel, 1998; Striano & Bertin, 2005a; Venezia, Messinger, Thorp, & Mundy, 2004). Infants' abilities to share interest and request objects and actions impacts their growth and development as they are exposed to language and social stimulation through the shared exploration of their environment (Hobson, Patrick, Crandell, Garcia Perez & Lee, 2004; Mundy, Kasari & Sigman, 1992; Striano, Chen, Cleveland & Bradshaw, 2006). Triadic attention has been associated with communicative and social learning in infancy and into childhood (Dunham, Dunham, & Curwin, 1993; Smith & Ulvund, 2003; Ulvund & Smith, 1996). Two key aspects of triadic attention are joint attention, the use of verbal and nonverbal communication behaviors to involve another in an experience, and behavioral requesting, the use of verbal and nonverbal communication to elicit help from another. Mundy and colleagues (2007) found that the first year of life is a time of significant triadic attention development, with triadic attention behaviors typically emerging and becoming frequently utilized by 12 months of age.

In order to better understand the timing of the emergence of triadic attention behaviors in typically developing infants within the first year, Striano and Bertin (2005a, b) observed the development of triadic attention behaviors in typically developing infants from five to 10 months of age using dichotomous coding of presence or absence of infant-initiated triadic attention behaviors. Utilizing a cross-sectional design, Striano and

1

Bertin (2005a) found that infants began demonstrating coordinated attention and gaze at approximately eight months of age. Using the same dichotomous coding scheme, these authors also longitudinally examined the emergence of triadic attention behaviors with different social partners (Striano & Bertin, 2005b), as such differences have been demonstrated in studies of social attention in infancy (e.g., Bigelow, 1998; Jaffe, Beebe, Feldstein, Crown, & Jasnow, 2001). Using a dichotomous coding scheme allowed an easy distinction between infants who demonstrated the behavior and those who did not. The longitudinal study demonstrated that the number of infants initiating joint engagement (i.e., coordinated attention between an object and a social partner), increased between five and seven months of age (Striano & Bertin, 2005b). This increase, however, was demonstrated only in the examiner condition. No difference was noted over time in the number of infants initiating joint engagement with their parents. In addition, by nine months of age more infants were initiating joint engagement with the examiner than with their parent, suggesting that context (i.e., social partner) may influence the demonstration of triadic attention behaviors in infancy (Striano & Bertin, 2005b). These findings indicate that typically-developing infants are able to initiate triadic attention behaviors by eight months of age. Potential deviances from typical developmental trajectories, however, were not addressed by Striano and Bertin (2005a, b).

Triadic Attention Deficits in Autism Spectrum Disorders (ASD)

One group of children with known deficits in triadic attention is children with Autism Spectrum Disorders (ASDs). Impaired initiation of joint attention is a characteristic deficit in children with ASDs (Mundy & Burnette, 2005), and has been

linked to impairments in language, play, and social development (Mundy, 1995). The infant siblings of children with ASDs (ASD-Sibs) have been shown to demonstrate similar social and communication deficits as their diagnosed older siblings (Cassel et al., 2007; Goldberg et al., 2005; Presmanes, Walden, Stone, & Yoder, 2007; Yirmiya et al., 2006). While ASD-Sibs may function within the typical range on some cognitive and social communication tasks (Yirmiya et al., 2006), deficits have been found in nonverbal requesting gestures and infant-initiated synchrony during play with their caregiver, both elements of triadic attention. Cassel and colleagues (2007) demonstrated differing trajectories between ASD-Sibs and a comparison sample of infant siblings of typically developing children (COMP-Sibs), with ASD-Sibs showing lower levels of infant-initiated behavioral requesting at 12 months of age compared to COMP-Sibs, and lower levels of infant-initiated joint attention at 15 months of age. While not all ASD-Sibs will develop a diagnosable ASD, these findings suggest evidence of differing developmental trajectories from COMP-Sibs.

Social Context and Triadic Attention

The literature on typically-developing infants suggest that social context may influence the social communication behaviors infants demonstrate (Adamson & Bakeman, 1985; Bakeman & Adamson, 1984; Bigelow, 1998; Hobson, Patrick, Crandell, García Peréz, & Lee, 2004; Jaffe et al., 2001; Legerstee, Markova, & Fisher, 2007; Striano & Bertin, 2005b). Infants have been shown to demonstrate more triadic attention behaviors with strangers than with caregivers (Bigelow, 1998; Jaffe et al., 2001; Striano & Bertin, 2005b). In addition, maternal sensitivity has been shown to relate to infant triadic attention, with infants of more sensitive mothers spending more time in joint

engagement (Hobson, Patrick, Crandell, García Peréz, & Lee, 2004; Legerstee, Markova, & Fisher, 2007). Such social contextual differences in infant behavior have also been demonstrated in infants at-risk for developmental delays based on parental risk factors such as low socioeconomic status and psychopathology (Goldsmith & Rogoff, 1997; Hart, Field, del Valle & Pelaez-Nogueras, 1998; Raviv, Kessenich, & Morrison, 2004). For example, infants of depressed mothers have been shown to demonstrate less joint engagement with their mothers than infants of nondepressed mothers (Goldsmith & Rogoff, 1997).

Early examinations of social contextual differences in joint attention and communication in children with ASDs have shown inconclusive results. Some studies found improvement in child-initiated communication and joint attention with greater non-caregiver adult structure (Clark & Rutter, 1981; Schopler, Brehm, Kinsbourne, & Reichler, 1971), while others found fewer overall behaviors and little difference associated with the amount of non-caregiver adult structuring (Landry & Loveland, 1989). Roos and colleagues (2008) found that toddlers with autism demonstrated different frequencies of triadic attention behaviors depending upon the context in which these behaviors were assessed (the semi-structured ESCS versus a more naturalistic free play with an examiner), although the behaviors were positively associated between contexts. These findings contribute to the developing picture of potential contextual influences on the behaviors demonstrated by children on the autism spectrum. The current study is the first to examine the effect of structure and social partner on child-initiated social communication behaviors in infants at-risk for ASDs, a group that may

shed light on early atypical developmental patterns in the effect of social partner on triadic attention behavior.

The Early Social Communication Scales (ESCS)

The Early Social Communication Scales (ESCS; Mundy et al., 2003) is a semi-structured assessment designed to elicit triadic communication behaviors in infants and young children. This measure has contributed to a better understanding of the development of infant-initiated social communication behaviors, both in typically-developing samples (Mundy et al., 2007, Mundy & Gomes, 1998) and in samples of infants with and at-risk for ASDs and other developmental disorders (Cassel et al., 2007; Goldberg, et al., 2005; Mundy, 1995; Yirmiya et al., 2006).

The eliciting nature of the ESCS, whereby items of high interest to infants and young children are placed within view but out-of-reach of the child (Mundy et al., 2003), provides a setting in which infants and children are likely to communicate with the examiner about the items. The current study postulates that this may be creating an environment in which such behaviors are more likely to occur, in that the measure gives many opportunities for triadic attention behaviors. As infants typically spend more time in less-structured free plays with their caregivers than in structured situations in which items of interest are introduced but withheld from their grasp, it is possible that the typical triadic attention behaviors demonstrated by infants differ from those demonstrated during the ESCS.

