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Responding to Joint Attention: Growth and Prediction to Subsequent Social Competence in Children Prenatally Exposed to Cocaine

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RESPONDING TO JOINT ATTENTION: GROWTH AND PREDICTION TO SUBSEQUENT SOCIAL COMPETENCE IN CHILDREN PRENATALLY EXPOSED TO COCAINE

By

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Responding to Joint Attention (RJA) involves an infant's ability to follow a gaze or point by a partner. Prenatal cocaine exposure (PCE), which places a child in danger of numerous risks, has been accepted as having subtle effects on developmental outcomes such as social competence and associated socio-emotional outcomes. The current study looked at a sample of 166 children prenatally exposed to cocaine who were attending an early intervention program. The study established group and individual trajectories of responding to joint attention from 12, 15, and 18 months of age. Hierarchical modeling identified two groups, a delay group and an average group, while individual trajectories identified a linear pattern of growth of RJA. Both individual and group trajectories indicated that children with higher RJA from 12 to 18 months demonstrated better social competence at three years of age and first grade. The delay and average group showed significant differences on later social competence measures, but not problem behaviors, such that RJA, a positive behavior, may connect more closely with later positive behaviors than with behavior problems. RJA may therefore be useful in a preventative intervention targeted at enhancing positive social behaviors and as an important and simple screening tool for possible delay early in a child's life, helping to deliver early intervention services in a targeted and effective manner.

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CHAPTER 1: INTRODUCTION

Joint Attention/Responding to Joint Attention

Joint attention (JA) is the name given to a group of skills infants acquire that allow them to coordinate attention between themselves, a caregiver, and an object (e.g. Bakeman & Adamson, 1984; Bruner, 1981; Carpenter, Nagell, & Tomasello, 1998; Mundy & Sigman, 2006; Tomasello, Kruger, & Ratner, 1993). An infant's development of these nonverbal skills has been connected to important cognitive and language skills (e.g. Morales et al., 2000; Ulvand & Smith, 1996). JA skills also involve a level of social coordination with a partner that is important to later social learning and competence (Baldwin, 1995; Mundy & Sigman, 2006; Sheinkopf, Mundy, Claussen, & Willoughby, 2004). An emerging body of literature has begun to show that JA skills play an important role in both socio-emotional and behavioral outcomes (Mundy & Sigman, 2006; Sheinkopf et al., 2004; Van Hecke et al., 2007).

When a child begins to follow and, later, interact with an adult's pointing and gazing behaviors, the child is demonstrating a new capacity for attention-sharing. Attention-sharing allows a child to capitalize on the adult's focus of attention in order for the child to learn and communicate in a social manner (Deak, Walden, Yale, & Lewis, in press). An adult can both elicit and direct a child's attention through verbal or nonverbal cues such as pointing, gazing, and using the child's name or an imperative utterance (Deak, Walden, Yale, & Lewis, in press). Children as young as two months can shift their gaze to match an adult's gaze, setting the stage for attention sharing (Butterworth & Cochran, 1980; Scaife & Bruner, 1975). Attention-sharing is different from simply following a gaze; the child not only looks at what is attracting the attention of another

person, but is also aware of and enjoying the awareness of sharing the experience (Bakeman & Adamson, 1984; Tomasello, 1995). While attention-sharing, a child coordinates attention with an object of interest in an adult's view, essentially learning how that adult interacts with and talks about that object (Butterworth, 1991). Through this process of linguistic mapping, a child learns object labels and begins to increase his or her vocabulary (Morales et al., 2001; Ninio & Bruner, 1978; Tomasello & Farrar, 1986). In accordance with this capacity for attention-sharing, infants in the first two years of life begin to intentionally communicate using a progression of language skills within the context of social interaction (Carpenter, Nagell, & Tomasello, 1998; Warren, Yoder, & Leew, 2002). Attention-sharing also allows for social referencing, in which the child picks up an adult's emotions about an object or situation through following the adult's attention (Feinman, 1982). Sharing attention, both by following an adult's lead and by initiating the attention-sharing, is one of the earliest demonstrations of a child's understanding of communicating with others towards a social end.

Joint attention has been operationalized through paradigms that look at individual difference in infant attention gaze. Three types of nonverbal social communication skills emerge from 3 to 18 months including : RJA, IJA, and IBR (Seibert, Hogan, & Mundy, 1982). Responding to Joint Attention (RJA) involves an infant's ability to follow a gaze or point by a partner (Seibert, Hogan, & Mundy, 1982). RJA shows the greatest change in the period from 6 to 18 months (Morales et al., 2000), but consolidates around 9 to 10 months of age (Corkum & Moore, 1998). An infant's initiation of a shared social moment with a caregiver through pointing and gaze shifting is called Initiating Joint Attention (IJA; Seibert et al. 1982). Finally, an infant's ability to request an object through gestures

and eye contact is called Initiating Behavior Request (IBR; Seibert et al. 1982). RJA and IJA specifically seem to involve an element of social sharing because they create an opportunity for social engagement and learning.

RJA and IJA are separate constructs and each have unique variance in numerous later outcomes (Mundy, Block, Vaughn Van Hecke, Delgado, Parlade, & Pomeras, 2007). IJA and RJA contribute at different times and in different – but significant – ways to language and cognitive outcomes, as well as socio-emotional outcomes. IJA has been found to be a strong predictor of expressive language, while RJA is a stronger predictor of receptive language (Mundy & Gomes, 1998). Twelve-month RJA and 18-month IJA both uniquely predicted 24-month language when controlling for cognition (Mundy et al., 2007). Socio-emotionally, RJA and IJA seem to contribute to different behavioral outcomes, with RJA at 12, 15, and 18 months compositely positively related to positive social behavior at 36 months, and an IJA composite negatively relating to the same outcome (Sheinkopf et al., 2004). Also, RJA shows a relatively quadratic developmental trend from 9 months to 12, 15, and 18 months in typically developing children, while IJA seems to grow in a cubic pattern (Mundy et al., 2007). These studies demonstrate that RJA and IJA tap into different early social communication skills in the joint attention construct.

RJA, specifically, has been connected to inhibition, attention, and planning, a constellation of skills thought to describe executive functioning. RJA is thought to require a child to inhibit his current interest and shift attention to a new object of interest. It has been connected with self-regulation, as in a delay of gratification paradigm (Morales et al., 2005), and with the capacity to disengage, for instance, from the face of a

caregiver (Morales, Mundy, & Rojas, 1998; Mundy, Card, & Fox, 2000). RJA, more than IJA, is connected with inhibitory functions that may reflect on how a child interacts in a social setting. For instance, early understanding and mastery of inhibitory control may affect later behavior regulation in the classroom and in interactions with others. These executive function skills help facilitate social interactions and may describe a pathway between RJA and later social and behavioral situations and outcomes.

Social Competence

How children succeed in such social situations through resilient and prosocial behavior has been called social competence (Masten & Coatsworth, 1998; Eisenberg et al., 1997). Many definitions of social competence exist to explain effective functioning, but nearly all incorporate strong socio-emotional skills, self-regulation, and good communication. Masten and Coatsworth (1998) focus on the ability for resilience in the face of risks that is supported through a child's social competence. A child's social competence is a helpful tool; its development may, however, be hindered by many earlier insults to the child. Social competence has its basis in early childhood interactions, and may shape the trajectory for a child's later development (Masten et al., 1999). A child's early competence in a friendship may shape his later interactions with teachers and peers in a classroom setting (Masten & Coatsworth, 1998). For that reason, having strong, early, social competence lays the groundwork for a child's ability to positively interact with the environment at later stages.

Socio-emotional skills. Social competence combines many skills that a child must learn in order to effectively navigate a social interaction. Strong socio-emotional skills allow a child to interact in a positive manner that engages others. This allows a child to

continue a social interaction while keeping the other partner- peer or adult- interested. Children who are seen as more popular and socially competent have an easier time engaging with peers and learning social interaction skills (Sober & Wilson, 1998).

Self-regulation. Self-regulation is another aspect that is important to functioning at a socially competent level. In infancy, compliance and self-control learned through consistent parenting set the base for a child to learn in a classroom environment (Masten & Coatsworth, 1998). The ability to regulate and control attention allows a child to learn through social interaction. Self-regulation of attention may allow an infant to disengage from an otherwise interesting object in order to attend to an important interaction (Eisenberg et al., 1997; Ruff & Rothbart, 1996). The ability to inhibit a response also contributes to social competence; a social interaction involves both engaging with another person and inhibiting an inappropriate response (Ruff & Rothbart, 1996). Children with good behavior regulation skills have better stress resiliency, which led to being more well-liked by peers (Eisenberg et al., 1997). This ability to inhibit a socially incorrect response is also tied to noncompliance and may have an impact on a child's later behavior. Children who break rules, demonstrating disruptive and chaotic behavior in a classroom, have poor academic competence, possibly because they have a hard time self-regulating (Masten et al., 1995). This can lead to more behavior problems as the demands for a child to sit and engage in appropriate classroom behaviors are heightened.

