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The Effects of Prenatal Cocaine Exposure on the Mutual Regulation of Attention in Mother-Infant Dyads

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Under the Direction of Roger Bakeman

ABSTRACT

Mutual regulation of attention was investigated in a group of prenatally cocaine-exposed and non-exposed mother-infant dyads during a 5-minute videotaped free play session. Mutual regulation was measured using a state-based coding scheme designed to categorize dyadic interactions into three mutually exclusive and exhaustive states: maternal bid, mutual engagement, and non-involved. Results revealed no significant differences between cocaine-exposed and non-exposed dyads in overall amount of mutual engagement displayed. Cocaine-exposed dyads exhibited significantly longer mutual engagement episodes. Mothers in the two groups did not differ in the number or quality of bids for mutual engagement, and infants in both groups were equally responsive to maternal bids. No ecological variables were found to predict mutual engagement.

INDEX WORDS: Mutual regulation, Mother-infant interaction, Joint attention, Prenatal cocaine exposure, Parenting, Substance Abuse

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Chapter 1

Literature Review

Prevalence of Cocaine Use and Prenatal Exposure

The epidemic of cocaine abuse is a relatively new phenomenon, beginning with the widespread introduction of crack cocaine in the mid-1980s (Schutter & Brinker, 1992). Prior to the advent of crack, cocaine use was restricted to middle- to upper-class, predominantly European-American populations. However, as a result of the increased availability of the drug in the mid-1980s, cocaine abuse has increased across all socioeconomic classes, ethnicities, races, and ages, such that it is currently found in all socioeconomic classes and in all age groups of our society (Chasnoff, 1989; MacDonald, 1992). Furthermore, following the introduction of crack cocaine, women began consuming cocaine at rates equal to men (Boyd & Mieczkowski, 1990; Kelly, 1992).

Cocaine, including crack cocaine, is reportedly the most commonly used illicit drug among women of childbearing age (Chasnoff, 1989). It has been estimated that approximately 15% of all cocaine users are women of childbearing age (Rosenak, Diamant, Yaffe, & Hornstein, 1990), and that between 10% and 30% of all mothers have used cocaine at some point during their pregnancy (Chasnoff, 1989; MacDonald, 1992). However, actual prevalence rates of cocaine use by pregnant women are extremely difficult to determine. Prevalence rates across different studies have varied greatly, depending upon geographical area studied and method of data collection (Frank et al., 1988; Hawley & Disney, 1992; Sparks, 1993). In general, hospitals that perform routine toxicologies on pregnant women report higher rates of substance abuse, including cocaine use, than do hospitals that rely on self-reports. Pregnant women are often

unwilling to report use of cocaine during their pregnancy for fear that authorities will refer them to child protective services with a charge of abuse or neglect (Schutter & Brinker, 1992). This fear may be especially salient to women living in low-income areas who may depend upon the same authorities for health care and subsequent assistance in caring for their children. Therefore, estimates based on self-report are likely an underestimate of the true incidence of cocaine use during pregnancy, especially among low-income women. However, even with the likelihood of underreporting, it has been estimated that over 375,000 children each year are born prenatally exposed to drugs, and that more than 100,000 of these are born prenatally exposed to cocaine (Hawley & Disney, 1992).

It is important to note that, although cocaine use is found in all socioeconomic levels, much of what we know about cocaine users is based on low-income samples. This is particularly true of studies investigating the use of crack cocaine. While most of these studies include socioeconomic status as a variable in the research, it should be kept in mind that much of the research cited in the following dissertation targets a lower-income substance abusing population.

Consequences of Prenatal Cocaine Exposure on Infant Growth and Development

Since the beginning of cocaine's widespread use among women of childbearing age, an increasing body of research has investigated the developmental effects of prenatal exposure to cocaine. However, because the cocaine epidemic is a relatively new phenomenon, the long-term effects on the developmental and behavioral outcomes of children prenatally exposed to the drug are only beginning to be investigated and documented. To date, the majority of the studies of

cocaine and polydrug exposed children focus on developmental outcomes in infancy and toddlerhood.

Early studies of prenatal cocaine exposure have tended to concentrate on the physiological, teratogenic effects of cocaine, and have suggested catastrophic effects of cocaine exposure on perinatal development. These early negative findings, as well as the social stigma applied to substance abusing pregnant women, have resulted in the popular stereotype of the "crack baby" as "brain damaged, handicapped, uncontrollable, and uneducable" (Hutchings, 1993). However, many of these early studies have failed to control for the possible effects of a less-than-optimal environment. Many have also failed to control for the effects of other illicit substances being used in conjunction with cocaine, and have relied on animal models that may not correlate well with human growth and development. More recent studies suggest that many of the early negative study results are questionable and that the "crack baby" stereotype is largely unfounded. Although current investigations of children prenatally exposed to cocaine continue to yield somewhat contradictory results, the overall developmental outcomes of cocaine/polydrug exposed children have been found to be generally consistent with those of children raised in similar impoverished environments without being exposed to drugs.

Pregnancy Outcomes and Congenital Malformations. One of the most consistent findings among studies of cocaine-exposed infants is an association between prenatal cocaine exposure and poor fetal growth and premature delivery. Several studies have found that infants prenatally exposed to cocaine had significantly smaller birthweights, birth lengths, and head circumferences than did infants who had not been prenatally exposed to illicit drugs (Arendt, Singer, Angelopoulos, Bass-Busdiecker, & Mascia, 1998; Brown, Bakeman, Coles, Sexson, &

Demi, 1998; Chasnoff, Griffith, Freier, & Murray, 1992; Coles, Platzman, Smith, James, & Falek, 1992; Eisen et al., 1991; Hurt et al., 1995; Lester et al., 1996; Neuspeil, Hamel, Hochberg, Greene, & Campbell, 1991). Based on their review of the research, Hawley and Disney (1992) suggest that approximately 30-40% of all substance-exposed infants are born with low birthweights. Substance-exposed children have also been estimated to be three times as likely as non-exposed children to be microcephalic, or to have a head circumference below the tenth percentile (Hawley & Disney, 1992). Furthermore, it has been estimated that 30-35% of infants prenatally exposed to cocaine are born prematurely (Handler, Kristin, Davis, & Ferre, 1991; Hawley & Disney, 1992), thereby increasing their risk for difficulties in achieving later developmental milestones.

Although not as consistently demonstrated, research investigating pregnancy outcomes following prenatal cocaine exposure has also reported increased incidence of such perinatal problems as spontaneous abortion, small for gestational age infants, abruptio placentae, and sudden infant death syndrome among women who abuse cocaine during pregnancy and their infants (Chasnoff, 1989; Hadeed & Siegel, 1989; Handler, Kistin, Davis, & Ferre, 1991; Little & Snell, 1991Keith et al., 1989; Zuckerman et al., 1989). However, previous research reveals no consistent pattern of congenital abnormalities in children prenatally exposed to cocaine, nor has an increased incidence of malformations been consistently demonstrated (Behnke & Eyler, 1993).

Developmental and Cognitive Outcomes. Although early studies of infants prenatally exposed to cocaine have suggested that prenatal cocaine exposure is predictively linked to severe developmental delays across a variety of diverse domains, more recent studies report mild to no

impairments in the overall developmental and cognitive functioning of prenatally exposed infants (Azuma & Chasnoff, 1993; Chasnoff et al., 1992; Edmonsdon & Smith, 1994; Hawley et al., 1995; Mayes, Bornstein, Chawarska, & Granger, 1995). Rather than exhibiting significant cognitive deficits, the majority of cocaine-exposed infants recently studied have exhibited low-average to average intellectual functioning (Freier, Griffith, & Chasnoff, 1991; Griffith, Azuma, & Chasnoff, 1994). This level of intellectual ability is consistent with intellectual abilities of children from populations with similar socioeconomic backgrounds.

A large-scale study conducted by the National Association for Perinatal Addiction Research and Education (*NAPARE)* has followed the development of a group of 106 cocaine-exposed infants from birth to age three years. Results of this longitudinal study revealed no mean differences between infants exposed prenatally to cocaine and alcohol and the two non-cocaine exposed control groups in either the mental or motor domains of the Bayley Scales of Infant Development (BSID) at 3, 6, 12, 18, or 24 months of age. Results also revealed no significant difference in overall IQ as measured by the Stanford-Binet at 3 years (Asuma & Chasnoff, 1993; Chasnoff et al., 1992; Griffith et al., 1994). However, by age 3, deficits in the verbal reasoning component of the Stanford-Binet were noted in prenatally cocaine-exposed children (Azuma & Chasnoff, 1993; Griffith et al., 1994). Interestingly, the effects of prenatal cocaine exposure on the Stanford Binet at age 3 were mediated through the quality of the home environment, the infant's head circumference, and poor perseverance (Azuma & Chasnoff, 1993), suggesting that the relationship between prenatal cocaine exposure and developmental outcomes may be more complicated than once thought.

Similar results were noted in longitudinal studies conducted by Allessandri, Benderski, and Lewis (1998) and Hurt and colleagues (1995), who found no significant differences between prenatally cocaine exposed and non-exposed infants on either the Mental Developmental Index (MDI) or Psychomotor Developmental Index (PDI) of the Bayley Scales of Infant Development (BSID). However, Allessandri and colleagues (1998) reported that, by 18 months, children who were prenatally exposed to large amounts of cocaine received significantly lower scores than non-exposed children on the MDI. Children exposed to smaller amounts of cocaine received scores similar to those of non-exposed children. These results suggest that the amount of cocaine to which the infant is exposed may moderate the overall effects of prenatal cocaine exposure on subsequent development.

Mayes, Bornstein, Chawarski, and Granger (1995) reported no significant differences between cocaine exposed and non-exposed infants on the MDI. However, they did find that cocaine exposed infants in their sample displayed depressed performance on the Psychomotor Developmental Index (PDI) of the BSID when compared to non-exposed infants. This difference disappeared after the researchers controlled for birth weight and length, maternal tobacco use, education, and prenatal care, again suggesting a more complex relationship between prenatal exposure and child development.

Although the mean BSID scores of the three groups in the NAPARE study did not differ, when compared to the other two groups a higher percentage of cocaine-exposed infants scored 2 standard deviations below the mean (Chasnoff et al., 1992). Furthermore, there were differences between the groups in the types of items failed. Infants prenatally exposed to cocaine were able to perform at age level on test items that were highly structured by the examiner, but had

difficulty on tasks requiring them to attend to several objects at the same time or that required them to structure the task themselves. Similarly, qualitative differences were found in other studies of cognitive development. Prenatally cocaine exposed infants in Mayes et al.'s (1995) study demonstrated a greater likelihood than non-exposed infants to be irritable and to have difficulty initiating habituation to new stimuli. Bendersky, Alessandri, Sullivan, and Lewis (1995) found cocaine exposed infants to be less engaged in learning and to exhibit a lower level of arousal than non-exposed infants. Likewise, although they found no significant differences in terms of BSID scores, Edmonson and Smith (1994) found the drug exposed infants in their sample to be rated by their mothers as harder to manage, uncooperative, and arrhythmic.

Contrary to the majority of the results described above, Beckwith et al. (1994) found that prenatally cocaine exposed preschoolers performed within the borderline range of intellectual functioning with scores significantly lower than those of a matched control sample. Similarly, Singer et al. (1997) found both lower MDI and PDI scores in prenatally cocaine exposed 2-year-olds. However, it should be noted that the performance of the cocaine-exposed children in Singer et al.'s (1997) study was still in the average range.

Because of the relative recency of the cocaine epidemic, studies of the intellectual functioning of older cocaine exposed children are rare. Future research integrating both direct and indirect (i.e. moderating and mediating) effects of prenatal cocaine exposure may further illuminate patterns of strengths and deficits as these children age.

Neurodevelopmental Outcomes. Although studies of overall developmental competence suggest few differences between children prenatally exposed to cocaine and non-exposed children, studies of more specific developmental functions suggest that children prenatally

exposed to cocaine may have more difficulties than non-exposed children in the areas of attention and state or arousal regulation.

Studies using the Brazelton Neonatal Behavioral Assessment Scale (NBAS) and other habituation paradigms have yielded somewhat inconsistent results. However, while some researchers have found no significant differences between prenatally cocaine-exposed and non-exposed infants (Alessandri et al., 1998; Neuspiel et al., 1991; Richardson & Day, 1991), the majority have reported significant differences between the two groups in one or more areas of attention and state regulation.

Infants prenatally exposed to cocaine have been found to exhibit a decreased ability to regulate sleep and alert states, poorer habituation to stimuli, a significant depression of organizational response and emotional responsivity, and a greater likelihood to exhibit abnormal reflexes than non-exposed infants (Bendersky, Alessandri, & Lewis, 1996; Coles et al., 1992; Eisen et al., 1991; Espy, Riese, & Francis, 1997; Mayes, Granger, Frank, Schottenfeld, & Bornstein, 1993). Significant differences have also been found between cocaine-exposed and non-exposed infants in startle responsivity, neonatal orientation, tremulousness, irritability, cry characteristics and reactivity to novelty (Brown et al., 1998; Chasnoff et al., 1989; Gottwald & Thurman, 1994; Lester & Tronick, 1994; Oro & Dixon, 1987;). Black and colleagues (1992) found that cocaine-exposed infants had less optimal neurodevelopment than non-exposed infants at birth, demonstrating less favorable scores on three of the six scales of the NBAS. Although differences between the two groups were no longer evident when the children were retested at 4 weeks, by the time the infants were six weeks old the cocaine-exposed infants again displayed more difficulties in autonomic regulation than non-exposed infants (Black et al., 1992). Results

are similar to those of Coles et al. (1992), who found significant differences in autonomic regulation and abnormal reflexes between cocaine exposed and non-exposed infants at four weeks of age, and Eisen et al. (1991), who found that cocaine exposed neonates exhibited significantly inferior performance on the habituation cluster of the NBAS. Such results are significant in light of the belief that impairments in state and arousal regulation may influence children's attention, reactivity, and response in both social and non-social situations (Mayes & Bornstein, 1996).

Behavior and Social/Emotional Outcomes. The integration of results of developmental studies and studies investigating state and arousal regulation suggests that both organizational and regulatory skills may be specifically vulnerable during the first few years of life in children prenatally exposed to cocaine. Considerably less, however, is known about the behavioral and social/emotional development of cocaine-exposed children. There is little empirical research available to either support or refute claims of behavioral and social difficulties among young children prenatally exposed to cocaine. Preliminary results from a study of the social and emotional development of pre-school aged children of cocaine abusing mothers suggest that these children do exhibit a range of emotional and behavioral difficulties (Hawley, Halle, Drasin, & Thomas, 1995). Results of this study indicated that 8 of the 18 children studied scored within the clinical range on at least one subscale of the Achenbach Child Behavior Checklist. Similarly, both biological and foster mothers of drug exposed children in another study described their children as overactive, restless, inattentive, perseverative, hypersensitive, sensitive to sensory stimulation, and difficult to calm (Kelly, 1992). Children prenatally exposed to drugs have also been rated as more aggressive than non-exposed children (Griffith et al., 1994).