The Triadic Play Interaction (TPI)

In order to better capture behavior patterns during a less-structured interaction, a play interaction was designed for the current study. Based on Striano and Bertin (2005b),

the Triadic Play Interaction (TPI) seats the infant on a mat across from his/her caregiver, with attractive toys placed between the infant and caregiver. Caregivers are instructed not to initiate interactions with their infant, after one initial comment about a toy while holding it within sight of the infant, in order to allow the infant to spontaneously initiate interactions with their caregiver. This measure allowed a more free-play like setting in which to observe the spontaneously generated triadic attention behaviors infants demonstrate with their caregivers. In addition, it provides a setting in which to determine whether ASD-Sibs show a differential pattern of behavior compared to COMP-Sibs within this context.

Hypotheses

This study examined the development of two important aspects of triadic attention, infant-initiated joint attention (IJA), the sharing of interest in an item or event with a social partner, and infant-initiated behavioral requesting (IBR), the use of verbal and nonverbal communication to elicit help from a social partner. These behaviors were examined and compared between ASD-Sibs and COMP-Sibs. Two measures of triadic attention were utilized in order to understand the development of these behaviors across context and social partners. The measures were expected to show positive associations, with infants demonstrating high frequencies of triadic attention on one measure expected to show high frequencies on the other. ASD-Sibs were expected to show decreased frequency of triadic attention behavior across both measures. In addition, the triadic attention deficits demonstrated by ASD-Sibs were expected to be more pronounced during the TPI, as the less-structured nature of this measure was expected to remove the potential for elevated levels of triadic attention due to elicitation of these behaviors.

CHAPTER TWO

METHOD

Participants

This study assessed IJA and IBR longitudinally in a sample of infants (*n*=57, 34 male) at eight, 10, and 12 months of age (see Table 1). All participating infants were enrolled in a longitudinal study of early development, the Sibling Studies Measuring Infant Learning and Emotion (Sib SMILE) Project, at the University of Miami. Two participants from Cassel and colleagues (2007) overlap with the current study. ASD-Sibs (*n*=40, 26 male; 14 non-Hispanic Caucasian, 21 Hispanic, 2 Asian, 2 African/Caribbean-American, 1 Other) had at least one older sibling with a community diagnosis of an ASD. Older siblings' community diagnoses were confirmed upon study enrollment by the administration of the Autism Diagnostic Observation Schedule (ADOS; Lord et al., 2000) and clinical diagnosis by a licensed clinical psychologist using the Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition Text Revision (DSM-IV-TR; APA, 2000). COMP-Sibs (*n*=17, 7 male; 5 non-Hispanic Caucasian, 10 Hispanic, 1 Asian, 1 Other) were the infant siblings of children who demonstrated no elevations on the Social Communication Questionnaire (SCQ; Berument, Rutter, Lord, Pickles, & Bailey, 1999), an ASD symptomatology screener (i.e., did not exceed conservative cut-off score of nine). Inclusionary criteria for both groups included gestational ages between 37 and 41 weeks, no major medical complications or illness, and attendance to at least one of the eight, 10, and 12 month visits.

Procedure

As part of a larger longitudinal study, participating infants were administered two measures of triadic attention during visits at eight, 10 and 12 months of age: the Early Social Communication Scales (ESCS) (Mundy et al., 2003), and the Triadic Play Interaction (TPI).

Measures

Early Social Communication Scales (ESCS). The Early Social-Communication Scales (ESCS) (Mundy et al., 2003), a semi-structured child-examiner assessment of nonverbal communication lasting approximately 15 - 20 minutes, was administered to study participants. The assessment begins with an adult examiner and the infant facing one another at a small table, with the infant seated on a caregiver's lap. The examiner systematically presents the infant with an array of novel toys (five active wind-up toys and three hand-activated toys). In each presentation, the examiner activates the toy on the table in front of, but out of reach of, the child. After the toy has ceased moving, the examiner allows the infant to play with the toy briefly. This is the context in which Initiating Joint Attention (IJA) and Initiating Behavioral Requesting (IBR) are typically coded.

Triadic Play Interaction (TPI). The Triadic Play Interaction (TPI), lasting six minutes, was also administered to study participants. Adapted from the measure used by Striano and Bertin (2005a), during the TPI the infant is seated across from her caregiver on a mat on the floor, with a variety of age-appropriate toys (e.g., balls, blocks, stacking animals and tractor, teddy bear) arrayed about the mat. Parents are given instructions to briefly initiate one interaction with their infant by handing a toy to them while

commenting on the toy, and then to refrain from initiating any further interactions with their infant, instead responding briefly (e.g., "I see you!") to their infant looking at them, vocalizing to them, or handing something to them. IJA and IBR are coded throughout the TPI.

Coding

Infant-initiated joint attention (IJA), sharing interest in an object or event with a social partner, and behavioral requesting (IBR), requesting an object or event from a social partner, (see Tables 2 and 3 for full descriptions of codeable behaviors for each measure) were coded during the ESCS and the TPI by research assistants trained to reliability and blind to subject performance on the other measure.

The ESCS defines IJA as including eye contact to the examiner while holding or watching a toy, pointing to an object of interest, with or without eye contact, and showing a toy to the examiner by holding it up toward the examiner's face with eye contact. IBR includes reaching toward a toy, with or without eye contact to the examiner, eye contact to the examiner regarding an out-of-reach inactive toy, pointing to a desired object, with or without eye contact, and giving a toy to the examiner, again, with or without eye contact. Twenty percent of ESCSs were coded for reliability, with the mean absolute intraclass correlation for IJA equal to .80, and the mean absolute intraclass correlation for IBR equal to .78.

Coding of infant-initiated behaviors during the TPI was modelled on IJA and IBR coding from the ESCS, with some accommodations for the less-structured nature of the TPI. The TPI defines IJA as including eye contact from a toy to the infant's caregiver, eye contact from a toy to caregiver and back to the same toy, pointing to an object of

interest, with or without eye contact, and showing an object to the infant's caregiver by holding it up toward the caregiver's face. IBR includes reaching toward an out-of-reach toy, with or without eye contact to the caregiver, eye contact to the caregiver regarding an out-of-reach toy, pointing to a desired object, with or without eye contact, and giving a toy to the caregiver, again, with or without eye contact. Twenty-two percent of TPIs were coded for reliability, with the mean absolute intraclass correlation for IJA equal to .93, and the mean absolute intraclass correlation for IBR equal to .96.

In order to capture behaviors initiated by the infant, throughout the ESCS both the examiner and the infant's caregiver were asked to refrain for moving or talking, except when the examiner presented a toy. During the TPI, the caregiver was asked to refrain from initiating any interaction with their infant, instead responding briefly to their infant's vocalizations, eye contact, or play bids, and then continuing to watch their child play. Any movement by the parent or examiner during the ESCS resulted in the infant behavior being coded as a response behavior. The TPI does not have categories regarding infant responses to parent-initiated interactions, and thus any infant behavior occurring as a result of their caregiver initiating an interaction (e.g., talking to the infant, handing the infant a toy, etc.) was designated as uncodeable behavior.

RESULTS

Rates of IJA on each measure and rates of IBR during the ESCS were summed and divided by the total time in minutes of the measure in order to create rate-per-minute scores for analyses. In order to correct for non-normal distribution, defined as skew > |.8| or kurtosis > |3.0| (Tabachnick & Fidell, 1989), a Log10 transformation (LG10(X+1)) was used for IJA during the ESCS, and an inverse transformation (1/(X+1)) was used for IJA during the TPI and IBR during the ESCS. The negative of correlations involving inverted variables are reported below. Due to the infrequency of infant-initiated behavioral requests (IBR) during the TPI, IBR during the TPI could not be normalized via the above transformations. Instead, IBR during the TPI was dichotomized, such that one indicated the presence of one or more infant initiated behavioral request during the TPI, and zero indicated the infant did not initiate a behavioral request during this six minute play. See Table 4 for information regarding kurtosis and skew before and after transformations.