Communication. Good communication skills are essential to social competence. Two facets of good communication are cognitive and language skills. Social competence in school-aged children has been positively correlated with higher IQ and achievement, and, later, with future self-competence (Masten & Coatsworth, 1998). Differences in

language are also associated with individual differences in social competence (Beitchman, Hood, & Inglis, 1990), demonstrating a possible pathway between joint attention, language, and social competence.

Early social competence may help set the developmental course for a child's later academic, social, and emotional outcomes (Masten & Coatsworth, 1998). It may help a child overcome early obstacles and enable typical developmental outcomes. Children with strong social competence skills have adaptive systems that allow them to overcome or thrive in adversity (Masten & Coatsworth, 1998). However, Masten and Coatsworth (1998) specifically mention the ability for high-risk environments, such as violence, poverty, and toxicity, to damage these systems and make it extremely difficult to achieve competency. The study of social competence, therefore, often has included the study of adverse populations, and what is required to remain at a competent level under such adversity (e.g. Masten et al., 1995).

Joint Attention and Behavioral and Socio-Emotional Outcomes

The connection between joint attention and socio-emotional and behavioral outcomes has only recently been explored. Current research shows a connection between infant JA skills and later social outcomes (Mundy & Sigman, 2006; Sheinkopf et al., 2004). Research has looked at both typically developing and at-risk populations, such as children with autism or children in poverty.

Previous research has focused on the association between JA and language and cognition. Joint attention is seen as a precursor to language development (Bakeman & Adamson, 1984; Morales et al., 2000; Mundy & Gomes, 1998). Through sharing attention, a child acquires words by attending to a parent's point or look and mapping the

name of the object to the physical object (Baldwin, 1995; Ninio & Bruner, 1978; Tomasello, 1988). Individual differences in RJA strongly correlated with receptive language skills and predict later receptive language and cognitive ability (Morales, Mundy & Rojas, 1998; Mundy, Kasari, Sigman, & Ruskin, 1995). RJA also correlated highly with measures of expressive and receptive language taken at the same time point (Mundy & Gomes, 1998). This held true even after controlling for cognitive ability, showing that joint attention uniquely predicted language ability above and beyond cognition. Specifically, measures of RJA at 6, 8, 10, and 18 months were significantly correlated with language at 30 months (Morales et al., 2000). In children prenatally exposed to cocaine, IJA and RJA at 13 months predicted 24-month receptive language (Ulvund & Smith, 1996). IJA at 13 months was also associated with later language and cognitive measures as far as 60 months of age (Ulvund & Smith, 1996). In another sample of cocaine exposed children, RJA and IJA at 12 months predicted cognitive ability at 18 months, and RJA predicted expressive and receptive language at 36 months (Neal, 2002). Individual differences in early JA also predicted the frequency of later JA episodes with a caregiver, as well as cognitive ability (Markus, Mundy, Morales, Delgado, & Yale, 2000). Joint attention has been connected with later vocabulary, expressive and receptive language, and cognitive ability. However, joint attention has been shown to predict later social competencies even above and beyond language development (Acra, 2006; Sheinkopf et al., 2004).

Theoretically, the different types of JA do not necessarily correlate with the same outcomes. Because they represent different competencies and skills, they may predict to divergent and unique processes later in development (Mundy et al., 2007). The Multiple

Process Model (Mundy et al., 2007; Mundy, Card, & Fox, 2000) theorizes that different executive function skills contribute to the development of the various JA skills in unique ways. This theory emphasizes the study of individual differences in joint attention and the ways that those differences connect to other processes, both linguistic and cognitive as well as socio-emotional and behavioral. Mundy and colleagues (2007) found support for the Multiple Process Model by finding different patterns of growth and predictive ability in the different types of joint attention. IJA and RJA proved to be different and unique parts of joint attention that had strong stability over time but were not predictive of the same later outcomes. This indicates that RJA and IJA tap into different executive functions that are important to the development of later outcomes. It has been hypothesized that RJA connects to attention shifting and social orienting behavior, while IJA may have more to do with social motivation and intentional social engagement (Mundy & Sigman, 2006). These unique executive functions that contribute to different aspects of joint attention may also contribute differently to language and behavioral development, suggesting a reason for different types of joint attention to predict more accurately to unique developmental outcomes. For example, the attention shifting necessary to respond to a joint attention episode at 9 months, which has a unique effect on 24 month receptive language, may also be connected with later classroom behavioral issues associated with attentional difficulties.

Research is beginning to explore the behavioral and socio-emotional outcomes associated with infant joint attention. A growing literature has looked at the continuity between joint attention at infancy and social competence measures at 36 months and beyond. Certain kinds of joint attention may draw out positive caregiving from a parent

(Mundy & Sigman, 2006). Caregiver scaffolding at 9 months was positively correlated with 12 month IJA (Vaughan et al., 2003). The quality of child attachment to the caregiver, however, seems not to be correlated with JA skills, except in the case of disorganized attachment (Claussen, Mundy, Mallik, & Willoughby, 2002). Vaughn et al. (2003) studied joint attention and 30 month outcomes in typically developing children. Both IJA and RJA were associated with temperament measures at 30 months, as well as externalizing and internalizing behavior and social competence. Another study of typically developing children found a positive correlation between 6-month RJA and 24-month delay of gratification (Morales et al., 2001). Sheinkopf et al. (2004) explored this continuity with a group of at-risk children who were prenatally exposed to cocaine. Composite scores of IJA and RJA, attained by combining 12, 15, and 18 month scores, were correlated with 36 month behavioral outcomes. Above and beyond cognition and language ability, higher rates of both IJA and RJA predicted to lower disruptive behavior scores. RJA was also predictive of positive social behavior at three years. Using a similar group of children prenatally exposed to cocaine, Acra (2006) extended these outcomes to the first grade classroom. Eighteen-month IJA was positively correlated with social competence and negatively associated with hyperactivity and attention problems. Unlike the Sheinkopf et al. (2004) study, this study found that RJA was not directly related to later social competence, but was related to internalizing behavior. RJA was also indirectly related to social competence and school problems through a cognitive-language factor (Acra, 2006). RJA has been connected with 36-month positive social behavior, externalizing and internalizing behavior, 24-month delay of gratification, receptive language, and cognition. The discrepancy in social outcomes extending further than 36

months, however, demonstrates the need for further research into the connection between responding to joint attention and later social competence.

Prenatal Exposure to Cocaine

Prenatal cocaine exposure (PCE) is an insult to the formation of a child's system. A red flag for a high risk environment, PCE is connected with violence, poor parenting, high custody changes, poverty, and more (e.g. Bono, Dinehart, Dobbins, & Claussen, 2007). Children prenatally exposed to cocaine and children raised in similar environments that were not prenatally exposed had similar negative developmental outcomes (Hurt, Malmud, Betancourt, Bordsky, & Giannetta, 2001; Phelps, Wallace, & Bontrager, 1997). PCE places children at risk for language and cognitive delays, again through exposing a child to heightened risk for low SES and maternal education (Bandstra et al., 2002; Frank et al., 2001; Singer et al., 2002). Children prenatally exposed to cocaine often also have associated caregiver problems such as parental psychopathology and homelessness (Claussen, Scott, Mundy, & Katz, 2004). Prenatal cocaine exposure may in fact be a red flag for children who are living with extreme poverty and hardship.

PCE has been accepted as having subtle effects on developmental outcomes, rather than the overt effects once hypothesized. One of the subtle areas affected by PCE is social competence and associated socio-emotional outcomes. Poor impulse control, poor emotional regulation skills, and emotional lability were seen in children prenatally exposed to cocaine (Bendersky & Lewis, 1998; Mayes, Grillon, Granger, & Schottenfeld, 1998). PCE has a negative effect on task persistence and sustained attention in preschool through first grade (Bandstra, Morrow, Anthony, Accornero, & Fried, 2001). PCE has

also been connected with a rise in general problem behaviors through early childhood, particularly, externalizing problems (Chasnoff, Anson, Hatcher, Stenson, Iaukea, & Randolph, 1998; Richardson, 1998). Four year olds prenatally exposed to cocaine were also more disruptive and more easily frustrated than their non-exposed peers (Dennis, Bendersky, Ramsay, & Lewis, 2006). Children prenatally exposed to cocaine are less able to control their emotions and attention and are more likely to have later problems because of poor executive functioning. Through contact with a high risk environment, children prenatally exposed to cocaine have an increased chance for numerous language, cognitive, and socio-emotional delays and impairments.

Purpose of the Study

Due to these effects of cocaine exposure on socio-emotional, behavioral, and language development, children prenatally exposed to cocaine are especially suitable to research involving joint attention and social competence. These children show a wide range of normal and clinical outcomes that make this population especially useful for such research. Previous research involving PCE, JA, and social competence has shown mixed results.