Research has only recently begun to investigate the long-term development of these children beyond the infant and preschool ages. Not surprisingly, studies that have begun to investigate long-term development have also yielded contradictory results. Bender and colleagues (1995) reported no differences between prenatally cocaine exposed, postnatally environmentally cocaine exposed, and non-exposed 4-6-year-olds in terms of hyperactivity, distractibility, or ability to follow directions. On the other hand, teachers have anecdotally reported that cocaine-exposed children who have entered kindergarten and the first grade tend to be hyperactive, disruptive, and have significant learning problems (Norris, 1991).

Attachment Outcomes. Miller (1996) argues that feelings of inadequacy, guilt, and depression may leave the substance abusing mother emotionally unavailable to form a secure attachment with her infant. Studies of separation and attachment have indeed revealed increased rates of insecure attachment behaviors in children of substance abusing mothers (Rodning, Beckwith, & Howard, 1989, 1991). Rodning et al. (1991) found that the majority of substance-exposed children in their study were insecurely attached, while the majority of control children exhibited secure attachments. Furthermore, the substance-exposed children in Rodning et al.'s (1991) study exhibited particularly high rates of disorganized attachments. These differences remained even after controlling for whether the children were being raised by their biological or foster mothers or by extended family members (Rodning et al., 1991). However, children in foster care have often been raised for several months to years by their biological parents before being placed in foster care, and many such children have experienced numerous foster care placements and disruptions in caretaking. Although Rodning and colleagues attempted to control for custodial factors, the home and parenting environments of cocaine exposed infants

are characterized by multiple disruptions and instability. As a result, it remains difficult to determine whether differences in attachment behaviors of children prenatally exposed to cocaine are a direct result of cocaine exposure, an indirect result of the postnatal parenting environment, or a combination of the two.

Summary. Research investigating consequences of prenatal cocaine exposure on infant growth and development has yielded somewhat contradictory results. Although research has consistently demonstrated an association between prenatal cocaine exposure and poor fetal growth and premature delivery, results of research investigating developmental and cognitive outcomes have been less clear. While differences in cognitive outcomes have been demonstrated in some studies, others have found no differences when other environmental factors were controlled. Many studies have demonstrated an association between prenatal cocaine exposure and difficulties in attention and arousal regulation as well as anecdotal reports of increased irritability and behavioral difficulties. However, much of the existing research is limited to early development and little is known about prenatally-exposed children's development past the preschool years. Additional research may be required to better illuminate possible relationships between prenatal cocaine exposure and developmental and cognitive outcomes throughout children's development.

Consequences of Prenatal Cocaine Exposure on Parenting, Play, and Dyadic Interactions

Zuckerman (1994) argues that the heavy use of illicit substances interferes with a mother's ability to provide the types of consistent and nurturing caregiving that promote optimal development, self-esteem, and the ability to regulate affect and impulses in their children.

Studies investigating cocaine abusing mothers' own experiences and perceptions of their roles as parents have supported Zuckerman's argument. Bauman and Dougherty (1983) found that substance-abusing mothers report a variety of parenting difficulties, including reliance on more disciplinarian, disapproving, and threatening styles of parenting and on negative reinforcements. Both biological and foster mothers of cocaine-exposed children have reported problems in attachment and a lowered sense of parental competence (Kelly, 1992). Research has also demonstrated a trend for non-abusing mothers to provide a more child-oriented home environment and to be more nurturing than cocaine abusing mothers (Black et al., 1992).

Mothers who used drugs during pregnancy have also reported higher levels of parenting stress and social isolation than either foster mothers of substance exposed children or mothers of non-exposed children (Kelly, 1992). Furthermore, cocaine-abusing mothers have been found to be less successful than non-abusing mothers in accessing formal resources or using social supports to buffer parenting stress (Black et al., 1992).

Mother-Child Interaction. Significant dyadic pathology has been reported between substance abusing mothers and their infants (Chasnoff et al., 1987), and many researchers have pointed to a lack of mutual regulation in the substance abusing dyad (Beeghly & Tronick, 1994). Substance abusing mothers often have poor affective regulation due to drug use, while their infants may be dysregulated due to prenatal substance exposure (Harden, 1998). As a result, the dyadic interaction between the substance abusing mother and child may be characterized by regulatory dysfunction, disrupting the infant's ability to accomplish developmental tasks such as state regulation and joint attention (Beeghly & Tronick, 1994).

In their study of cocaine abusing mothers, Freier and colleagues (1991) reported two different types of parenting dysregulation. One group of mothers detached from their infants as a result of their infants' failure to respond to their overtures, while the other group presented as more intrusive in their attempts to get their infants to respond. A similar group of detached mothers were described by Gottwald and Thurman (1994), who found that cocaine using mothers spent significantly more time disengaged from and passively looking at their neonates than did non-using mothers.

Dysregulation has been noted in both maternal and infant contributions to dyadic interactions. Fitzgerald and colleagues (1990) reported a tendency toward noncontingent interactions between cocaine-addicted mothers and their children, suggesting that these dyads were unable to successfully read the other's cues and/or regulate their behavior accordingly. Similar results were obtained in other studies of mother-child interaction. Barabach, Glazer, and Norris (1992) reported that cocaine abusing mothers were less sensitive to their infants' cues than non-abusing mothers, while cocaine exposed infants were more likely to send unclear cues and be less responsive to their mothers. Similarly, Burns, Chethik, Burns, and Clark (1991) found that cocaine-abusing mothers showed relatively few reciprocal behaviors with their infants and infrequently structured or mediated their child's environment. Mothers in their study demonstrated a tendency toward rigidity and overcontrol, lack of enjoyment and pleasure in relating to their infants, and limited emotional involvement and responsivity toward their children (Burns et al., 1991). Their infants, in turn, displayed limited happiness, pleasantness, and cheerfulness in their mood.

Other studies of parent-child interaction have revealed no significant differences between substance abusing and non-abusing dyads. Neuspeil and colleagues (1991) found no differences between cocaine-exposed and non-exposed mother-infant dyads on the Nursing Child Assessment of Feeding Scale (NCAFS), which measures mother infant interaction during feeding. Benderski and Lewis (1998) reported no significant differences between cocaine abusing and non-abusing mothers in stimulation or sensitivity during en face play. Similarly, Hagan and Myers (1997) found that the majority of the cocaine abusing women in their study created cooperative, accepting environments for their children. No significant differences were found between cocaine exposed and non-exposed dyads in the amount, quality, or appropriateness of mothers' contributions to spontaneous play, or in the cognitive or affective aspects of the toddlers' spontaneous play (Hagan & Myers, 1997). Furthermore, Hagan and Myers (1997) reported that none of the toddlers in their study displayed the types of disorganized or disturbed interactions suggested by the literature.

Two studies of toddler play have suggested that cocaine exposed children may have delays in spontaneous play abilities. Drug exposed 2-year-olds have been found to exhibit significantly more immature play strategies (e.g. mouthing and banging), less sustained attention, more deviant behaviors, more abrupt transitions, and fewer positive social interactions with their mothers during free play than non-exposed 2-year-olds (Beckwith et al., 1994). Substance exposed toddlers have also been found to exhibit less representational play and less spontaneous play than non-exposed toddlers during unstructured play situations (Rodning, 1989).

Summary. Research suggests that substance abusing mothers report a variety of parenting difficulties and a lowered sense of parental competence. In addition, cocaine abusing

mothers have demonstrated dysregulation in their interactions with their children, often being either detached or overly intrusive in their interactions. Such research suggests that these mother-infant dyads may have difficulty reading and reacting to each others cues and may send a greater number of ambiguous cues to their partners. However, it should be noted that research in the area of mother child interaction among prenatally exposed infants has also yielded some contradictory results, again suggesting a complicated relationship between prenatal cocaine exposure and later development.

Mechanism of Effects

The exact mechanisms through which prenatal cocaine exposure affects perinatal growth and development, as well as long-term outcomes, are yet to be determined. However, it is generally agreed that cocaine affects infant development through multiple pathways, and that it is rarely possible to identify a pure cocaine effect on child development.

Cocaine has direct effects on neurotransmitters in the brain, resulting in the depletion of central levels of dopamine and norepinephrine and a reduction in the number of postnatal dopamine receptors (Miller, 1996). Cocaine easily crosses the placental barrier, profoundly changing the in-utero environment of the developing infant (Scherling, 1994). Once it has entered the bloodstream of the fetus, cocaine increases sympathetic nervous system effects, possibly leading to vasoconstriction, increased blood pressure, tachycardia, and the possibility of seizures (Miller, 1996). Vasoconstrictive effects of cocaine on the mother also reduce oxygen and nutrient availability to the fetus (Haskett, Miller, Whitworth, & Huffman, 1992). The use of cocaine during pregnancy has been associated with poor intra-uterine growth and prematurity,

leading several researchers to propose that many of the negative effects of prenatal cocaine exposure may be mediated through its strong association with prematurity and growth deficits.

The post-natal environment, including home environments, parenting behaviors, and dyadic interactions, has also been proposed to play mediating and/or moderating roles in the relationship between prenatal cocaine exposure and child outcome. Harden (1998) describes a "continuum of caretaking causality", highlighting the "synergistic influences of perinatal events and the postnatal caretaking context" of children prenatally exposed to cocaine. However, studies of cocaine-exposed infants have only relatively recently begun to use transactional and ecological models (e.g. Bronfenbrenner, 1979; Sameroff & Chandler, 1975) to investigate the development of prenatally cocaine-exposed children. It is likely that the long-term developmental sequella of prenatally exposed children is dependent upon the individual, familial, social, and economic environments in which the children develop, as well as the complex interactional relationships between the child and significant others in his/her environment.

Profile of the Female Cocaine Abuser

Childhood and Early Family Environment. Although rarely studied, the early childhood environments of cocaine using women likely play a role in their subsequent behaviors as mothers of prenatally cocaine exposed infants. As such, a greater understanding of the early years of substance abusing women may aid in the understanding of their behavior as adults.

The early family environments of substance abusing women are commonly characterized by parental death or desertion, marital discord, divorce, substance abuse, and high rates of physical and sexual abuse (Boyd, 1990; Mayes & Bornstein, 1996; Regan, Ehrlich, & Finnegan,

1987). Regan and colleagues (1987) found that 19% of the pregnant drug abusers in their study had been physically beaten as children. They also found that pregnant drug abusers were significantly more likely to have been sexually molested as children than a socioeconomically matched sample of non-drug abusers. Twenty-eight percent of the pregnant drug abusers in their study reported a childhood history of sexual molestation.

Early childhood experiences of substance abusing women have also been characterized by neglect and early role reversal. Many cocaine abusing mothers have experienced extensive childcare and housekeeping responsibilities as children being raised in violent and impoverished families of origin (Kearney, Murphy, & Rosenbaum, 1994). Examples of, or opportunities for, achievement in areas other than mothering were often rare and much of their childhood may have been usurped by early adult-like responsibilities. As a result, the excitement, money, and fun involved in the drug-using lifestyle may have represented a rare opportunity for the young girls to forget their early responsibilities and play. Furthermore, inadequate education in inner city schools and limited occupational opportunities have limited their chances of succeeding on career paths, further opening the doors to a drug abusing lifestyle (Kearney et al., 1994).

Gender Differences. Patterns of drug use differ between male and female cocaine abusers, with women beginning their drug use, and subsequently seeking drug treatment, at earlier ages than men (Griffin, Weiss, Mirin, & Lange, 1989). Women are more likely than men to use drugs at home or alone (Lester, 1992), and they more often report emotional or life-event reasons for beginning their substance use (Griffin et al., 1989). Emotional and interpersonal factors are also more likely to lead to substance abuse relapse in women than in men. Furthermore, female substance abusers tend to have fewer financial resources, less employment

experience, greater instability in their personal relationships, and more disturbances among member of their immediate families, including spouses or partner who also abuse illicit substances (Moise, Reed, & Ryan, 1982). They are more likely than male addicts to have experienced sexual or physical abuse prior to their substance abuse, and they report more social isolation, lower self-esteem, and greater depression than do substance-abusing men (Mayes & Bornstein, 1996). Furthermore, cocaine-abusers are more likely than non-abusers to be single parents. Approximately two-thirds of women whose children have been prenatally exposed to cocaine are unmarried (Neuspiel et al., 1991).

Perinatal Health Conditions. Pregnant cocaine abusers are significantly more likely to be non-White, multiparous, and of a low socioeconomic status than pregnant nonusers (Mayes & Bornstein, 1996). They are at greater risk for poor general health, poor nutritional habits, and inadequate weight gain than non-abusing women (MacDonald, 1992). Pregnant cocaine abusers experience more frequent and more closely spaced pregnancies and are significantly more likely than non-cocaine abusing women to use cigarettes, alcohol, and other illicit substances during their pregnancy (Frank et al., 1988). They have been shown to experience higher rates of infectious diseases (e.g. hepatitis, syphilis, HIV infection) and vitamin deficiencies than non-substance-abusing women (Behnke & Eyler, 1993; Chasnoff et al., 1987; Frank et al., 1988).

Due to their drug use, cocaine-abusing women often experience irregular menstrual cycles. Such irregularities may delay awareness of pregnancy and result in increased risk to the fetus due to lack of early prenatal care and persistence of high-risk behaviors early in the pregnancy (Chasnoff et al., 1987). Substance abusing women are significantly less likely than non-abusing women to receive adequate prenatal care, and it has been estimated that

approximately 60-70% of pregnant, cocaine-abusing women receive no prenatal care throughout their pregnancies (Dixon & Bejar, 1989; Oro & Dixon, 1987).

All of the perinatal health factors mentioned above may increase the possible teratogenic effects of prenatal cocaine use on the developing infant by directly compromising the infant's physical health and by reducing the biological buffers available to protect the child from the negative effects of intra-uterine cocaine exposure (Schutter & Brinker, 1992).

Mental Health. Psychiatric disturbances, such as depression and attention deficit disorder, are prevalent among substance abusing adults, with the majority of these disturbances predating the substance abuse (Mayes & Bornstein, 1996). Studies have documented prevalence rates of mental disorders as high as 90% in substance abusing populations (Harden, 1998). Substance abusing adults exhibit rates of major depression (Boyd, 1990; Haller, Knisely, Dawson, & Schnoll, 1993; Hawley et al., 1995; Lawton, 1992; Singer et al., 1997) and recurrent and early psychiatric hospitalizations higher than those found in the general population (Mayes & Bornstein, 1996). Haller and colleagues (1993) found that 75% of their sample of pregnant and postpartum substance abusers had one or more confirmed personality disorders, including high rates of antisocial, borderline, paranoid, and dependent personality disorders. They also found high rates of compulsive and sleep disorders, including insomnia and hypersomnia. Substance abusing women have been characterized to exhibit lowered self-esteem, guilt, anger, aggression, and irritability (Chavkin, Paone, Friedman, & Wilets, 1993). In addition, pregnant and postpartum substance abusers have been found to be undereducated and to exhibit IQ's in the low average range of intelligence (Haller et al., 1993).