The association between triadic attention variables in the ESCS and TPI

IJA and IBR within ages between measures. See Table 5 for information regarding all correlations. At eight months of age, the frequency of IJA during TPI was associated with the frequency of IJA during the ESCS, $r(30)=.37$, $p<.05$. In addition, presence of IBR during the TPI at eight months was associated with the frequency of IBR during the ESCS at eight months, $r(30)=.38$, $p<.05$, indicating that infants who initiated a behavioral request during the TPI had higher frequency of IBR during the ESCS at eight months than infants who did not initiate a behavioral request during the TPI at eight

11

months. (This correlation is equivalent to using a t-test to test for differences in the frequency of ESCS IBR based on a dichotomous grouping of IBR during the TPI.) There were no other significant associations of constructs within ages (e.g., IJA to IJA within age levels) between the ESCS and the TPI.

IJA and IBR within TPI and ESCS. Presence of IBR during the TPI at 10 months was associated with the frequency of IJA during the TPI at 10 months, $r(41)=.40$, $p<.01$. No other associations were found within the TPI. Frequency of IJA during the ESCS at eight months was associated with frequency of IJA during the ESCS at 10 months, $r(27)=.62$, $p<.01$. Frequency of IJA during the ESCS at 10 months was associated with frequency of IJA during the ESCS at 12 months $r(36)=.52$, $p<.01$. Lastly, frequency of IBR during the ESCS at 10 months was associated with frequency of IJA during the ESCS at 12 months, $r(36)=.38$, $p<.05$. No other associations were found within the ESCS.

IJA and IBR between ages between measures. Frequency of IJA during the TPI at eight months was associated with frequency of IJA during the ESCS at 10 months, $r(27)=.40$, p<.05. Frequency of IJA during the ESCS at eight months was associated with frequency of IJA during the TPI at 12 months, $r(23)=.64$, $p<.01$, and presence of IBR during the TPI at 12 months, $r(25)=.48$, $p<.05$. There were no associations with mean frequency of variables across the three time points. These modest associations suggest that the two measures may be providing different information regarding the development of triadic attention in ASD-Sibs compared to COMP-Sibs.

Frequencies of IJA and IBR in the ESCS and the TPI

Infants initiated significantly fewer IJA bids during the TPI than during the ESCS at all three ages, 8 month $t(31)=8.04$, $p<.01$, 10 month $t(42)=8.01$, $p<.01$, 12 month $t(45)=10.02$, $p<.01$. Binomial tests using the proportion of infants who initiated IBR during the TPI as the test proportion indicated that significantly more infants initiated IBR during the ESCS than during the TPI at all three ages. At eight months of age, 28 percent of infants initiated IBR during the TPI, compared to 91 percent of infants during the ESCS, $p<.01$. At 10 months of age, 16 percent of infants initiated IBR during the TPI, compared to 100 percent of infants during the ESCS, $p<.01$. At 12 months of age, 28 percent of infants initiated IBR during the TPI, compared to 100 percent of infants during the ESCS, $p<.01$. IJA during the TPI differed by gender at 12 months of age, $t(44)=3.64$, $p<.01$, with girls initiating more IJA bids than boys. No other gender effects were found.

Differences across ages and groups

Due to the modest and variable associations between the ESCS and the TPI, the measures were analyzed separately. For each outcome (e.g., IJA during TPI), an unconditional hierarchical linear model was applied to test whether there was sufficient variability in the outcome to warrant exploring the within- and between-subjects predictors of the outcome. Gender was examined as a grouping variable due to the literature on typically developing infants indicating earlier onset of language in females (Fenson et al., 1994).

Infant-Initiated Joint Attention during TPI. The unconditional hierarchical linear model indicated that there was not significant variability in infant-initiated joint attention

during the TPI, $\chi^2(1, n=46)=7.24, p<.01$. Eighty-two percent (28 of 34) of ASD-Sibs did not initiate a behavioral request at 12 months of age, whereas only 42 percent (5 of 12) of COMP-Sibs did not initiate at least one behavioral request at 12 months of age. Gender, again, did not differentiate between infants who initiated IBR and those who did not during the TPI at 12 months, $\chi^2(1, n=46)=3.06, p>.05$.

When the three time points were combined, group status differentiated between infants who initiated IBR at least once during the TPI at any age and those who never initiated a behavioral request at any age, $\chi^2(1, n=57)=5.97, p<.05$. Seventy percent (28 of 40) of ASD-Sibs never initiated a behavioral request during the TPI at any age, whereas only 35 percent (6 of 17) of COMP-Sibs never initiated a behavioral request during the TPI. Gender did not differentiate between infants who initiated IBR at least once during the TPI at any age and those who never initiated a behavioral request at any age, $\chi^2(1, n=57)=3.29, p>.05$.

Infant-Initiated Joint Attention during ESCS. Infant-initiated joint attention (IJA) during the ESCS was examined using an unconditional hierarchical linear model in order to assess the within-subject variability in IJA during the ESCS. The unconditional model of IJA indicated that this behavior demonstrated significant variability within participants, $\chi^2(56, I=57)=212.55, p<.01$, which warranted exploration of the growth and predictors of IJA. After the unconditional model of IJA was applied, visit ages (age_{ti}) were introduced into the model, using Full Maximum Likelihood in the estimation of the parameters, in order to examine the within-subject change in IJA over time (see Figures 5 and 6). Age was centered at eight months and simplified such that age=0, 1, 2 corresponded with age eight, 10, and 12 months, respectively, and a 1-unit increase in

age_{ti} corresponded to a 2-month increase in age. In addition, a quadratic age variable ($\text{age}^2{}_{ti}$) was included, in order to explore the potential for a quadratic effect of age on IJA. The quadratic age variable was calculated by multiplying age_{ti} by itself. Both linear, $\beta=.10$, $SE=.04$, $p<.05$, and quadratic, $\beta=-.05$, $SE=.02$, $p<.05$, age effects were significantly different from zero, indicating that frequency of joint attention during the ESCS changes over time. There was significant between-subject variance in the intercept, $\chi^2(55, I=57)=222.33$, $p<.01$. There was not significant variance in the linear rate of change, $\chi^2(41, I=57)=34.82$, $p>.05$, or the quadratic rate of change, $\chi^2(41, I=57)=35.46$, $p>.05$, and thus both terms was fixed for all future analyses. With the slope terms fixed, intercept variance remained significant, $\chi^2(56, I=57)=214.07$, $p<.01$, with infants initiating an average of 1.45 joint attention bids per minute during the ESCS at eight months, $B=.37$, $SE=.02$, $t(56)=15.71$, $p<.01$. Gender was entered into the model at the intercept in order to understand the effect of gender on frequency of IJA during the ESCS at eight months of age. Gender was not a significant predictor of frequency of IJA at eight months of age, $B=.05$, $SE=.03$, $t(55)=1.66$, $p>.05$, and was thus removed from the model. Group status was entered into the model at the intercept in order to estimate the effect of group status on frequency of IJA during the ESCS at eight months of age. Group status was a significant predictor of frequency of IJA at eight months, with ASD-Sibs initiating an average of 1.08 fewer joint attention bids during the ESCS than COMP-Sibs at eight months of age, $B=-.08$, $SE=.04$, $t(55)=-2.20$, $p<.05$ (see Graph 3). An examination of the growth model with group status in the intercept indicated that this model fit the data significantly better than the growth model without group status, $\chi^2(1, I=57)=4.81$, $p<.05$.

