Maternal Sensitivity in Mother-Infant Interactions for Infants with and without Prenatal Alcohol Exposure

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Abstract

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Objective: To examine maternal sensitivity behaviors in mothers of infants ages 6-15 months with and without prenatal alcohol exposure (PAE) in response to a developmental social stress paradigm.

Background: Children with PAE are at high risk for negative mother-child interactions, which can affect the quality of maternal and child relationship and child social-emotional development. Maternal behavior characteristics such as being stable, predictable, and responsive are known to facilitate more positive and satisfying mother-child relationships and healthy child development. Understanding the quality of interactions between high-

risk dyads is important to investigate as a means to identify mothers and children who may need supportive early intervention services to enhance the parent-child relationship.

Participants: Nine infants with moderate-heavy PAE (age 10.7 ± 3.1 months, 77% female) and nine control infants (age 10.7 ± 2.9 months, 44% female) completed the study. All mothers in the study were biological caregivers. Mothers of infants with moderate to heavy PAE were recruited from local treatment centers, all were in recovery or receiving substance abuse treatment. Comparison group mothers were recruited by word of mouth. Both were convenience samples.

Setting: The study was conducted in a local children's hospital as part of a larger study.

Design: This was a descriptive 2 group comparison sub-study completed as part of an IRB approved pilot study exploring biobehavioral regulatory functions in infants with moderate to heavy PAE.

Measures: Video recorded maternal and infant behaviors were coded by a rater masked to group status using 1) the Infant and Caregiver Engagement Phases (ICEP) and 2) the Coding Interactive Behavior (CIB) during a play and reunion episode of the Still Face Paradigm, an established infant social stress protocol. Data analysis included estimated proportions of maternal engagement behaviors (positive, negative and neutral) as measured by the ICEP, a group comparison of maternal sensitivity behaviors as measured by the CIB using the Mann-Whitney U test, and a group comparison of estimated proportions of matched/mismatched maternal and child behaviors on the ICEP.

Results: Positive engagement behaviors and similar levels of matched/mismatched dyadic interactions were noted for both groups on the ICEP. The CIB revealed statistically significant group differences ($p < .05$) on six of nine behaviors measuring

maternal sensitivity. Together these findings suggest that the mothers of infants with PAE had strengths in engaging their children in positive ways, but they had some challenges or differences in the quality of their interactions with their child such as reading infant cues in a sensitive manner.

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0. Acronyms

ARBD = alcohol-related birth defects

ARND = alcohol-related neurodevelopmental disorders

CES-D = Center for Epidemiological Studies-Depression Screen

CIB = Coding Interactive Behavior

CNS = central nervous system

DLC = Difficult Life Circumstances

FAS = fetal alcohol syndrome

FASD = fetal alcohol spectrum disorders

F-BAS = Frequency-Binge Aggregate Score

HIPAA = Health Insurance Portability and Accountability Act

IBQ-R = Revised Infant Behavior Questionnaire

ICEP = Infant and Caregiver Engagement Phases

IRSS = Infant and Maternal Regulatory Scoring Systems

IOM = Institute of Medicine

IRB = Institutional Review Board

ITSC = Infant-Toddler Symptom Checklist

MRSS = Monadic Phases Scoring System

PAE = prenatal alcohol exposure

PSI = Parenting Stress Index

SAMHSA = Substance Abuse and Mental Health Services Administration

SFP = Still Face Paradigm

1. Introduction

1.1. Statement of the Problem

Alcohol is a neurobehavioral teratogen that affects the typical growth and development of fetuses. Prenatal alcohol exposure (PAE) is a significant risk factor that can have enduring negative outcomes for children, including physical anomalies, damage to the central nervous system, and behavioral and cognitive impairments (Olson, Jirikowic, Kartin, & Astley, 2007). These impairments may depend upon the volume of alcohol consumed which can range from light to heavy drinking; the timing during the pregnancy, such as first trimester only versus drinking throughout the pregnancy; and the patterns of drinking, which could be binge drinking or drinking the same amount each day. Typically, higher levels of alcohol consumed during pregnancy are associated with more significant and pervasive deficits in the child's neurodevelopmental system (Olson et al., 2007).

Mother-infant interaction may be influenced by multiple factors, including child factors such as polysubstance exposure, maternal factors such as maternal depression, and environmental factors such as poverty and low maternal education level (Bowlby, 2007; Coyl, Roggman, & Newland, 2002; Karen, 2008; Swanson, Beckwith, & Howard, 2000). From the maternal side, substance use and depression are factors that could make providing sensitive and responsive caregiving difficult for the mothers (Lemola, Stadlmayr, & Grob, 2009). Infants and young children who have PAE often present challenging behavioral characteristics such as negative affect (Brown, Olson, Croninger, 2010). When placed in high-risk environments, such as living with caregivers who are

dealing with substance abuse, these children are at risk for negative mother-child interactions.

Because children with PAE are at high risk for negative mother-child interactions, which can negatively affect development, it is important to pay attention to the social-emotional development of prenatally exposed infants and young children. One of the characteristics commonly found in young children affected by PAE is the presence of challenging regulatory behaviors including negative affect, fussiness, and irritability (O'Connor and Paley, 2006; Brown, Olson, Croninger, 2010). O'Connor (2001) found that infants with heavy PAE demonstrated more negative affect such as whining, shouting, crying, and gesturing than infants exposed to lower levels of alcohol. Brown et al. (2010) found that infants exposed to four or more drinks per week demonstrated sensory regulation challenges in the following areas: demanding attention, being difficult to raise, and quickly going "from a whimper to a cry" as measured by the Infant/Toddler Symptom Checklist (ITSC, DeGangi, Poisson, Sickel, & Wiener, 1995). Challenging regulatory behaviors such as the ones presented above could negatively affect mother-infant interactions and ultimately the mother-infant relationship, since irritability and negative affect are characteristics that could make providing sensitive and responsive caregiving difficult for mothers.

Maternal sensitivity is an important factor that influences mother-infant interactions. Maternal sensitivity is defined as the mother's ability to be aware of and interpret the infant's behavioral cues and respond to the infant in a timely and appropriate manner (Ainsworth, Blehar, Waters, & Wall, 1978). Maternal sensitivity to infant cues and behaviors plays a strong role in secure attachment. Secure attachment in infants is

presumed when the child happily seeks contact with the mother after separation, is easily comforted, and is able to resume playing after a stressful event (Ainsworth, Blehar, Waters, & Wall, 1978). Mothers who provide consistent, sensitive, and positive caregiving, especially prompt and comforting response to distress, tend to have securely attached children, while mothers who care for their children inconsistently, negatively, and insensitively tend to have insecurely attached children (Ainsworth, Bell, & Stayton, 1971). O'Connor et al. (2002) found children with sensitive mothers were better able to regulate their emotions and demonstrated more secure attachments. O'Conner et al. (2002) point out that infants with PAE have more negative affect and higher rates of insecure attachments, but they also found that despite PAE, mothers who were able to provide sensitive care were more likely to have secure infants.

Observing maternal sensitivity in mothers of infants with PAE is one way to better understand the risks, challenges, and strengths of these dyads. Therefore, examining maternal sensitivity in mother-infant dyads who are at risk for relationship challenges is an important step to identify risks as early as possible and to ultimately understand the intervention needs of this population. Increasing maternal sensitivity has the potential to reduce social emotional risks for disrupted caregiving experiences as well as later behavior and developmental challenges for children affected by PAE.

1.2. Purpose of the Study

While attachment behaviors have been examined in children with PAE, maternal sensitivity in biological mothers of infants with PAE has yet to be fully explored. Maternal sensitivity among mothers of children in the youngest age group is an area that deserves further attention because maternal sensitivity plays an important role in mother-

infant interactions, which in turn influence child development in the areas of social-emotional, receptive and expressive language, and cognition (Belsky & Fearon, 2002). Exploring how mothers respond to their infants under playful and stressful situations can shed light on whether mothers respond to their infants in a sensitive manner. Tronick, Als, Adamson, Wise, and Brazelton (1978) developed the Still Face Paradigm (SFP) in order to study this type of mother-infant interaction. The SFP is a standardized developmental paradigm used to study infant affect and stress regulation, and it involves a normal play interaction, a still-face episode, and a reunion episode, with each episode lasting 2 minutes.

The purpose of this study was to examine maternal sensitivity behaviors of two groups of mothers: one with 6-15 month old infants with moderate to heavy PAE and another with infants 6-15 months old with minimal to no PAE (the comparison group), in response to developmental social stress paradigm known as the Still Face Paradigm (Tronick et al., 1978).

2. Literature Review

The review of the relevant literature is presented in the following order. First, the prevalence of prenatal alcohol use among women in the United States will be reviewed. Then, the effects of PAE on infants, followed by the biological and environmental factors that influence the mother-infant relationship will be described. In addition, common parenting practices among mothers of children PAE will be presented. Finally, the importance of maternal sensitivity in the mother-infant relationship will be reviewed.

2.1. Prevalence of Substance Use Amongst Women of Childbearing Age

Substance abuse remains problematic among woman of childbearing age in the United States. The Substance Abuse and Mental Health Services Administration (SAMHSA) interviewed pregnant woman ranging in age from 15 to 44 years old and assessed their level of alcohol use. Of the pregnant women interviewed, 10.8% reported currently using alcohol and 3.7% reported binge drinking. Binge drinking, which is defined as consuming large quantities of alcohol at one point in time, is associated with the greatest amount of harm to the developing fetus (Olson, Jirikowic, Kartin, & Astley, 2007). Of the women who reported binge drinking, 10.1% reported doing so during the first three months of pregnancy. However, drinking at any point during pregnancy places the fetus at risk for birth defects and neurodevelopmental disabilities as well as fetal alcohol spectrum disorders (FASD; U.S. Surgeon General's Advisory on Drinking and Pregnancy, 2005). Women who drink alcohol during their pregnancy often use a variety of other drugs in addition to alcohol. SAMHSA's 2010 survey found that 4.4% used illegal drugs such as cocaine, heroin, marijuana, and hallucinogens, while one in every six reported having smoked cigarettes while pregnant (Substance Abuse and Mental Health Services Administration, 2011). This indicates that many women who use alcohol heavily during pregnancy may also use other substances, which pose cumulative risks for infants and young children.

2.1.1. Infants and children with prenatal alcohol exposure. Alcohol disturbs the typical growth and development of fetuses. Prenatal exposure to alcohol can have a wide range of effects on the baby such as facial anomalies, damage to the central nervous system, and behavioral and cognitive impairments. These effects might depend upon the volume consumed (light versus heavy drinking), timing during the pregnancy (first

trimester only versus throughout the pregnancy), and patterns (binge drinking versus the same amount each day). Typically, higher levels of alcohol consumed during pregnancy correspond with more significant and pervasive deficits in the child's neurodevelopmental system (Stratton, Howe, & Battaglia, 1996).

2.1.1.a Definitions of fetal alcohol spectrum disorders. There are several diagnostic categories for children affected by PAE and each depends on the degree of damage to the child. Fetal alcohol spectrum disorders (FASD) is a term used to describe the substantial neurodevelopmental disabilities children experience as a result of exposure to alcohol in utero (Centers for Disease Control and Prevention, 2012). There are three diagnoses that fall under the umbrella term of FASD: Fetal alcohol syndrome (FAS), alcohol-related neurodevelopmental disorders (ARND), and alcohol-related birth defects (ARBD) (Stratton et al., 1996).

Fetal alcohol syndrome (FAS) is a lifelong birth defect caused by heavy amounts of alcohol consumed by a woman during pregnancy. Children diagnosed with FAS have distinctive facial features, neurological challenges, evidence of delayed growth, and are typically born to mothers who drank heavily during their pregnancy. To receive a diagnosis of FAS children must meet the following criteria: (1) evidence of a characteristic pattern of facial irregularities (e.g. short palpebral fissures, smooth philtrum, thin upper lip), (2) evidence of poor growth before and/or after birth, (3) evidence of abnormal and/or deficient brain growth (e.g. small head circumference, abnormal development of brain structures), and/or (4) confirmation of exposure to alcohol (Astley, 2004). Alcohol-related neurodevelopment disorder (ARND) describes children with evident damage to their central nervous system, which could include

evidence of abnormal brain growth and/or cognitive and behavioral delays. Children with ARND experience significant deficits in the areas of behavior and learning. Alcohol-related birth defects (ARBD) is a term that refers primarily to physical anomalies.