High rates of psychiatric disturbances likely affect infants' development not only through impaired relationships with the disturbed parent, but also through the possible intergenerational transmission of an increased genetic risk for certain psychiatric conditions. Mothers' psychological characteristics may greatly affect their availability to their children (Harden, 1998). Previous literature consistently documents the detrimental effects of maternal depression on maternal responsivity and sensitivity to her infant (Gelfand & Teti, 1990; Mayes & Bornstein, 1996). Such effects of depression may be exacerbated among substance abusing women as a result of poor social support, the chronic stress of poverty and violence, and the poor physical health associated with active substance abuse. In addition, both affective disorders (e.g. depression) and impairments in attention regulation (e.g. Attention Deficit/Hyperactivity Disorder) may be at least partially genetically transmitted from the substance abusing mother to her child (Mayes & Bornstein, 1996).

Summary. Female cocaine abusers often have early histories characterized by family dysfunction, abuse, parentification, and poor education. They are more likely than male abusers to use drugs alone and more frequently cite emotional and interpersonal factors leading to their abuse. Pregnant cocaine abusers are at greater risk for poor general health than their non-abusing counterparts and are generally of a lower socioeconomic status. In addition, psychiatric disturbances are prevalent among substance using adults. All of these factors may influence cocaine abusing mothers' ability to appropriately care for and interact with their children.

Adoption of Parenting Roles and Definition of Motherhood

Maternal Role Attainment. It has been argued that the pregnant substance abuser often fails to begin the early steps of parental role attainment during her pregnancy (Bushong, 1990). Due to chronic neglect of her body as a result of substance abuse, many substance abusing women do not know that they are pregnant until several months into their pregnancy (Chasnoff, 1987). As a result, they do not follow the usual trajectory of psychological preparation for the upcoming baby (Bushong, 1990). Furthermore, many pregnant substance abusers hold unrealistic expectations about how the pregnancy will affect their lives, believing that it will make their partners more attentive and committed to them and that it will serve as an effective motivation to stop using illicit drugs.

The pregnant cocaine-abusing woman's own personal needs and expectations of the pregnancy may interfere with her ability to attach to the unborn child. Continued denial and fear may prevent her from seeking appropriate prenatal care, and any adverse effects following the baby's birth may be attributed to child illness or unmanageability rather than possible effects of prematurity or prenatal drug exposure (Bushong, 1990). The mother may come to see her child as difficult and hard to manage or begin to feel that she is incapable of being a good mother. Such fears may be reinforced by the fact that a vast majority of substance-abusing mothers received very little nurturing mothering themselves and therefore lack appropriate role models for motherhood.

Guilt and shame about her substance abuse may also cause the substance abusing mother to view a difficult or irritable child as a punishment for her drug use, causing her to withdraw from her child in order to escape from her own guilt. Many prenatally exposed children have

difficulty sustaining interpersonal engagement, which is often interpreted by the substance abusing mother as personal rejection, again leading her to withdraw from her infant (Bushong, 1990). Furthermore, the substance abusing mother often is egocentric, viewing her child as a possession who exists to meet her own nurturing needs (Miller, 1996). As a result, role reversal may occur among such dyads as the mother begins to rely on her infant and older child to assume the parental role of nurturer and caretaker while at the same time resenting the child for being too demanding (Bushong, 1990; Miller, 1996).

The Meaning of Motherhood. Mothers who abuse cocaine have often been characterized as selfish and uncaring women who pursue their own pleasures while neglecting the basic needs of their children. However, recent research suggests that this uncaring, selfish profile is not necessarily accurate. A field-based study interviewing female cocaine users who were not in treatment has revealed that, although motherhood was often unintentional and unplanned among these women, cocaine-abusing mothers felt a strong sense of pride and responsibility toward their children once they were born (Kearney et al., 1994). Furthermore, feelings of pride toward their children persisted regardless of whether or not the mothers had raised their children themselves.

Across all women interviewed by Kearney et al. (1994), two main goals of motherhood emerged: nurturing, including keeping children clean and well-dressed, and modeling. However, cocaine abusing mothers reported that their crack use interfered with their parenting goals by causing a drain on their attentiveness, financial resources, and efforts to be appropriate role models. Several mothers described “vicious cycles” of crack use, consisting of using crack to

relieve the multiple pressures of mothering, sobering to face the financial and moral damage to their mothering role, and using crack again to alleviate the resulting worry and guilt.

Cocaine abusing mothers in Kearney, et al.'s (1994) study described several strategies for coping with the effects of their cocaine use on their mothering role. One such strategy involves separating the child from the drugs by both keeping the children physically apart from drug use and by keeping their drug-user identity separate from their identity as a mother. The majority of mothers realized that they were less able to care adequately for their children while they were smoking crack, and they dealt with this reality by either getting others to watch their children while they smoked or by waiting until the children were asleep before getting high. They also took efforts to make sure their appearance did not reveal their drug use status when dealing with schools or other agencies concerned with their children. The women described dealing with the financial pressures placed on them by their drug use by separating family money from drug money and by making sure that the family's financial needs were met before purchasing drugs. However, for almost 70% of the women interviewed, the strategies described above eventually broke down as their increasing drug use overshadowed their caregiving standards (Kearney et al., 1994). Kearney et al. (1994) reported that these mothers ultimately experienced a downward slide as their increased drug use resulted in a decreasing engagement in mothering, often resulting in the out-of-home placement of their children.

Summary. Several studies have suggested that pregnant substance abusers' expectations of their pregnancies may differ from those of non-abusing women. Pregnant substance abusers may hold unrealistic expectations of how the pregnancy may change their lives. They may also experience a sense of shame and guilt surrounding their drug use, thus interfering with their

ability to attach to their child. Furthermore, subsequent drug use may interfere with the attainment of parenting goals, leading substance abusing mothers to rely on less-than-optimal practices to care for their children while maintaining their drug use.

The Environmental Context of the Cocaine Exposed Infant

Environmental Instability. Although rarely studied, perhaps the most salient aspect of the environment for infants is the proximal home and caregiving environment. Substance-abusing mothers often fail to provide their children with a stable home environment, changing residences significantly more often than non-abusing populations (Hawley et al., 1995). One study of cocaine-abusing mothers revealed that only 62% reported that they had a stable place to live; 21% were homeless and living in shelters or on the street, 10% were in inpatient drug treatment centers, and 7% were temporarily living with relatives or friends, lacking a permanent residence of their own (Kelley et al., 1991). Young children of substance abusing mothers have been found to move an average of 1.13 times per year, with some children moving as many as six times per year, compared to an average of .32 moves per year in non-abusing populations (Lawton, 1992). Such frequent moves may result in a loss of the sense of stability that a more consistent, orderly environment may provide (Hawley & Disney, 1992). Platzman, Coles, Lynch, Bard, and Brown (2001) found that mothers of cocaine exposed children reported significantly greater caretaking instability than mothers of non-exposed children when their children were 12 months old, reflecting significantly less consistency in parenting in this group.

As many cocaine abusing women come from disorganized and abusive homes, they do not have a stable extended family to aid them in raising their children. Substance abuse has been

found to be related to lower levels of social support, particularly due to a lack of stability in the families of substance abusing women. Furthermore, the types of social supports most commonly used differ between substance abusing and non-abusing populations. Burns and Burns (1988) found that substance abusing mothers were more likely than non-abusing mothers to rely on institutional sources of support. They have also been found to receive less support from spouses or partners and to be less likely to have consistent contact with their children's fathers than non-abusing mothers (Hawley et al., 1995; Kelley et al., 1991). Moreover, because the majority of substance abusing mothers come from homes in which substance abuse and family dysfunction were common, many lack positive role models for parenting and maintaining a positive home atmosphere (Brooks et al., 1994).

Substance abusing women also have been found to exhibit many irresponsible and impulsive behaviors, such as using financial resources to support a drug habit instead of providing for their children's physical care (Brooks et al., 1994). Such preoccupation with obtaining drugs often stands in the way of the pursuit of more adaptive achievements, such as education or employment. It may also interfere with the development of supportive family, peer, and professional networks that may otherwise add a sense of stability to the young child's environment.

Fear and Violence. The larger cocaine-using world is often characterized by family discord, virtual homelessness, poverty, chronic uncertainty, despair, and fear in both cocaine-abusing adults and their children (Mayes & Bornstein, 1996). Drug-abusing women have been found to be significantly more likely to be the victims of physical violence, with one study revealing that 70% of a sample of pregnant substance abusers were physically beaten and 21%

were raped as adults (Regan et al., 1987). Spouse abuse is not uncommon among drug abusing populations (Regan et al., 1987). Furthermore, many drug abusing women live in public housing neighborhoods where drugs are often sold openly and frequent outbreaks of violence are likely to occur (Regan et al., 1987). As such, children of substance abusers are more likely to witness violence both in and outside of the home. Such exposure to violence may have long-term implications for many aspects of the children's development, including attention regulation, emotional stability, and disoriented perception of the future (Brooks et al., 1994; Zuckerman, 1994).

Cocaine-abusing women often are directly or indirectly involved in criminal activity, such as prostitution, theft, or drug dealing, in order to maintain their addiction (Harden, 1998; Mayes & Bornstein, 1996; Regan et al., 1987). Such activities are likely to place their children at risk for indirect harm through exposure to the criminal element associated with the drug market (Haskett et al., 1992). Furthermore, as a result of increased involvement in criminal activities, cocaine-abusing women are more likely than non-abusing women to be arrested and incarcerated repeatedly, placing their children at risk for multiple separations and out-of-home placements with foster families, neighbors, or relatives.

Child Maltreatment and Out-of-Home Placement. Past research has revealed an increased incidence of abuse and neglect among children of cocaine-abusing mothers (Hawley et al., 1995; Kelly, Walsh, & Thompson, 1991; Wasserman & Leventhal, 1991). One case control study of hospital evaluations of injuries thought to have resulted from abuse found that children who were physically abused were significantly more likely to live in households with parents who were actively abusing cocaine (Wasserman & Leventhal, 1993). Similarly, 50% of the

parents in a court sample of maltreated children had an alleged substance abuse problem (Murphy et al., 1991), and two-thirds of the cases in a review of child maltreatment records involved substance abuse (Famularo, Kinscherff, & Fenton, 1992). In one interview study, 60% of substance-abusing mothers in a drug treatment center reported that they had emotionally neglected or abused their children. Sixty percent also reported that they had failed to meet their children's physical needs, often claiming that their desire for the drug had outweighed their desire for taking care of their children (Hawley et al., 1995; Lawton, 1992).

Primarily as a result of high rates of child maltreatment, the number of children from cocaine-abusing families who are in foster care or other placements are proportionately higher than the national average (Rogosch, Cicchetti, Shields, & Toth, 1995). In their study of language delays in 50 cocaine exposed children, Rivers and Hedrick (1992) found that only 10% of the children in their sample were in the care of their biological parents. Forty-four percent of their sample, on the other hand, was in foster care placements. In many states, evidence of maternal substance abuse during pregnancy is considered child abuse, and may result in removal of the infant from the mother's care immediately following birth (MacDonald, 1992). If substance-abusing mothers are not immediately separated from their children, they remain more likely than non-abusing mothers to have their children removed from the home, particularly if their substance use persists. Both Zuckerman (1994) and Hawley et al. (1995) found that children of cocaine-abusing mothers are significantly more likely to be placed in out-of-home care than are children of non-substance-abusing mothers. Similarly, Kelley (1992) found that cocaine-exposed children were significantly more likely to be referred to state authorities due to physical and medical neglect than were a socioeconomically matched sample of non-exposed children.

Summary. Children of substance abusing mothers have been found to have greater instability in terms of residence and live in families who rely more heavily on institutional, rather than familial, sources of support. They often grow up in larger environments characterized by poverty and violence. Research has revealed an increased incidence of abuse and neglect among children of substance abusing parents and children of cocaine abusing families are disproportionately represented in foster care and other out-of-home placement. Such instability in environment may play a significant role in the development of substance exposed children.

Implications for Research and Intervention

Failures of research to find clear answers to the question of the effect of prenatal cocaine exposure on infant and child development may be due in part to a tendency for researchers to rely on "main effect" statistical models to compare substance exposed and non-exposed children. It has not been until relatively recently that the transactional relationship between the direct effects of prenatal cocaine exposure and the indirect effects of growing up in a multi-risk environment has received considerable attention. More process-oriented research investigating potential contributions of biological, environmental, and interactional variables to the development of cocaine exposed infants may help clarify the factors associated with both risk and resilience in substance exposed children. Variables to be considered for further investigation include amount and duration of substance exposure, prenatal health, stability in caregiving and home environments, maternal psychological functioning, paternal involvement, patterns of parent-child interaction, participation in substance abuse treatment and early intervention programs, and innate temperamental characteristics of both mothers and children. A focus on the

identification of variables related to resiliency may also aid in the elimination of the common stereotype of the crack baby as an inevitably damaged and uneducable burden on society.

Society is much less tolerant of female substance abusers than male substance abusers (Bresnahan, Brooks, & Zuckerman, 1991). Attitudes toward substance abusing women are often judgmental, punitive, and rejecting. Substance abusing women are portrayed as selfish, uncaring women who care more about themselves and their drug use than they do about their children. However, interviews with substance abusing women suggest that these women feel a strong sense of responsibility for and pride in their children (Kearney et al., 1994). They value highly their maternal role, even when active substance abuse prevents them from adequately caring for their children. This emotional involvement with their children is an often overlooked strength of substance abusing mothers.

Many mothers of substance exposed children continue to actively abuse drugs after their children are born, frequently seeking treatment only when the alternative is criminal punishment (Scherling, 1994). However, women who do seek treatment are often frustrated by the lack of appropriate treatment programs that meet the needs of both the substance abusing woman and her children. Treatment centers have been traditionally designed by men to treat male addicts (Bresnahan et al., 1991). As such, they have tended to focus solely on the individual and not on the significant others, including children, in the substance abuser's life. To date, few treatment programs offer services for pregnant substance abusers or substance abusing women who do not wish to be separated from their children. As a result, substance abusing women may be reluctant to leave their children in order to enter treatment, or may fear losing their children permanently if they temporarily give up custody to seek treatment.

Like models proposed for research, models for treatment and intervention for cocaine exposed infants and their mothers should incorporate an understanding of the transactional relationships between the mother, child, and environments in which they live. Sparks (1993) argues for a risk, as opposed to deficit, model for understanding the complex phenomenon of prenatal substance exposure. Deficit models assume that children prenatally exposed to drugs have experienced some level of fundamental damage to their functioning. Risk models, on the other hand, recognize that, while prenatal substance exposure may jeopardize the developmental processes of the infant, deleterious outcomes are not inevitable. Risk models acknowledge that environmental, as well as innate constitutional, factors may serve to buffer possible negative effects of prenatal substance exposure and contribute to positive developmental outcomes.

Sameroff and Fiese (1990) argue that intervention strategies may be grouped into three broad categories: remediation, redefinition, and reeducation. According to their model, remediation involves interventions which are focused directly on the child. Remediation may include medical, therapeutic, and/or educational interventions. Redefinition and reeducation, on the other hand, focus on the mother's contribution to the child's development. While redefinition focuses on changing the mother's perceptions of her child and his/her behavior, reeducation focuses on helping mothers develop specific strategies of interaction with their children. While all three of these intervention strategies may prove beneficial to the development of substance exposed infants, interventions that focus solely on the mother-child dyad may not be sufficient.