Infant-Initiated Behavioral Requesting during ESCS. The unconditional hierarchical linear model indicated that there was not significant variability in incidence of infant-initiated behavioral requesting (IBR) during the ESCS to justify including time or between-subject predictors into the model, $\chi^2(56, I{=}57){=}59.84$, $p{>}.05$, thus IBR during the ESCS was examined using a 3 (Age) x 2 (Group Status) x 2 (Gender) Mixed Design ANOVA ($n{=}23$) (see Figures 7 and 8). IBR during the ESCS did not differ significantly by age, $F(2, 38){=}3.11$, $p{=}.06$, gender, $F(1, 19){=}.30$, $p{>}.05$, or group status, $F(1, 19){=}.19$, $p{>}.05$. There were no significant interactions, all ps${>}.05$. IBR during the ESCS was dichotomized as during the TPI to test for gender and status effects on whether infants initiated at least one behavioral request during the ESCS. All infants initiated at least one behavioral request at 10 and 12 months of age. Group status did not differentiate between infants who did and did not initiate a behavioral request at eight months of age, $\chi^2(1, n{=}32){=}1.51$, $p{>}.05$.

CHAPTER FOUR

DISCUSSION

Deficits in initiating triadic attention are hallmark of children with autism spectrum disorders (ASDs), and have been demonstrated in their infant siblings, as well (Cassel et al., 2007; Goldberg et al., 2005; Presmanes, Walden, Stone, & Yoder, 2007; Yirmiya et al., 2006). This study examined the development of triadic attention in the first year of life in a sample of infants at-risk for developing an ASD (due to having an older sibling with an ASD) and compared their developmental trajectory to that of infants with older siblings with no ASD symptomatology. Two measures of triadic attention were used in order to better understand infant-initiated triadic attention behaviors across context and social partner.

The present study found modest associations between the two measures, with infant-initiated joint attention (IJA) and infant-initiated behavioral requesting (IBR) positively associated between the Triadic Play Interaction (TPI) and the Early Social Communication Scales (ESCS) at eight months. Infants initiated significantly fewer triadic attention behaviors during the TPI than during the ESCS at all ages. Significantly fewer ASD-Sibs initiated behavioral requests (18 percent) than COMP-Sibs (58 percent) at 12 months of age during the TPI. In addition, frequency of IJA during the ESCS at eight months also differed significantly by group, with ASD-Sibs initiating significantly fewer joint attention bids than COMP-Sibs. Lastly, frequency of IJA during the TPI at 12 months differed significantly by gender, with girls initiating more joint attention bids than boys.

18

Findings from the current study suggest that the TPI and the ESCS provide unique information about the development of infant-initiated triadic attention in the first year of life in ASD-Sibs as compared to COMP-Sibs. At eight months of age, ASD-Sibs initiated significantly fewer joint attention bids than did COMP-Sibs during the semi-structured ESCS. This difference was not found in the more naturalistic TPI, where group status was not related to frequency of infant-initiated joint attention bids. The ESCS, an assessment in which triadic attention behaviors are elicited through the introduction of interesting items within sight but out-of-reach of the infant, appears to be a context in which there is greater demonstration of IJA behaviors. Within this context, findings from the current study suggest that group differences may be notable. Levels of IJA during the TPI were low at all three time points, with the mean frequency at around one bid every two minutes, compared to a mean frequency of about one bid per minute during the ESCS, which may have made group differences difficult to find. The quadratic pattern of IJA during the ESCS demonstrated in the current study, with a decrease in IJA at 12 months, is reminiscent of the finding by Mundy and colleagues (2007), who reported that IJA decreased at 15 months of age. That this pattern was not found during the TPI is unsurprising, given the low frequency of IJA demonstrated during the TPI at all three ages.

While the ESCS highlighted group differences in infant-initiated joint attention bids at eight months of age, group status was not associated with frequency of infant-initiated behavioral requests during the semi-structured ESCS. During the TPI, however, presence of IBR at 12 months differed significantly based on group status, with only 18 percent of ASD-Sibs initiating a behavioral request at 12 months during the TPI,

compared to 58 percent of COMP-Sibs. IBR during the ESCS was dichotomized to explore whether presence of IBR differed by group status in the ESCS. By 10 months all infants initiated at least one behavioral request during the ESCS, and group status did not differentiate those who did initiate a behavioral request during the ESCS from those that did not. This finding is inconsistent with Cassel and colleague's (2007) finding that ASD-Sibs initiate fewer behavioral requests during the ESCS at 12 months. It is interesting that, in the current study, differences in IBR were found at the same age as in the 2007 study by Cassel and colleagues, but on a different measure. The less structured TPI, where the infant is seated across from his/her caregiver with attractive toys placed in between the two, is not designed to elicit specific behaviors. It is instead conceived of as a more naturalistic context in which to observe the spontaneous behavior of infants with their caregivers. In this context, joint attention bids may be more likely (although still less frequent than during the ESCS), because, although the infant's caregiver is not engaging with the infant, he/she is present and watching the infant explore new toys. Requesting an item during the TPI is less "required," in that the infant can access all items without needing her caregiver's help or consent. In this context, it may be more significant that some infants do request an item. The findings from the current study suggest that this may be an effective context in which to examine group differences in infant-initiated behavioral requesting, as it is a behavior that was seen in over half of COMP-Sibs, and in less than one-quarter of ASD-Sibs, at 12 months.

A gender effect was demonstrated in frequency of IJA during the TPI at 12 months, with girls initiating significantly more joint attention bids than boys. Mundy et al. (2007), found a similar gender difference at 9 months of age on the ESCS, with girls

initiating more joint attention bids than boys. This replicated finding indicates that girls may demonstrate IJA more robustly at an earlier age than boys, regardless of their risk status. As this finding was only demonstrated on the semi-structured ESCS, it suggests that social context may be influencing the demonstration of joint attention behaviors differently for boys and girls.

Infants demonstrated significantly fewer triadic attention behaviors during the TPI than during the ESCS. This difference is consistent with a literature indicating that infants demonstrate more triadic attention with strangers than with their caregivers (Bigelow, 1998; Jaffe et al., 2001; Striano & Bertin, 2005b). In addition, it is not surprising that infants initiated fewer triadic attention behaviors during the less-structured TPI, as they were free to explore the toys on their own instead of all toys being controlled by an adult. This finding is consistent with the literature in typically developing infants indicating that social context influences the social communication behaviors demonstrated by infants (Adamson & Bakeman, 1985; Bakeman & Adamson, 1984; Bigelow, 1998; Hobson, Patrick, Crandell, García Peréz, & Lee, 2004; Jaffe et al., 2001; Legerstee, Markova, & Fisher, 2007; Striano & Bertin, 2005b).

That ASD-Sibs in particular demonstrated differences on distinct triadic attention behaviors between the ESCS and TPI suggests that social context may be influencing the demonstration of triadic attention behaviors in ASD-Sibs. While the literature on children with ASDs is not conclusive regarding how social context influences the demonstration of joint attention and communication behaviors (Clark & Rutter, 1981; Landry & Loveland, 1989; Roos et al., 2008; Schopler, Brehm, Kinsbourne, & Reichler, 1971), the current study suggests that such effects are in play within the first year of life.