The current study looks at a sample of children prenatally exposed to cocaine who were attending an early intervention program. The goal of the study is to establish trajectories of responding to joint attention from 12, 15, and 18 months of age. Previous research has looked at individual differences in RJA, but has not attempted to model growth and change in RJA in a sample prenatally exposed to cocaine. The study will then look at the connections between these trajectories and behavioral and social outcomes at 36 months and first grade.

Research Objectives

The first objective of this study is to determine the developmental patterns of RJA growth in a group of infants with PCE. RJA is hypothesized to show a linear increase with age with a lower starting point as compared to typically developing samples for the group as a whole due to delay. Exploratory analyses will also be conducted to see if this group of infants displays different patterns or trajectories of RJA development.

The second objective is to examine the predictive relationship of early RJA and later social competence measures. Analyses will be used to determine the effects of sex, birthweight, race, and treatment group on RJA. These interactions will then be used to look at the predictive ability of individual RJA scores to three- and six-year social competence. It is expected that individual differences in early RJA will predict three- and six-year social competence measures. Exploratory analyses will again be used to examine whether different trajectories patterns of RJA development are predictive of later social competence measures.

CHAPTER 2: METHOD

Participants

The final sample consisted of 166 children who were prenatally exposed to cocaine and enrolled in the Linda Ray Intervention Program (LRIP) from 1992 to 2005. Descriptive statistics are presented in Table 1. The children were 73.5% African American (n = 122) and 56.6% female (n = 94). All of the children have 3-year outcomes, and 61 of the 166 children have subsequent 6-year outcomes.

Some participants in the current study have been previously examined in the Sheinkopf et al. (2004) and the Acra (2006) studies. There was an overlap of 30 subjects with 12, 15 and 18 month data with the Sheinkopf study. The Acra study used the 18 month data of the same 30 subjects as Sheinkopf et al. (2004), and 18 month data of an additional 60 subjects, leading to a maximum overlap of 90 subjects. However, it is important to note that the current study has more than 130 new participants compared to the Sheinkopf study and more than 75 new participants compared to the Acra study, in addition to examining additional age points.

Procedure

Intervention program. The Linda Ray Intervention Program (LRIP) was designed to provide various degrees of services to children prenatally exposed to cocaine from birth to three. The children received one of three treatments: a) a center-based program that provided the child with primary care and an intensive intervention for 5 hours a day, 5 days a week, or b) a home-based intervention that provided the child with primary care and an at-home program for one and a half hours, twice a week, or c) primary care only. More details about the intervention can be found in Claussen, Scott, Mundy, & Katz

(2004). The intervention was created as a way to prevent further developmental delay by providing the child with a developmentally appropriate environment; in intensive curriculum focused on cognitive, linguistic, social-emotional, motor, and self-help development.

Data collection. The Early Social Communication Scales (ESCS) was administered at three time points: 12, 15, and 18 months. The RJA score is a percentage calculated using the number of times a child correctly looked and responded to the experimenter's joint attention bid over the number of total trials administered. Three year outcomes consisted of the Adaptive Social Behavior Inventory (ASBI) and the Child Behavior Checklist (CBCL), and six year outcomes included the Social Skills Rating System (SSRS) and the Behavior Assessment System for Children (BASC).

Measures

Joint attention measure. Responding to joint attention was assessed using the Early Social Communication Scales (ESCS; Mundy, Hogan, & Doehring, 1996). The ESCS is a twenty minute videotaped assessment. An assessor and the child are seated across the table from each other, with a set of interesting toys next to the assessor. Posters are placed at ninety degree angles to the left and right of the child, and one is placed directly behind the child.

The child is given a total of six RJA pointing trials, left, right, and behind. The administrator makes sure the child is attending to the administrator's face. Then the administrator looks at the poster to the right, points, across his body, and says the child's name three times. The administrator waits three seconds and then returns to face the

child. He then repeats this procedure while pointing to the poster to the left and behind the child. The three trials are then repeated again at a later time in the assessment.

RJA was coded as a percentage of correct looks over total trials. The child was given a score of either correctly responding to the joint attention bid by looking at the poster, or not. All of the scores were added and then divided by the number of total trials administered. Reliability was assessed using interclass correlations (ICCs) on 10% of the sample, with ICCs of .91 for right trials, .84 for left trials, and .87 for back trials.

Three year behavioral outcome measures. The Adaptive Social Behavior Inventory (ASBI; Hogan, Scott, & Bauer, 1992) is a pen and paper questionnaire designed to look at both adaptive and maladaptive behavior in preschool children. The measure produces three subscales: Comply, Express, and Disrupt. The Comply subscale deals both with a child's compliance towards directions and with a child's compliance in social situations that demand waiting, turn-taking, or helping behaviors. The Express subscale captures a child's expression of emotion and socialization, such as sympathy and empathy. The Disrupt subscale focuses on maladaptive behaviors such as bullying and inappropriately displaying emotion. The three scales have shown to be internally consistent, with alphas of .79, .79, and .71 (Hogan, Scott, & Bauer, 1992).

The Child Behavior Checklist (CBCL 2-3; Achenbach, 1992) is a measure of behavior problems in children. It is a 99 item questionnaire which asks how true a statement is about the child. The questionnaire yields externalizing and internalizing subscales, as well as subscales of Withdrawn, Anxiety, and Aggression. The CBCL has internal consistencies of .78, .84, and .92 for the three latter scales, respectively (Achenbach, 1992).

Six year behavioral outcome measures. The Social Skills Rating System (SSRS; Gresham & Elliott, 1990) is a pen and paper measure of children's academic competence, problem, and pro-social behavior. The questionnaire has a parent and teacher version, with 55 and 57 items respectively. These forms measure the two scales of Social Skills, made up of Cooperation, Assertion, and Self-Control subscales, and Problem Behaviors, made up of Externalizing and Internalizing subscales. The teacher form also measures an Academic Competence subscale. The SSRS has internal consistency scores of .91 for Social Skills, .85 for Problem Behaviors, and .95 for Academic Competence scales.

The Behavior Assessment System for Children (BASC; Reynolds & Kamphaus, 1992) is a pen and paper questionnaire that assesses behavior in children of elementary school age. The teacher and parent versions, 147 and 138 items, respectively, capture competencies and skill development as well as problem behavior. The teacher questionnaire yields four subscales of Externalizing Behaviors, Internalizing Behaviors, Problem Behaviors, and Adaptive Skills. The parent form does not include a Problem Behaviors score.

Data Analysis

Hierarchical linear modeling (HLM) was used to examine the developmental progression of age in this sample. Exploratory analyses used a developmental growth modeling program to determine if there were different trajectories for RJA. After developmental trajectories were determined, one-way analyses of variance (ANOVAs) were run to examine the group differences of three-year and first grade socio-emotional outcomes based on the RJA trajectories. Hierarchical linear regressions also were run to

examine the predictive ability of individual differences in slope and intercept of RJA growth in terms of three-year and first grade social competence measures.

CHAPTER 3: RESULTS

The final sample consisted of 166 children who were prenatally exposed to cocaine and enrolled in the Linda Ray Intervention Program (LRIP) from 1992 to 2005. Descriptive statistics are presented in Table 3.1. The children were 73.5% African American (n = 122) and 56.6% female (n = 94). All of the children had 3-year outcomes, and 61 of the 166 children had subsequent 6-year outcomes. Descriptives for three-year and first grade outcomes are presented in Tables 3.2 and 3.3.

Group growth trajectories

Exploratory analyses used a developmental growth modeling program called PROC TRAJ (Jones & Nagin, 2007) to determine if there were different trajectories of growth for RJA. PROC TRAJ models longitudinal data in developmental trajectories through a semi-parametric, group-based approach. It is less subjective than other growth modeling procedures because it allows for the data to dictate the number of trajectories, instead of the researcher (Nagin, 1999; Nagin & Tramblay, 2001). This program allows each group to vary on intercept and growth parameters; the order of growth parameters can also vary between groups, letting groups be linear, quadratic, cubic and so forth as the data permits. PROC TRAJ estimates the proportion of the population that each trajectory accounts for by estimating individual growth curves, identifying group curves from the individual ones, choosing groups that describe the data, and then estimating which group an individual fits into best. Because the program identifies distinct groups of trajectories, and not individual level variability, development does not have to vary regularly across the population.

Multilevel models were run using PROC TRAJ to determine group trajectories. Models were capped at a linear growth parameter due to the number of data points. A maximum likelihood criterion, the Bayesian Information Criteria (BIC), was used to determine model fit. The model was chosen by looking for the smallest BIC along with the most parsimonious, theory-driven model. The BIC indicated that a two group model best fit the data (Table 3.4). Two statistically distinct trajectories were found (see Figure 3.1 and Table 3.5). The first group consisted of 13.2% (n=19) of the population (p=.001), and was considered the delayed group. The delayed group had an intercept at 12 months that was not significantly different from 0 (M=18.6, SD=18.2), and a zero order slope, indicating no growth. This group started with no demonstrable RJA at 12 months and continued out to 18 months with no significant growth in their joint attention. The second group contained the rest of the population (86.8%, n=147, p<.001), and was considered the average group. This group began at 12 months with a higher RJA percent correct score (M = 42.6, SD=27.2) compared to the delayed group, and showed a steady linear increase in RJA development through 18 months.