The need for the expansion of intervention services to include larger ecological systems is becoming increasingly acknowledged. Such interventions focus not only on the child's

relationship with the primary caretaker, but also on the larger social context in which the child and caretaker are embedded. For example, interventions directly addressing the mother's substance abuse and recovery are clearly beneficial and necessary. Assisting substance abusing mothers in developing appropriate career and life skills also indirectly benefits the substance exposed child. Substance abusing mothers have been shown to be undereducated and underemployed. They are often homeless and lack the skills necessary to gain stable employment and adequate housing. Dysfunctional family histories have also left many substance abusing mothers without role models for positive parenting and without extended family and social support networks. Interventions addressing all of these factors within a comprehensive framework may be necessary to alleviate many of the environmental risk factors to which children of substance abusing mothers are exposed.

Chapter 2

Rationale

While studies of overall cognitive development have revealed few significant differences between children prenatally exposed to cocaine and non-exposed children (e.g. Alessandri, Bendersky, & Lewis, 1998; Arendt, Singer, Angelopoulos, Bass-Busdiecker, & Mascia, 1998; Chasnoff, Griffith, Freier, & Murray, 1992; Hurt et al., 1995; Mayes, Bornstein, Chawarska, & Granger, 1995), studies of more specific developmental functions suggest that children prenatally exposed to cocaine may have more difficulties in areas of attention and state regulation. Studies using the Brazelton Neonatal Behavioral Assessment Scale (NBAS) have suggested that infants prenatally exposed to cocaine exhibit decreased ability to regulate sleep and alert states, have poorer habituation to stimuli, poorer state regulatory behaviors, poorer autonomic stability, and are more likely to exhibit abnormal reflexes than non-exposed infants (e.g. Black, Schuler, & Nair, 1993; Chasnoff, Burns, Schnoll, & Burns, 1985; Coles, Platzman, Smith, James, & Falek, 1992; Eisen et al., 1991; Mayes, Granger, Frank, Schottenfeld, & Bornstein, 1993; Oro & Dixon, 1987). Cocaine-exposed infants have been reported to be more difficult to manage and more arrhythmic (Edmondson & Smith, 1994), and to demonstrate significantly less sustained attention in free play episodes (Beckwith et al., 1994) than non-exposed infants. Furthermore, previous research, as well as anecdotal reports, suggest that prenatal cocaine-exposed infants' attentional difficulties continue well into the preschool and early school years (Griffith, Azuma, & Chasnoff , 1994; Hawley, Halle, Drasin, & Thomas, 1995; Scherling, 1994).

Although a relatively large body of research has documented attentional difficulties in children prenatally exposed to cocaine, few studies have attempted to explore the possible mechanisms through which prenatal cocaine exposure may influence infants' attentional abilities. Similarly, early research focusing on prenatal cocaine exposure has rarely investigated the early caregiving environments of cocaine-exposed infants. The proposed study argues that the types of attentional difficulties documented in previous studies of prenatally cocaine-exposed infants may be a result, in part, of a poorly regulated interactional system in the mother-infant dyad.

Cocaine abusing mothers often exhibit parenting behaviors and parent-child interactions that are less than optimal. Past research has revealed an increased incidence of physical abuse and neglect among children of cocaine-abusing mothers (Rogosch, Cicchetti, Shields, & Toth, 1995; Scherling, 1994; Wasserman & Levanthal, 1993). Substance-abusing mothers have reported a variety of parenting difficulties, including reliance on a more disciplinarian and threatening style of parenting, reliance on negative reinforcements (Bauman & Dougherty, 1983), emotional neglect and abuse of their children, and failure to meet their children's physical needs (Lawton, 1992). Cocaine-using mothers have been found to spend significantly more time than non-using mothers passively looking at their infants, to show relatively few reciprocal behaviors with their infants, to be less sensitive to their infants' cues, and to infrequently structure and mediate their infants' environments, all of which suggest a tendency for cocaine-using mothers to be disengaged from their infants (Barabach, Glazer, & Norris, 1992; Burns, Chethik, Burns, & Clark, 1991; Gottwald & Thurman, 1994). Such neglecting and

insensitive parenting behaviors suggest that cocaine-using mothers may be less available to participate with their infants in mutual regulatory behaviors.

It has not been until relatively recently that studies of the effects of prenatal substance exposure have begun to utilize transactional models of child development that examine the inter-relationships between the child, parent, and environment (e.g. Sameroff & Chandler, 1975). Following the Mutual Regulation Model (Brazelton, 1982; Gianino & Tronick, 1988), Beeghly and Tronick (1994) stress the important role of the transactional relationship between the child and caregiver in the development of cocaine-exposed infants. More specifically, they argue that the long-term developmental outcome of infants prenatally exposed to cocaine is largely determined by the *mutually regulated system* developed between mother and child. According to the Mutual Regulation Model, this mutually regulated system is the means through which parents and children regulate each others' attentional, affective, and behavioral states through an ongoing exchange of affective-communicative gestures and responses (Tronick, 1989).

In infants and young children, the ability to self-regulate is not yet fully developed and self-regulation must be supplemented by external regulation from caregivers. In order for mutual regulation to be effective, the caregiver must read and respond correctly to early indications of failures of self-regulation in order to help the infant and young child regulate (Brooks, et al., 1994), while at the same time remaining sensitive to the infant's emerging abilities to self-regulate. Maternal attempts at mutual regulation that are poorly timed or intrusive may result in infants who establish a style of self-directed regulatory behaviors, such as turning away or escaping, that may preclude their exploration of the environment and distort their interactions with other people (Tronick, 1989). Similarly, infants who are not receptive to external regulation

efforts or who fail to provide understandable feedback in response to caregiver's regulation attempts may have difficulty mastering independent self-regulatory skills.

Prenatally cocaine-exposed infants' difficulties in attention and state regulation, Beeghly and Tronick (1994) argue, may be greatly influenced by a failure of the mutually regulated system and the resulting inability of the mother-infant dyad to mutually regulate each member's attentional states. There are several reasons to hypothesize that prenatal cocaine exposure might lead to poor mutual regulation of attention in the mother-infant dyad.

1. Prenatal cocaine exposure may directly affect infants' attentional abilities. Prenatal cocaine exposure is believed to directly affect attention regulation behaviors by altering the neurotransmitter function in the areas of the brain involved in the regulation of attention and states of arousal (Mayes & Bornstein, 1996). Infants with biological vulnerabilities in the areas of attention and state regulation may be more difficult to structure and regulate during parent-child interactions, possibly resulting in less successful mutual regulation of attention.

2. Infants who are prenatally exposed to cocaine may be exposed to poor prenatal environments that may have deleterious effects on their subsequent development. The physical conditions of cocaine abusing women may contribute to the risk of health and developmental difficulties in their infants, including difficulties in attention and state regulation (Schutter & Brinker, 1992). Women who abuse cocaine are significantly more likely than non-users to receive inconsistent or no prenatal care (Behnke & Eyler, 1993; Oro & Dixon, 1987), to abuse other types of illicit drugs (Frank et al., 1988), to use cigarettes and alcohol during their pregnancy (Behnke & Eyler, 1993; Bresnahan, Brooks, & Zuckerman, 1991), and to exhibit more frequent and closely spaced pregnancies than non-abusing women, all of which are risk

factors for poor pregnancy outcomes (Frank et al., 1988). Pregnant women who abuse illicit substances have been shown to experience higher rates of infectious diseases (i.e. hepatitis, venereal diseases, and HIV infection) than non--abusing women (Behnke & Eyler, 1993; Chasnoff et al., 1987), and to exhibit high rates of vitamin deficiencies and poor nutrition (Frank et al., 1988). Cocaine-abusing women also often experience irregular menstrual cycles, which may delay awareness of pregnancy and result in increased risk to the fetus due to lack of early prenatal care and persistence of high-risk behaviors early in the pregnancy (Chasnoff et al., 1987). Research has demonstrated a tendency for prenatally cocaine-exposed infants to be born significantly smaller in terms of birth weight, birth length, and head circumference, and to be born at a significantly shorter gestational age than non-exposed infants (e.g .Arendt et al., 1998; Azuma & Chasnoff, 1993; Brown, Bakeman, Coles, Sexson, & Demi, 1998; Chasnoff et al., 1992; Eisen et al., 1991; Handler et al., 1991; Hurt et al., 1995; Lester, 1992), all of which may result from poor prenatal environments and are risk factors for less than optimal development. Infants with less than optimal development may, in turn, present their caretakers with disorganized behavior and communicative efforts, compromising both the infant's ability to express and respond to his/her caretaker's behavior and the caretaker's ability to respond appropriately to the infant.

3. Women who abuse cocaine exhibit several psychological comorbidities which may limit their abilities to regulate their own attention and structure their own environments. The mental health status of the cocaine-abusing mother may impede her ability to regulate her own attentional states, which may in turn contribute to difficulties with the mutual regulation of attention in the mother-infant dyad. Mothers must be able to self-regulate their own behavior in

order to foster the development of self-regulatory behaviors in their children (Brooks, et al., 1994). The cocaine-abusing parent, like her child, may have more labile or extreme affective states resulting in reduced capacities for reading and responding appropriately to the child's communicative signals (Beeghly & Tronick, 1994). She often shows qualities of behaviors similar to those demonstrated by her child as evidence of poor self-regulation, including difficulty modulating her voice and paying attention, poor control over movements, and erratic and unpredictable behavior (Brooks et al., 1994). Furthermore, psychiatric disturbances, such as depression and attention deficit disorder, are prevalent among substance abusing adults, with the majority of these disturbances predating the substance abuse (Hawley et al., 1995; Mayes & Bornstein, 1996).

4. Women who abuse cocaine exhibit several social risk factors that may limit their abilities to regulate their own attention and structure their own environments. The early family environments of substance-abusing women may also affect their ability to participate effectively in the mutual regulation of attention between mother and child. The childhood environments of substance-abusing women are commonly characterized by parental death or desertion, marital discord, divorce, substance abuse, and high rates of physical and sexual abuse (Bresnahan et al., 1991; Kearney et al., 1994; Mayes & Bornstein, 1996). As many cocaine-using women come from disorganized and abusive homes, they may not have a stable extended family to aid them in raising their children or providing a consistent, well-structured family environment, nor do they have adequate role models of positive parenting practices or stable home environments. As a result of such chaotic and disorganized early environments, women's opportunities to learn methods of structuring and regulating their own environments and attentional states may be

limited. Therefore, the cocaine-abusing mother may have difficulty fulfilling her regulatory functions in the dyad, failing to structure her interactions with her infant in a way that fosters infant self-regulation of attention. Failure to both provide structure in these interactions and to respond appropriately to infant's communicative bids may ultimately disrupt the infant's early efforts at self-regulation.

5. The current caregiving environments of prenatally cocaine-exposed infants may influence the dyad's ability to mutually regulate attention. Cocaine-abusing mothers often provide unstable, disorganized caregiving environments for their infants. One study of cocaine-abusing mothers revealed that only 62% reported that they had a stable place to live (Kelley, Walsh, & Thompson, 1991), and young children of substance abusing mothers have been found to change residence significantly more often than children in non-abusing populations (Hawley et al., 1995; Lawton, 1992). Furthermore, examination of a subsample (N=126) of the longitudinal research project on which the current research is based (Coles, Platzman, & Sexson, 1990) revealed that cocaine-using mothers reported higher levels of caregiving instability, with cocaine/polydrug exposed infants experiencing less consistent caretaking, more instability in caretakers, and less reliable environmental routines (Bard, Coles, Platzman, & Lynch, 2000). Such instability and disorganization in proximal home and caregiving environments has been demonstrated to have significant negative effects on parenting behaviors and child outcomes (Beeghly & Tronick, 1994; Hawley & Disney, 1992). Furthermore, the larger cocaine-using world is also often characterized by family discord, virtual homelessness, poverty, and chronic uncertainty, despair, and fear in both cocaine-abusing adults and their children. It may be argued that children growing up in such an environment may experience difficulties in the development

of centrally regulated, basic psychophysiological functions such as the ability to regulate states of arousal in response to stimulation or novel situations (Mayes & Bornstein, 1996).

Ways in which prenatal cocaine exposure may affect mother-infant interactions have received considerably less attention than have the actual developmental outcomes of the infants. Studies that investigate parent-child interactions often focus on the parenting behaviors of cocaine abusing mothers and rely on indirect and global measures such as surveys of the incidence of child abuse and neglect and assessments of the adequacy of the child's physical care. The few studies that have directly investigated parent-child interactions have tended to focus on broader measures of parent-child interaction, such as intrusiveness, sensitivity, and responsiveness. It is the author's belief that research employing more sensitive, fine-grained assessments of parent-child interactions of prenatally cocaine-exposed infants may illuminate the more subtle types of interactional, mutual-regulatory behaviors which may contribute to prenatally cocaine-exposed infants' difficulties in attention and state regulation.

Adamson and Bakeman (1991) argue that the observation of infant and caregiver's behaviors during episodes of joint attention may enable an investigation of the ways in which infant's activities and attention are regulated within the mother-infant dyad. The current study adopts this argument by investigating directly maternal bids for joint attention and infant responses to these bids. However, the quality of videotaped interactions in the current study (e.g. inability to adequately determine direction of gaze and mutual eye contact) required the use of a slightly less stringent criteria for joint attention than in previous studies utilizing the same construct. As such, the term "mutual engagement" will be used to identify episodes in which the mother and infant are jointly attending to the same object in the environment.

The current study focuses on mother-infant interactions when infants are 12-months old. There are two reasons for selecting children of this age. First, the Mutual Regulation Model relies heavily on the establishment of a pattern of relating within the mother-infant dyad. The study of older infants allows for the investigation of such well-established interactional patterns within the mutually regulated system. Second, the infant's ability to integrate his/her attention between objects and persons (i.e. joint attention) does not begin to emerge until the end of the first year of life. At this age, the mother often serves as a scaffold to help her child maintain his/her focus on objects in ways that may otherwise be too difficult for the infant alone. Furthermore, by accepting the mothers scaffolding, the infant reinforces the mother's attempts to engage his/her attention. Therefore, the current study argues that successful mutual regulation of attention may be inferred from instances of mother-infant dyads initiating and sustaining episodes of mutual engagement. It is also hoped that careful study of the characteristics of maternal bids for mutual engagement and infants' responses to these bids may help illuminate strengths and weaknesses in the dyad's mutual regulatory efforts.

Hypotheses and Research Questions

The development of the mutual regulation of attention within cocaine-exposed parent-infant dyads has rarely been investigated through direct observation. The current study compares the mutual regulation of attention in mother-infant dyads containing prenatally cocaine-exposed infants and mother-infant dyads containing non-exposed infants by looking directly at maternal bids for mutual engagement, infant responses to these bids, and durations and characteristics of subsequent mutual engagement episodes. Two broad questions are addressed. The first question

is whether mother-infant dyads containing infants prenatally exposed to cocaine display fewer and/or less successful mutual regulation behaviors than mother-infant dyads containing non-exposed infants. To answer this question, five specific hypotheses will be tested.