This study was impacted by several limitations. First, the infants in this paper have not yet reached three years of age, and therefore have not yet been evaluated for ASD symptomatology within the Sibling Studies Measuring Infant Learning and Emotion (Sib SMILE) Project. Using older sibling diagnostic status instead of observed child's diagnostic status results in a group of ASD-Sibs that are likely quite heterogeneous, as only a percentage of ASD-Sibs are expected to develop an ASD (Landa & Garrett-Mayer, 2006). Therefore, these analyses will be re-examined when the children reach three years of age and are able to be classified as either meeting criteria for an ASD or not demonstrating ASD symptomatology. This will allow an understanding of whether these measures are sensitive to early risk in infants who go on to develop an ASD, and not just to older sibling status. Another limitation that affected this study was attrition and sample characteristics. More than half of the infants in the current study did not attend all three visits, leading to these children being dropped from the repeated measures ANOVAs used to analyze the data. In addition, caregiver rule-breaking during the measures, by talking or gesturing to their infant, may have affected the amount of time infants were able to spontaneously initiate triadic attention behaviors. In order to control for this possibility, analyses were done using rate-per-minute frequencies.

Despite the above limitations, the current study provides new information regarding infant-initiated triadic attention behaviors demonstrated across context and social partner in the first year of life. This study found that the development of these essential social communication behaviors differed between groups, with ASD-Sibs demonstrating deficits in triadic attention across both measures used. These deficits

suggest that ASD-related developmental differences are manifesting prior to 12 months of age, which has significant ramifications for early screening and intervention efforts.

REFERENCES

Adamson, L. B., & Bakeman, R. (1985). Affect and attention: Infants observed with mothers and peers. *Child Development, 56*, 582-593.

American Psychiatric Association: *Diagnostic and Statistical Manual of Mental Disorders,* Fourth Edition, Text Revision. Washington, DC, American Psychiatric Association, 2000.

Bakeman, R., & Adamson, L. B. (1984). Coordinating attention to people and objects in mother-infant and peer-infant interaction. *Child Development, 55*, 1278-1289.

Berument, S. B., Rutter, M., Lord, C., Pickles, A., & Bailey, A. (1999). Autism screening questionnaire: Diagnostic validity. *British Journal of Psychiatry, 175*, 444-451.

Bigelow, A. E. (1998). Infants' sensitivity to familiar imperfect contingencies in social interaction. *Infant Behavior and Development, 21*, 149-161.

Cassel, T. D., Messinger, D. S., Ibanez, L. V., Haltigan, J. D., Acosta, S. I., & Buchman, A. C. (2007). Early social and emotional communication in the infant siblings of children with Autism Spectrum Disorders: An examination of the broad phenotype. *Journal of Autism and Developmental Disorders, 37*, 122-132.

Clark, P., & Rutter, M. (1981). Autistic children's responses to structure and to interpersonal demands. *Journal of Autism and Developmental Disorders, 11*, 201-217.

Dunham, P. J., Dunham, F., & Curwin, A. (1993). Joint attentional states and lexical acquisition at 18 months. *Developmental Psychology, 29*, 827-831.

Fenson, L., Dale, P. S., Reznick, S., Bates, E., Thal, D. J., & Pethick, S. J. (1994). Variability in early communication development. [Monograph] *Monographs of the Society for Research in Child Development, 59*(5), 72-84.

Goldberg, W. A., Jarvis, K. L., Osann, K., Laulhere, T. M., Straub, C., Thomas, E., Filipek, P., & Spence, M. A. (2005). Brief report: Early social communication behaviors in the younger siblings of children with autism. *Journal of Autism and Developmental Disorders, 35*, 657-664.

Goldsmith, D. F., & Rogoff, B. (1997). Mothers' and toddlers' coordinated joint focus of attention: Variations with maternal dysphoric symptoms. *Developmental Psychology, 33*, 113-119.

Hart, S., Field, T., del Valle, C., & Pelaez-Nogueras, M. (1998). Depressed mothers' interactions with their one-year-old infants. *Infant Behavior & Development, 21*, 519-525.

24

Hobson, R. P., Patrick, M. P. H., Crandell, L. E., García Peréz, R. M., & Lee, A. (2004). Maternal sensitivity and infant triadic communication. *Journal of Child Psychology and Psychiatry, 45*, 470-480.

Jaffe, J., Beebe, B., Feldstein, S., Crown, C. L., & Jasnow, M. (2001). Rhythms of dialogue in infancy: Coordinated timing in development. *Monographs of the Society for Research in Child Development, 66* (2, Serial No. 131).

Landa, R., & Garrett-Mayer, E. (2006). Development in infants with autism spectrum disorders: A prospective study. *Journal of Child Psychology and Psychiatry, 47*, 629-638.

Legerstee, M., Markova, G., & Fisher, T. (2007). The role of maternal affect attunement in dyadic and triadic communication. *Infant Behavior & Development, 30,* 296-306.

Lord. C., Risi, S., Lambrecht, L., Cook, E. H., Leventhal, B. L., DiLavore, P. C., Pickles, A., & Rutter, M. (2000). The autism diagnostic observation schedule-generic: A standard measure of social and communication deficits associated with the spectrum of autism. *Journal of Autism and Developmental Disorders, 30*, 205-223.

Messinger, D. S., & Fogel, A. (1998). Give and take: The development of conventional infant gestures. *Merrill-Palmer Quarterly, 44*, 566-578.

Mundy, P. (1995). Joint attention and social-emotional approach behavior in children with autism. *Development and Psychopathology, 7*, 63–82.

Mundy, P., Block, J., Delgado, C., Pomares, Y., Van Hecke, A. V., & Parlade, M. V. (2007). Individual differences and the development of joint attention in infancy. *Child Development, 78*, 938-954.

Mundy, P., & Burnette, C. (2005). Joint attention and neurodevelopment. In F. Volkmar, A., Klin, & R. Paul (Eds.), *Handbook of Autism and Pervasive Developmental Disorders*, *3,* 650-681. Hoboken, NJ: John Wiley.

Mundy, P., Delgado, C., Block, J., Venezia, M., Hogan, A., & Siebert, J. (2003). Early Social Communication Scales. University of Miami.

Mundy, P., & Gomes, A. (1998). Individual differences in joint attention skill development in the second year. *Infant Behavior & Development, 21*, 469-482.

Mundy, P., Kasari, C., & Sigman, M. (1992). Nonverbal communication, affective sharing, and intersubjectivity. *Infant Behavior & Development, 15*, 377-381.

Presmanes, A. G., Walden, T. A., Stone, W. L., & Yoder, P. J. (2007). Effects of different attentional cues on responding to joint attention in younger siblings of children with autism spectrum disorders. *Journal of Autism and Developmental Disorders, 37*, 133-144.

Raviv, T., Kessenich, M., & Morrison, F. J. (2004). A mediational model of the association between socioeconomic status and three-year-old language abilities: The role of parenting factors. *Early Childhood Research Quarterly, 19*, 528-547.

Roos, E. M., McDuffie, A. S., Weismer, S. E., & Gernsbacher, M. A. (2008). A comparison of contexts for assessing joint attention in toddlers on the autism spectrum. *Autism, 12*, 275-291.

Schopler, E., Brehm, S. S., Kinsbourne, M., & Reichler, R. J. (1971) Effect of treatment structure on development in autistic children. *Archives of General Psychiatry, 24*, 415-421.