2.1.1.b. Incidence of fetal alcohol spectrum disorders. In 1996, the Institute of Medicine (IOM) stated the incidence of infants born in the United States with FAS to be 0.5 to 3 cases for every 1000 births (Stratton et al., 1996). A recent estimate of the incidence of FAS showed even higher numbers than the IOM, with 2 to 7 cases for every 1,000 births in the United States (May et al., 2009). The number of children with FAS is relatively low when compared to the number of children who were exposed to alcohol in utero without a diagnosis of FAS. In the United States and in parts of Western Europe, 2-5% of school-aged children are estimated to have FASD (May et al., 2009). Consequently, FASD represents a significant neurodevelopmental problem here in the United States (O'Connor, Kogan, & Findlay, 2002).

Infants and young children with PAE are at increased risk for substantial neurodevelopmental disabilities early on in life (Olson & Montague, 2011). Regulatory problems such as irritability and fussiness are a particular area of concern among infants and young children. Regulatory problems can strain the parent-child relationship, placing these children at high risk for poor mother-infant interactions. In combination with high risk environmental and caregiving characteristics, such as maternal substance use and depression, regulatory problems places children with PAE at even greater risk for relationship challenges.

2.2. Dyadic Interactions of Mothers of Infants with Prenatal Exposure

Parenting practices, such as playful, attentive, negative, harsh, intrusive, and unpredictable behaviors influence the interactions between mothers and infants. Caregivers differ in their parenting practices; some practices are more beneficial to the social-emotional development of children than others, and some can have long-term adverse consequences. Below is a review of the research related to parenting practices among children with prenatal substance exposure and caregivers.

2.2.1. Playful and attentive. Lowe, Handmaker, and Aragon (2006) looked at the play interactions of 76 mothers and their 6-month old infants with PAE before and after a stressful event - the Still Face Paradigm (Tronick, Als, Adamson, Wise, & Brazelton, 1978). Interactions were observed in the home for 67% of participants and in a clinic setting for the other 33%. Mothers demonstrated a variety of interaction styles. Some were very active and engaged the infant in play activities, while others were passive. Mothers who, prior to the stressor, displayed more playful styles of interaction with their infants (such as peek-a-boo) had infants who demonstrated more positive affect. In contrast, infants demonstrated higher levels of negative affect when mothers paid little attention to them. Additionally, mothers who were able to read infant cues of engagement and disengagement correctly had higher levels of positive responses from the infant. These findings suggest that infant affect is better regulated when mothers use playful interaction styles in combination with correctly reading infant cues (Lowe et al., 2006). More research is needed on this topic since playful and attentive styles of parenting might help promote positive interactions between mothers and infants with PAE, which in turn might facilitate healthy social and emotional development in the infants.

2.2.2. Negative and harsh discipline. Negative and harsh discipline can be a risk factor that negatively influences mother-child interactions for children exposed to alcohol prenatally, as observed by Eiden et al. (1999), who examined the quality of caregiving among infants and young children with prenatal polysubstance exposure. The 94 children in this study ranged in age from 2-69-months old. As in previous studies with polysubstance users, the mothers in both the cocaine and non-cocaine groups used alcohol during pregnancy. Differences in parenting styles were found between the two groups, with mothers who used cocaine and other substances during pregnancy being more likely to use negative discipline strategies. For example, mothers in the substance group were more likely to discipline their children by shouting and/or ignoring than the non-cocaine exposed group. These negative discipline strategies can lead to later behavior problems in children, which is of concern in this group (Eiden et al., 1999).

Bennett et al. (2002) examined 223 mothers and their 4-year old children with polysubstance exposure. Although cocaine was the primary drug used prenatally, prenatal alcohol use was reported by 61 of cocaine users and 21 of the non-cocaine users. Mothers were asked about the frequency of specific physical and psychological disciplinary techniques. Examples of physical discipline included spanking, hitting, and smacking, while psychological discipline included shouting, threatening, and cursing. Bennett et al. (2002) found an association between harsh parent discipline and externalizing behaviors in children, with more harsh discipline associated with internalizing behaviors. Based on this study, it appears that specific practices of parents, such as harsh parenting, can negatively influence the parent-child relationship.

2.2.3. Unpredictable parenting. Unpredictability can be a risk factor that negatively influences parent-infant interactions for children exposed to alcohol prenatally, as shown by Platzman et al. (2001), who interviewed 132 parents of infants with and without prenatal polysubstance exposure at 6, 12, and 24-months of age. They examined important aspects of caregiving that support the social and emotional development in infants and young children. Parents in the polysubstance exposure group scored higher, indicating more environmental problems, for caregiving instability. This reflects unpredictably in the parenting received by the children. Infants with prenatal exposure experienced more unpredictable caregiving when compared to infants without PAE.

2.3. Biological Factors that Influence Maternal Sensitivity

Substance use and depression are factors that could make providing sensitive and responsive caregiving difficult for the mothers. Infants and young children who have PAE often present with challenging behavioral characteristics such as negative affect. Central nervous system (CNS) damage is a common sequelae resultant of alcohol exposure and frequently results in lifelong developmental challenges. Exposing a child to alcohol prenatally can cause biological vulnerabilities (Olson et al., 2007) by affecting brain development, which can result in "fussier" babies, which in turn, can negatively influence mother-infant interactions. Children with PAE often have sensory processing and neurological challenges, which can influence their affect resulting in more negative behaviors such as whining, frowning, pouting, and crying (Wengel, Hanlon-Dearman, & Fjelsted, 2011; O'Connor et al., 2002). These biological vulnerabilities in combination

with insensitive caregiving can increase the risk for more problems later in the child's life.

2.3.1. Child polysubstance exposure. In addition to the biological risk factor of PAE, children with PAE have often been exposed prenatally to other substances (e.g., cocaine, tobacco, marijuana) (Bergin & McCollough, 2009). Eiden (2001) examined the interactions between mothers and 2-month old infants with prenatal polysubstance exposure. Forty-five mothers and infants participated in the study. The dyads were split into two groups, infants with and without prenatal exposure to cocaine. Mothers in the cocaine group reported much higher rates of alcohol use (68%) during pregnancy than the non-cocaine group (27%) (Eiden, 2001). Challenging temperamental characteristics, such as distress in novel situations and higher negative affect, were reported more frequently in the cocaine exposed infant group. Also, higher levels of conflict were found between mothers and infants in the cocaine-exposed group. The results of this study suggest that the use of substances during pregnancy places the mother-infant relationship at risk for negative interactions

2.3.2. Maternal factors. Researchers have studied maternal factors that influence mother-infant interactions, including mental health status, depression, age, education level, socioeconomic status, and relationship status. Lemola et al. (2009) found that infant irritability was related to several factors including prenatal alcohol use and depressive symptoms of the mother. Infants with mothers who drank during pregnancy and demonstrated depressive symptoms after birth were more likely to be irritable at 5 months of age. Mental health impairments, such as maternal depression, place the infant and mother at risk for negative interactions because there are several characteristics of

mothers with depression that can negatively influence the parent-child relationship, including intrusiveness, unpredictability, and neglectful caregiving (Goodman & Brand, 2009). Additionally, infants of mothers with depression are at risk for developmental challenges (Goodman & Brand, 2009). For example, depressive symptoms in mothers was related to emotional and behavior problems in children with prenatal polysubstance exposure (Bennett, Bendersky, & Lewis, 2002).

May et al. (2009) identified a wide array of maternal risk factors for children with PAE. When compared to the control group, mothers of children with PAE were older and had lower levels of education. Mothers who drank alcohol during pregnancy were also more likely to live in lower socioeconomic status areas and were more likely to be single. These risk factors may make the mother less available, attentive, and able to read and respond to the infant's cues. Maternal characteristics such as being stable, predictable, warm, nurturing, and responsive are known to facilitate healthy development in children and may serve to buffer biological and environmental risks (Shonkoff & Phillips, 2000).

2.4. Factors Affecting the Infants Contribution to Dyadic Interaction

Children with PAE frequently spend several of their crucial, early years growing up in high-risk environments (Olson et al., 2007; Streissguth, Bookstein, Barr, Sampson, O'Malley, & Young, 2004). Therefore it is important to understand these factors when studying dyads because they directly influence maternal sensitivity and parenting practices, which in turn may influence the quality of mother-child interactions.

The environment may be filled with both risk factors and protective factors that affect mother-infant interactions. The relationships children have with their parents can

provide a buffer from, or worsen the effects of the risk factors (Zeanah & Zeanah, 2009). Families with more risk factors than protective factors might have a more challenging time establishing positive mother-child interactions and could be at greater risk for negative mother-child interactions. There are many environmental risk factors that influence maternal sensitivity and impact the mother-child relationship including multiple foster care placements, receiving a late diagnosis of PAE, and maternal stress levels.

2.4.1. Environmental risk factors.

2.4.1.a. Multiple home placements. Children with PAE are at high risk for out of home placements. A high percentage of children with PAE are removed from the care of their biological mother and placed with a family member or into the foster care system (Astley, Stachowiak, Clarren, & Clausen, 2002). Platzman et al. (2001) examined infants with and without PAE at 6, 12, and 24 months of age. They found that infants with PAE were not living with a biological parent more often than infants in the control group. At 24 months old, 9% of infants in the control group were living without a biological parent compared to 49% of children in the polysubstance exposed group. The environment of the foster home also plays a significant role in influencing the social-emotional development of infants, either positively or negatively (Cole, 2005).

2.4.2. Environmental protective factors. There are environmental protective factors that affect the parent-child relationship including time spent in a stable home, availability of age-appropriate toys, and amount of maternal emotional support. Details of which are presented below.

2.4.2.a. Time spent in a stable home. Streissguth et al. (2004) examined detailed records of 415 persons with PAE. Their age ranged from 6 to 51 years old and there

were 162 children in the age category of 6-11.9 years old. A strong protective factor against adverse outcomes related to PAE was the length of time spent in a stable and nurturing home. Families where children received a diagnosis of FAS early while also living the majority of their lives in stable, nurturing home were better able to plan successfully for the move from adolescence to adulthood and maintain appropriately close connections with their children in early adulthood. This substantiates the need for early intervention services for families of infants with PAE, which in turn may also support parent-child relationships.

2.4.2.b. Age-appropriate toys. Cole (2005) identified factors that promote positive parent-child interactions between foster parents and infants using the Home Observation for Measurement of the Environment (HOME) instrument (Caldwell & Bradley, 1984). Protective factors included age-appropriate and stimulating toys for the children, as well as a structured home environment. When parents provide their children with age-appropriate stimuli, they demonstrate an appropriate understanding of the developmental stage of the child. Children, who feel understood by their parents, are more apt to explore their surrounding environments, and exploration of that environment facilitates the child's social and emotional development.

2.4.2.c. Emotional support. Emotional support from husbands appears to be a statistically significant protective factor against negative mother-infant interactions. Lemola et al. (2009) interviewed 374 mothers of five-month-old infants. Infants were found to be more irritable when mothers received less support from their partners ($p < .01$), and mothers with less supportive husbands were more likely to have depressive symptoms ($p < .01$). Infants with fathers who emotionally supported their wives

demonstrated reduced levels of irritability (Lemola et al., 2009). Researchers have found that parents and children who live in environments that have more protective factors than risk factors for negative interactions are in a better position to focus on their relationship (Knitzer & Perry 2009), which is essential for healthy infant development.

2.5. The Importance of Maternal Sensitivity

Maternal sensitivity is defined as the mother's ability to be aware of and interpret the infant's behavioral cues and respond to the infant in a timely and appropriate manner (Ainsworth et al., 1978). The quality of maternal sensitivity between a mother and child is of utmost importance because maternal sensitivity is critical to the social and emotional development of infants and young children. There are many factors that influence the mother-child relationship, including biological and environmental factors as well as their combination. According to Belsky and Fearon (2002) the quality of interaction between a mother and her infant has a profound impact on the child's language, cognition, and social-emotional development. Negative maternal-child interactions have the potential to adversely impact the social and emotional development of infants and toddlers. Infants and young children who have PAE often present challenging behavioral characteristics such as negative affect. Challenging regulatory behaviors, such as negative affect, could negatively affect mother-infant interactions and ultimately the mother-infant relationship, because irritability and negative affect are characteristics that could make providing sensitive and responsive caregiving difficult. It is important to look at the role of maternal sensitivity in the interactions of mothers and prenatally exposed infants and children because children with PAE are at risk for negative mother-infant interactions.

2.5.1. The role of maternal sensitivity in mother-infant interactions. Maternal sensitivity can influence the quality of mother-infant interactions for children with PAE. Maternal sensitivity can be characterized by one of the following behaviors: sensitive and responsive, or insensitive and disinterested.