Individual growth trajectories

Hierarchical linear modeling (HLM) was used to capture individual growth trajectories (Bryk & Raudenbush, 1987). HLM models individual level intercepts and slopes for each person's trajectory, and it also allows for a partitioning of variance into intraindividual and interindividual differences.

Level 1 model. Level 1 modeled the within subject, or intraindividual, growth by using a time variable. The level one model was:

$$Y_{it}=\pi_{0i}+\pi_{1i}(time)_{it}+e_{it}$$

In this model, Y_{it} was the observed RJA at the t^{th} time for the i^{th} child, where *i* denoted the individual (i=1,2,…166), while *t* denoted the time point (t=0,1,2). The time variable, $(time)_{it}$, was centered at 12 months and simplified, such that time = 0, 1, 2 corresponds with age 12 months, 15 months, and 18 months, and a 1-unit increase in $(time)_{it}$ corresponded to a 3-month increase in age. π_{0i} referred to child *i*'s true RJA percent correct at 12 months, and π_{1i} referred to child *i*'s rate of true change in RJA percent correct every three months from 12 months to 18 months. Finally, e_{it} was the residual RJA at the t^{th} time for the i^{th} child.

Level 2 model. Level 2 modeled the between subjects, or interindividual, variance and was composed of two equations:

$$\pi_{0i} = \beta_{00} + r_{0i}$$

$$\pi_{ii} = \beta_{10} + r_{1i}$$

The Level 2 fixed effects included β_{00}, which is the average RJA at 12 months, and β_{10}, which is the average rate of change in RJA every 3 months. The Level 2 random effects were r_{0i}, which is the i^{th} child's error around RJA at 12 months, and r_{1i}, which is the i^{th} child's error around the true rate of change in RJA.

Time-Invariant Covariates. A time-invariant covariant, or between-subjects covariate, was included in the model at Level 2:

$$\pi_{0i} = \beta_{00} + \beta_{01}(gender) + r_{0i}$$

$$\pi_{ii} = \beta_{10} + \beta_{11}(gender) + r_{1i}$$

Sex was tested in the intercepts and slopes. Results showed that sex affected the intercept of RJA at 12 months, β_{01}=6.79, t (164) = 2.10, p<.05, such that girls had a mean difference 6.79 units of RJA percent correct higher than boys at 12 months. However,

sex did not impact the rate of RJA growth, β_{11}= -3.13, *t* (164) = -1.20, *p*= 0.23, with no differences in rate of growth based on sex (Figure 3.2).

Models incorporating race, treatment group, and welfare status were used to determine that no other time-invariant covariate significantly affected the intercepts or slopes.

Final model. The final combined model was:

$$RJA_{it} = \beta_{00} + \beta_{01}(gender) + \beta_{10}(time)_{it} + r_{0i} + r_{1i}(time)_{it} + e_{it}$$

The final model was chosen by comparing model deviances. A saturated model with treatment group, welfare status, and sex in the intercept and slope was compared to the final model; the saturated model did not fit the data significantly better than the final model ($\chi^2(7)$= 5.53, $p > .5$). The final model, with sex in the intercept, fit the data significantly better than the model with only time at Level 1 ($\chi^2(1)$= 4.33, $p < .05$).

Fixed effects. An examination of the fixed effects revealed that RJA grows nearly 13 units every 3 months, β_{10}=12.85, *t* (164) = 9.88, $p<.001$. In addition, the time-invariant covariate demonstrated that sex affects the starting point of RJA at 12 months, but not the rate of growth, such that girls started higher but grew at a rate similar to boys (see Table 3.6).

Variance components. Variance components included interindividual variance around both average RJA at 12 months and average rate of change in RJA from 12 months to 18 months, as well as intraindividual variance around RJA. Variance components were obtained from an empty model, a time model, and the final model. The variance components of the final model showed that both the intercepts and the means

should be allowed to randomly vary, such that individuals started at different levels of RJA at 12 months and grew at significantly different rates of change (see Table 3.7).

The intraclass correlation (ICC) partitions the variance into intraindividual variance and interindividual variance and is calculated in the empty model by dividing the Level 2 variance by the total variance ($\frac{\tau_{00}}{\tau_{00}+\sigma^2}$). The ICC = .189, meaning that 18.9% of the variance in RJA was attributable to interindividual, or Level 2, differences. The proportion of variance accounted for (PVAF) explains how much of the variance was explained at each level by other variables. At Level 1, PVAF ($\frac{\sigma^2_{empty}-\sigma^2_{time}}{\sigma^2_{empty}}$) =.365, or 36.5% of the intraindividual variance was explained by time.

RJA and outcome correlations

Means of RJA percent correct were calculated at each time point for each trajectory group and for each gender (Table 3.8). Correlations between RJA and the ASBI and CBCL (Table 3.9), SSRS (Table 3.10), and BASC (Table 3.11) were calculated in order to assess relationships between RJA and variables of interest. RJA at 12 months was moderately correlated with RJA at 15 and 18 months (r_{RJA15} = .32, p <.01, r_{RJA18} = .26, p <.01). 15 month RJA was also moderately correlated with RJA at 18 months (r = .43, p <.01).

RJA at 12 months correlated with teacher ratings of three year expressiveness (r = .29, p <.01), teacher and caregiver ratings of three year internalizing behaviors ($r_{teacher}$ = -.21, p <.05, $r_{caregiver}$ = -.22, p <.05), and teacher ratings of externalizing behavior at three years (r = -.26, p <.01), but not with any first grade outcomes. RJA at 15 months correlated with caregiver ratings of internalizing behavior at first grade only (r = .35, p

<.05). 18 month RJA also correlated only with caregiver ratings of internalizing behavior at first grade (r = .31, p <.05).

Group trajectory ANOVAs

One-way analyses of variance (ANOVAs) tested group differences in the social competence outcomes based on group trajectory membership. Group means and standard deviations are presented in Table 3.12. For the 36-month outcomes, caregivers rated children in the average group higher on the Express scale of the ASBI than children in the delayed group, $F(1, 117) = 4.88$, p <.05. Teacher report of the Express scale of the ASBI also showed significant differences, $F(1, 117) = 5.38$, p <.05. Finally, there were significant differences in the caregiver report of the Comply scale, $F(1, 116) = 6.72$, p <.05, such that infants in the average group had higher caregiver reported scores on the Comply scale.

ANOVAs on the 6-year social competence measures based on group trajectories showed a number of group differences. Total social skills as reported by the child's first-grade teacher significantly differed based on group membership, $F(1, 49) = 4.452$, p<.05, such that children in the average group were rated higher than children in the delay group. Similarly, children in the average group were rated significantly better by their first-grade teacher than children in the delay group in academic competence, $F(1, 49) = 6.005$, p<.05 and adaptive skills, $F(1, 45) = 4.164$, p<.05. Finally, children in the delay group were rated significantly lower by their caregivers than children in the average group on internalizing behavior, $F(1, 59) = 4.695$, p<.05.

Individual intercept/slope regressions

Individual level RJA intercepts were correlated with the following outcomes: 36-month caregiver report of internalizing behavior ($r_{intercept}$ = -.224, p<.05); 36-month teacher report of externalizing behavior ($r_{intercept}$ = -.236, p<.01); 36-month teacher reported expressiveness ($r_{intercept}$ = .261, p<.01); and first-grade caregiver-reported internalizing behavior ($r_{intercept}$ = .304, p<.01, r_{slope} = .264, p<.05). The intercepts and slopes were highly correlated with group membership ($r_{intercept}$ = -.551, p<.001, r_{slope} = -.485, p<.001).

ANOVAs were run to determine group differences in the outcomes based on sex, race, treatment group, and birthweight. The outcomes did not vary based on sex. Three-year caregiver report of internalizing behavior differed based on race, F(1, 113)=4.285, p<.05, with Black children rated as having significantly higher internalizing behaviors than other children (M_{Black}= 54.61, SD= 10.46; M_{other}= 49.90, SD = 11.34). It also differed based on treatment group, F(1, 112)=4.154, p<.05, with children in the center condition rated with lower internalizing behavior (M_{center}= 52.12, SD= 10.55) than children in the other conditions (M_{other}= 56.71, SD= 11.08). Teacher report of the ASBI expressiveness scale differed based on birthweight, F(1, 101)=6.966, p<.01, with normal birth weight children rated as higher expressiveness (M_{normal}= 31.95, SD= 5.56) than children born with a low birth weight (M_{low}= 28.256, SD= 7.88).