Hypothesis 1. Prenatally cocaine-exposed dyads will spend a significantly smaller percentage of time in mutual engagement states during a standardized free play session than will non-exposed infants.

Hypothesis 2. Prenatally cocaine-exposed dyads will exhibit significantly shorter mutual engagement states than will non-exposed dyads. In other words, cocaine-exposed dyads will have greater difficulty sustaining mutual engagement states once they have established a focus of joint attention.

Hypothesis 3. Shorter mutual engagement episodes in cocaine-exposed dyads may be partially a result of a tendency for cocaine-abusing mothers to direct their child's attention to solitary play with an object rather than joint attention/mutual engagement. Therefore, it is hypothesized that a greater percentage of cocaine-abusing mother's bids for mutual engagement will direct their child's attention to solitary play (i.e. object focus) than will non-abusing mothers.

Hypothesis 4. Cocaine-abusing mothers will exhibit significantly shorter bids than will non-abusing mothers, possibly resulting in lessened opportunities for their infants to accept their bids.

Hypothesis 5. Prenatally cocaine-exposed infants will accept a smaller percentage of maternal bids for mutual engagement than will non-exposed infants. This may be a result of less

optimal maternal bids (e.g. bids that are too short or fail to gain the child's attention) or less responsiveness to maternal bids by cocaine-exposed infants.

The second broad question investigates the relationship between mutual regulation and a variety of biological, maternal, and environmental variables. Two specific hypotheses will be tested.

Hypothesis 6. The mother-infant dyad of the prenatally cocaine-exposed infant may be at risk for poor mutual regulation of attention as a result of transactional relationships between the biological vulnerabilities of the child, maternal psychological and social risk factors associated with cocaine use, and instability in the caregiving environment. More specifically, it is hypothesized that the duration of mutual engagement episodes and the proportion of time the dyad spends in mutual engagement will be predicted by prenatal cocaine-exposure, gestational age, maternal mental health status, maternal social risk, and instability of the caregiving environment.

Hypothesis 7. Finally, it is hypothesized that prenatal cocaine exposure will not only influence the mutual regulation of attention directly through the pharmacological affects of the drug on the developing infant, but that it will also influence the mutual regulation of attention indirectly through its effects on gestational age, maternal mental health status, maternal social risk, and instability of the caregiving environment (see Figure 1).

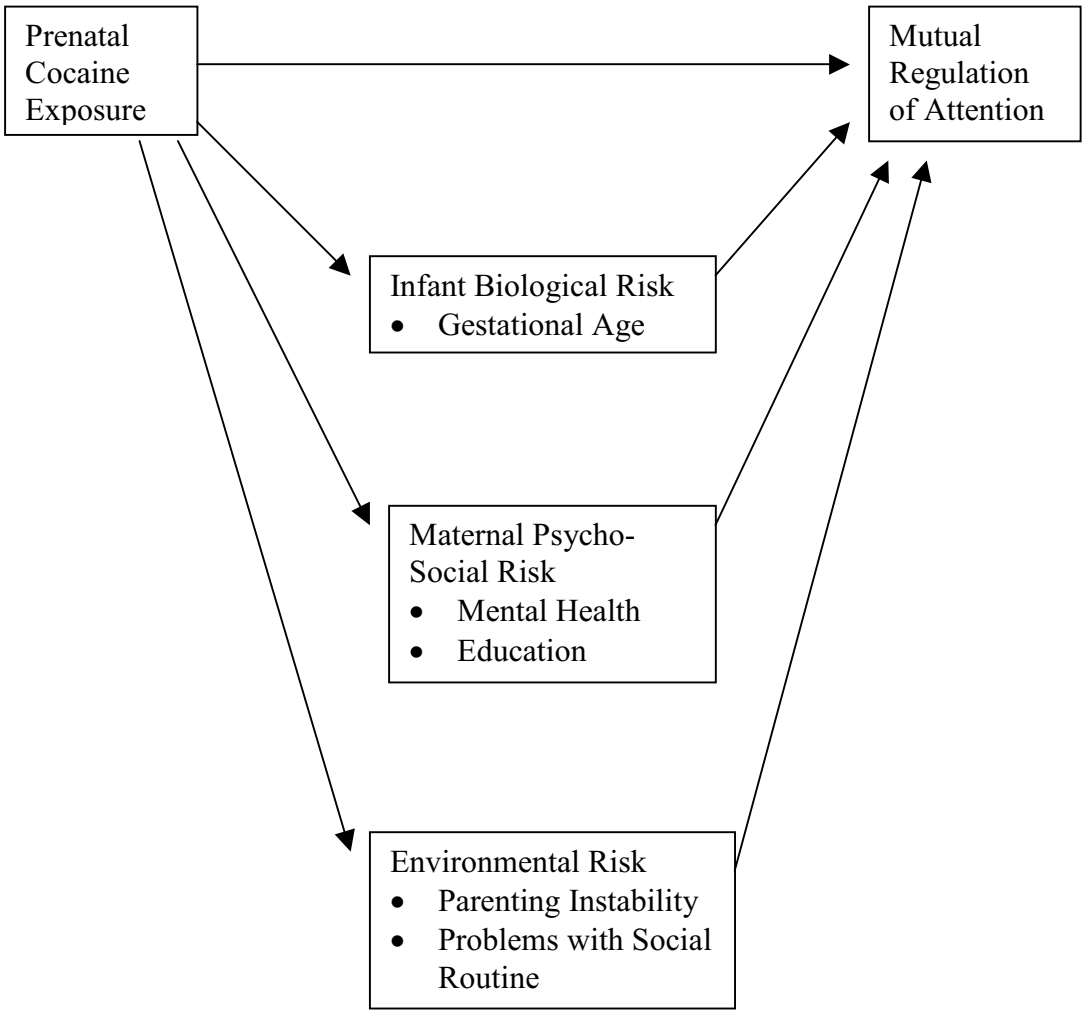

Figure 1
Conceptual Model of Direct and Indirect Relationships Between Prenatal Cocaine Exposure and Mutual Regulation of Attention

Chapter 3

Method

Participants

Participants of the current study consist of a subsample of 59 low-income, primarily African-American mothers and their infants who participated in a larger longitudinal research study of the effects of prenatal cocaine and polydrug exposure on infant development (Coles et al., 1990). Participants were recruited between January 1992 and December 1994 after giving birth at an urban hospital. All mothers were 19 years or older, were English speaking, had no major medical conditions (e.g. HIV infection, active syphilis, diabetes, psychiatric disorders requiring medication, tuberculosis), and used no drugs other than cocaine, alcohol, tobacco, and marijuana. All infants were either healthy full-term infants or pre-term infants without medical complications. Infants were not included in the study if they: (a) received oxygen for more than 28 days, (b) developed major infections, (c) had seizures, IVH (Grades III or IV), or perventricular leukomalasia, (d) were diagnosed with genetic disorders or major malformations, (e) were HIV positive or needed major surgery, or (f) showed other problems which might affect development. One group of mothers were identified as cocaine-polydrug users after either reporting cocaine use, having a positive urine screen, or both. The remaining mothers reported no use of cocaine, had no positive urine screens, reported no use of alcohol, and were subsequently identified as non-users.

Participants from the larger study were selected into the current study using the following criteria: (a) the mother must have been identified as either a cocaine-polydrug user or non-user (participants identified as using alcohol only were excluded from the current study), (b) the

mother must be the biological mother of the child, (c) the mother and child must have been assessed when the child was 6 and 12 months old, including participation in a videotaped free-play interaction when the child was 12 months old, and (d) the mother must have been both the primary caretaker and the person to accompany the child to the assessments when the child was 6 and 12 months old. It was of particular importance to the researcher that the mother was the consistent primary caretaker of the child between the ages of 6 and 12 months as much of the rationale of the current study relies on the history of the mutually regulated mother-child system. In other words, it is believed that the types of mother-child interactions experienced throughout the infants' early development will influence the types of attentional behaviors displayed when the infants are 12 months old.

After selecting a potential subsample, the sample was further reduced by viewing the videotaped 12 month free-play session. If the child was not visible during a large part of the session, the dyad was dropped from the subsample. If the mother was not visible during a large part of the session but (a) it could be determined that she was sitting in the room with her child, (b) her child was visible during the majority of the session, and (c) interactions (or lack thereof) between the mother and child could be either seen or heard, the dyad was not dropped from the subsample. It was hoped that these inclusion criteria would allow for the inclusion of mother-infant dyads in which mothers were in the testing room but unengaged with their children.

Fifty-nine participants met criteria for inclusion in the current study and had acceptable free-play videotapes. A power analysis based on a multiple regression analysis using six independent variables and a medium effect size of .3 revealed that 58 subjects would be needed to have an 85% chance of finding true significant results at an alpha level of .05. Therefore, it

was concluded that the sample of the current study was large enough to reveal significant results, if present.

Procedures

Data for the proposed research were collected as part of a larger longitudinal study designed to investigate the effects of prenatal cocaine-polydrug exposure on infant development (Coles et al., 1990).

Recruitment. Participants were recruited for the larger study through Grady Memorial Hospital, which serves a predominantly African-American, low-income population in an urban setting. Infant nursery records were examined daily by one of two trained recruiters who then approached potential participants. The recruiters administered two questionnaires to mothers who agreed to participate in the study: a demographic questionnaire and the Drug Checklist During Pregnancy (Coles et al., 1992), which includes questions about type of drug use during pregnancy, duration of drug use, and frequency of use. Urine samples were also collected from mothers and infants during recruitment.

Assessments and Observational Sessions. As part of the larger longitudinal project, mothers and infants were assessed when infants were 8 weeks, and 6, 12, and 24 months old. Assessments were conducted in a laboratory at the Georgia Mental Health Institute (GMHI), and all infant examinations and mother-child interactions were videotaped through a one-way mirror. During the 8-week assessment, infants' heart rates were recorded in response to a series of auditory (rattle), visual (red ring), and social (examiner's face and voice) stimuli. (For a more detailed description of the methodology used in recording infant heart rates, see Bard, Coles,

Platzman, & Lynch, 2000). During the 6, 12, and 24 month assessments, experimenters administered the Structured Clinical Interview (SCI; Platzman et al., 2001) to the mother and the Bayley Scales of Infant Development to the child while the mother watched. All infant assessors were blind to the mothers' substance abuse status. In addition, the mother and child participated in a five-minute free play session when their children were 6, 12, and 24 months old. During the free play sessions, mothers were provided with a standardized set of age-appropriate toys (e.g. stacking rings and cups, rattles, toy trains, stuffed toys) and instructed to interact with their infants as they would at home. Mothers and infants were left alone in the examination room during the free play session. Finally, the mothers completed the Symptoms Checklist-90-R (SCL-90-R; Derogatis, 1986) when their children were 6 and 12 months old.

Coding Scheme. A state-based coding scheme based on Adamson, McArthur, Markov, and Dunbar's (1999) event-based scheme was used to measure the amount of time spent in different mutual regulation states and record specific characteristics of these states (see Appendix A). The purpose of the revised coding scheme is to characterize maternal bids for mutual engagement, the infant's response to these maternal bids, and the duration and termination of subsequent mutual engagement states. Three engagement states were defined and used to divide the dyad's behavior into mutually exclusive and exhaustive states: (a) maternal bid, (b) mutual engagement, and (c) non-involved. In addition, maternal bids were further characterized by coding the origin, topic, form, quality, and child response to the bid. Mutual engagement states were further characterized by coding the person who terminated the state as well as the affect of the termination.

(a) Maternal Bid. Maternal bids were defined as any instance in which the mother seeks to engage the child's attention with a toy, or attempts to join the child and participate with the child in an activity with a toy. Maternal bids began when the mother made a distinct attempt to direct her child's attention toward a particular object in the room. Such attempts typically involved the mother offering the child a toy or attempting to join the child in play with a toy the child already held. In such cases, the onset of the bid was coded when the mother reached for the object that was to be the focus of mutual engagement. Maternal bids lasted until either the child accepted the bid or the mother stopped trying to attract her child's attention to the particular object. In addition to coding the onset and duration of maternal bids, several characteristics of the bids were also coded (see below).

(1) Bid Origin. The origin of the bid was classified into one of two mutually exclusive categories: mother *offered* the child an object or *joined* the child in play with an object to which the child was already attending.

(2) Bid Topic. The topic of the bid was classified into one of three mutually exclusive categories: a *shared* object or toy, an *object* that the mother did not seek to share with the child, or a *default* code that was used when the maternal bid was not accepted and it was therefore unclear whether the mother intended to share focus with the child.

(3) Bid Form. The form of the bid was assigned one of three mutually exclusive categories: *conventional, literal,* or *both*. *Conventional* bids were invitations which used only socially negotiated means to direct the child's attention (e.g. pointing or directing the child's attention with language). *Literal* bids emphasized a specific part of the

environment by making it more salient perceptually (e.g. noisily tapping a toy or putting an object close to the child's face). Bids coded as *both* included both literal and conventional aspects.

(4) Bid Quality. The quality of the bid was classified into one of three mutually exclusive categories: *positive* maternal affect, *negative* maternal affect, or *tease*.

(5) Child Response to Bid. The child's response to the maternal bid was assigned to one of five mutually exclusive categories: *accepted, declined, rejected, unreceived,* or *withdrawn*. A bid was coded *accepted* if the child's attention turned to the object offered by the mother. It should be noted that the child need not coordinate his/her attention between the mother and object in order for the bid to be coded accepted; the child need only focus his/her attention on the object offered by the mother. A bid was coded *declined* if the child appeared aware of the maternal bid but did not focus his/her attention on the object she offered. A bid was coded *rejected* if the child appeared aware of the maternal bid but actively and negatively refused to direct his/her attention to the object offered by the mother. A bid was coded *unreceived* if there was no indication that the child was aware of the mother's bid. Finally, a bid was coded *withdrawn* if the mother withdrew the invitation (e.g. placed the offered toy out of reach of the child) before the child had an opportunity to respond to the bid.

(6) Response Quality . The quality of the child's response was classified into one of two mutually exclusive categories: *positive* child affect or *negative* child affect.

(b) Mutual Engagement. The onset of a mutual engagement state was coded at the instant the infant accepted a maternal bid (see Child Response to Bid above). As previously stated, the

child need not acknowledge the mother's participation in play in order to sustain a mutual engagement state. However, the mother's participation must clearly affect the child's experience with the environment (e.g. the mother holds the post for a set of stacking rings so that the child may more easily place a ring on it). Therefore, the mutual engagement state may be compared to supported joint attention as defined by Adamson et al. (1995). Mutual engagement states lasted until either the mother or infant terminated the mutual engagement by focusing his/her attention away from the object of joint attention. In addition to coding the offset time of the mutual engagement state, coders also recorded the individual *who terminated* the state (i.e. mother or infant) and the *quality of the termination* (i.e. positive or negative).