2.5.1.a. Sensitive and responsive behavior. O'Conner et al. (2002) found a relationship between child temperament and the supportive presence of the mother. Children with mothers who provided sensitive and responsive care demonstrated better coping mechanisms for handling stress. Children with better coping strategies were also more likely to have more positive mother-infant interactions. Based on the results of the study, mothers that provided emotional support to their children had more positive mother-infant interactions, despite PAE.

2.5.1.b. Insensitive and disinterested. On the other hand, when mothers provided less sensitive care, children with alcohol exposure were more likely to develop ineffective coping strategies and experience negative mother-infant interactions. Biological and environmental risk factors, such as poverty, mental health problems, low levels of education, and mother-only households, often are present in the lives of mothers who use drugs and alcohol. Because of these risk factors, mothers who use substances may have more difficulty providing their children with high quality caregiving. Bergin and McCullough (2009) looked at the interactions between mothers and infants with prenatal substance exposure. There were 35 mother-child dyads in each the drug-using and drug-free comparison groups. All infants were 12 months of age. In the drug-using group, the predominant drugs used by the mother included cocaine, marijuana, tobacco, and alcohol. Mothers were primarily single (92%), living in poverty (93%), and African

American (86%). Dyads were observed for a two-hour feeding and play-based assessments. Maternal involvement and sensitivity were examined when determining the quality of caregiving. In this study, a positive relationship between sensitive maternal behaviors and positive mother-infant interactions was found. Most of the mothers in the drug-using group demonstrated insensitive and disinterested behaviors. Insensitive maternal behaviors included regularly ignoring clear cues such as distress and anger from the infant. Some mothers demonstrated disinterested behaviors such as physically turning away from the hysterically crying infant. Other mothers required verbal reminders from the research staff to feed their distraught infant. Some of the same insensitive caregiving behaviors were observed in the mothers in the non-drug using group. For both groups, mothers who demonstrated more sensitive and involved caregiving had infants who were more securely attached. Sensitive caregiving behaviors included responding promptly to the child's cues of distress and having warm and comforting interactions. The authors concluded that maternal sensitivity and involvement were better predictors of positive mother-infant interactions than prenatal exposure to substances (Bergin & McCollough, 2009).

2.5.2. Dyadic matching behavior. Another way of measuring maternal sensitivity is the use of dyadic matching behaviors. Dyadic matching is defined as a state shared by both mother and infant at the same point in time. For example, a dyadic match would be the mother in a positive state and the infant in a positive state. A dyadic mismatch is defined as a non-shared state by both mother and infant at the same point in time. For example, a mismatch would be the mother in a neutral state and the baby in a positive state (Tronick et al., 2005). Tronick & Gianino (1986) found frequent

mismatches among mother-infant dyads. They also discovered that infants who experienced mismatches less than 50% of the time learned more effective coping strategies for repairing mismatches while infants who experienced mismatches more than 50% of the time used fewer coping strategies.

2.6. Social-Emotional Development of Prenatally Exposed Infants & Children

Children who have been exposed to alcohol in utero have social-emotional challenges in addition to neurobehavioral problems, including externalizing behaviors such as hyperactivity and internalizing behaviors such as depression. O'Connor & Paley's (2006) study showed that young children with PAE have social-emotional challenges and these problems are evident in school-aged children too. The challenges faced by infants and young children with PAE do not go away and can get worse over time (Olsen et al., 2007). Researchers have found that negative mother-infant interactions in infancy are directly related to competency in the areas of social and emotional development later in life (Ward, Lee, & Lipper, 2000), therefore these early interactions are important to study among high-risk dyads.

2.6.1. Prenatal alcohol exposure and parenting. In this section, the influence of PAE, parenting practices, and maternal sensitivity on mother-infant interactions will be discussed. In this section, the terms "parent", "mother", and "caregiver" will be used interchangeably, and will refer to the adult primarily responsible for the child's care.

2.6.1.a. Foster parents. Multiple placements in foster care are a risk factor for negative parent-child interactions in young children and children with PAE who are frequently placed in foster care. Children with PAE are more likely to live without a biological parent during the first few years of life than children without prenatal

substance exposure (Platzman et al., 2001). There are significant associations between the mother's prenatal alcohol consumption, her rate of binge drinking during pregnancy, and the length of time her child spent in foster care (Eiden, Peterson, & Coleman, 1999). Infants and young children with PAE in foster care can experience multiple home placements, an additional risk for negative mother-infant interactions. Therefore, it is important to consider the experiences of foster families with raising children exposed to alcohol prenatally.

2.6.1.b. Adoptive parents. The quality of parent-child interactions is a concern for adoptive parents of children with PAE. McCarty et al. (1999) interviewed 20 adoptive parents and used the Parenting Stress Index (PSI) (Abidin, 1995) to detect if any parent-child systems were at risk. The children ranged in age from 1 to 6 years old. According to the interviews, adoptive parents reported behavioral and interaction challenges, with 36% of parents having higher scores on the stress scale (higher values on the PSI mean more stress in the parent-child relationship). Parents also mentioned being concerned for their child's emotional health and well-being. Behavioral concerns included struggling with the child over eating food, the child "melting down," complaining, and having difficulty with transitioning. Parents experienced stress due to their child's behavior, with 48% scoring in the clinical range on the PSI (McCarty et al., 1999). Characteristics of children with PAE such as negative affect and demanding/dependent behaviors are examples of behaviors that could make providing sensitive and responsive caregiving difficult for adoptive parents, thus increasing the likelihood of negative mother-infant interactions.

2.6.1.c. Biological parents. Children with PAE living with their biological parents are at high risk for negative mother-infant interactions. O'Connor, Sigman, and Brill (1987) found that among 46 dyads, the majority of 12-month old infants with heavy amounts of PAE and who lived with their biological parents demonstrated negative mother-infant interactions. Most of the 46 women were Caucasian (92%), college graduates (72%), middle income (100%), and married (98%). Mothers were divided into 3 groups depending upon the amount of alcohol consumed during pregnancy each day: abstinent-light (≤0.10 ounces), light-moderate (0.11-0.99 ounces), and moderate-heavy (>1.0 ounces). Mothers who drank less or were abstinent during their pregnancy had higher rates of positive mother-infant interactions than mothers who drank more during their pregnancy. The percentage of negative mother-infant interactions grew with increasing amounts of PAE: abstinent-light group (22%), light-moderate (48%), and moderate-heavy (83%).

O'Connor et al. (2002) examined the relationship between PAE and mother-child interactions among young children living with their biological mothers. The sample group consisted of 42 high-risk mother-child dyads with children between 4-5 years of age. The group was split into two subgroups depending on the amount of alcohol consumed during pregnancy. Per drinking occasion, the abstinent-light group reported consuming one or less drinks whereas the moderate-heavy group reported consuming two or more drinks. On average, mothers consumed 4.5 drinks. The quality of mother-child interactions varied depending on the amount of PAE. In the moderate-heavy group, 80% percent of the children had higher levels of negative mother-child interactions. For the children in the abstinent-light group, 36% had higher levels of negative mother-child

interactions. This older group of children (4-5 years old) differed from the infants in the previous research (O'Connor et al., 1987) in that they lived in high-risk environments and their mothers drank more during pregnancy. Environmental risk factors for negative mother-child interactions for this older group included living in a single parent home (86%) and low socioeconomic status (65%). Further, children with PAE demonstrated higher levels of negative mother-child interactions (80%), which were higher than other studies of mother-child interactions with children living in poverty (59%), children born prematurely (41%), and children with mothers with depression (59%) (Van Ijzendoorn, Schuengel, & Bakersmans-Kraneburg, 1999). Based on these findings, children with PAE are at risk for negative mother-child interactions, and the risk is even greater when children with PAE are living in high-risk environments.

2.7. Contributions of Mothers and Infants with PAE to Mother-Infant Interactions

Mothers who use substances often have difficulty noticing, interpreting, and responding sensitivity to their infant's cues (Eiden, 2001). Both, mothers who use substances and infants with PAE, have risk factors that can impact their interactions. Infants with heavy PAE have sensory processing and neurological challenges that can influence their affect, resulting in a "fussier" demeanor (O'Connor et al., 2002), placing mothers and infants at risk for more negative interactions. Low-quality mother-infant interactions are also thought to negatively influence infant development (Eiden, 2001). It is probable that these negative interactions will impact attachment and the mother-child relationship later on in the child's life. Therefore, offering early intervention services to mothers of infants and young children exposed to alcohol in utero could promote the mother-infant relationship by improving maternal sensitivity and caregiving practices.

3. Aims and Hypotheses

While research on mother-child interactions has been done with various populations of children with polysubstance and prenatal exposure, specific research on mother-infant interactions in infants with moderate to heavy PAE has yet to be studied in greater depth. Examining maternal sensitivity in mother-infant dyads who are at risk for relationship challenges is an important step towards identifying risks as early as possible and to understanding the intervention needs in this population. The goals of this study were:

Aim 1: To compare biological mother-child dyads of 6-15 month old infants with moderate to heavy PAE to biological mother-child dyads with minimal to no PAE on indicators of maternal sensitivity, as measured by the type and frequency of observable affective behaviors. Behaviors were measured using the Infant and Caregiver Engagement Phases (ICEP) and Coding Interactive Behavior (CIB) instruments, during the play and reunion phases of a standardized infant stressor, the Still Face Paradigm (SFP).

Hypothesis 1.1: Mothers of infants with moderate-to-heavy PAE will show lesser frequency of positive engagement behaviors on the ICEP (such as less social monitoring and less social positive engagement) during the play and reunion phases of a social stressor (SFP) when compared to mothers of infants with minimal to no exposure.

Hypothesis 1.2: Mothers of infants with moderate-to-heavy PAE will show lesser intensity of maternal sensitivity behaviors on the CIB (such as less positive affect and less acknowledging) during the play and reunion phases of a social stressor (SFP) when compared to mothers of infants with minimal to no exposure.

Aim 2: To compare biological mother-child dyads of 6-15 month old infants with moderate-to-heavy PAE to biological mother-child dyads with minimal to no PAE on mother-child affective matching before and after a social stressor as established by the number of dyadic matches versus mismatches using the ICEP.

Hypothesis 2: Mother-infant dyads where the infant was exposed to moderate-to-heavy PAE will show higher overall levels of mismatched engagement states in both SFP episodes when compared to dyads where the infant had minimal to no exposure.

4. Methods

4.1. Study Description

4.1.1. Study design. This study was part of a larger study that compared biobehavioral regulatory functions of nine 6-15 month-old infants with PAE to nine 6-15 month-old infants with minimal to no PAE. In the primary study, biological mothers were observed interacting with their children in a developmental social stress paradigm, the Still Face Paradigm (SFP), which is described below. This study examined the data collected regarding maternal affective behaviors with the infants before and after the

SFP. Child data from the primary study has already been analyzed and is being prepared for publication (Jirikowic, Chen, Gendler, Nash, and Carmichael Olson, 2012). Analysis of the maternal behaviors and examination of the dyadic matching of maternal-child behaviors was the focus of the present study.

4.1.2. Study sample. Participants were recruited and enrolled in accordance with the Institutional Review Board (IRB) guidelines approved by Seattle Children's Research Institute, with confidentiality safeguarded by following the Health Insurance Portability and Accountability Act (HIPAA) and IRB guidelines.

Infants with PAE were recruited through local substance abuse treatment centers using established and sensitive recruitment strategies. Clients from treatments centers who met inclusion criteria were first identified by the center staff, and were given a study brochure. If verbal permission was granted, the mother was contacted by the study recruiter. Inclusion criteria for infants with PAE included: 1) male or female; 2) all races/ethnic backgrounds; 3) age 6-15 months at the time of enrollment in the study; and 4) moderate-to-heavy PAE, as determined by addiction severity and gestational alcohol use. The Frequency-Binge Aggregate Score (F-BAS; Barr & Streissguth, 2001) was used to identify mothers at risk for having alcohol-affected children. Occasional history of other drug use during pregnancy was allowed, but meeting F-BAS criteria was required, and alcohol had to be the primary substance abused prior to and during pregnancy. Participating women also had to self-report being in treatment or recovery at the time of enrollment. Exclusion criteria for children with PAE included infants with significant disruptions in the primary caregiving relationship (i.e., more than 2 different home placements or living with current caregiver for less than 50% of chronological age).

Participants in the comparison group with minimal to no PAE were recruited through word of mouth. Caregivers of age-eligible children were provided with a study brochure at the infant well-child visits along with study contact information. Responders were screened by phone by the study recruiter using inclusion/exclusion criteria and a brief set of questions about alcohol use during pregnancy.