Regressions were run from the intercepts and slopes to the correlated outcome, controlling for the variables on which the outcome differed. Individual level RJA intercepts predicted an additional 4% of the variance in 36-month caregiver report of internalizing behavior when controlling for race and treatment group, R^2 change= .042, β

= -.206, *SE* = .09, *F* (3, 110) = 4.90, *p* = .003, such that higher RJA intercepts at 12 months predicted lower internalizing behavior. Intercepts also predicted 5.6% of the variance in 36-month teacher reports of externalizing behavior, R^2 = .056, β = -.236, *SE* = .08, *F* (1, 124) = 7.30, *p* = .008, such that higher 12-month RJA intercepts predicted lower externalizing behavior. Teacher reported expressiveness was predicted by intercepts when controlling for birth weight, R^2 change= .041, β = .209, *SE* = .06, *F* (2, 100) = 5.813, *p* = .004, with higher intercepts at 12 months predicting higher teacher reports of expressiveness at 36 months. First grade parent reported internalizing behavior was predicted by RJA intercepts, R^2 = .092, β = .304, *SE* = .10, *F* (1, 59) = 6.00, *p* = .017, and slopes, R^2 = .07, β = .264, *SE* = .34, *F* (1, 59) = 4.41, *p* = .04, such that higher intercepts at 12 months predicted higher internalizing behavior at first grade and such that faster growth of RJA predicted higher internalizing behavior at first grade.

CHAPTER 4: DISCUSSION

This study looked at the growth of responding to joint attention, as well as its ability to predict to later social competence outcomes, in a sample of children prenatally exposed to cocaine. Using hierarchical modeling, the growth patterns of both the group at large and the individual were determined. The use of both modeling approaches allows for a varied and in depth look at how RJA grows within this population.

Group Trajectories

Group trajectories allowed for an overarching description of what RJA growth looks like in a PCE sample. The group trajectories identified a large group, 87% of the sample, that showed a linear growth pattern that started lower than a typically developing (TD) sample reported in Mundy et al., 2007, t (2, 208) = 2.33, $p < .02$, but caught up to the TD sample by 18 months, t (2, 207) = .17, $p = .86$. The group grew at a steady linear rate of change, with children progressing from less than half of RJA bids correct at 12 months to nearly three quarters of RJA bids correct at 18 months. The smaller "delay" group, which accounted for 13% of the population, started with RJA percentage correct that was not significantly different from zero, and which did not demonstrate any growth. The delay group showed no significantly demonstrable RJA development or growth in the first 18 months. The delay group's RJA scores were significantly different from both the average group and the TD comparison sample at all time points (Table 4.1), showing a large gap between this group and all other children. These children seem to have growth that differs from other prenatally exposed and typically developing children.

It is of note that although the groups are labeled "delay" and "average", both groups show levels of delay in RJA when compared to typically developing groups (see

Mundy et al., 2007). The groups did not compare to the quadratic growth seen by Mundy and colleagues, but instead showed slight to no growth in the first year and a half. This pattern of delay is consistently seen in the LRIC population, all of whom are classified as meeting criteria for a developmental delay.

Delay group. A significant portion of the sample in this study was placed in an extremely low functioning group that showed little to no RJA or RJA growth. This finding suggests that in children prenatally exposed to cocaine, as many as one infant in eight struggles with a basic skill that seems to be critical for the typical growth of language, cognition, and behavior. It is very possible that children in this delayed group may also show delays in other aspects of development. Interestingly, this pattern of recognizably slow joint attention growth is best seen when looking at population-wide patterns that have not been employed when modeling the growth of typically developing infants. Group growth trajectories may be a useful step in studying the growth of other high risk groups as well as typically developing children. This procedure suggests that there may be significant subgroups of children in the typically developing population that do not match the growth seen on average.

In this sample, there were a significant proportion of children who showed both no responding to joint attention and no gain in RJA as they develop. Significantly, these children also were reported by teachers and caregivers to be lower on important social competence measures such as academic competence and social skills. Early detection of RJA deficits may have far reaching implications that affect a child in both the academic and social spheres. Risk and resiliency theory would suggest that a skill such as RJA that

combines both social and cognitive-linguistic factors may be a useful tool in aiding a child onto a positive developmental pathway.

Children prenatally exposed to cocaine, who display a range from mild to more severe developmental delay, are an especially important group to highlight when looking at marker skills that may be useful in detection of early delay. RJA bids seem to be a relatively easy and cost effective way to screen for possible developmental delay in this group of children. RJA is also a skill that is seen early enough to allow for early detection in a pediatrician's office, far before most children are screened for developmental delay in preschool. The children in this study were in fact part of an intervention study that targeted language and cognition but not RJA. As expected, that intervention had no effect on joint attention; there was no effect of treatment group on RJA at any time. Using the ESCS RJA segment as an assessment may be useful in screening for RJA deficits if an appropriate RJA intervention is designed. This sample represents a group of children who, once leaving their intervention program, continue on into Head Start and the public school system. Earlier identification and intervention for social and behavioral problems may lead to a lessened burden on the teachers and resources in Head Start and public schools.

Individual Trajectories

The Hierarchical Linear Modeling (HLM v.6; Raudenbush, Bryk, Cheong, & Congdon) program calculated individual growth trajectories. The trajectories demonstrated that RJA started at about 22 percentage correct units and RJA growth was best described in a linear fashion, growing at a rate of close to 13 units every 3 months, or one more correct response to a joint attention bid every 3 months. Prenatally cocaine

exposed children seem, on average, to be gaining the ability to respond to a play partner in a linear manner.

Time–invariant covariates. Sex was included in the model as a time-invariant covariate, and explained a significant amount of the variance around the intercepts, such that girls started at 12 months demonstrating about 7 units of RJA percent correct higher than boys at 12 months. RJA growth was not impacted; boys and girls grew at the same average rate from 12 to 18 months. Neither race, treatment group, nor welfare status significantly affected the intercepts or slopes, and so were not included in the final model. This suggests that although common demographic factors may have an impact on where a child starts with regards to RJA, variables outside of these demographics may be playing a far more important role in the growth of RJA. Because of the homogeneity of key demographics such as race and welfare status in the Linda Ray population, it is possible that a study conducted with a different population may find an impact of these variables on RJA. In the LRIC population, other variables may have been more sensitive to each child's environment, such as number of custody changes or the status of the parents in the child's life.

The lack of effect of treatment group, however, suggests that there is more that can be done to help children with joint attention deficits. Although the LRIP curriculum does not specifically target joint attention skills, it does target motor skills, language, cognition, and behavior, all aspects that joint attention later predicts. Children who receive the full LRIP curriculum display significantly better behavior, language, and cognition skills than those who had either the less intensive curriculum or no curriculum at all (see Bono, Sheinberg, Scott & Claussen, 2007). It is surprising, then, that joint

attention seems not to be impacted by the curriculum, even if it is not directly addressed. It is possible that if a joint attention component were added to the curriculum, children would demonstrate even larger gains in positive behavior.

Individual variation. The random effects in the model explore this unexplained variance. Most importantly, both the variance around the intercept and the variance around the slope were found to randomly vary, showing that individuals both start at different intercepts and grow at different rates. This random variation also demonstrates that there is more variance around both the intercepts and slopes that can be explained, such that other variables along with sex can explain individual differences in beginning RJA and RJA growth.

Comparing Growth Models

Using the two growth models allows for a varied view of how a population looks. Group trajectories allow for a more holistic view that may be useful in designing large scale interventions by showing a consistent group level pattern. For example, it is useful to know that children who demonstrate little to no growth between 12 and 15 months may be more at risk for later diminished social competence. However, this information is useful on a group level but can not pick up individual differences in intercept and growth.

The power of individual trajectories is in the ability to study individual differences. Individual trajectories, which provide individual level data, have the ability to predict later outcomes. Prediction allows for a more concise explanation of the relationship between joint attention and later outcomes. For instance, knowing that joint attention growth predicts later internalizing problems is a powerful tool in targeting children with problems and adjusting caretaker expectations. Due to the nature of

developmental research, the ability to predict later outcomes through individual differences in a child's growth or intercept of a skill has wide implications for a how an assessor, researcher, or caretaker can track and intervene with that child. Being able to target an individual's change over time in a skill and to connect that with important outcomes lends weight to the utility of the skill as a developmental milestone.

Both forms of growth models show the importance of using all available data for each child at each time point. Although previous studies have looked at individual differences at a specific time point or aggregate, they lose important information about the child's skill level. By aggregating data, information is lost about the child's ability level at each time point; by using only one time point, data is lost about that child's overall ability level and how they reached that skill level. Growth models allow for a more holistic view of how a skill develops in a child and for more precise questions about the skill.

Social Competence

G*roup differences.* Using the group trajectories, membership was assigned to each member of the sample. Significant differences in social competence measures at both 3 years and first grades were found by comparing the two groups. At 3 years, the average group was consistently rated higher on caregiver reports of expressiveness and compliance. Teachers also rated children in the "average" group as demonstrating higher expressiveness. Interestingly, there were no significant group differences on the disrupt scale, the only problem behavior scale in the ASBI, emphasizing the usefulness of exploring positive social competence and resilience in children as opposed to focusing on negative deficits.