Smith, L., & Ulvund, S. E. (2003). The role of joint attention in later development among preterm children: Linkages between early and middle childhood. *Social Development,12*, 222-234.

Striano, T., & Bertin, E. (2005a). Social-cognitive skills between 5 and 10 months of age. *British Journal of Developmental Psychology, 23,* 559-568.

Striano, T., & Bertin, E. (2005b). Coordinated affect with mothers and strangers: A longitudinal analysis of joint engagement between 5 and 9 months of age. *Cognition and Emotion, 19*, 781-790.

Striano, T., Chen, X., Cleveland, A., & Bradshaw, S. (2006). Joint attention social cues influence infant learning. *European Journal of Developmental Psychology, 3*, 289-299.

Tabachnick, B. G., & Fidell, L. S. (1989). *Using multivariate statistics, Second edition*. New York, NY; Harper & Row.

Ulvund, S. E., & Smith, L. (1996). The predictive validity of nonverbal communicative skills in infants with perinatal hazards. *Infant Behavior and Development, 19,* 441-449.

Venezia, M., Messinger, D. S., Thorp, D., & Mundy, P. (2004). The development of anticipatory smiling. *Infancy, 6*, 397-406.

Yirmiya, N., Gamliel, I., Pilowsky, T., Feldman, R., Baron-Cohen, S., & Sigman, M. (2006). The development of siblings of children with autism at 4 and 14 months: Social engagement, communication, and cognition. *Journal of Child Psychology and Psychiatry, 47*, 511-523.

Figure 1

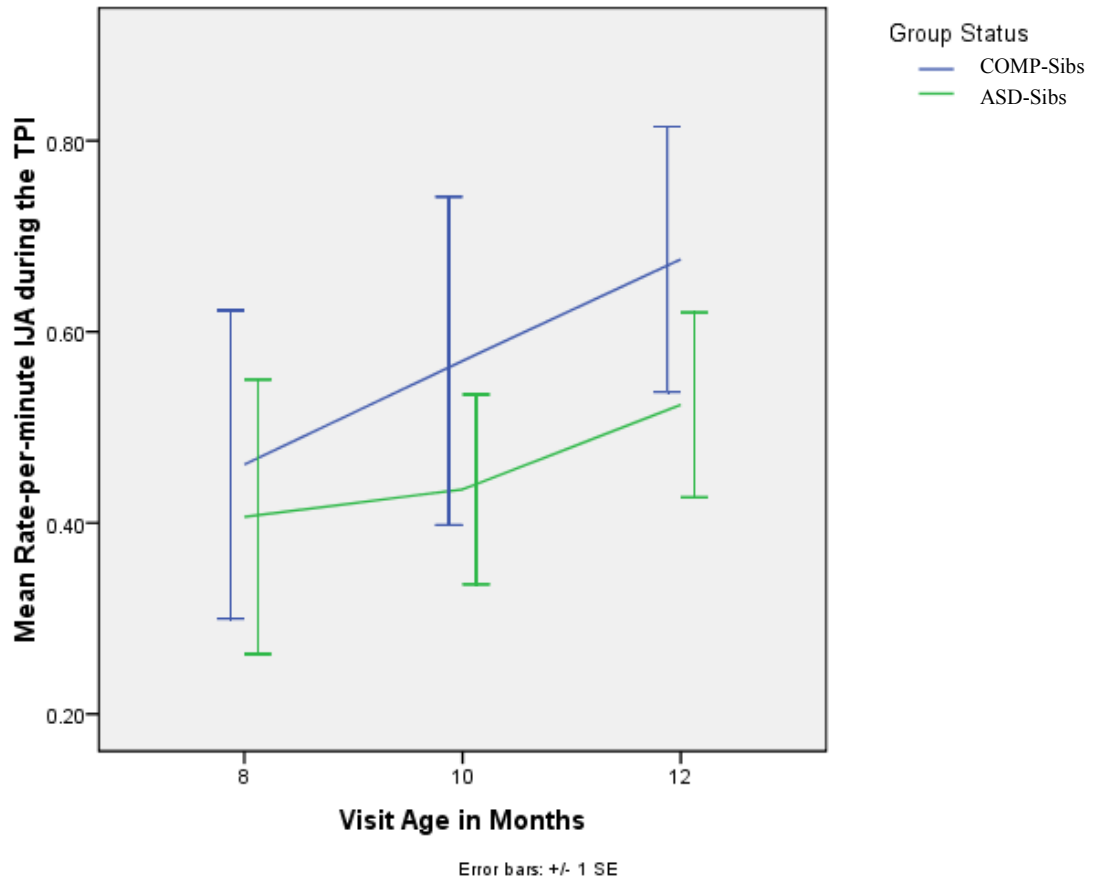*Mean frequency of IJA during the TPI by group status*

Figure 2

Mean frequency of IJA during the TPI by gender
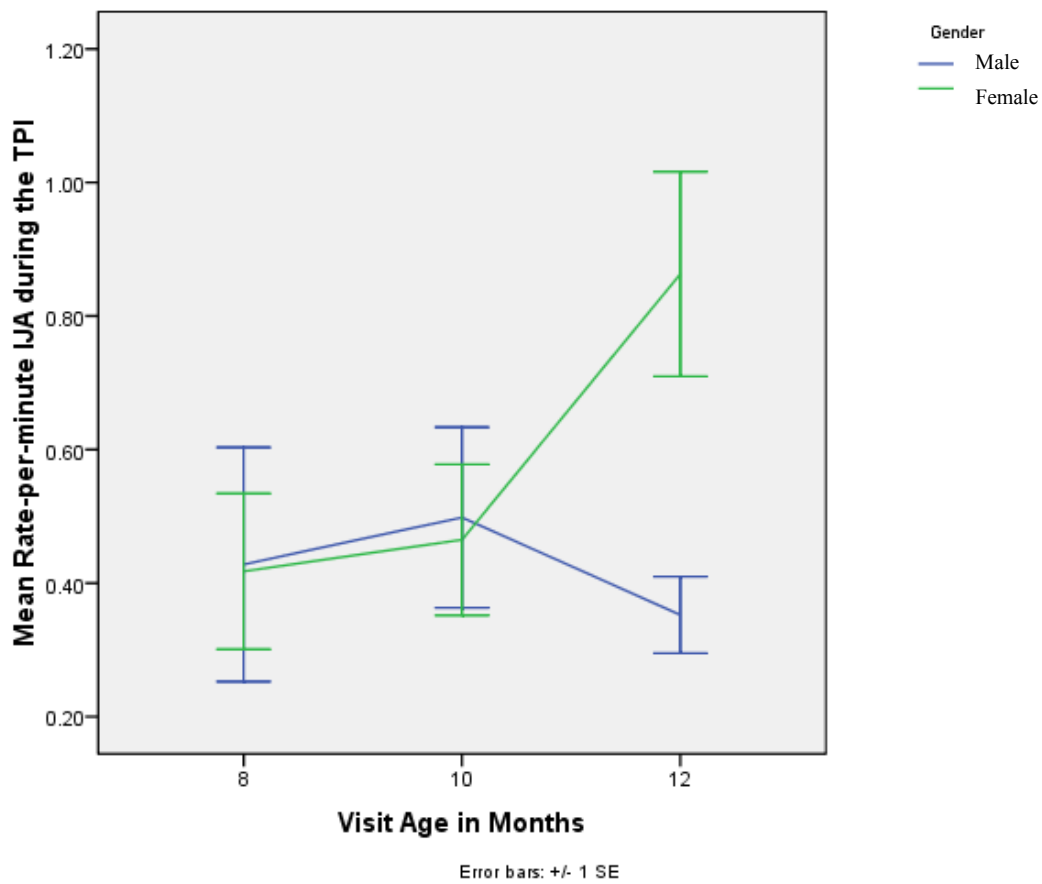
Figure 3