Exclusion criteria for both groups included premature birth (<37 weeks gestation), any congenital abnormalities or any acute or chronic medical conditions affecting the cardiac, respiratory, or neuromuscular systems at the time of enrollment in the study. To account for the higher probability of cumulative developmental risks in the group of children with PAE, multiple indicators of postnatal environmental risk were assessed. Maternal depressive symptoms were screened using the Center for Epidemiological Studies-Depression Screen (CES-D; Radloff, 1977). The frequency and type of social problems and difficult life events such as substance abuse and unemployment was assessed with the Difficult Life Circumstances (DLC) questionnaire (Barnard, 1994) for descriptive purposes. All mothers enrolled in the study were the infants' biological mothers.

4.1.3. Procedure. Informed consent was obtained prior to beginning study procedures. The study was conducted at Seattle Children's/Pediatric Clinic Research Center (PCRC) following an overnight sleep study with the mother-infant dyad. As part of the larger study, all infants had electrodes attached to their heads and chest to monitor autonomic activity. The mother-infant interaction sub-study added approximately one hour in the morning to the PCRC overnight visit. After the child awoke and had time to eat and settle with the caregiver, the Still Face Paradigm (SFP; Tronick et al., 1978) was

presented as the social stressor. The SFP is a standardized developmental paradigm used to study infant affect and stress regulation, and it involves a normal play interaction episode, a still-face episode, and a reunion episode, with each episode lasting 2 minutes. A research assistant conducted the SFP using standardized procedures (Tronick et al., 1978). For the SFP, the caregiver was instructed to play with her child. During the still-face episode the mother was instructed to maintain a neutral facial expression, remain still, and look slightly above the infant's head to avoid eye contact. During the final reunion episode the mother resumed a normal play interaction. To assure procedural fidelity, the primary investigator randomly observed the SFP administration on four (25%) dyads. The SFP procedure has been used extensively in infant and toddler research and with alcohol-exposed parent-infant dyads (Haley, Handmaker, & Lowe, 2006). The SFP has been used with infants and with toddlers and although the SFP has been more frequently used with younger children (e.g., 6-9 month old children) (Weinberg, Tronick, Cohn, & Olson, 1999), for consistency, it was used with all children in this study, which included a few 10-15 month old children.

4.1.4. Instrumentation: Measures of interactive behavior and maternal sensitivity. In this study, infant and mother affective responses were recorded during the SFP using split screen video-recording equipment. With the software selected for this study, maternal behaviors were coded in discrete, one-second intervals. Video recordings were stopped in one-second intervals allowing coders to make a judgment and assign a code. The video recording of the mother-infant interaction was coded using two instruments: the Infant and Caregiver Engagement Phases (ICEP; Weinberg & Tronick,

1999) and the Coding Interactive Behavior (CIB; Feldman, 1998), both of which are described below.

4.1.4.a. Infant and caregiver engagement phases. The Infant and Caregiver Engagement Phases (ICEP; Weinberg & Tronick, 1999) is a microanalytic coding scheme where the coder observes each clip of the recorded interaction (at a sampling rate of one code per second) and classifies the behavior of mother and infant in that frame. For the infant, the coded categories were: 1) negative engagement, 2) protest, 3) withdrawn, 4) object/environment engagement, 5) social monitor, 6) social positive engagement, 7) sleep and 8) unscorable. For the mother, the categories were: 1) negative engagement, 2) hostile/intrusive, 3) withdrawn, 4) non-infant focused engagement, 5) social monitor/no vocalizations or neutral vocalizations, 6) social monitor/positive vocalizations, 7) social positive engagement, 8) exaggerated positive engagement, and 9) unscorable.

The ICEP is a well-established scoring system used to code mother and infant interactions. Tronick and Weinberg (1999) developed the ICEP based on Tronick and Weinberg's Infant and Maternal Regulatory Scoring Systems (IRSS) and Tronick's Monadic Phases Scoring System (MRSS). Weinberg et al. (1999) determined the reliability of ICEP codes using percent agreement. Proximity codes ranged from 76%-94%, gaze codes ranged from 89%-98%, vocalization codes ranged from 79%-96%, touch codes ranged from 80%-100%, and elicits codes ranged from 77%-93%. Kappa values were 0.79 for gaze and 0.85 for proximity (Weinberg et al., 1999).

As part of the main study, an examiner masked to group status coded infant behaviors by using the ICEP. Using the same ICEP scoring system, maternal behaviors

were coded by the primary investigator, who was also masked to group status. Prior to coding, a computerized software program (Mangold Interact®) available through the Behavior Observation Laboratory and Coding Facility at the University of Washington Center for Human Development and Disability (CHDD), was used to create an interface between the DVD recordings and the computer-based real-time scoring. Behaviors were coded in one-second intervals within each SFP episode. Positive, negative, and neutral behaviors were coded using the ICEP coding categories. Negative codes included negative engagement, hostile/intrusive, and withdrawn. Non-infant focused engagement was the neutral code and positive codes included social monitor/no vocalizations or neutral vocalizations, social monitor/positive vocalizations, social positive engagement, and exaggerated positive engagement. The coding category of social positive engagement was used if the mother expressed positive affect such as full smiles (closed or open), laughter, or play faces. The coding category of exaggerated positive engagement was used if the mother expressed behaviors such as exaggerated play, surprise, mock and coo faces. If the mother's face was obscured due to poor camera angles or technical problems, the coding category of unscorable was used (Weinberg & Tronick, 1999).

Outcome data from the ICEP is the percent of all seconds where mother (or child) displayed a certain behavior in one of the categories described above. The ICEP categories were used to address Hypothesis 1.1 from Aim 1, for both play and reunion episodes.

4.1.4.b. Coding Interactive Behavior. Although the ICEP has a variety of coding categories for engagement behaviors in mothers, it does not focus on maternal sensitivity

or the mother's ability to monitor and respond to the child. Maternal behaviors that indicate sensitivity include responsiveness, positivity, affection, encouragement, support, and warmth. The Coding Interactive Behavior (CIB; Feldman, 1998) protocol is a system for coding parent-infant interactions using a set of observable behaviors. It is a well-established tool that has been validated across a wide range of ages, cultures, with low-risk and high-risk dyads (Feldman, 2010; Feldman, Eidelman, & Rotenberg, 2004; Feldman & Klein, 2003; Feldman & Masalha, 2010). The CIB has also demonstrated sensitivity to differences in parent-child interactions related to the family's culture, sex of the parent, social-emotional risk factors as well as biological risk factors (Feldman, 2000; Feldman, Eidelman, Sirota, & Weller, 2002; Feldman, Masalha, & Nadam, 2001; Keren, Feldman, & Tyano, 2001). The CIB codes 43 behaviors using a 5-point scale with 1 indicating a minimal level and 5 indicating a maximal level of the specified behavior. Twenty-two of the 43 coded behaviors pertain to the parent. The CIB is designed to code interactions with children ranging from 2-months old through 36-months of age. Since the CIB does not require a specific type of task, has specific codes designed to measure sensitive caregiving, and the children in this study where within the age range covered by the CIB, we used the parent codes from this tool to asses maternal sensitivity.

For this study, the focus of the CIB coding system was on the effectiveness of the mother to monitor and respond to her infant. The specific codes used from the CIB to measure maternal sensitivity included: 1) Acknowledging, 2) Parent Gaze/Joint Attention, 3) Positive Affect, 4) Vocal Appropriateness, Clarity, 5) Appropriate Range of Affect, 6) Consistency of Style, 7) Resourcefulness, 8) Parent Supportive Presence, and

9) Adaptation-Regulation (Feldman, Weller, Sirota, & Eidelman, 2003; Feldman & Eidelman, 2009).

The outcome for the CIB is a score between the values of 1 and 5 for each category described above. The CIB average scores were used to address Hypothesis 1.2 from Aim 1 for both play and reunion phases.

4.1.4.c. Coding and interrater reliability. The principal investigator of this study trained a research assistant and established interrater reliability using percent agreement (>88%) for the ICEP maternal behavioral coding. Training took six hours and included reviewing the ICEP manual, discussing each code in detail, coding two practice tapes, and comparing codes for practice tapes. For each tape, the principal investigator and research assistant had two scoring sheets, one scoring sheet for the play episode and one scoring sheet for the reunion episode (see Appendix C for ICEP Score Sheet). Each cell on the coding sheet denotes one second and the raters would write one of the nine possible ICEP codes in each cell for both the play and reunion episodes. Each episode lasted a total of 120 seconds.

Interrater reliability was checked by the primary investigator on four randomly selected tapes (25% of the sample, two from each group) during the early to mid stage of coding. Reliability was calculated using the number of agreements within the episodes and dividing that figure by the sum of total observations (Weinberg & Tronick, 1996). Interrater agreement for the four tapes was 88%, 90%, 91%, and 92%. To account for the variability and random chance of agreement, Cohen's kappa was used and the values were 0.46, 0.47, 0.52, and 0.72. According to the classification by Fayers and Machin (2000), all kappa values ranged from moderate to good strength of agreement. Cohen's

kappa can be misleading as it is influenced by several factors including the total percentage of positives. This occurred in two out of the four scorings. For the lowest kappa values of .46 and .47, the mothers demonstrated social positive engagement most of the time and both raters scored the mother's positive behaviors with high percent agreement. This resulted in lower kappa values despite the high percent agreement.

Two research assistants, trained and reliable in scoring the CIB, obtained CIB interrater reliability on three randomly selected tapes (one from the PAE group, two from the comparison group). Scores for maternal sensitivity codes were entered onto two separate sheets per video, one coding sheet for play (see Appendix D) and one coding sheet for reunion (see Appendix E). Reliability was calculated using the number of agreements within the episodes and dividing that figure by the sum of total observations (Weinberg & Tronick, 1996). Interrater reliability for the three tapes was 28%, 39%, and 39%. Point-by-point agreement was used to determine interrater reliability, however, if interrater reliability were to be reassessed using intraclass correlation coefficient (ICC) as the measure of reliability, reliability could be higher because many of the ratings between coders were similar although not exact.

4.1.5. Measure of dyadic matching behavior. To measure dyadic matching behaviors we calculated the proportion of seconds in which each mother and infant presented with matched/mismatched behaviors during both the play and reunion phases. Dyadic matching was defined as a state shared by both mother and infant at the same point in time. For example, a match would be the mother in a positive state and the infant in a positive state. Dyadic mismatching was defined as a non-shared state by both mother and infant at the same point in time. For example, a mismatch would be the mother in a

neutral state and the baby in a positive state (Tronick et al., 2005). Coding was completed second by second and ICEP maternal and child data was used when determining dyadic matching. To determine mismatched behaviors, we collapsed the nine ICEP categories into the following three categories for both maternal and child behaviors: negative (negative engagement, hostile/intrusive, withdrawn), neutral (non-infant focused engagement), and positive (social monitor/no vocalizations or neutral vocalizations, social monitor/positive vocalizations, social positive engagement, exaggerated positive engagement). Categories were collapsed according to Tronick et al. (2005) using the ICEP to examine matching and mismatching among mothers and infants.

4.1.6. Other measures. Two standardized infant behavior questionnaires were completed by the caregiver as part of the intake procedures for the larger study, requiring approximately 30 minutes to complete. The Revised Infant Behavior Questionnaire (IBQ-R; Gartstein & Rothbart, 2003) measures temperament and behavior in infants between the ages of 3 and 12 months. Acceptable internal reliability is reported for three IBQ-R broad factors (Cronbach's alpha = 0.91 to 0.92). Inter-rater agreement between primary and secondary caregivers is reported as moderate *(r* = 0. 30 to 0.71). The Infant-Toddler Symptom Checklist (ITSC; DeGangi et al., 1995) assesses regulatory behaviors and symptoms of dysregulation for infants 7-30 months old. Evidence of construct validity of the ITSC has been reported and it is considered an accurate screening tool to differentiate normal and regulatory-disordered infants.

Two brief caregiver questionnaires to assess postnatal ecological risk factors were also completed: the Center for Epidemiological Studies-Depression Scale (CES-D;

Radloff, 1977) and the Difficult Life Circumstances (DLC; Barnard, 1984). The CES-D is a reliable and valid 20-item self-rating scale used to screen for depressive symptoms in the general population. A cutoff score above 16 is considered clinically significant. Internal consistency is reported as high (coefficient alpha = 0.85 to 0.90), test-rest reliability is reported moderate (r = 0.45 to 0.67), and concurrent validity is reported as excellent. The DLC questionnaire is a reliable and valid 28-item self-report that measures the frequency of maternal and social problems and stressful life events. Test-retest reliability is reported as moderate (r = 0.40 to 0.70) and statistically significant correlations were found between the Beck Depression Inventory (Beck, Ward, Mendelson, Mock, & Erbaugh, 1961) score (r = 0.20 to 0.59) and the DLC (Barnard, 1989).