The finding of higher ratings of expressiveness suggests a connection between earlier joint attention capability and later adult report of social and emotional expressiveness. Although the pathway is not causal, it demonstrates the importance of joint attention to the relationship between a child and the adult on which they rely. The higher caregiver rating on the Comply scale also suggests that in the preschool child, caregivers may see children who are more adept at joint attention as also more capable of listening and being appropriately responsive. Due to the nature of how RJA is conceptualized and measured, responding to joint attention as a skill captures many other skills an infant may use. RJA requires that a child pay attention, follow directions and show interest in a social interaction. These skills closely line up with adult expectations for compliance and expressiveness in a social context; it seems possible that this connection explains some of the continuity between an early joint attention skill and later adult definitions of social competence. This also suggests that RJA, and joint attention in general, are really the beginning of a more complex set of social and linguistic tools that an infant uses to navigate the social world.

Competence and deficits. RJA, a positive behavior, seems to connect more closely with later positive behaviors than with behavior problems. Possibly, RJA is a behavior that is best examined in a paradigm that looks for exceptional or positive growth leading to positive outcomes, instead of loss or delay leading to poor outcomes. Even children in the delayed group did not show significantly more problem behaviors, but instead showed significantly less positive behaviors. These skills, which in the past may have been dismissed as unimportant due to their lack of prediction to problem behaviors, may

actually be a component of resiliency or part of an arsenal of skills that a socially competent child employs.

In fact, joint attention as a skill follows many of the steps that Crick and Dodge's (1994) social information processing theory states are integral to the creation of a socially competent response. Infants using joint attention must learn to encode and interpret social cues, as well as generate, evaluate, and decide on a response. The parallel growth of RJA and the cognitive executive function skills suggest that, in a social context, joint attention may be a beginning skill that allows a child to test and understand the process through which more complex later behaviors emerge.

In first grade, the average group was again consistently rated higher on measures of social competence than the delayed group. On the SSRS, teachers rated children in the average group as significantly higher on both the total social skills and the academic competence subscales than children in the delayed group, while on the BASC, teachers reported the "average" group children as being higher on the adaptive subscale than the delayed children. In neither case did teachers report differences on any of the problem behavior subscales, again supporting the use of adaptive instead of maladaptive behaviors as nonclinical-level outcomes. The total social skills subscale, made up of the cooperation, assertion, and self-control scales, is an implication that higher or more regularly developing RJA may connect with facets of self-regulation socially and within the classroom. This again lends support to the connection between RJA growth and regulation and executive function. Children who are more adept at this socially laden skill also show greater regulation skills. Perhaps joint attention is a skill that mimics later behavioral and cognitive processes in a less demanding way.

Individual prediction. Using the individual growth curves, regression analyses allowed for the prediction of later outcomes. In these analyses, RJA only predicted one social competence measure; preschool teacher reports of expressiveness were predicted by a child's 12 month beginning RJA intercept. Surprisingly, RJA intercept predicted nearly all of the problem behaviors, as well, such as three year internalizing and externalizing behavior and first grade internalizing behavior. The growth of RJA, however, only predicted first grade internalizing behavior, suggesting that individual growth may be less informative across the whole sample. It is possible that RJA growth would predict a host of problem behaviors in the "delayed" group of children who are showing no steady growth, but that the more average growth of RJA, even if delayed and in a more linear fashion, is enough to place a child out of the scope of problem behaviors.

Contrary to what was expected, RJA at 12 months had more predictive ability to later behavior than RJA growth. It was expected that the growth parameter would be a strong predictor of later behavioral outcomes, because growth demonstrates the coalescence, understanding and use of the skill. It is possible that, with the use of a more targeted intervention, growth would be a more effective predictor of behavior than it was in this study. As mentioned, although there were distinct patterns of growth in this population, all of the children still showed delays in comparison to their typically developing peers. This homogeneity of delay in the sample may have hindered the predictive ability of growth; possibly in a group with a wider range of growth patterns, growth would be more indicative of later behavior. It is also possible that due to the general development of this skill in most children, growth, except in extreme circumstances of absolutely no growth, is not as strong of a predictor as where a child's

skill started. Because most children fully develop joint attention at some point, it may be that where and when a child starts to develop RJA is more indicative of general competence than the actual growth parameter.

Internalizing behavior. The only consistent problem behavior to be predicted, internalizing behavior, emphasized a crucial point. Caregivers reported differences in first grade on internalizing behaviors, such that children in the average group were reported as higher on internalizing behavior. This is the only problem behavior subscale that was significantly different across groups, and, interestingly, the average group had a higher incidence of reported problem behaviors. Individual RJA intercepts negatively predicted three year internalizing behavior, but positively predicted first grade internalizing behavior. First grade internalizing behavior was also the only outcome predicted by the growth of RJA. This suggests a switch in the effect of joint attention on later outcomes based not only on how it begins, but how it develops. It is possible that more rapid growth of joint attention in this high risk sample leads to a child getting less attention from a caregiver as the child is perceived as more regulated. This may indirectly lead to a higher level of later internalizing behaviors. It may also be the case that early RJA skill is connected with attention regulation and inhibition. As suggested by Sheinkopf et al. (2004), a child who early on looks self-regulated and contemplative may later become a child who shows more internalizing problems due to overregulation. As RJA is connected with inhibitory executive functions, a child who has better growth of RJA may also be a child with advanced executive functions.

Specifically in the PCE population, behavior problems are a serious concern. Children with so many high risk markers often show an abundance of externalizing

behavior problems (Bada et al., 2007). In the LRIC population, however, there is also a subsample of children who could be described as hypervigilant. These children show an excess of watchfulness and over regulation, especially in social contexts. Perhaps this hypervigilance is demonstrated early on by high RJA skills and later manifests as internalizing problem behaviors.

These findings highlight the importance of focusing on an early emerging skill such as joint attention. Children who progress more readily with joint attention skills are consistently rated as having higher adaptive, expressive, and academic skills by teachers and caregivers. This finding seems to hold across a long span of years, with teachers in first grade still rating children in the average group as more socially competent. Acra (2005) suggests an indirect path to first grade social competence through a concurrent cognitive-linguistic skill, which may be an explanation for the differences seen on the social competence scales between groups. However, these data show that there is also a direct difference in the child's basic group status and later social competence above and beyond that child's individual 18 month RJA.

Limitations

Limitations of this study include the difficulty of obtaining strong measures of social competence. Both teachers and caregivers have different contexts in which to define a child's social competence, which may explain the differential findings in parent-report and teacher-report. Parents and teachers may understand or represent the questions about social competence differently depending on their experience with the child and with other children. Also affecting the study was a lack of a fourth data point. Data at nine months would have given the opportunity to possibly see a more quadratic growth

pattern that was not established in the data. The data points could also have been collected in uneven waves for use in HLM, so that children were assessed more between 12, 15, and 18 months, and then less so before or after those periods. This would have given a more complete picture of the time points of interest. Finally, HLM and PROC TRAJ both model growth trajectories through maximum likelihood and model fit. Structural equation modeling, while most likely yielding the same results, would have provided a model fit estimate for a combined model of individual growth and later prediction. Finally, this at-risk population does not describe the growth and prediction of RJA in a typically developing population.

Implications

Social competence. In this study, data show that RJA group trajectory consistently demonstrates group differences on later social competence measures. However, teacher and parent measures were differentially able to show group differences. In preschool, both teacher and caregiver reports showed the effect of RJA group placement on social competence. Not surprisingly, expressiveness, the only scale on which both teachers and caregivers reported group differences, was also the only scale in which their reports were correlated. The lack of correlation between teacher and parent report has been widely reported; it has been suggested that teachers and parents evaluate children's behaviors in different contexts and therefore are reporting on slightly different aspects of the construct. In the case of 36 month social competence behaviors, the two reports did not correlate on a measure of compliance which demonstrated group differences, $r(98) = .32$, $p < .001$, suggesting that caregivers were more aware of the everyday implications of complying with directions both in general, and in the RJA skill. This lack of correlation

suggests that caregivers and teachers see different social skills being used in the home and in the classroom, and that those skills may be important in different ways.

Researchers often use social competence measures as indicative of later academic outcomes; this suggests that social competence in the classroom may be useful in a different way outside of the classroom. It is possible that social competence within the classroom is indicative of a slightly different set of skills than social competence outside of the classroom. RJA development, which often occurs from interaction both at home and in the classroom, is a naturalistic way to practice positive social competence skills. The way a teacher or a parent interacts with the child in joint attention may affect different aspects of social competence based on the context. Conceptually, it is possible that social competence plays out in slightly different ways across different contexts based solely on the adult participant's expectations for a child.