Presence of IBR during the TPI by group status and gender
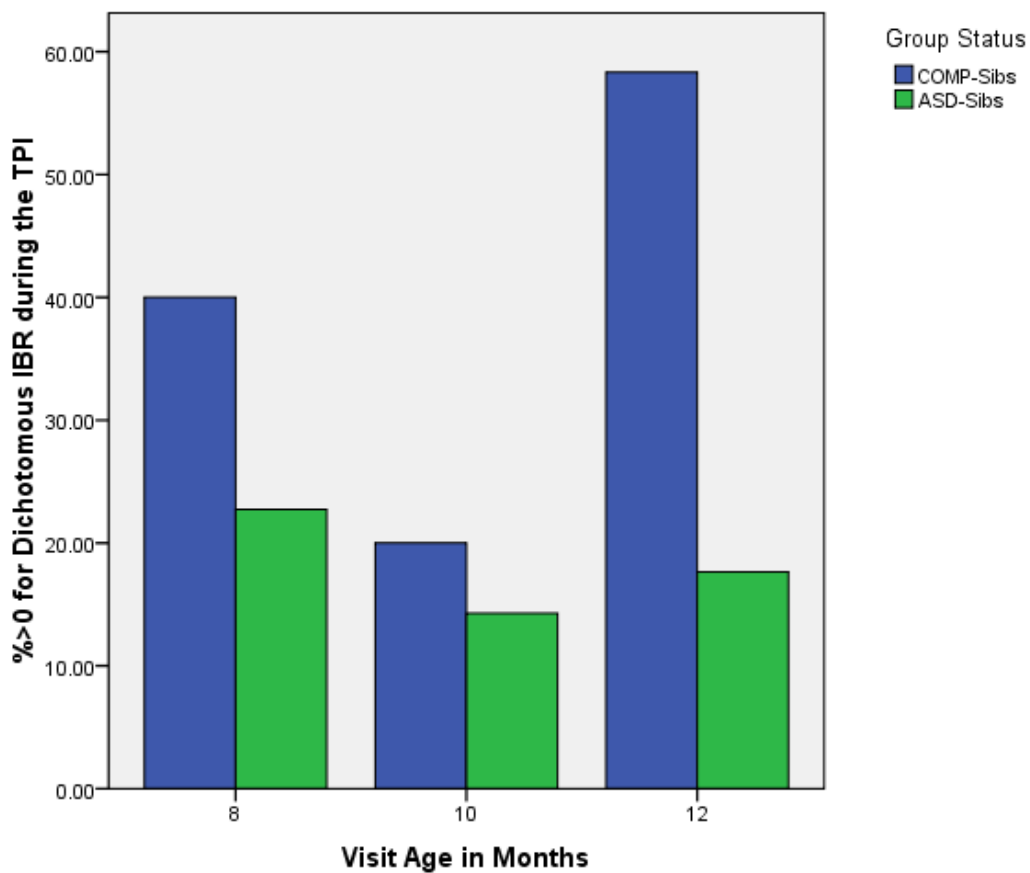
Figure 4

Mean frequency of IJA during the ESCS by group status

Error bars: +/- 1 SE

Figure 5

Mean frequency of IBR during the ESCS by group status
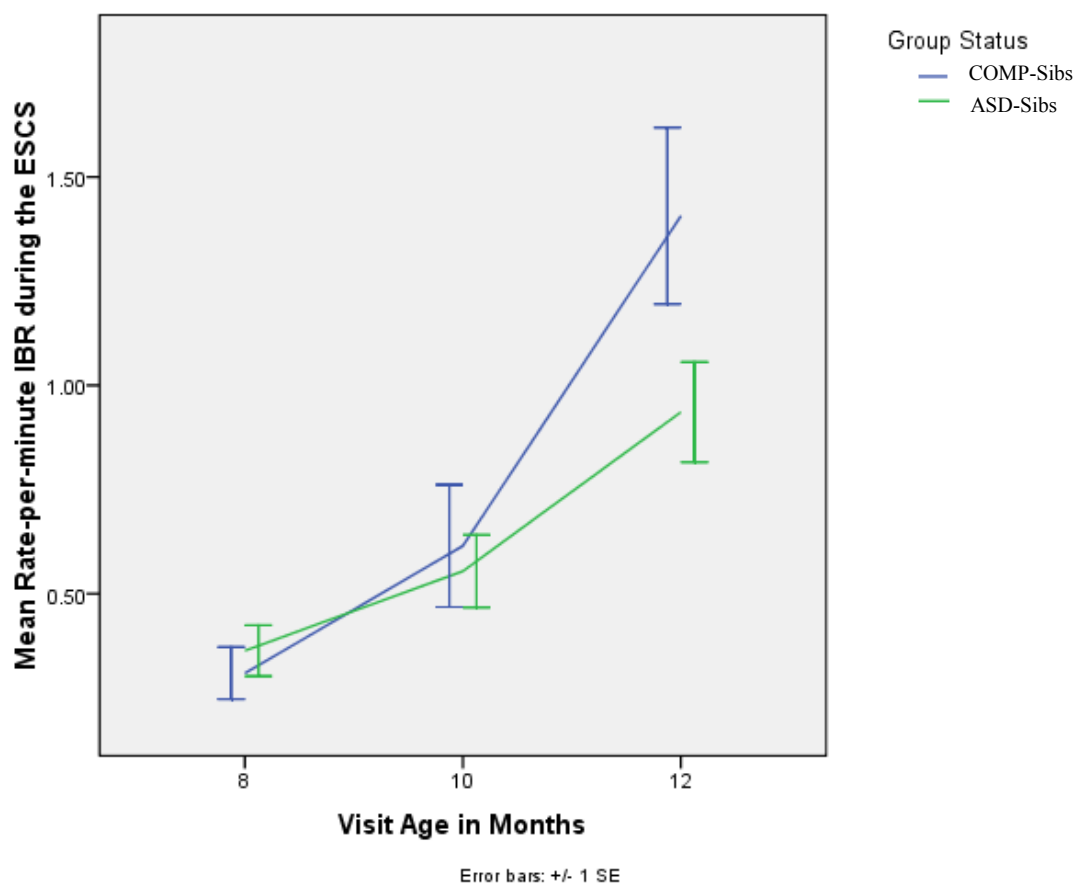
Table 1

Participant information by Group Status

Visit Age	ASD-Sibs	COMP-Sibs
	n(males)	*n*(males)
8 Months	22 (*n*=13)	10 (*n*=5)
10 Months	28 (*n*=17)	15 (*n*=5)
12 Months	34 (*n*=22)	12 (*n*=5)
All Ages	16 (*n*=9)	7 (*n*=3)
Total	40 (*n*=26)	17 (*n*=7)