4.2. Statistical Analysis

Descriptive statistics were calculated by group (PAE and comparison) for all variables of interest. Since the sample sizes were small and this was an exploratory study, analyses were mostly descriptive and exploratory. To test medians for maternal sensitivity behaviors we used non-parametric tests that did not require assumption of a specific parametric distribution of the data. While there were multiple tests in this small data set, we did not correct for multiple comparisons, given the exploratory nature of the study. Therefore, the results are to be interpreted with caution with the understanding that they need to be corroborated in further studies and are useful to direct future research.

To compare the behaviors of mothers of infants with and without PAE using the ICEP (hypothesis 1.1), we calculated the proportion of the time in which the mother

presented each of the nine behaviors in both the play and reunion phases of the SFP. Of the three SFP phases – play, still face, and reunion – only the play and reunion phases were coded because the still face phase requires the mother to not interact with the infant. Since the behaviors for each mother are mutually exclusive and have to sum to 1, we are basically comparing the distribution of behaviors (within nine categories) for each woman. There is no simple way to test for the differences of distributions in such a small sample, and therefore, we did not carry out any statistical tests. Histograms of the means of each group and for each mother were used for comparison to explore the differences between the two groups.

To compare the behaviors of mothers of infants with PAE and comparison infants using the CIB (hypothesis 1.2), we calculated the median score for each category by group (for both, play and reunion phases) and tested for difference in medians by using the Mann-Whitney U test.

To assess the differences in maternal behaviors during the play and reunion episodes using the ICEP (hypothesis 2), we subtracted the proportion of positive behaviors in the reunion episode from the play episode for each mother. To determine dyadic mismatched behaviors, we calculated the proportion of the time in which each mother and infant presented with matched/mismatched behaviors for both the play and reunion phases.

5. Results

Sociodemographic characteristics of the mothers for both groups are reported in Table 1. Mean ages for mothers were comparable between groups. Mothers of infants

with PAE had lower household income, lower level of education, and slightly higher levels of past diagnosis and/or treatment for depression than the comparison group. By design, mothers of infants with PAE consumed moderate-to-heavy amounts of alcohol during pregnancy and tended to binge drink during pregnancy more than drinking daily. The comparison group consumed little or no alcohol during pregnancy, in either binge or daily use. Mothers in the PAE group reported a high level of tobacco and drug use during pregnancy; the comparison group reported no use at all. According to the DLC questionnaire mothers of infants with PAE reported higher levels of life stressors than the comparison group. Results from the CES-D were similar between the two groups, showing that 7 mothers from the PAE group and 7 mothers from the comparison group were below the cutoff score of 16 for significant depressive symptomatology. Mean scores on the CES-D for mothers in the PAE group were slightly higher than the comparison group.

Sociodemographic characteristics and parent-rated child regulatory and temperament outcomes for infants are reported in Table 2. Mean infant age was comparable between groups. The group of infants with PAE had a larger percentage of females. With the ITSC, two children in the PAE group scored in the atypical range, and one child in the comparison group scored in the atypical range. Mean scores on the ITSC were higher for the children in the PAE group. Scores on the ITSC above cutoff scores 10 (7-9 month olds), 12 (10-12 month olds), and 19 (13-18 month olds) can indicate challenges in the areas of self-regulation, sleep and feeding, and sensory processing. For temperament characteristics, mean scores on each IBQ subtest were relatively comparable with the exception of the fear category, where the mean raw score difference

exceeded one point. Higher scores on the IBQ indicate more of a specified behavior. See Jirikowic et al. (2012), for a full descriptive profile of infant biobehavioral characteristics.

Table 1

Sociodemographic Characteristics of Mothers

Characteristic	PAE (n=9)	Comparison (n=9)
	% or Mean (SD)	% or Mean (SD)
Maternal age in years, Mean (SD)	32.6 (6.7)	33.2 (4.3)
Maternal Characteristics		
Income: low, %	100	0
Education level: low, %	88.9	11.1
Self-report of past or current depression: yes, %	55.6	44.4
Frequency-Binge Aggregate Score		
5-drink binge, Mean (SD)	34.7 (38.9)	0.1 (0.1)
Daily (> 1 oz per drinking day), Mean (SD)	4.9 (7.9)	3.9 (6.2)
Tobacco use: yes, %	44.4	0
Any elicit drug use: yes, %	77.8	0
Meth during: yes, %	55.6	0
Marijuana during: yes, %	44.0	0
DLC Total, Mean (SD)	8.0 (5.6)	1.9 (0.8)
Total CES-D Depression, Mean (SD)	12.0 (5.7)	10.3 (3.5)

Note. DLC = Difficult Life Circumstances. CES-D = Center for Epidemiological Studies-Depression Screen.

Table 2

Sociodemographic Characteristics of Infants

Parent Questionnaire	PAE (n=9)	Comparison (n=9)
	% or Mean (SD)	% or Mean (SD)
Infant age in months, Mean (SD)	10.7 (3.1)	10.7 (2.9)
Infant sex: Female, %	66.7	44.0
ITSC		
Atypical, %	22.2	11.1
Total raw score, Mean (SD)	8.2 (8.5)	4.9 (4.2)
IBQ subtest scaled scores		
Cuddliness, Mean (SD)	5.6 (0.6)	5.4 (0.8)
Approach, Mean (SD)	5.5 (0.9)	5.8 (0.9)
Vocal reactivity, Mean (SD)	5.5 (0.9)	5.4 (1.0)
Smile, Mean (SD)	5.2 (0.7)	5.5 (0.7)
Soothability, Mean (SD)	5.2 (0.9)	5.6 (0.8)
Rec Distress, Mean (SD)	4.6 (1.2)	5.5 (1.0)
Perceptive sensitivity, Mean (SD)	4.3 (2.2)	3.9 (1.1)
Orienting, Mean (SD)	4.3 (1.2)	3.9 (1.2)
Fear, Mean (SD)	3.7 (1.5)	2.8 (1.2)
Activity, Mean (SD)	3.5 (0.5)	3.6 (0.6)

Note. ITSC = Infant-Toddler Symptom Checklist. IBQ = Infant Behavior Questionnaire.

5.1. Comparison of ICEP Between PAE and Comparison Groups

Primary Aim #1 results are reported in Tables 3 and 4. Proportions of maternal affective behaviors observed during the two-minute SFP episodes of play and reunion are shown in Table 3. Each cell contains the mean percentage of time a group spent engaging in a specific maternal behavior during either the play or reunion episode (columns sum up to 100%).

5.1.1. ICEP play. The following maternal behaviors were seen during the play episode of the SFP. Within both groups, positive behaviors were the primary observed maternal behavior, for the mothers of infants with PAE and comparison group (95.8% and 98.1%, respectively). Mothers in both groups showed some neutral behaviors (3.6% and 1.2% for PAE and comparison groups, respectively). A small number of negative behaviors were seen in the PAE group (0.7%), with no negative behaviors observed for the comparison group. Across both groups, of the observed positive behaviors, social positive engagement behaviors (positive affect such as full smiles, laughter, or play faces) occurred the most frequently (74.9% and 81.0% for PAE and comparison groups, respectively).

5.1.2. ICEP reunion. The following behaviors were seen during the reunion episode. Positive behaviors were the primary observed maternal behavior for the mothers of infants with PAE and comparison group (95.6% and 98.7%, respectively). Mothers in both groups showed some neutral behaviors (4.3% and 1.1% for PAE and comparison groups, respectively). No negative behaviors were observed for mothers in either group. Across both groups, of the observed positive behaviors, social positive engagement

behaviors occurred the most frequently (78.3% and 71.9% for PAE and comparison groups, respectively).

Table 3

Mean Percentage of Maternal Affective Behaviors Observed During Play and Reunion Episodes

Maternal Behavior Codes	PAE (n=9)		Comparison (n=9)	
	Play Mean (SD)	Reunion Mean (SD)	Play Mean (SD)	Reunion Mean (SD)
Negative				
Negative engagement	0.64 (1.3)	0.0	0.0	0.09 (0.3)
Hostile-intrusive	0.1 (0.3)	0.0	0.0	0.0
Withdrawn	0.0	0.09 (0.3)	0.0	0.0
Neutral				
Non-infant focused engagement	3.6 (4.2)	4.3 (3.7)	1.2 (1.4)	1.1 (1.2)
Positive				
Social positive engagement	74.9 (30.1)	78.3 (15.0)	81.0 (11.5)	71.9 (30.0)
Social monitor/Positive vocs	9.0 (20.1)	0.8 (1.4)	3.8 (4.0)	8.2 (12.0)
Social monitor/No vocs	7.2 (9.0)	10.4 (13.7)	7.9 (12.6)	17.2 (25.0)
Exaggerated positive engagement	4.7 (4.5)	6.1 (5.6)	5.4 (3.8)	1.4 (2.4)
Unscorable	0.0	0.0	0.83 (2.0)	0.0

Note: vocs = vocalizations.

5.2. Comparison of CIB Between PAE and Comparison Groups

Means and standard deviations by group and group contrasts for the CIB Parent Sensitivity Codes for the episodes of play and reunion are shown in Table 4. For the play episode, statistically significant differences between the PAE group and the comparison group were found for the categories of positive affect, vocal appropriateness, clarity, and appropriate range of affect ($p < 0.01$), and acknowledging, parent supportive presence, and adaptation, regulation ($p < 0.05$). For the reunion episode, a significant difference between the PAE group and the comparison group occurred only for the category labeled appropriate range of affect ($p = 0.03$).

Table 4

Descriptive Statistics: Coding Interactive Behavior Parent Sensitivity Codes

Parent Sensitivity Codes	Play					Reunion				
	PAE (n=9)		Comparison (n=9)		p-value[a]	PAE (n=9)		Comparison (n=9)		p-value[a]
	M	SD	M	SD		M	SD	M	SD	
Consistency of style	4.6	0.4	4.5	0.4	0.60	4.7	0.3	4.6	0.4	0.93
Parent gaze/Joint attention	4.3	0.6	4.7	0.5	0.19	4.7	0.4	4.9	0.1	0.22
Vocal appropriateness, clarity	4.1	0.3	4.6	0.3	0.01	4.3	0.4	4.7	0.3	0.06
Appropriate range of affect	4.1	0.3	4.6	0.3	0.01	4.2	0.6	4.7	0.3	0.03
Acknowledging	3.9	0.6	4.6	0.5	0.02	4.4	0.9	4.8	0.3	0.44
Positive affect	3.9	0.2	4.8	0.4	0.01	4.1	0.5	4.3	0.6	0.19
Parent supportive presence	3.7	0.8	4.4	0.4	0.03	3.1	1.1	3.6	0.8	0.22
Adaptation, regulation	3.7	0.8	4.4	0.5	0.04	3.1	1.1	3.6	0.2	0.26
Resourcefulness	2.7	1.3	3.0	1.2	0.34	3.7	0.9	4.4	0.4	0.11

Note: Mann-Whitney U test for comparison of medians

5.3. Comparison of Mismatched Behaviors Between PAE and Comparison Groups

Results from primary Aim #2 are reported in Figures 1, 2, and 3. Dyadic matching was defined as a shared behavioral state (e.g., as defined by the ICEP categories of positive, neutral or negative) by both mother and infant at the same point in time. Dyadic mismatching was defined as a non-shared state by both mother and infant at the same point in time (Tronick et al., 2005). The sample size for examining dyadic matching was eight dyads in each group (with PAE and comparison). The decrease in sample size was due to technical problems with two video-recorded files.

5.3.1. Mismatched behaviors during play. Comparison of mismatched behaviors using the ICEP combined categories of negative, neutral, and positive for mothers and comparison infants and mothers and infants with PAE during the 2-minute SFP episode of play is presented in Figure 1. During the play episode, mothers and infants in the comparison group had scores that showed more variability, ranging from 29% to 100% for mismatched behaviors, than the PAE group where scores ranged from 41% to 97% for mismatched behaviors.