Responding to joint attention. The data also show that RJA is an early skill that has powerful implications for the development of later social competence. This information suggests that an RJA intervention may be a uniquely targeting way to bump a child onto a positive trajectory. Early detection of RJA delay by a pediatrician would be an easy way to screen for a possible negative developmental trajectory; such detection would make placement for an intensive early intervention quicker. Early screening may allow for greater preventative care before the need for ameliorative treatment has to be met. RJA would also be a useful tool for caregivers and teachers in the attempt to bolster a child's self competent behavior. Joint attention appears to be a simple yet effective way to start children on a track towards positive social interactions. Children at risk due to

poor caregiving and high poverty may benefit from teachers and caregivers attending to this important skill.

This study modeled the growth of responding to joint attention in a group of children prenatally exposed to cocaine. Children who were especially vulnerable due to a host of risks showed a marked delay in joint attention. However, strong RJA skills were indicative of better social competence later. This connection with social competence behaviors suggests that RJA could be used as a skill in a preventative intervention targeted at enhancing positive social behaviors. This study highlighted the importance of RJA in the sequence of children's social and behavioral development; RJA was shown to have predictive ability to 36 months and first grade. Early detection of RJA delay and the enhancement of RJA development in at-risk populations may be a way to help boost children onto a positive developmental trajectory.

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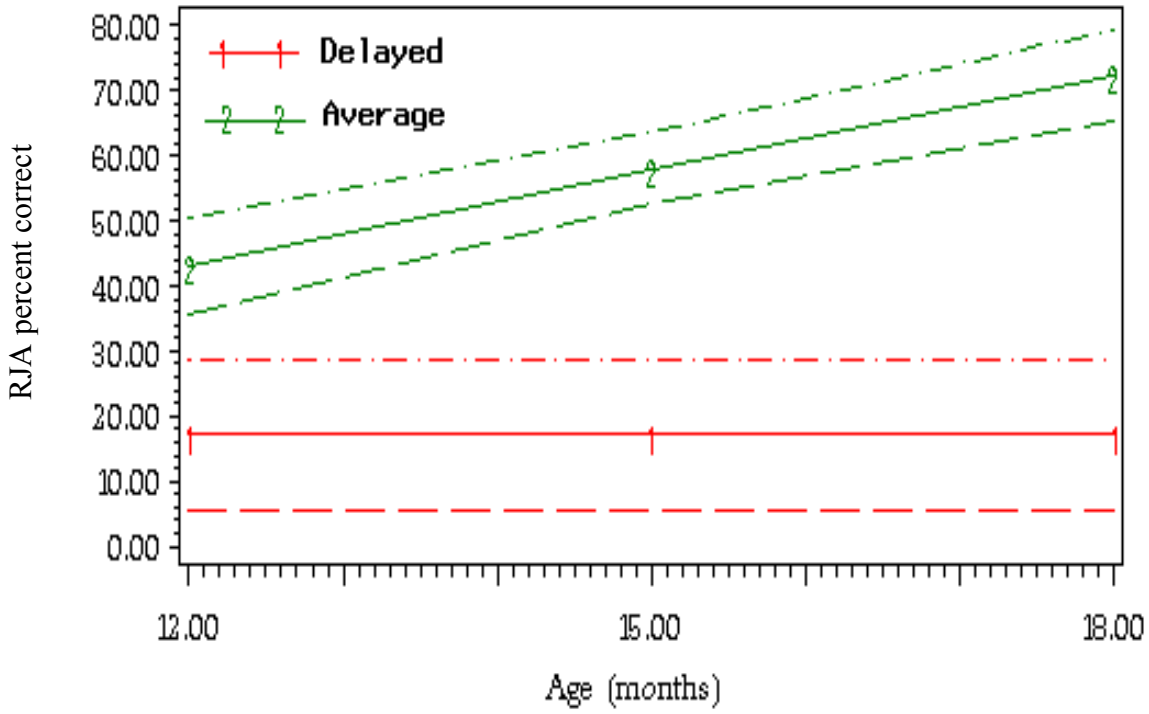
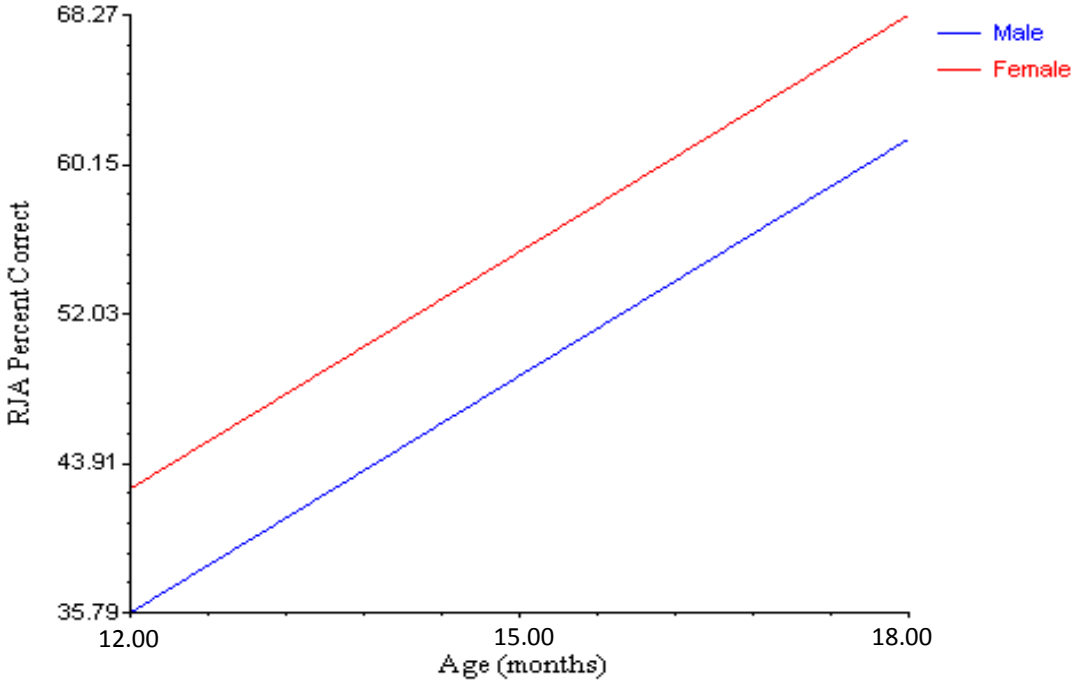
Figures

Figure 3.1. RJA percent correct growth over time.



Note. Two statistically distinct trajectories were found. The Delay group consisted of 13.2% of the sample and showed no statistically significant 12 month RJA or RJA growth. The Average group contained 86.8% of the sample began at 12 months with an average RJA percent correct score of 42.6, and showed a steady linear increase in RJA development through 18 months.

Figure 3.2. RJA growth as a function of sex.



Note. RJA grew nearly 13 units every 3 months (β_{10}=12.85, t(164)=9.88, p<.001). Sex, the time-invariant covariate, affects the starting point of RJA at 12 months, but not the rate of growth, such that girls started higher but grew at a rate similar to boys.

Table 3.1

Demographic Data

	Center-based (n=121)		Home-based (n=21)		Primary care (n=24)		Total Sample (n=166)	
	n	%	*n*	%	*n*	%	*n*	%
Sex								
Female	66	54.5	10	47.6	18	75.0	94	56.6
Male	55	45.5	11	52.4	6	25.0	72	43.4
Ethnicity								
Black	89	73.6	13	61.9	20	83.3	122	73.5
Hispanic	18	14.8	3	14.3	1	4.2	22	13.2
Other	14	11.5	5	23.8	3	12.5	22	13.2

Table 3.2

Descriptive Statistics for 36-month Social Competence Outcomes

Outcome	*n*	*M (SD)*	*Skewness*	*Kurtosis*
ASBI				
ASBI Express- T	119	30.83 (6.45)	-1.35	2.39
ASBI Express- P	119	33.36 (4.24)	-1.34	3.03
ASBI Comply- T	119	21.95 (5.35)	-0.54	0.51
ASBI Comply- P	119	22.34 (3.98)	-0.53	0.61
ASBI Disrupt- T	119	10.49 (3.08)	-0.06	0.72
ASBI Disrupt- P	119	11.40 (2.65)	1.29	4.72
CBCL				
CBCL Internalizing- T	126	49.87 (12.21)	0.20	-0.65
CBCL Internalizing- P	114	53.37 (10.85)	0.04	-0.33
CBCL Externalizing- T	126	47.10 (10.82)	0.48	-0.34
CBCL Externalizing- P	114	51.40 (9.63)	0.21	-0.25