Table 2

Description of triadic behavior codes during the TPI

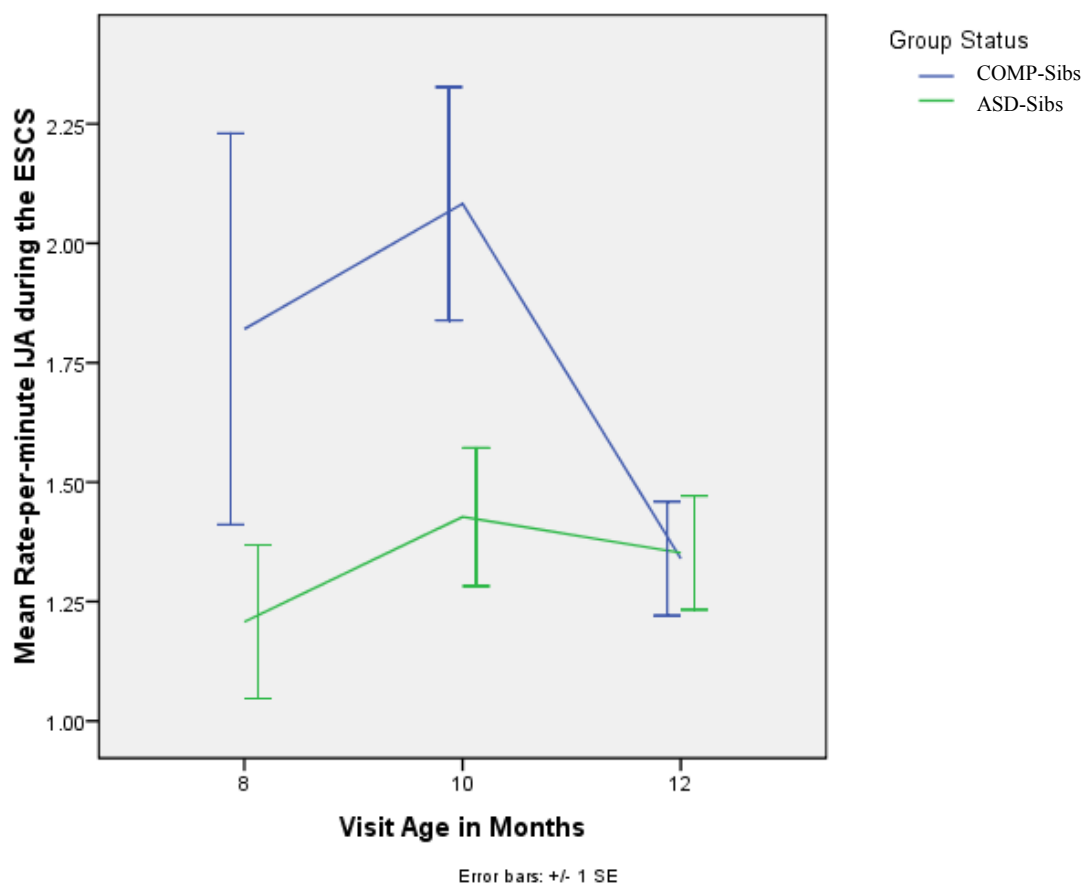| Category	Code	Description
Initiating Joint Attention		
	Eye contact	Child looks from object to parent, can look back to same object
	Point	Index finger point to toy/object, wall poster, any other unobtainable object (e.g., camera)
	Point with eye contact	Point and EC simultaneously
	Show	Child intentionally raises toy upward toward parent's face while looking at parent
Initiating Behavioral Request		
	Eye contact	Child makes EC with parent for purpose of requesting something
	Reach	Child extends arm fully (i.e., arm stretched out straight) toward out-of-reach object (NOT coded if child obtains the object)

	Appeal	EC and reach/clear requesting behavior
	Point	Point to request something
	Point with eye contact	Point to request something with simultaneous eye contact
	Give	Child pushes, throws, holds out to, or hands object to parent to request that parent repeats action or gets rid of object (e.g., giving blocks to parents repeatedly)
	Give with eye contact	Give with simultaneous eye contact
Unspecified		
	Unspecified eye contact	Eye contact that cannot be categorized as IJA or IBR
Uncodeable		
	Uncodeable behavior	Parent movement/speech within 2 seconds prior to child behavior

Table 3

Description of triadic behavior codes during the ESCS

Category	Code	Description
Initiating Joint Attention		
	Eye contact	Eye contact with parent/examiner while touching toy/object
	Alternate	Child alternates between looking at active object and parent's/examiner's eyes
	Point	Clear index finger point to active object (can touch object) or unobtainable event/object
	Point with eye contact	Simultaneous point and eye contact
	Show	Child raises object toward parent's/examiner's face with eye contact
Initiating Behavioral Request		
	Eye contact	Eye contact to parent/examiner when object inactive and child not touching object

Reach	Child extends arm toward out of reach object (not coded if child obtains object)
Appeal	Eye contact and reach/clear requesting behavior simultaneously
Point	Point to request object/event
Point with eye contact	Point to request with simultaneous eye contact
Give	Child pushes, throws, holds out to, or hands object to parent/examiner to request
Give with eye contact	Give with simultaneous eye contact

Table 4

Descriptive statistics for triadic attention behaviors in each measure

	Raw Variable			Transformed Variable	
	Mean RPM	SD RPM	Skew, Kurtosis RPM	Transformation	Skew, Kurtosis RPM
TPI IJA					
8 Month	.42	.62	2.95, 10.65	Inverse	-.76, .14
10 Month	.48	.57	1.68, 2.03	Inverse	-.56, -.51
12 Month	.56	.54	2.05, 6.26	Inverse	-.21, -.58
TPI IBR					Percentage O Values
8 Month	.10	.20	2.04, 3.03	Dichotomous	72
10 Month	.03	.09	2.54, 5.85	Dichotomous	84
12 Month	.12	.29	3.73, 16.83	Dichotomous	72
ESCS IJA					
8 Month	1.40	1.00	1.31, 1.64	Log10	.59, -.48
10 Month	.95	.95	.77, -.19	Log10	.20, -1.39
12 Month	.75	.81	.84, -.30	Log10	.38, -1.33
ESCS IBR					
8 Month	.35	.26	1.31, 1.64	Inverse	-.16, -.54
10 Month	.43	.46	1.12, .50	Inverse	-.33, -1.23
12 Month	.69	.74	2.22, 6.33	Inverse	-.23, -.71

Table 5

Correlations between triadic attention dimensions within and between time points (n=57)

| | 8 Months | | | | 10 Months | | | | 12 Months | | | |
| | IJA | | IBR | | IJA | | IBR | | IJA | | IBR | |
Dimension	TPI	ESCS	TPI	ESCS	TPI	ESCS	TPI	ESCS	TPI	ESCS	TPI	ESCS
8 months												
TPI IJA	__	-.37*	-.15	.34	.28	-.40*	-.22	.13	.01	.14	.35	.02
ESCS IJA		__	-.24	.23	-.27	.62**	-.07	-.23	-.64**	.48*	-.20	.33
TPI IBR			__	-.38*	.02	.16	.16	.04	.16	-.02	.04	.04
ESCS IBR				__	-.09	-.06	.04	.02	-.15	.00	.20	-.01
10 months												
TPI IJA					__	-.23	-.40**	.16	.16	-.04	.07	-.04

ESCS IJA	—	-.06	-.19	-.16	.52**	-.11	-.03
TPI IBR		—	.18	-.05	-.17	.00	.17
ESCS IBR			—	.32	.38*	-.02	.28
12 months							
TPI IJA				—	-.18	-.16	.15
ESCS IJA					—	.01	.23
TPI IBR						—	-.28
ESCS IBR							—

* Significant at .05 level

** Significant at .01 level