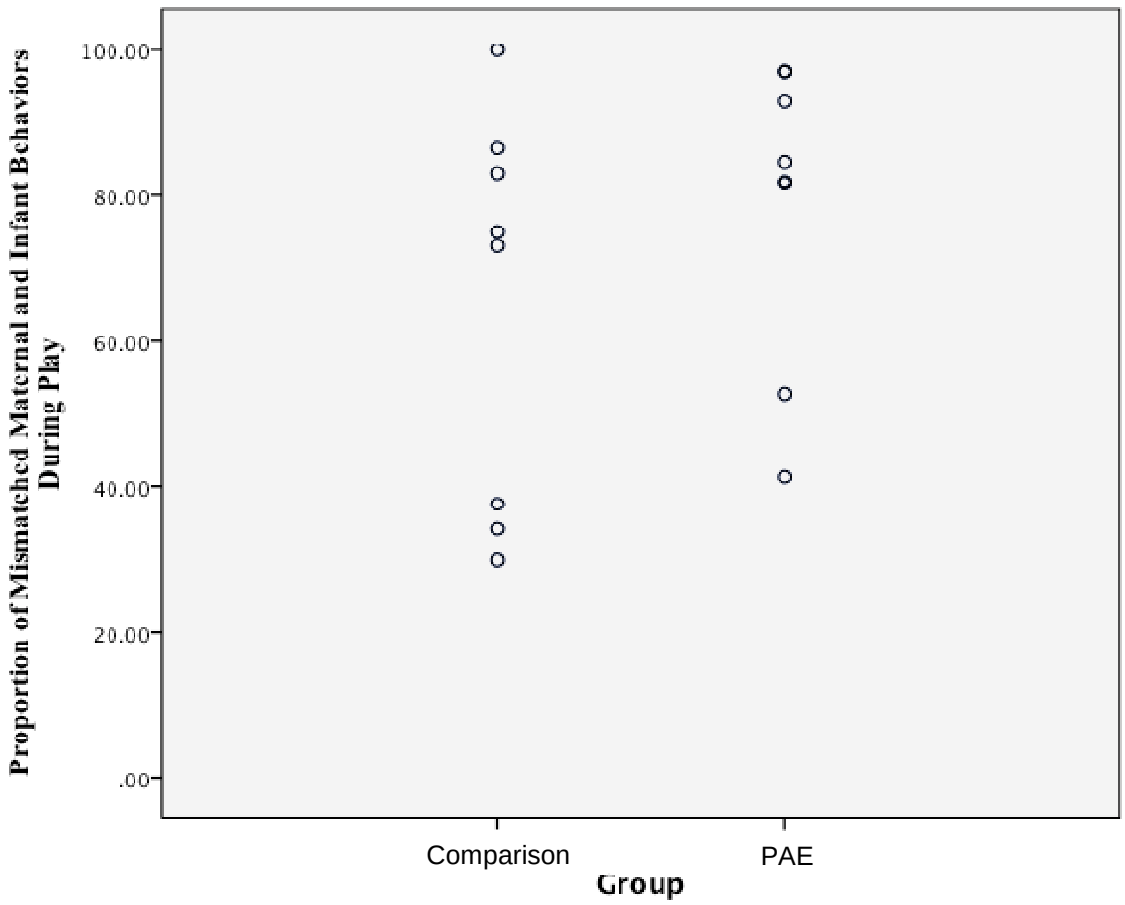

Figure 1: Comparison of mismatched behaviors (positive, neutral, and negative) of mothers and comparison infants and mothers and infants with PAE during the play phase of the Still Phase Paradigm.

5.3.2. Mismatched behaviors during reunion. Comparison of mismatched behaviors using the ICEP combined categories of negative, neutral, and positive for mothers and comparison infants and mothers and infants with PAE during the 2-minute SFP episode of reunion is presented in Figure 2. During the reunion episode, both groups of mothers and infants had similar distributions of mismatched behaviors with the

comparison group ranging from 33% to 100% and the PAE group ranging from 31% to 100%.

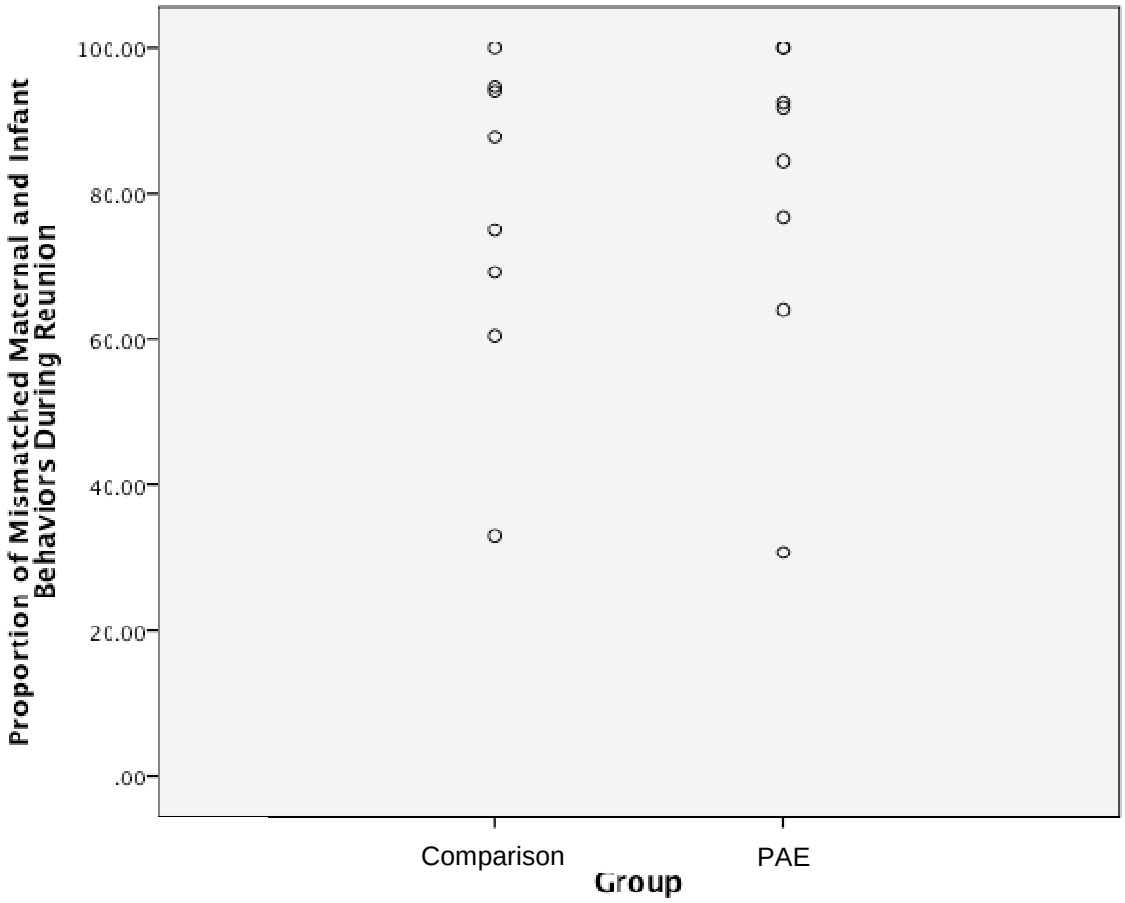

Figure 2. Comparison of mismatched behaviors (positive, neutral, and negative) of mothers and comparison infants and mothers and infants with PAE during the reunion phase of the Still Phase Paradigm.

5.3.3. Difference in positive behaviors between groups. Comparison of the difference in positive behaviors using the ICEP for mothers and comparison infants and

mothers and infants with PAE across phases of the Still Phase Paradigm is presented in Figure 3. For positive behaviors across episodes, mothers and infants in the comparison group had differences that showed less variability (ranging from -1.0 to 5.0) than the PAE group (ranging from -4.0 to +13.0). Four mothers in the PAE group demonstrated more negative differences than the comparison group. Mothers with negative differences demonstrated more positive behaviors in the play phase than in the reunion phase. Mothers in the PAE group demonstrated less consistency in positive behaviors (3 mothers with -4.0 and 1 mother with -2.0) across episodes than the comparison group (2 mothers with -1.0).

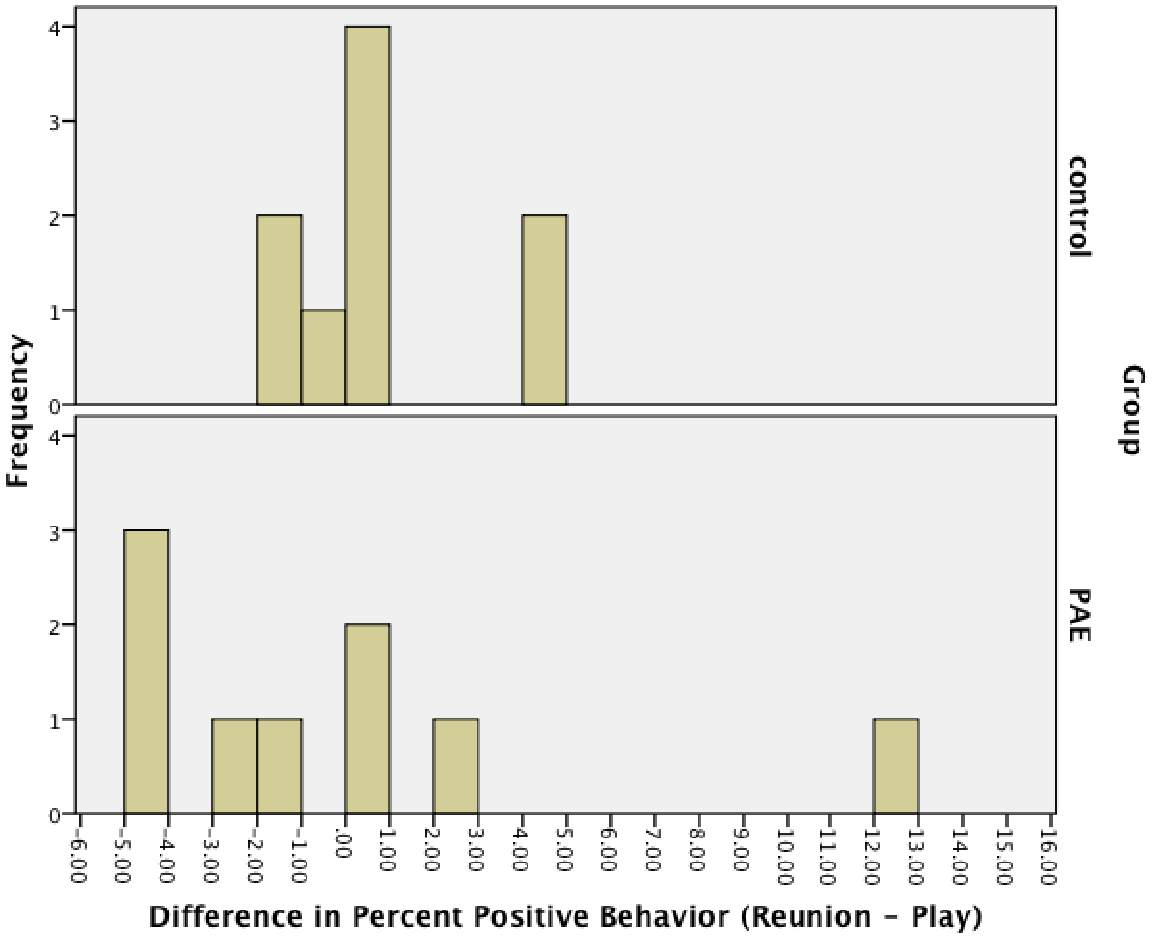

Figure 3. Comparison of the difference in positive behaviors of mothers and comparison infants and mothers and infants with PAE across phases of the SFP.

5.4. Exploratory Analysis: Mismatched Behaviors

After examining the distribution of mismatched behaviors for both groups during play, it was determined that more information was needed about the characteristics of the dyads in either group that had more matches versus mismatches. For exploratory purposes the mismatched behaviors and selected sociodemographic characteristics of the mothers (age, education level, depression, CES-D, DLC, F-BAS Binge, F-BAS Daily, polysubstance use) and the infants (age, gender, ITSC, IBQ) were examined by dyad.

Given the purely descriptive nature of this portion of the study, these results should be interpreted with caution.