(c) Non-involved. The dyad was coded as being non-involved when they were neither in a maternal bid nor mutual engagement state. As such, non-involved was a default code used when the dyad was not involved in any attempts to mutually regulate each other's attention. It should be noted that infants very rarely made bids for mutual engagement. Therefore, it is argued that attempts at mutual regulation during the free play sessions took place almost exclusively in maternal bid and mutual engagement states.

Coding Procedures and Reliability. Two coders, the primary researcher (secondary coder) and a research assistant blind to the study hypotheses (primary coder), coded the five minute, 12 month videotaped free-play interactions. The two coders trained for 9 weeks prior to the start of data collection in order to achieve reliability on the Mutual Regulation Coding Scheme. Training consisted of joint discussion of the various codes while watching pre-selected videotapes, as well as independent coding of practice videotapes. All training videotapes were selected from the participants in the larger data set who did not meet criteria for

the proposed study. Data collection began when the two coders achieved consistently adequate reliability (Cohen's kappa = .69-.95) on training videotapes. A third person then assigned sets of 5 videotapes to the primary coder, while selecting one videotape from each set to be coded by the secondary coder as well. As a result, a total of 12 videotapes (20%) were coded by both coders to assess reliability. Equal numbers of male and female infants and cocaine-using and non-using mothers were included in the videotapes selected for reliability. Reliability was calculated using Cohen's kappa. For coding decisions that involved discriminating between the 3 mutually exclusive and exhaustive states, the pooled kappa was .90. The unit used to calculate Cohen's kappa for the state-based aspects of the coding scheme was one second with a one second window. For coding decisions that involved characterizing Bid Origin, Bid Topic, Bid Form, Bid Quality, Child Response, Response Affect, Person Terminating, and Termination Affect, values for kappa were .83, .84, .80, 1.0, .78, .66, .92, and .97, respectively.

Measures

Prenatal Cocaine Exposure. Maternal cocaine-use was determined based on the following four data sources: (a) maternal medical records, often including results of urine screens during pregnancy and delivery, (b) maternal self-reports in the hospital using the Drug Checklist During Pregnancy (Coles et al., 1992), (c) maternal self-reports during a home visit conducted at 1 week and 1 month following hospital discharge using the Addiction Severity Index (ASI; McClellan, Luborsky, & O'Brien, 1983), and (d) postpartum infant and mother urine samples which were analyzed for cocaine metabolites. Mothers were designated as "cocaine-users" if they reported cocaine use and/or they or their infant had a positive urine screen at any point

during pregnancy, at delivery, or postpartum. Many participants also reported alcohol, tobacco, and marijuana use. As such, the "cocaine-user" group may include women who also used other illicit drugs. Several women who denied using cocaine did report using tobacco and/or alcohol. Women who reported using alcohol but denied cocaine use, and who had urine screens free of cocaine metabolites, were excluded from both the "cocaine-user" and "non-user" groups. The "non-user" group was selected from women who denied cocaine, marijuana, and alcohol use and whose urine screens were negative for cocaine metabolites.

Mutual Regulation of Attention. Mutual regulation of attention was measured using the Mutual Regulation Coding Scheme. It is argued that, in the 12- month free play session, mutual regulation of attention occurs within episodes of mutual engagement, a construct similar to supported joint attention. In order for mutual regulation of attention to occur, the mother and infant must both be influenced by the presence of the other. In instances of mutual engagement, as defined in the current study, the mother must be attending to the child, and the child must be influenced by this attention. Because infants at the age of 12-months are not yet adept at coordinating their attention between different foci (e.g. a person and an object), infants need not attend directly to their mothers in order to enter a mutual engagement state. Instead, it is argued that the infant fulfils his/her role in the mutual regulation of attention by attending to the object which the mother attempts to share. The infant regulates his/her attention, as well as the attention of his/her mother, by either choosing to attend to this object or to decline the invitation. If the infant chooses to attend to the object offered by the mother, he/she may be said to be influencing the mother's attention by encouraging the mother to remain involved with the object. Similarly, mother and infant may both regulate each other's attention by remaining involved with

the object of joint focus and thereby encouraging the other to do so as well. Therefore, the dyad's ability to mutually regulate each other's attention was measured by (a) the total percentage of time the dyad spent in mutual engagement during the free-play session and (b) the average duration of each mutual engagement episode.

Infant Gestational Age. Infant gestational age was determined using the Ballard scoring system (Ballard, Novak, & Driver, 1979). The Ballard score is computed by adding the summary score for six neurologic items (e.g., posture and arm recoil) to the summary score for six physical items (e.g., skin and plantar creases). The Ballard scoring system was used instead of estimates based on the mother's last menstrual period because the latter has been found to be unreliable in low income populations (e.g. DiPietro & Allen, 1991). However, Ballard examinations were not conducted on all infants. In cases in which the Ballard was not available, gestational age was determined based on information about the mother's last menstrual period and prenatal ultrasound examinations. For a more complete discussion of the justification for the use of the Ballard scale in the determination of gestational age in this population, see Brown, Bakeman, Coles, Sexson, and Demi (1998).

Maternal Mental Health. Maternal mental health status was measured using the Symptoms Checklist-90-R (SCL-90-R; Derogatis, 1986). Mothers completed the SCL-90-R when their children were 6 and 12 months old. The SCL-90-R data collected when infants were 12 months old will be used for the current research. The SCL-90-R measures nine primary symptom dimensions (Somatic, Obsessive-Compulsive, Interpersonal Sensitivity, Depression, Anxiety, Hostility, Phobic Anxiety, Paranoid Ideation, and Psychoticism) and gives three global measures of psychological distress (Global Severity Index, Positive Symptom Distress Index,

and Positive Symptom Total). The General Severity Index (GSI) t-score, which provides information about current psychological resources, will be used as the measure of the mothers' overall mental health status.

Maternal Social Risk. A Social Risk factor was computed for the complete sample (N=235) of the larger longitudinal study by examining the correlations between seven main maternal demographic variables. These seven variables were factor analyzed (see Brown et al., 1998), and two factors (Social Risk and Obstetric Risk) emerged, accounting for 47% of the variance. The Social Risk factor included education and income (weighted negatively) and never married (weighted positively). However, as education and income are not significantly correlated in the current study, the Social Risk factor cannot be replicated for the subsample used here. Therefore, maternal education by itself was used as a measure of maternal social risk.

Stability of Caregiving Environment. To assess the stability of the caregiving environment, the Structured Clinical Interview (SCI; Platzman et al., 1999) was administered to mothers when their infants were 6 and 12 months old. The SCI data collected when infants were 12 months old was used for the current research. The SCI provides information in the following areas: Demographics, Caregiving History (including involvement with protective services and alternative caregivers), Household Composition (including adult male or father's involvement), Preparations for Baby, Household Routine (including feeding, sleeping, and other activities), and Health Care Arrangements (i.e. plans for routine and emergency care, vaccinations, and well baby visits). Based on theoretical criteria, items on the SCI are clustered into several domains. For the current study, the Parenting Instability and Problems with Social Routine clusters were used to measure the stability of the caregiving environment. See Appendix B for a complete

listing of the items making up the Parenting Instability and Problems with Social Routine clusters.

Chapter 4

Results

Demographic Characteristics of Mothers

Maternal demographic characteristics are presented in Table 1. A total of 59 mothers participated in the study. Twenty-seven mothers were assigned to the drug group and 32 mothers were assigned to the control group. As a general rule, there were very few differences between mothers in the drug and control groups. The majority of the mothers were African American, received little training beyond high school, reported monthly incomes of less than $300 a month, and were never married. However, mothers in the drug group were significantly older and reported significantly more previous live births than did mothers in the control group. A significantly larger percentage of mothers in the control group were high school graduates and reported receiving prenatal care. Although Symptom Checklist-90-R (SCL-90-R) Global Severity Index (GSI) t-scores were not significantly different between groups, significantly more mothers in the drug group reported symptoms in the clinically significant range than did mothers in the control group.

Self-reported frequencies of maternal substance use are presented in Table 2. Only 17 of the 27 mothers in the drug group reported using cocaine. The remainder of the mothers in the drug group were assigned to this group based upon maternal medical records or postpartum mother and infant urine screens which were analyzed for cocaine metabolites. Of those who self-reported using cocaine, the majority (71%) reported at least weekly cocaine use during pregnancy. Similarly, the majority of the mothers in the drug group reported at least weekly alcohol consumption (54%) and tobacco use (84%) during pregnancy. Only twenty percent of

Table 1
Maternal Demographic Characteristics

	Drug Group			Control Group				
Variable	n	M or %	(SD, range)	n	M or %	(SD, range)	t or χ^2	eta^2 or tau
Maternal Age (years)	27	31.2	(5.0,19-40)	32	26.0	(5.0, 19-37)	3.96*	.22*
Number of Previous Live Births	25	3.0	(1.3, 1-5)	31	2.1	(1.7, 0-7)	2.16*	.08*
SCI Instability Cluster	26	1.5	(.86, 0-3)	32	1.2	(.83, 0-3)	1.26	.03
SCI Routine Cluster	26	1.8	(1.4, 0-5)	32	1.7	(1.1, 0-5)	.18	.00
SCL-90 GSI t-score	25	52.6	(12.1, 30-72)	32	46.8	(11.2, 30-69)	1.86	.06
GSI t-score (% > 60)	25	40		32	13		5.73*	.10*
Prenatal Care (% Yes)	23	39		31	65		4.09*	.07*
Ethnicity	27			32			1.68	.03
African American		100			94			
Other		0			6			
Level of Education	27			32				
< High School		56			34		3.15	.05
High School Graduate		18			50		7.61*	.13*
Some College/Tech		26			13		1.94	.03
College Graduate		0			3		.83	.01
Income	27			32				
< $300/Month		56			56		.01	.00
$301-$600/Month		37			38		.05	.00
$601-$900/Month		4			0		1.25	.02
>$901/Month		4			6		.17	.00
Marital Status	27			32			.00	.00
Married, Separated, etc.		18			19			
Never Married		82			81			

* $p < .05$

Table 2
Self-reported Frequency of Maternal Substance Use

	Drug Group		Control Group	
Variable	n	%	n	%
Cocaine Use	17		32	
Never		0		100
> Daily		6		0
Daily		6		0
3-4 Times/Week		6		0
1-2 Times/Week		53		0
2-3 Times/Month		18		0
< Once/Month		12		0
Alcohol Use	24		32	
Never		33		100
> Daily		4		0
Daily		8		0
3-4 Times/Week		21		0
1-2 Times/Week		21		0
2-3 Times/Month		13		0
< Once/Month		0		0
Tobacco Use	25		30	
Never		16		87
> Daily		80		13
Daily		4		0
3-4 Times/Week		0		0
1-2 Times/Week		0		0
2-3 Times/Month		0		0
< Once/Month		0		0
Marijuana Use	25		31	
Never		80		100
> Daily		0		0
Daily		0		0
3-4 Times/Week		4		0
1-2 Times/Week		12		0
2-3 Times/Month		4		0
< Once/Month		0		0

Note: Participants testing positive for cocaine metabolites were placed in the Drug group regardless of self-reported cocaine use.

the mothers in the drug group reported using marijuana during pregnancy. Mothers in the control group were pre-selected from those who denied using cocaine, alcohol, or marijuana. However, thirteen percent of the mothers in the control group did report smoking cigarettes during pregnancy.

Demographic Characteristics of Children

Infant demographic characteristics are presented in Table 3. A total of 31 male and 28 female infants participated in the study. There were no significant differences between the drug and control groups on any infant demographic characteristics. Nine infants in the drug group were born pre-term, as were twelve infants in the control group. However, for the following reasons, pre-term infants were not differentiated from their full-term counterparts: (a) there was an insufficient number of pre-term participants to form separate pre-term groups, (b) all pre-term infants included in the study were pre-selected to have no major medical complications at birth or prior to hospital discharge, (c) all pre-term and full-term infants were tested at the same conceptional ages, and (d) previous research has found no significant differences between pre-term and full-term infants in the amount of joint attention displayed during free play (Landry, 1986).

The infants' mean birthweight was 2674 grams. Mean birth length was 47 centimeters and mean head circumference at birth was 33 centimeters. The infants' mean five minute Apgar Score was 8.8. As previously mentioned, infants were pre-selected to include only those infants without medical complications or other problems which might affect development.

Table 3
Child Demographic Characteristics

	Drug Group			Control Group				eta^2 or
Variable	n	M or %	(SD, range)	n	M or %	(SD, range)	t or χ^2	tau
Sex (% male)	27	52		32	53		.06	.00
Gestational Age (weeks)	26	38	(2.4, 33-42)	32	38	(2.6, 33-42)	-.46	.00
Term (% full term)	27	67		32	63		.11	.04
Birth Weight (grams)	26	2556	(691, 1030-4060)	32	2770	(733, 1585-4110)	-1.13	.02
Birth Length (cm)	26	47	(4.4, 34-58)	31	48	(3.8, 40-55)	-.92	.01
Head Circumference (cm)	26	33	(2.7, 26-41)	30	33	(2.4, 25-36)	-.16	.00
5-Minute Apgar Score	26	8.8	(.6, 7-10)	32	8.7	(.8, 5-9)	.49	.00
12-Month Bayley MDI	19	99.5	(20.9, 54-130)	29	100.6	(9.9, 81-119)	-.24	.00
12-Month Bayley PDI	19	98.7	(22.5, 58-134)	29	103.1	(15.4, 70-139)	-.81	.01
24-Month Bayley MDI	16	80.1	(10.2, 62-96)	25	84.4	(9.6, 63-106)	-1.35	.04
24-Month Bayley PDI	16	102.7	(14.3, 80-122)	25	102.9	(15.6, 48-132)	-.05	.00

Note: There were no significant differences between Drug and Control groups on any child demographic characteristics.

Mutual Regulation States

Descriptives. Mean frequencies, probabilities, and average durations of the three mutual regulation states (maternal bid, mutual engagement, and non-involved) are presented in Table 4. All mothers made at least one bid for mutual engagement, and all but one dyad were engaged in at least one mutual engagement episode. The single dyad which did not exhibit a mutual engagement episode was in the drug group. The dyads' attention during the free play sessions was distributed fairly evenly among the three mutual regulation states. Dyads spent an average of 33% of their time in maternal bid states, 38% of their time in mutual engagement states, and 29% of their time in non-involved states. Mothers made an average of 11 bids per free play session. Dyads engaged in an average of 6 mutual engagement episodes per session. On average, mutual engagement episodes lasted approximately twice as long as maternal bids.

Group Differences. A series of one-way Analyses of Variance (ANOVA's) were used to compare drug and control groups in terms of frequencies, probabilities, and average durations of the three mutually exclusive, exhaustive states. With a single exception, there were no significant differences between the drug and control groups in any of these variables. Contrary to expectations, the mean duration of mutual engagement states was greater in the drug group than the control group. The hypotheses that prenatally cocaine-exposed dyads will spend a significantly smaller percentage of time in mutual engagement than non-exposed dyads, that prenatally cocaine-exposed dyads will exhibit significantly shorter mutual engagement states than non-exposed dyads, and that mothers of cocaine-exposed infants will exhibit significantly shorter bids than will mothers of non-exposed infants were not supported.