Table 3.3

Descriptive Statistics for First Grade Social Competence Outcomes

Outcome	*n*	*M (SD)*	*Skewness*	*Kurtosis*
SSRS				
SSRS Social Skills- T	50	91.94 (18.65)	-0.05	-0.65
SSRS Social Skills- P	61	93.98 (17.88)	0.11	-0.66
SSRS Externalizing-T	49	3.82 (3.64)	0.55	-1.08
SSRS Externalizing- P	61	3.97 (2.18)	0.47	-0.08
SSRS Internalizing-T	51	2.88 (2.68)	0.49	-1.18
SSRS Internalizing- P	60	3.25 (2.18)	0.45	-0.29
SSRS Academic Comp- T	51	94.35 (14.87)	-0.14	-0.75
BASC				
BASC Internalizing- T	48	48.46 (10.60)	1.65	2.27
BASC Internalizing- P	61	42.82 (8.40)	0.81	0.74
BASC Externalizing- T	48	53.77 (11.84)	0.71	0.12
BASC Externalizing- P	61	49.10 (10.58)	0.66	-0.01
BASC Adaptive Skills- T	47	47.64 (12.99)	0.31	-1.09
BASC Adaptive Skills- P	61	46.02 (10.22)	0.46	0.50

Table 3.4

Model Bayesian Information Criteria (BIC)

Number of Groups	Group Order [a]	BIC [b]
1	0	-1856.81
1	1	-1829.98
2	***0, 1***	***-1815.33***
2	1, 1	-1817.57
3	0, 1, 0	-1815.59
3	0, 1, 1	-1816.78

Note. A maximum likelihood criterion, the Bayesian Information Criteria (BIC), is used to determine model fit. The model is chosen by looking for the smallest BIC along with the most parsimonious, theory-driven model. The BIC indicated that a two group model best fit the data.

[a] Group order refers to the slope order, 0=no change, 1=linear change. [b] Both BIC size and parsimony are used to determine the final number of groups and group order.

Table 3.5

Group trajectory descriptive statistics

	Delay Group		Average Group	
Variable	ML Estimate	SE	ML Estimate	SE
Percent of population	13.19**	4.09	86.81**	4.09
Intercept	9.92	6.55	42.35**	2.48
Linear Slope	-	-	16.48**	1.80

Note. Two distinct trajectories were found, a delay group with no growth and no 12 month RJA and an average growth with a linear slope and a higher intercept.

**p<.001.

Table 3.6

Final hierarchical model fixed effects

Predictor	Coefficient	*SE*	t ratio
For π_{0i} (Intercept)			
Intercept, β_{00}	22.94	3.49	6.58**
Sex, β_{01}	6.79	3.23	2.10*
For π_{1i} (Slope)			
Intercept, β_{10}	12.85	1.30	9.88**

Note. The hierarchical linear model that best fit the data had fixed effects such that RJA started at 22.94 units and grew at a rate of nearly 13 units every 3 months. A time invariant covariate, sex, impacted the intercepts at 12 months, but not the growth, of RJA. *p<.05. **p<.001.

Table 3.7

Variance components

	Empty Model			Time Model			Final Model		
Parameter	Estimate	χ^2	df	Estimate	χ^2	df	Estimate	χ^2	df
$Var(\pi_{0i})=\tau_{00}$	166.51	265.68**	165	287.35	283.57**	165	266.84	274.94**	165
$Var(\pi_{1i})=\tau_{11}$	-	-	-	52.77	204.23*	164	53.03	204.50*	164
$Var(e_{it})=\sigma^2$	713.85	-	-	453.49	-	-	452.89	-	-

Note. The variance components of the empty, time only and final hierarchical linear models showed that there was significant variance in the slopes and intercepts still to be explained.

*p<.05. **p<.001.

Table 3.8

RJA Percent Correct Means and Standard Deviations by Sex and Group

	12 months		15 months		18 months	
Group	*M*	*SD*	*M*	*SD*	*M*	*SD*
Sex						
Male (*n*=72)	33.93	25.75	49.80	27.47	63.10	29.95
Female (*n*=94)	44.10	27.85	54.30	28.57	67.10	25.70
Trajectory Group						
Delay (*n*=19)	17.90	18.37	18.33	22.56	10.70	12.79
Average (*n*=147)	42.51	27.09	57.37	25.10	72.49	19.95
TD (*n*= 63)[a]	51.70	23.10	66.80	21.90	72.00	18.80

[a] Means and SDs used from Mundy, Block, Delgado, Pomares, Van Hecke, and Parlade (2007).

Table 3.9

Correlations among 36-month social competence and RJA

	1	2	3	4	5	6	7	8	9	10	11	12	13
1. 12 m RJA	1												
2. 15 m RJA	.32**	1											
3. 18 m RJA	.26**	.43**	1										
4. ASBI Express- T	.29**	.14	.11	1									
5. ASBI Express- P	.14	-.03	-.01	.32**	1								
6. ASBI Comply- T	.16	.08	.06	.61**	.10	1							
7. ASBI Comply- P	.02	.14	.02	.09	.55**	.05	1						
8. ASBI Disrupt- T	-.08	-.01	-.13	.16	-.04	-.29**	-.07	1					
9. ASBI Disrupt- P	-.12	-.19	-.15	-.05	-.05	-.07	-.29**	.02	1				
10. CBCL Internalizing- P	-.21*	-.17	-.15	-.26*	-.28**	-.26*	-.38**	.12	.47**	1			
11. CBCL Internalizing- T	-.22*	.00	-.05	-.36**	-.35**	-.10	-.16	-.08	.05	-.01	1		
12. CBCL Externalizing- P	-.11	-.19	-.05	-.14	-.21	-.28**	-.36**	.22*	.52**	.75**	-.04	1	
13. CBCL Externalizing- T	-.26**	-.15	-.14	-.06	-.05	-.09	-.06	.20*	.09	.10	.68**	.18	1

* $p<.05$, ** $p<.01$

Table 3.10
Correlations between RJA and SSRS

	1	2	3	4	5	6	7	8	9	10
1. 12 m RJA	1									
2. 15 m RJA	.32**	1								
3. 18 m RJA	.26**	.43**	1							
4. Social Skills- T	.17	.03	.19	1						
5. Social Skills- P	-.11	.16	-.15	-.83**	1					
6. Externalizing-T	-.03	.23	-.14	-.71**	.93**	1				
7. Externalizing- P	-.21	-.01	-.19	-.21	.17	.14	1			
8. Internalizing-T	.02	.23	.01	-.61**	.75**	.60**	-.12	1		
9. Internalizing- P	-.06	.01	.11	.09	-.13	-.117	.40**	-.09	1	
10. Academic Comp- T	.10	.06	.26	.74**	-.66**	-.49**	-.43**	-.53**	-.06	1

* $p<.05$, ** $p<.01$

Table 3.11
Correlations between RJA and BASC

	1	2	3	4	5	6	7	8	9
1. 12 m RJA	1								
2. 15 m RJA	.32**	1							
3. 18 m RJA	.26**	.43**	1						
4. Internalizing- T	.05	.07	-.07	1					
5. Internalizing- P	.15	.35*	.31*	-.02	1				
6. Externalizing- T	-.18	.07	-.18	.52**	-.04	1			
7. Externalizing- P	-.12	.06	.03	-.01	.34**	.46**	1		
8. Adaptive Skills- T	.19	-.04	.19	-.51**	-.19	-.68**	-.37*	1	
9. Adaptive Skills- P	.18	-.08	.14	-.03	.01	-.20	-.19	.36*	1

* $p<.05$, ** $p<.01$

Table 3.12

ANOVA group descriptive statistics

	Delay Group		Average Group	
Measure	*n*	Mean (SD)	*n*	Mean (SD)
36 months				
ASBI Express-T	14	27.14(5.57)	105	31.32(6.43)*
ASBI Express-C	12	30.83(3.79)	107	33.64(4.21)*
ASBI Comply-C	12	19.58(5.52)	106	22.65(3.67)*
1st grade				
Total social skills-T	5	75.80(10.78)	45	93.73(18.55)*
Academic comp-T	5	79.60(14.67)	46	95.96(14.13)*
Adaptive skills-T	5	36.80(7.60)	42	48.93(12.95)*
Internalizing-C	8	37.00(5.13)	53	43.70(8.48)*

Note. Children in the average trajectory group were reported as significantly higher on social competence measures at 36 months and first grade by teachers and caregivers.

*$p<.05$.

Table 4.1

T-test comparisons between typically developing (TD)[a], average PCE (Ave), and delay PCE groups

	TD/Ave		TD/Delay		Ave/Delay	
RJA time	t	df	t	df	t	df
12 months	2.33*	208	5.85**	80	3.86**	164
15 months	2.41*	153	7.45**	75	5.50**	104
18 months	.168	207	13.29**	80	13.11**	163

Note. The delay group has significantly lower RJA scores than either the average group or a typically developing comparison at every time point. The average group began with significantly lower RJA than the typically developing comparison group, but by 18 months had statistically similar RJA scores.

[a] Means and SDs used from Mundy, Block, Delgado, Pomares, Van Hecke, and Parlade (2007).

*p<.05. **p<.001.