After examining these characteristics, a table with four quadrants was created. A comparison of mismatched behaviors of the mothers and infants from each group are reported in Table 5. Each quadrant represents a group, comparison or PAE, and a percentage (with a cutoff of above or below 50%) used to determine a category of typical or atypical mismatched behaviors. The cutoff for mismatched behaviors was 50% based on Tronick's work in this area (Tronick & Gianino, 1986). A higher percentage of mismatches increase the risk for negative mother-infant interactions. Infants who experience mismatches above 50% have shown decreased use of coping strategies (Tronick & Gianino, 1986) and spend more time focusing on coping behaviors aimed at maintaining self-regulation and less time focusing on repairing the interaction with the mother (Tronick, 2007). Experiencing mismatches below 50% is better for infants and for the mother-infant relationship. Infants who experience mismatches below 50% appeared to learn effective coping strategies for repairing mismatches such as self-comfort, gaze aversion, signaling, and withdrawing. In the PAE group, seven of eight mothers (87.5%) had mismatches above 50% and one of eight mothers (12.5%) had mismatches below 50%. In the comparison group, five of eight mothers (62.5%) had mismatches above 50% and three of eight had mismatches below 50%.

Table 5

Comparison of Mismatched Behaviors

Percent of Mismatched Behavior	**PAE**	**Comparison**
% Above 50	7 (87.5%)	5 (62.5%)
% Below 50	1 (12.5%)	3 (37.5%)

5.4.1. Past diagnosis of and/or treatment for depression. Depression was a variable of interest for mothers. A depression label of "yes" indicated that the mother had reported being diagnosed or treated for depression, including post-partum depression at any time. A depression label of "no" indicated that the mother had not been diagnosed or treated for depression. Of mothers in the PAE group with mismatched interactions above 50%, 4 of 7 mothers (57.1%) reported past or current depression. In the comparison group 2 of 5 mothers (40.0%) with mismatched interactions above 50% also reported past or current depression. In contrast, of the mothers in the PAE group with mismatched interactions below 50%, 0 of 1 (0.0%) reported no past depression. One of 3 mothers (33.3%) in the comparison group with mismatched interactions below 50% reported no past depression.

5.4.2. Mean IBQ fear scores. When examining child factors, the mean score on the IBQ fear subtest was of interest because infants with PAE demonstrated a higher mean score on this subtest than infants with little to no PAE. Fear is operationalized in the IBQ as a startle or distress to sudden changes in stimulation, novel physical objects or

social stimuli as well as an inhibited approach to novelty. A mean score above 2.8 indicates atypical levels of fear (Gartstein & Rothbart, 2003). Of infants in the PAE group with mismatched interactions above 50%, 5 of 7 infants (71.4%) had mean fear scores above 2.8. In the comparison group 2 of 5 infants (40.0%) with mismatched interactions above 50% also had mean fear scores above 2.8. In contrast none of the infants in either the PAE or comparison group with mismatched interactions below 50% had mean fear scores above 2.8.

6. Discussion

This exploratory study provides a descriptive behavioral profile of nine mothers of high-risk infants with moderate-to-heavy PAE compared to nine mothers of infants with minimal to no PAE. This study examined the affective behaviors of mothers with their infants before and after a standardized infant stress protocol, the Still Face Paradigm (SFP). According to the ICEP outcomes, positive engagement was the maternal behavior primarily observed for both groups across SFP play and reunion episodes. For the CIB outcomes, mothers in the PAE group demonstrated less sensitive behaviors than the comparison group in several categories. Mothers and infants with PAE had similar overall levels of mismatched interactions when compared to mothers of infants with little to no PAE. Together these findings suggest that the mothers of infants with PAE had strengths in engaging their children in positive ways, but they had some challenges or differences in the quality of their interactions with their child such as reading infant cues in a sensitive manner. Because the sample sizes were small and this was an exploratory

study, results are to be interpreted with caution with the understanding that they need to be corroborated in further studies.

6.1. Maternal and Child Factors

Sociodemographic characteristics of mothers and infants indicated that women in the group of children with PAE had lower household incomes and lower levels of education than mothers of comparison infants. Interestingly, mothers from both groups had similar levels on the CES-D depression screen, which was unexpected. This could have potentially affected outcomes for the comparison group, resulting in scores more similar than expected, because it is possible that maternal depression made providing sensitive and responsive caregiving more challenging for mothers in both groups. Although the infants in both groups had comparable scores on the IBQ-R, the infants with PAE had higher scores on the ITSC suggesting the possibility of more regulatory challenges than the comparison group (Jirikowic et al., 2012). These regulatory challenges were not statistically significantly different between the groups. A larger sample would be needed to determine the presence of more regulatory challenges among the children with PAE.

6.2. Comparison of Observable Affective Behaviors

The results comparing biological mother dyads of 6-15 month old infants with moderate-to-heavy PAE versus biological mother dyads with minimal to no PAE on indicators of maternal sensitivity, as measured by the type and frequency of observable affective behaviors using the Infant and Caregiver Engagement Phases (ICEP) did not support hypothesis 1.1. Mothers of infants with moderate-to-heavy PAE did not show lesser frequency of positive engagement behaviors on the ICEP (such as more

withdrawn/intrusive and less social positive engagement) during the play and reunion phases of a social stressor (Still Face Paradigm) when compared to mothers of infants with minimal to no PAE. Mostly positive maternal behaviors and very few negative maternal behaviors were noted for both groups in both play and reunion episodes. The type of positive behavior observed most frequently was social positive engagement defined as the caregiver expressing positive affect such as full smiles (closed or open), laughter, or play faces (Weinberg & Tronick, 1999). This finding suggests that mothers of infants with PAE have strengths in engaging their children in positive ways. It was encouraging to see so many positive behaviors among this high-risk group of women who were struggling with risk factors including low education levels, depression, low SES, and other stressful life circumstances.

The lack of negative behaviors for the mothers of children with PAE could be performance-related. Mothers of children with PAE feel and expect to be judged by society (Wood, 2010). Therefore, mothers of infants with PAE could have felt a stronger pressure to "do a good job" of playing with and comforting their infants. Findings are in contrast to other studies that describe how high risk parenting styles are more prominent among mothers of children with prenatal exposure (Eiden et al., 1999; Eiden 2001). In this study experimental circumstances could have effected how the mothers from both groups interacted with their infants. For example, the number of observers, the location, and presence of video cameras, all could have influenced mothers to "perform" well for the study. It could also be that the ICEP is more sensitive in capturing positive behaviors than it is with negative behaviors.

When comparing maternal affective behaviors between play and reunion episodes, mothers of infants with PAE had slightly higher percentages of non-infant focused engagement and slightly lower percentages of social monitoring without vocalizations than the comparison group. Mothers in the PAE group spent more time looking at things in the environment, which were rated as non-infant focused engagement, than the comparison group. This is important because looking at an infant when playing with or comforting them is crucial to reading their cues and engaging with them. Perhaps the mothers of infants with PAE were concerned and self-conscious about their performance, especially when their babies became upset and they were not able to calm them in a timely manner. During these stressful moments, the mothers of infants with PAE would look more frequently at objects in the environment.

Hypothesis 1.2 stated that mothers of infants with moderate to heavy PAE would show lesser intensity of maternal sensitivity behaviors on the CIB during the play and reunion phases of a social stressor (Still Face Paradigm) when compared to mothers of infants with minimal to no PAE. In support of hypothesis 1.2, mothers of infants with moderate-to-heavy PAE showed lesser intensity of maternal sensitivity behaviors on the CIB during both the play and reunion phases of the SFP when compared to mothers of infants with minimal to no PAE, group differences were in the expected direction.

The CIB codes maternal sensitivity behaviors at a global level. For the CIB play episode, there were statistically significant group differences in numerous important categories that comprise maternal sensitivity. Mothers in the comparison group were more acknowledging, vocally appropriate, supportive, able to adapt and regulate, had more positive affect and an appropriate range of affect than the PAE group. This

suggests that during the play episode the mothers in the PAE group had trouble interacting with their infants in a sensitive manner. It could be that mothers in the PAE group found it more challenging to read subtle infant cues, for example during the play episode, and easier to read the more potent infant cues that seemed to occur more frequently in the reunion episode.

For the CIB reunion episode, mothers from both groups acted similarly in almost all categories, with one exception. A statistically significant group difference was found for the category of appropriate range of affect. The contrast between maternal sensitivity behaviors in the play versus reunion episodes suggest that mothers of infants with PAE paid less attention to their infants when their infants were distressed, though it could have happened by chance alone, given the small sample size and multiple comparisons performed in this study. Mothers in the PAE group appeared to be sympathetic to the distress of their children and wanted to comfort the infants, it could be that mothers in the PAE group had fewer "tools" to effectively comfort their distressed children. Positive mother-infant interactions form the foundation for development in all areas. Based on these findings, more research is needed examining mothers of infants with PAE and relationship-based interventions focusing on their sensitivity during play.

6.3. Comparison of Mismatched Behaviors

The purpose of comparing matched behaviors was to examine how frequently mothers and infants were in synchrony, as this may provide insight into how sensitive a mother is in accurately reading and responding to her infant's cues. In contrast to hypothesis 2, mother-infant dyads where the infant was exposed to moderate-to-heavy

PAE showed similar overall levels of mismatched engagement states when compared to dyads where the infants had minimal to no PAE.

During the SFP play episode, mothers and infants with PAE had mismatched interactions with slightly less variability (41% to 97% for mismatched behaviors) when compared to mothers and infants with minimal to no PAE (29% to 100% for mismatched behaviors). One possible reason for the high number of mismatches for both groups could be that there were very few "negative" behaviors demonstrated by mothers from either group, and many of the babies demonstrated "negative" behaviors (e.g., crying) during the reunion phase which resulted in many mismatches.

Mothers from the PAE group demonstrated less dyadic mismatching during the reunion episode, and their distribution of behaviors was very similar to the comparison group. When comparing the distributions for both groups for the play and reunion episodes, it appeared that mothers from both groups became more "in tune" with their infants after the stressor. One reason for this could be that the mothers of infants with PAE were not monitoring the infants closely until he/she became upset. It could also be that reading the infant's behaviors and cues was more challenging for the mothers of infants with PAE during play, as the infant cues tended to be more subtle during the play episode and stronger during the reunion episode. Because maternal sensitivity is critical in helping infants feel safe and secure following a stressful event, it was encouraging to see both groups demonstrating similar proportions of matched interactions, suggesting that these biological mothers were attempting to read and respond to their infant's cues after a stressful event.

Across SFP episodes, mothers in the comparison group showed less variability with their positive behaviors. Predictability is an important component to maternal sensitivity and healthy mother-infant interactions (Ainsworth, 1979). To examine predictability across episodes we subtracted the mean percentage of positive behaviors in the reunion episode from the play episode for each person. For the comparison group, the difference between their positive behaviors during the play and reunion episodes was smaller, indicating more steady positive behavior, than the mothers of infants with PAE. As seen in Figure 3, the lowest score of mothers in the comparison group was -1.0 (n=2), while the lowest score of mothers in the PAE group was -4.0 (n=3). A score of zero indicates no change in behavior. These findings suggest that mothers in the comparison group, even those with the scores below zero, had more predictable positive behaviors than mothers in the PAE group.

Many of the mothers in the PAE group (n=5) decreased their positive behavior in the reunion. In the PAE group, the scores ranged from as high as 12 (n=1) to as low as -5 (n=3). The difference between their positive behaviors during the play and reunion episodes was larger than the comparison group, indicating less predictable positive behavior. This is very important, because when a child is distressed they are in need of sensitive, predictable behaviors from their mother in order to regulate and recoup after a stressor (Ainsworth, Bell, & Stayton, 1971; Ainsworth et al., 1978). After looking at the distribution of mismatched behaviors for both groups during play, it was determined that more information about the characteristics of the dyads in either group that had more matches versus mismatches was needed.

6.3.1. Maternal factors influencing dyadic matching. Mothers from both groups reported past depression, mothers of the infants with PAE (n=4) and comparison group (n=3) respectively. Depression is important to look at because infants of mothers with depression are at risk for developmental challenges (Goodman & Brand, 2009). Among mothers with mismatched interactions at or above 50%, mothers in the PAE group showed slightly higher levels of past treatment for depression (n=4) than mothers in the comparison group (n=2). This finding of increased self-reported depression among mothers of infants in either group with more mismatched interactions is concerning because mental health impairments, such as maternal depression, place the infant and mother at risk for developing an insecure attachment based on the characteristics of mothers with depression that can negatively influence the parent-child relationship, including intrusiveness, unpredictability, and neglectful caregiving (Goodman & Brand, 2009). Depressive symptoms in mothers is related to emotional and behavior problems in children with prenatal polysubstance exposure (Bennett, Bendersky, & Lewis, 2002). Future studies need to look more closely at maternal factors including depression, current and past, as it relates to maternal sensitivity in the parent-child relationship among infants with high levels of PAE.