Table 4
Frequency, Probability, and Average Duration of Mutual Regulation States

	Drug Group			Control Group				
Variable	n	M	(SD, range)	n	M	(SD, range)	t	eta^2
Maternal Bid	27			32				
Rate (per minute)		2.0	(.94, .2-3.8)		2.3	(.74, .2-3.8)	-.98	.02
Average Duration (seconds)		9.0	(3.7, 1-16.9)		9.7	(4.5, 3.9-29.0)	-.62	.01
Mutual Engagement	27			32				
Probability		.42	(.19, 0-.79)		.34	(.19, .01-.69)	1.45	.04
Average Duration (seconds)		25.1	(19.0, 0-93.0)		15.7	(10.3, 1.8-39.7)	2.39*	.09*
Non-Involved	27			32				
Probability		.27	(.24, .01-.99)		.31	(.22, .04-.89)	-.80	.01
Average Duration (seconds)		21.7	(44.3, 1.3-197.1)		19.0	(44.0, 3.0-256.3)	.23	.00

* $p < .05$

Characteristics of Maternal Bids and Mutual Engagement Episodes

Descriptives. The mean probabilities of the various characteristics of maternal bids and mutual engagement episodes are presented in Table 5. The majority of maternal bids involved offering the child a new toy. Only 10% of maternal bids involved mothers joining their infants in play with a toy with which the child was already playing. Mothers sought to focus their infant's attention on a shared focus (bid topic=shared) twice as often as they sought to direct their child's attention to solitary play with a toy (bid topic=object). The majority of maternal bids included both conventional and literal aspects to attract the child's attention. Very few bids relied solely on conventional means to direct the child's attention. Maternal affect was almost exclusively positive during bids. The majority of maternal bids were accepted by the infants. When not accepted, bids were typically declined. Bids rarely were rejected, unreceived, or withdrawn. Child affect in response to maternal bids was almost exclusively positive. Mutual engagement episodes were slightly more likely to be terminated by mothers than by infants. The affect of the individual terminating the mutual engagement was almost exclusively positive. In fact, very little negative affect was coded throughout the five-minute free play episodes. As a result of the lack of variability in the three affective codes (Bid Quality, Response Affect, and Termination Affect), these variables were dropped from further analyses. Similarly, due to the low frequencies of Child Responses of rejected or unreceived, these two variables were also dropped from further analyses.

Group Differences. A series of one-way ANOVA's were used to compare drug and control groups in terms of the mean probabilities of the various characteristics of maternal bids and mutual engagement states. There were no significant differences between the drug and

Table 5
Mean Probabilities of Maternal Bid and Mutual Engagement Characteristics

	Drug Group			Control Group				
Variable	n	M	(SD, range)	n	M	(SD, range)	t	eta^2
Bid Origin	27			32				
Offered		.89	(.21, 0-1.0)		.91	(.10, .69-1)	-.34	.00
Joined		.11	(.21, 0-1.0)		.09	(.10, 0-.31)	.34	.00
Bid Topic	27			32				
Shared		.42	(.25, 0-1.0)		.38	(.24, 0-1.0)	.57	.01
Object		.18	(.14, 0-.38)		.22	(.15, 0-.50)	-1.27	.03
Default		.40	(.24, 0-1.0)		.39	(.18, 0-.75)	.20	.00
Bid Form	27			32				
Conventional		.10	(.23, 0-1.0)		.04	.08, 0-.30)	1.23	.03
Literal		.27	(.20, 0-.71)		.34	(.24, 0-.87)	-1.14	.02
Both		.63	(.22, 0-1.0)		.61	(.25, .13-1.0)	.27	.00
Bid Quality	27			32				
Positive		.98	(.05, .8-1.0)		.96	(.08, .67-1.0)	1.23	.03
Negative		.00	(.02, 0-.10)		.00	(.00, 0-0)	1.09	.02
Tease		.02	(.05, 0-.20)		.04	(.07, 0-.33)	-1.34	.03

(Continued)

Table 5 (Continued)

	Drug Group			Control Group				
Variable	n	M	(SD, range)	n	M	(SD, range)	t	eta^2
Child Response	27			32				
Accepted		.60	(.24, 0-1.0)		.61	(.18, .25-1.0)	-.19	.00
Declined		.31	(.21, 0-1.0)		.28	(.17, 0-.75)	.60	.01
Rejected		.01	(.04, 0-.20)		.00	(.02, 0-.09)	.61	.01
Unreceived		.02	(.05, 0-.20)		.02	(.05, 0-.17)	-.61	.01
Withdrawn[1]		.05	(.08, 0-.29)		.06	(.08, 0-.33)	-.76	.01
Response Affect	27			32				
Positive		.96	(.09, .6-1.0)		.98	(.05, .82-1.0)	-.93	.01
Negative		.03	(.08, 0-.40)		.01	(.03, 0-.15)	1.06	.02
Terminated By:	27			32				
Mother		.63	(.32, 0-1)		.56	(.28, 0-1)	-.11	.00
Child		.30	(.27, 0-1)		.37	(.27, 0-1)	-1.01	.02
Termination Affect	27			32				
Positive		.92	(.23, 0-.1)		.92	(.18, 0-.1)	-.87	.01
Negative		.01	(.02, 0-.14)		.01	(.03, 0-.17)	.01	.00

[1]Bid withdrawn by mother.

Note: There were no significant differences between Drug and Control groups in any of the above variables.

control groups in any of these variables (see Table 5). Thus, the hypotheses that mothers of cocaine-exposed infants will exhibit a greater percentage of object bids than mothers of non-exposed infants and that prenatally cocaine-exposed infants will accept a smaller percentage of maternal bids were not supported.

Infant, Maternal, and Environmental Risk Factors as Predictors of Mutual Regulation

Two separate hierarchical multiple regression analyses were used to analyze the potential roles of infant, maternal, and environmental risk factors as predictors of mutual regulation of attention (see Table 6 for zero-order correlation matrix). In the first analysis, the percentage of time the dyad spent in mutual engagement was regressed first on prenatal cocaine exposure (Group), second on infant gestational age as measured by the Ballard, third on maternal education, fourth on maternal mental health as measured by the SCL-90-R Global Severity Index, fifth on the SCI Instability Subscale, and sixth on the SCI Problems with Social Routine Subscale. In the second analysis, the average duration of mutual engagement episodes was regressed on the same set of independent variables in the identical order. Variables were entered into the regression equation in the predicted order of importance, from the variable predicted to account for the most amount of variance to the variable predicted to account for the least amount of variance.

Results of the first multiple regression analysis indicated that none of the infant, maternal, or environmental risk factors accounted for a significant amount of the variance in the percentage of time spent in mutual engagement (See Table 7). Results of the second multiple regression indicated that prenatal cocaine exposure accounted for a significant amount (10.6%)

Table 6
Zero-order Correlations Between Dependent and Independent Variables

Variable	1	2	3	4	5	6	7	8
1. Percent Time in Mutual Engagement (n)	_	.526* (59)	-.189 (59)	.002 (58)	.058 (57)	.049 (58)	-.139 (58)	.134 (58)
2. Mean Duration Mutual Engagement (n)		_	-.302* (59)	-.144 (58)	.283* (57)	.100 (58)	.056 (58)	.141 (58)
3. Group (n)			_	.062 (58)	-.266* (57)	.093 (58)	-.166 (58)	-.024 (58)
4. Gestational Age (n)				_	-.177 (56)	-.091 (58)	-.101 (58)	.030 (58)
5. SCL-90 GSI t-score (n)					_	-.176 (56)	.194 (56)	.341* (56)
6. Maternal Education (n)						_	.214 (58)	.054 (58)
7. SCI Instability (n)							_	.109 (58)
8. SCI Routine (n)								_

* $p < .05$

Table 7
Hierarchical Multiple Regression of Percentage of Time in Mutual Engagement on Group, Gestational Age, Maternal Education, SCL-90-R GSI, SCI Instability, and SCI Routine

Step	Variable Added	R^2 Total	$)R^2$	∃ After Step 1	∃ After Step 2	∃ After Step 3	∃ After Step 4	∃ After Step 5	∃ After Step 6
1	Group	.032	.032	-.180	-.182	-.186	-.180	-.213	-.218
2	Gestational Age	.033	.001		.032	.036	.037	.026	.016
3	Maternal Education	.036	.003			.050	.054	.106	.095
4	SCL-90-R GSI t-score	.036	.001				.028	.070	.018
5	SCI Instability Cluster	.079	.043					-.221	-.223
6	SCI Routine Cluster	.093	.014						.129

N=55
Note: None of the independent variables accounted for a significant amount of the variance in percentage of time spent in mutual engagement.

of the variance in the average duration of mutual engagement episodes, with dyads in the drug group exhibiting significantly longer mutual engagement episodes (See Table 8). None of the other independent variables in the analysis accounted for a significant amount of the variance in the average duration of mutual engagement.

With the exception of prenatal cocaine exposure, none of the independent variables accounted for a significant amount of the variance in either percentage of time in mutual engagement or average duration of mutual engagement episodes. Therefore, prenatal cocaine exposure could not indirectly affect mutual regulation of attention through any of the infant, maternal, or environmental variables, as hypothesized.

Exploratory Analyses

8-Week Infant Attention as a Predictor of Mutual Regulation at 12-Months. Exploratory analyses were conducted to determine the relationship between the mutual regulation of attention as measured in the current study with measures of infant attention obtained when the infants were 8 weeks old. As part of the larger research project, infant attention at 8 weeks was measured by recording infant heart rates in response to auditory (rattle), visual (red ring), and social (examiner's face and voice) stimuli (see Bard et al., 2000). Infant's heart rates were recorded at baseline, as well as 15, 30, and 45 seconds after the presentation of the stimulus, with a deceleration in heart rate following stimulus presentation being characteristic of focused attention and an increase in heart rate being indicative of distress or increased arousal. Results of Bard et al.'s (2000) study indicated that there were no significant differences between drug-exposed and non-exposed infants in baseline or in response to visual or auditory stimuli.

Table 8
Hierarchical Multiple Regression of Mean Duration of Mutual Engagement Episodes on Group, Gestational Age, Maternal Education, SCL-90-R GSI, SCI Instability, and SCI Routine

Step	Variable Added	R^2 Total	$)R^2$	∃ After Step 1	∃ After Step 2	∃ After Step 3	∃ After Step 4	∃ After Step 5	∃ After Step 6
1	Group	.106*	.106*	-.325*	-.316*	-.322*	-.273*	-.287*	-.288*
2	Gestational Age	.116*	.011		-.103	-.096	-.084	-.089	-.091
3	Maternal Education	.124	.008			.088	.119	.141	.138
4	SCL-90-R GSI t-score	.173*	.049				.230	.247	.235
5	SCI Instability Cluster	.181	.008					-.093	-.094
6	SCI Routine Cluster	.182	.001						.032

N=55
* $p < .05$

However, Bard et al. (2000) did find that drug-exposed infants showed an increased heart rate in response to social stimuli (indicative of distress or increased arousal) while nonexposed infants showed a decrease in heart rate (indicative of focused attention). Therefore, the current exploratory analyses are limited to infant heart rate in response to social stimuli as it appears to be the most sensitive measure in the population involved in the current study.

As 8-week data were available for only a subset of the current study (n=30), the following analyses are considered exploratory. Following the procedure set forth in the larger study, a heart rate difference score was computed by subtracting the baseline heart rate from the 30 second heart rate. By using the recording at the initiation of the stimulus as the baseline heart rate and the 30 second heart rate as an indication of the peak heart rate response for the trial, the heart rate difference score is designed to provide an indication of the infant's total heart rate response to the stimuli. Zero-order correlations were then computed between percentage of time spent in mutual engagement, average duration of mutual engagement episodes, and the heart rate difference score. It was hypothesized that infants with accelerating heart rates in response to social stimuli at 8 weeks would spend less time in mutual engagement and exhibit shorter mutual engagement episodes at 12 months. However, results indicated that neither percentage of time spent in mutual engagement nor average duration of mutual engagement episodes were significantly correlated with the heart rate difference score. Additional exploratory analyses investigated the relationship between the mean heart rate (computed by averaging the baseline, 15, 30, and 45 second heart rates) and the percentage of time spent in mutual engagement and the average duration of mutual engagement episodes. Results indicated that the mean heart rate in response to social stimuli was significantly correlated with the percent of time the dyad spent in

mutual engagement (See Table 9). Infants who exhibited lower mean heart rates at 8-weeks of age displayed a higher percentage of time spent in mutual engagement with their mothers at the age of 12 months. Additional research may be necessary to further explore the relationship between infant heart rate and mother-infant interactions among substance exposed populations.

12-Month Mutual Regulation as a Predictor of Concurrent and Future Developmental Status. Exploratory analyses also investigated the relationship between mutual regulation and developmental status. Zero-order correlations were computed between percentage of time spent in mutual engagement, average duration of mutual engagement episodes, and 12- and 24-month Bayley Mental (MDI) and Psychomotor (PDI) Developmental Indices (See Table 10). Results indicated that neither percentage of time spent in mutual engagement nor average duration of mutual engagement episodes were significantly correlated with 12-month or 24-month Bayley scores. Infants in both groups scored within the average range on both the 12 and 24 month Psychomotor Developmental Indices. Although infants scored within the average range on the Mental Developmental Index at 12 months (drug group m=99.5, sd=20.9; control group m=100, sd=9.9), their scores dropped to within the low average range by the time they reached 24 months of age (drug group m=80.1, sd=10.2; control group m=84.4, sd=9.6). This was true of infants in both the drug and control groups.

Table 9
Zero-order Correlations Between Mutual Regulation and 8-Week Heart Rate

Variable	1	2	3	4
1. Percent Time in Mutual Engagement (n)	_	.526* (59)	-.183 (30)	-.443* (30)
2. Mean Duration Mutual Engagement (n)		_	-.016 (30)	-.092 (30)
3. Heart Rate Difference (n)			_	.151 (30)
4. Mean Heart Rate (n)				_

* $p < .05$

Table 10
Zero-order Correlations Between Mutual Regulation and Developmental Status

Variable	1	2	3	4	5	6
1. Percent Time in Mutual Engagement (n)	_	.526* (59)	.228 (48)	.178 (48)	.212 (41)	.265 (41)
2. Mean Duration Mutual Engagement (n)		_	-.076 (48)	.148 (48)	-.066 (41)	-.157 (41)
3. 12-Month MDI (n)			_	.507* (48)	.151 (40)	.294 (40)
4. 12-Month PDI (n)				_	.072 (40)	.007 (40)
5. 24-Month MDI (n)					_	.284 (41)
6. 24-Month PDI (n)						_

* $p < .05$

Chapter 5

Discussion

The current study was conducted to investigate the mutual regulation behaviors of mother-infant dyads containing infants prenatally exposed to cocaine and a matched sample of mother-infant dyads containing non-exposed infants. Dyads were observed when infants were twelve months old, the point at which infants typically begin to develop an ability to jointly attend to objects in their environments and to people. In order for this fundamental skill to be developed, infants' self-regulatory abilities must be supplemented by external regulation from caregivers who help the infants direct and focus their attention. Caregivers must be sensitive to infants' need for assistance, while infants must be open and attentive to caregivers' scaffolding efforts. As such, the development of self-regulation in the infant is truly dependent upon the transactional mutually regulated system of child and caregiver.

Group Differences. Contrary to hypotheses, mother-infant dyads containing prenatally exposed infants did not differ from mother-infant dyads containing non-exposed infants in terms of the percentage of time spent in mutual engagement episodes. This finding suggests that there were no differences between the two groups in the amount of mutual regulation exhibited during free play. Also contrary to hypotheses, cocaine exposed dyads exhibited significantly longer episodes of mutual engagement than did non-exposed dyads. This result is somewhat confusing in light of the finding that mothers in both groups made the same number of bids and infants in both groups accepted the same percentage of bids. Given the same number of bids, the same probability of a bid being accepted, and equal percentages of time spent in mutual engagement in each group, it would seem logical that the average duration of mutual engagement episodes

would not differ. Therefore, it is likely that the difference between the two groups in terms of average duration of mutual engagement episodes, although statistically significant, is slight. In fact, eta^2, an effect size statistic similar to R^2, suggests that only approximately 9% of the variance in the average duration of mutual engagement was accounted for by group membership.

As previously mentioned, mothers of cocaine exposed infants made the same number of bids for their children's attention as did mothers of non-exposed infants. These results suggest that mothers in the two groups did not differ in the number of initial attempts to engage their children's attention. Similarly, cocaine exposed infants did not differ from non-exposed infants in the percentage of maternal bids accepted. This result may be interpreted in two ways. It may suggest that cocaine exposed and non-exposed infants did not differ in their attentiveness and responsiveness to their mothers' bids during the free play episode. This result may also suggest that cocaine abusing and non-abusing mothers' bids for mutual engagement were equally effective or equally ineffective. It is likely that the true interpretation of this result reflects both maternal and child contributions to the initiation of shared attention.

Cocaine abusing and non-abusing mothers did not differ in any of the coded characteristics of their bids for mutual engagement. Mothers in the two groups were equally likely to direct their children's attention to solitary play with an object. Similarly, they were equally likely to direct their children's attention to an object they wished to share. Mothers in both groups were more likely to direct their children's attention to a shared focus than to solitary object play. These results suggest that cocaine abusing and non-abusing mothers were equally invested in sharing their attention with their children. Cocaine abusing and non-abusing mothers also exhibited similar tendencies to incorporate language and manipulation of the environment in

their attempts to engage their children, suggesting that the two groups were not only similar in the amounts of bids they made, but also in the specific tactics they used to attract their children's attention.

Cocaine exposed and non-exposed dyads did not differ in terms of the likelihood of mother or child termination of mutual engagement. In both groups, mothers were more likely than children to terminate episodes of mutual engagement. This result suggests that once children became involved in shared attention with their mothers, they remained involved until their mothers withdrew from the interaction.

Study results regarding group differences are consistent with previous research that failed to find significant differences between prenatally cocaine exposed and non-exposed children in terms of cognitive and developmental outcomes (e.g. Azuma & Chasnoff, 1993; Edmonson & Smith, 1994; Hawley et al., 1995). However, results contradict previous reports of dysregulation in cocaine exposed dyads (Barabach et al., 1992; Burns et al., 1991; Fitzgerald et al., 1990; Freier et al., 1991) and deficits in attention and state regulation in cocaine exposed infants (e.g. Black et al., 1992; Eisen et al., 1991; Espy et al., 1997).

Although few significant group differences were revealed in terms of mutual regulation behaviors, anecdotal observations of free play sessions suggest that both cocaine abusing and non-abusing mothers displayed less-than-optimal interactional styles. Regardless of group membership, mothers exhibited a tendency to offer several bids in quick succession, often offering a new bid before the child had a chance to respond to the initial invitation. Once involved in mutual engagement, mothers frequently attempted to interrupt and control their children's play rather than following the child's lead. Such attempts at control often led the

infants to become disinterested in the interaction and to become fussy. Infants occasionally terminated the mutual engagement when mothers became too controlling. Mothers were also observed to become more interested in playing with the toys themselves than in interacting with their children. As such, several free play episodes were characterized by a type of parallel play between mother and child. Finally, several mothers in both groups were observed napping during the interaction, paying little attention to their infants.

Predictors of Mutual Regulation. None of the environmental variables hypothesized to mediate the relationship between prenatal cocaine exposure and mutual regulation of attention predicted a significant amount of the variance in either the probability or average duration of mutual engagement episodes. However, it is likely that the lack of significant relationships between environmental variables, prenatal cocaine exposure, and mutual regulation is due, in part, to the nature of the participant selection process. Participants in the current study were limited to only those women who were both biological mothers and primary caretakers of their children at the ages of 6 and 12 months. By excluding women who were not primary caretakers at both of these ages, the researcher hoped to control for disruptions in caretaking which occur with out-of-home placement. It should be noted that it was not possible to control for brief out-of-home placements that may have occurred between these two ages. In addition, it was hoped that inclusion of only those women who were consistent caretakers across the two ages would enable the investigation of well-established patterns of mutual regulatory behaviors. However, by excluding women who may have temporarily lost or surrendered custody of their children, it is likely that only those women who were more stable and well adjusted were included in the study.

The hypothesis that only a relatively stable subset of cocaine abusing women was included in the current study is supported by the finding that cocaine exposed and non-exposed dyads were very similar in terms of demographic variables. The majority of mothers participating in the current study appeared to be from similar low-income, undereducated, inner-city populations. Mothers in the drug group did not report lower incomes, less education, greater psychological distress, greater parenting instability, or more problems with social routine than did mothers in the control group. Likewise, infants in the drug group did not differ from infants in the control group in terms of gestational age, birthweight, length, and head circumference, or 5-minute Apgar score. As such, the types of risk factors cited in the literature to differentiate substance abusing women from non-abusing women and substance exposed children from non-exposed children did not appear evident in the sample selected for the current study. Therefore, it is possible that the mutual regulation behaviors of cocaine exposed dyads that may be at the greatest risk for negative outcomes were not directly investigated by this research.

Future research including dyads from more middle- to upper-class populations may further illuminate possible effects of income, education, and other environmental factors on mutual regulatory behaviors. Furthermore, comparisons of biological and foster/adoptive mothers with similar histories in terms of length and consistency of their relationship with their cocaine exposed children may shed light onto contributions of substance abusing mothers' early histories, temperaments, and psychosocial adjustment while controlling for direct effects of substance exposure on the infant.

Exploratory Analyses. Consistent with previous research, the results of the current study suggested that cocaine exposed and non-exposed children did not differ in either MDI or PDI

scores on the BSID at 12 or 24 months of age. Both cocaine-exposed and non-exposed infants earned developmental indices of near 100 on both the MDI and PDI at 12 months. Mental Developmental Indices for both groups decreased to approximately 80 at 24 months while PDI's remained near 100. Exploratory analyses suggested that the dyads' mutual regulatory abilities were neither concurrently nor predictively linked to their cognitive or psychomotor development. Exploratory analyses did, however, suggest a significant predictive relationship between infant heart rate at 8 weeks and mutual regulation at 12 months of age. Infants with lower mean heart rates at 8 weeks of age exhibited a greater percentage of time in mutual engagement with their mothers at 12 months. Although no significant differences were found in heart rates of cocaine exposed and non-exposed infants, results did suggest a relationship between physiological factors in the young infant and mutual regulation at 12 months.

Study Limitations. Several limitations of the current study should be considered when interpreting the results. As previously mentioned, the participant selection criteria may have eliminated mother-infant dyads who were at greater risk for mutual dysregulation. Similarly, self-selection factors may have limited the variability of study participants. It is likely that women who experienced greater personal stressors and environmental instability were unavailable or chose not to participate in the research. Furthermore, women who did participate in the study may have exhibited a social expectancy bias, adjusting their normal behavior to reflect what they believed to be more optimal mother-child interactions. Such a bias may be even more likely among mothers of cocaine exposed children who are often used to being observed by social workers, interventionists, and family members concerned about the welfare of their children. The researcher's anecdotal observations of cocaine abusing mothers in a

comprehensive treatment facility suggest that women in recovery programs are adept at adjusting their behavior to meet expectations. However, when unaware of being observed, these women often reverted to less optimal behaviors.

It is often difficult to ascertain whether mothers continue to use drugs following the births of their children. Reliance on self-reports of timing and dosage of maternal cocaine use may introduce error as women may be hesitant to accurately describe their substance use. The current study did not control for duration, timing, or dosage of prenatal cocaine exposure. However, previous research has suggested that these variables may contribute to developmental outcomes. Chasnoff et al. (1989) found that women who reported using cocaine only during their first trimester of pregnancy exhibited rates of preterm delivery, low birthweight, and intrauterine growth retardation that were not significantly different from a drug-free control group. Women who reported using cocaine throughout their pregnancies, however, had worse outcomes on all of these measures than did the drug-free group (Chasnoff et al., 1989). Similarly, Alessandri et al. (1998) reported significant effects of prenatal cocaine exposure on children's BSID MDI scores for children exposed to high cocaine dosages only. Future research controlling for these variables may clarify their effects on infant development. Similarly, future research should control for cocaine abusing mothers' participation in treatment programs as women's behavior may differ significantly following intervention.

Implications for Intervention and Social Policy. Apparent limitations in the variability of participants in this study may have limited the strength of analyses investigating the potentially complex relationship between biological, psycho-social, and environmental variables and mutual regulation. However, the lack of significant group differences in the well-matched samples of

cocaine exposed and non-exposed dyads suggests that there is indeed no direct effect of prenatal cocaine exposure on the mutual regulation of attention. Rather than documenting differences between substance abusing and non-abusing populations, the current study has resulted in a characterization of mother-child interaction and mutual regulation of attention in a population of low-income, predominantly African-American mothers and their children.

Results of the current study, as well as others that fail to find significant differences between cocaine exposed and non-exposed infants, have implications for the future direction of intervention and social policy. Schutter and Brinker (1992) argue that "if the category of cocaine exposed individuals is so poorly defined that a small percentage demonstrate developmental differences or some specific behavioral or learning problems, then it would behoove us to follow Hobbs's (1975) advice about classifying the problem rather than the individual" (pg. 101). It is argued that appropriate and effective interventions should not be designed as interventions for cocaine exposed children, but rather for children who are at high risk for developmental difficulties. Such programs should address the variety of biological and environmental variables that likely affect children's development. According to this model, maternal cocaine abuse may be viewed as simply another risk factor embedded in the child's larger ecology. The crack baby need not be singled out as an infant with unique developmental risks, but should instead be viewed as an infant being raised in a disadvantaged environment. So doing may help eliminate some of the social stigma of prenatal cocaine exposure and remove barriers to a productive and successful future.

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Appendix A

Mutual Regulation Coding Scheme
(Adapted from Adamson, McArthur, Markov, & Dunbar, 1999)

BID ORIGIN	Offered	Mother seeks to engage the child's attention with a toy to which the child previously had not been attending. Mother may hand the child an object, focus the child's attention on an object by animating, pointing to, or speaking about it, or arrange objects for the child to play with.
	Joined	Mother seeks to join the child's focus on an object and participate with the child in an activity with a toy to which the child had already been attending.

BID TOPIC	Shared	The mother primarily seeks to engage the child's attention to a shared toy or to actively participate with the child in a new activity.
	Object	The mother primarily seeks to focus the child's attention on an object that she does not seek to share with the child. The mother focuses the child's attention on the toy but does not actively participate in play once the child's attention has been focused. This bid topic tends to result in the child engaging in solitary play with the object.
	Default	This code is to be used when the child does not accept the maternal bid and it is therefore difficult to ascertain whether the mother intended to participate in play with the child.

BID FORM	Conven-tional	The mother uses socially negotiated means (e.g. pointing or language) to direct the child's attention to an object.
	Literal	The mother attempts to direct the child's attention by emphasizing a specific part of the environment by making it more salient perceptually (e.g. noisily tapping a toy, rolling a ball, or putting objects close to a child's face).
	Both	The maternal bid includes both a literal and conventional element (see above).

BID QUALITY	Negative	Mother yells, scolds, hits child, or evidences other negative affective response.
	Not Negative	Default code to be used if there is no evidence of negative affect.

CHILD RESPONSE	Accepted	The child accepts the mother's invitation to engage his/her attention with the shared toy or activity.
	Declined	The child is aware of the invitation, but remains passively unengaged or shows only a fleeting attention to the focus of the invitation.
	Rejected	The child actively rejects or avoids directing his/her attention to the shared focus (e.g. striking out, pushing away, strongly averting eye gaze). There is a definite sense of negativity with this code.
	Unreceived	The child appears unaware of mother's invitation. He/she may be either oblivious to the invitation or engrossed in some activity, shutting out the mother's bids.
	Withdrawn	The mother makes a bid, but withdraws the offer before the child has an adequate chance to respond. For example, mother may offer the child a toy from the box, but put it back before the child has a chance to reach for it.

RESPONSE AFFECT	Negative	Child cries, hits at mother, grunts angrily, strongly averts eye gaze, or evidences other negative affective response.
	Not Negative	Default code to be used if there is no evidence of negative affect.

TERM-INATION BY:	Mother	Mother terminates mutual engagement with child by re-focusing her attention onto an object other than the object of shared attention.
	Child	Child terminates mutual engagement with mother by re-focusing his/her attention onto an object other than the object of shared attention.

TERM-INATION AFFECT	Negative	Child cries, hits at mother, grunts angrily, strongly averts eye gaze, or evidences other negative affective response. Similarly, mother may yell, hit, spank, etc. the child or strongly avert her eye gaze. This code should be recorded with respect to the person who terminated the mutual engagement.
	Not Negative	Default code to be used if there is no evidence of negative affect.

Appendix B

Items in Structured Clinical Interview: Parenting Instability and Problems with Social Routine Clusters

Parenting Instability Cluster	Score
1. No male caregiver in household	Yes=1
2. Daycare for more than 40 hours weekly	Yes=1
3. No regular place to sleep	Yes=1
4. No regular baths	Yes=1
5. Has plans for urgent and routine health care	No=1
6. More than 50 hours away from primary caretaker	Yes=1
7. Infant has 1 or 2 other regular caregivers	Yes=1
8. Infant separated from primary caregiver 2 days/nights once a month	Yes=1
9. Respondent is biological parent, grandparent, or foster parent	No=1
10. If respondent is not mother, baby sees mother regularly	No=1
11. Infant is too outgoing	Yes=1
12. Infant falls or is injured frequently	Yes=1
13. Infant has been abused or neglected	Yes=1

Problems with Social Routine Cluster	Score
1. Infant calms with intervention	No=1
2. Infant prefers caretaker intervention to calm	No=1
3. Infant does not sleep in own bed	Yes=1
4. Infant is scared of strangers	Yes=1
5. Infant has always been scared of strangers	Yes=1
6. Infant likes regular caregiving routines	No=1

Note: Higher index scores imply less optimal functioning.