6.3.2. Child factors influencing dyadic matching. Child factors can also impact parent-child interactions. When examining child factors of interest (age, ITSC scores, IBQ scores), the behavior category labeled as fear on the IBQ-R stood out as a specific behavior that was somewhat elevated for infants with PAE. Fear is operationalized in the IBQ as a startle or distress to sudden changes in stimulation, novel physical objects or social stimuli as well as an inhibited approach to novelty. According to Gartstein &

Rothbart (2003), in a previous study mean fear scores for infants who are typically developing ranged from 2.3 to 2.8. In the group of infants with PAE the mean fear scores were higher, ranging from 1.4 to 5.7, while the comparison group ranged from 1.7 to 3.5. When examining fear among infants with mismatched interactions at or above 50%, the exploratory results suggested that infants with more mismatches were more likely to be fearful than infants with fewer mismatches. Infants in the PAE group with mismatched interactions at or above 50% showed higher levels of fear (n=5) than the comparison group (n=2). Interactions between mothers and infants with higher fear scores could be negatively impacted by parent perception of behavior. Infants with higher fear scores could be more challenging to care for in a sensitive and responsive way. The higher mean fear scores found in the infants with PAE, who also had higher proportions of mismatched interactions, could be negatively affecting the mother-infant relationship and this warrants further attention.

6.4. Compare and Contrast of ICEP & CIB

It is important for research and clinical purposes to compare the two measures used to capture maternal behaviors, so in the following section, the ICEP and the CIB coding schemes for analyzing parent-infant interactions will be compared and contrasted. In this study, the ICEP provided less useful information about the dyads because although the ICEP has a variety of coding categories for engagement behaviors in mothers, it does not focus specifically on maternal sensitivity or the mother's ability to monitor and respond to the child. In contrast, the CIB rates the quality of specific behaviors that are crucial to healthy parent-infant interactions. When comparing maternal sensitivity in groups of infants with moderate to heavy PAE and minimal to no PAE, Table 4 shows

that the data provided by the CIB is more discriminating than the ICEP data in Figures 1 and 2. In Figures 1 and 2, using the ICEP data, the distributions for the play and reunion episodes were similar for both groups. In Table 4, using the CIB data, the distributions for the play and reunion episodes were very different for both groups. Ultimately, the CIB was more sensitive to group differences than the ICEP.

From a clinical and practical standpoint, the two coding schemes differ widely on the time needed to code and objectivity, but are similar in the amount of training required and literature supporting the reliability of each. The CIB is faster to code, but it requires specific training and might be more subjective. A six-minute SFP video coding with the CIB required approximately 10 minutes. The ICEP is much more time-consuming, also requires training, but it can be more objective since it is based on a set of specified behaviors such as smiling and crying. Coding a six-minute SFP video using the ICEP can last between 60-90 minutes based on the quality of the video footage and the complexity of the parent-child relationship. Another difference between the two coding systems is that the ICEP is a microanalytic coding scheme while the CIB is a global coding scheme. Microanalytic coding schemes require the coder to observe each discrete, interval of the recorded interaction (at a sampling rate of one code per second) and classify the behavior of mother and infant in that interval while global coding schemes require the coder to watch an entire video clip and then code specific behaviors after viewing the clip from start to finish. In terms of the validity of the two tools, both have literature supporting their validity. For example, the CIB has been used across a wide range of ages, cultures, with low-risk and high-risk dyads (Feldman, 2010; Feldman, Eidelman, & Rotenberg, 2004; Feldman & Klein, 2003; Feldman & Masalha,

2010). Also, the ICEP has been used across cultures, with mothers with mental health challenges, with infants with prenatal substance exposure, as well as infants who are typically developing (Ham & Tronick, 2006; Kaitz, Maytal, Devor, Bergman, & Mankuta, 2010; Tronick et al., 2005). From my experience, calculating percent agreement was more time-efficient with the CIB. Although calculating percent agreement was more time-efficient with the CIB, reliability was lower because point-by-point agreement was used to determine interrater reliability. If interrater reliability were to be reassessed using intraclass correlation coefficient (ICC) as the measure of reliability, reliability could be higher because many of the ratings between coders were close on the Likert scale (e.g., 3.5 vs. 4.0), although not exact.

The ICEP has many disadvantages such as it requires a large amount of time and does not provide much information about maternal sensitivity during mother-child interactions. Based on these reasons, the ICEP may be less useful clinically. For the purposes of this study, the ICEP did not adequately capture maternal sensitivity. On the other hand, the CIB is a tool that could easily be incorporated clinically because it can be used in free play situations, requires very little time to code, and informs the therapist of specific behaviors pertaining to the quality of mother-infant interactions. Based on the reliability and validity of the CIB, as well as the many advantages found while using it with this study, the CIB has potential to be useful in evaluating dyads and in helping to plan relationship-based interventions. Future studies examining maternal sensitivity in high-risk populations and clinicians working with high-risk dyads should consider using the CIB to assess maternal sensitivity within the context of mother-infant interactions.

7. Limitations

The study findings are clearly exploratory and limited by a small sample size. Therefore, we cannot generalize the results to populations of mother-infant dyads with PAE, but we can generate important questions that can direct future studies. Given that data were gathered following a sleep study, the timing of the data collection is another limitation. The data were gathered following an overnight sleep study and as a result, many of the mothers and infants might have experienced a disruption in their typical sleep routine and been tired during the SFP test though infants in both groups experienced the same study conditions. Another limitation related to the sleep study involved the use of electrodes attached to the infant's foreheads. Several of the infants were distraught when the electrodes needed to be reattached prior to the start of the SFP. This could have affected their behavioral state during the play episode of the SFP. The CIB may have limitations to its use in combination with the SFP, since the CIB is often used in free play situations instead of a constrained situation. The SFP is a very structured protocol as the child is secured into a chair with a tray for the duration of the 6-minute procedure, which limits the infant's movement, the mother's ability to comfort the child, and the mother-infant play interactions. Finally, the mismatch data was analyzed at a basic level, match versus mismatch, at each video-frame. This is a simplistic approach, as it might miss responses from the mother that occur a few seconds after a child's behavior and responses from the child that occur a few seconds after the mother's behavior.

8. Conclusions

The findings from this study suggest that mothers of infants with PAE demonstrated similar levels of positive social engagement in both play and following a developmental stressor for infants when compared to mothers of infants with little to no alcohol exposure. Mothers of infants with PAE showed fewer sensitive behaviors demonstrating less positive affect, vocal appropriateness, appropriate range of affect, acknowledging, parent supportive presence, and adaptation during play than mothers in the comparison group. Mothers of infants with PAE were also less likely to demonstrate an appropriate range of affect following a stressful situation when compared to mothers of infants with little to no alcohol exposure. Lastly, mothers and their infants with PAE had similar overall levels of mismatched interactions when compared to mothers and infants with little to no PAE.

Together these findings suggest that mothers of infants with PAE have strengths in engaging their children in positive ways, but they have some challenges or differences in the quality of interactions such as reading the child's cues in a sensitive manner. This is especially important because moderate-to-heavy PAE is a risk factor known to be associated with poor developmental outcomes. In combination with mothers who also reported and demonstrated caregiving risk factors (e.g., maternal depression and less sensitive caregiving), findings suggest that more attention needs to be given to understanding how maternal sensitivity influences mother-infant interaction in order to best support child development in all areas and healthy parent-child relationships. Because maternal sensitivity is an important factor that strongly influences mother-infant interactions and based on study findings that mothers of infants with moderate-to-heavy

PAE may be less sensitive when playing with their infants, future studies focusing on maternal sensitivity in this high-risk population are needed. If these results are replicated mothers of infants with PAE may benefit from intervention focusing on their sensitivity during play, which has the potential to reduce social emotional risks as well as later behavior and developmental challenges for children affected by PAE.

9. Future Studies

More research is needed to explore the effects of PAE on maternal sensitivity in mother-infant interactions. Based on the above stated limitations, future studies should consider having a larger sample and using the CIB to specifically code maternal sensitivity behaviors. Maternal sensitivity has been linked to overall infant development (Belsky & Fearon, 2002) and therefore, a general indicator of child development such as the Bayley Scales of Infant Development, Third Edition (Bayley, 2005) should be used, as it would be helpful to know how the infants with PAE were doing developmentally in comparison to infants without PAE. More symptoms of possible regulatory challenges were present among infants in the PAE group as indicated by more atypical scores on the ITSC, and this issue deserves further investigation to better understand potential regulatory challenges in infants with PAE and the impact (if any) on the mother-infant relationship. An examination of sensory behaviors may provide more information on the elevated fear scores on the IBQ-R.

Findings that mothers of infants with PAE have similar overall levels of mismatched interactions when compared to dyads where the infants had minimal to no PAE needs to be explored further to better understand the quality of the interactions

during mismatched states. Data from this study examined interaction matches and mismatches without characterizing the type of mismatching. An important next step would be to analyze the quality and types of mismatches, since some are positive and some are negative. For example, if the majority of mismatches included the infant in a negative state and the mother in a positive state, that would be less than ideal in an interaction of mother and child. Alternatively, if the majority of mismatches included the infant in a negative state and the mother in a neutral state, this would be an acceptable mismatch, since the mother is trying to respond to the child's behavior in a sensitive and positive way. The exploratory findings from this study that mothers of infants with PAE had higher levels of past treatment for and/or diagnosis of depression and infants with PAE had higher levels of fear could be relevant clinically. However, the findings need to be interpreted with caution as the sample size was small and this study was exploratory in nature. More research is needed to understand maternal sensitivity in high-risk populations and the impact of maternal sensitivity on the mother-infant relationship.

Additionally, in the future the dyadic matching data could be analyzed in more depth. Dyadic matching was defined as a state shared by both mother and infant at the same point in time. Because examining dyadic matching data second by second has some limitations, future studies should consider examining data from the second before and the second after. Most back and forth interactions involve a slight lag time. For example, the mother smiles at the infant, the infant notices, processes and smiles back. This back and forth interaction could take longer than a second and should be considered a match. Some of the mismatches in this study could be matches if the data were examined from

the second before and the second after, through time series analysis, thus allowing for the lag time.

Maternal sensitivity in mothers of infants with PAE is an intriguing area. It deserves further attention because it is a complicated topic involving a high-risk group who are at risk for negative mother-child interactions, which can adversely affect development. Therefore, it is important to pay attention to the social-emotional development of infants and young children who are prenatally exposed. Ultimately, offering early intervention services to mothers of infants with PAE could promote more responsive caregiving by increasing maternal sensitivity, and positive parenting practices, which has the potential to reduce social emotional risks and risks for disrupted caregiving experiences for infants affected by PAE.

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11.1. Appendix A

ICEP Score Sheet

Coder: _____ Clip ID: _____ Episode: _____

1.		31		61		91	
2.		32		62		92	
3.		33		63		93	
4.		34		64		94	
5.		35		65		95	
6.		36		66		96	
7.		37		67		97	
8.		38		68		98	
9.		39		69		99	
10.		40		70		100	
11.		41		71		101	
12.		42		72		102	
13.		43		73		103	
14.		44		74		104	
15.		45		75		105	
16.		46		76		106	
17.		47		77		107	
18.		48		78		108	
19.		49		79		109	
20.		50		80		110	
21.		51		81		111	
22.		52		82		112	
23.		53		83		113	
24.		54		84		114	
25.		55		85		115	
26.		56		86		116	
27.		57		87		117	
28.		58		88		118	
29.		59		89		119	
30.		60		90		120	

11.2. Appendix B

CIB Coding Sheet: Play

CIB Coding Sheet
Maternal Sensitivity

Video ID_____

Episode__Play (first two minutes)_

Date_____

Parent Codes

1. Acknowledging _____
2. Parent gaze / Joint attention _____
3. Positive affect _____
4. Vocal appropriateness, clarity _____
5. Appropriate range of affect _____
6. Consistency of style _____
7. Resourcefulness _____
8. Parent supportive presence _____

Dyadic Code

9. Adaptation – regulation _____

11.3. Appendix C

CIB Coding Sheet: Reunion

CIB Coding Sheet
Maternal Sensitivity

Video ID_____

Episode__Reunion (last two minutes)_

Date_____

Parent Codes

1. Acknowledging _____
2. Parent gaze / Joint attention _____
3. Positive affect _____
4. Vocal appropriateness, clarity _____
5. Appropriate range of affect _____
6. Consistency of style _____
7. Resourcefulness _____
8. Parent supportive presence _____

Dyadic Code

9. Adaptation – regulation _____

11.4 Appendix D

Relationship Between Factors that Influence Mother-Infant Interactions