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An Investigation of Focused Attention Opioid-Exposed Toddlers

Jane W. Schneider
Loyola University Chicago

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AN INVESTIGATION OF FOCUSED ATTENTION IN OPIOID-EXPOSED TODDLERS

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Jane W. Schneider

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Dedication

I would like to dedicate this dissertation to all the children whose lives I have entered, who have touched me so greatly. I have learned so much from you; it has been my privilege to serve you. To the current special children in my life Gideon, Jesse, and Sean, thank you for always lifting my spirits during these months of study. Finally, I dedicate this dissertation to my own wonderful and talented children Lauren and John who continue to inspire me.

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CHAPTER I

INTRODUCTION

The human capacity to learn is one of the primary achievements that distinguishes human beings from other animal species. The ability to take in, organize and process vast amounts of information quickly, in order to solve increasingly complex problems, is a uniquely human characteristic. One of the first and most important steps in the learning process is the ability to attend. Attention is a multifaceted phenomenon involving multiple psychological processes and neural mechanisms (Posner and Boies, 1971; Pribram and McGuinness, 1975). It is generally agreed that attention plays an important role in enhancing selectivity and maximizing the intake and encoding of information (Ruff, 1986). In this way, attention allows individuals to focus on particular aspects of the environment and mobilize sufficient effort for problem solving and learning.

Issues of attention and learning are important throughout development. These issues become paramount at school-age, however, when it is noted that deficiencies in attention might be the basis for poor school performance in as many as 5-20 percent of American schoolchildren (Bosco and Robin,1980). As the numbers of school-aged drug-exposed children increase, the interest in issues related to attention and learning in this population has also increased. Before addressing attentional issues in the school-aged child, it seems reasonable to explore the attentional characteristics of younger children. Doing so might provide valuable insights into the attentional characteristics of older children, as well as early intervention strategies to allay future attentional difficulties.

The present study was undertaken to explore the focused attention of toddlers (both drug-exposed and non-drug-exposed) during free play. The neurobehavioral difficulties of drug-exposed newborns and infants have been well documented (Chasnoff,Hatcher and Burns,1982; Finnegan,1988; Hans et al.,1984). As drug-exposed children have matured, developmental sequelae of drug exposure, especially related to attentional issues, has become less empirical and more anecdotal. This may be because the sensorimotor capacities measured by standardized developmental tests do not conceptually or empirically assess the essential components of attention, such as encoding or information processing (McCall and Carriger,1993). Studies are needed to provide information about the attention of drug-exposed toddlers, as part of the developmental continuum between the newborn and infancy period and school-aged children.

Another reason for studying attention in drug-exposed toddlers relates to the ability to predict later developmental outcome from attentional information at 2 years of age. There is some precedent to indicate that prediction might be possible. Habituation and recognition memory have been used to measure constructs of attention in young infants. A recent meta-analysis of 23 habituation and recognition memory studies of risk and non-risk samples in the first year of life found significant prediction to later IQ assessed between 1 and 8 years of age (McCall and Carriger,1993). Predictions were somewhat higher for the risk than non-risk samples. For the risk samples only, however, prediction from these early attention measures was not consistently higher than predicting from standardized infant tests, parental education, or socioeconomic status. Since it appears that prediction from early attention measures is possible, even within high-risk samples, the data generated by the current study may prove useful in later prediction of cognitive development in older opioid-exposed children.

The development of attention is thought to be both biologically and environmentally based. The developing child must be able to neurophysiologically take in, organize and encode environmental information in order to attend to his surroundings. The development of attention is also externally influenced. The child's caregiver, by structuring the environment and the child's experiences within that environment, is able to facilitate the attentional capacities of the child.

Often children will exhibit significant signs of inattention that interfere with their ability to interact with the environment and learn. When such clinical signs are noted, controversy often exists as to the classification of the disorder and the etiology. Previous classifications of such disorders were known as Attention Deficit Disorder (ADD) with and without hyperactivity. The latest revision of the American Psychiatric Association's Diagnostic and Statistical Manual of Mental Disorders (DSM-III-R,1987) has dropped this distinction and redefined the three essential features of attention-deficit hyperactive disorder (ADHD) as developmentally inappropriate degrees of inattention, impulsivity and hyperactivity.

The concept of attention deficit, as applied to ADHD, is broad; that is, concepts such as sustained attention, selective attention, or capacity for attention are not addressed (Ostrum and Jenson,1988). Also, since only 4 of the 14 criteria needed for ADHD diagnosis deal with attentional deficits, and 8 out of the 14 criteria must be present for the diagnosis to be made, it is theoretically possible to make the diagnosis of ADHD without any attentional problems being identified. A new category of undifferentiated attention-deficit disorder (ADD) was also added to the DSM-III-R classification with the caveat, however, that further research is needed to define and validate that syndrome.

In addition to the classification difficulties of attention disorders, the exact nature and etiology of disorders like ADHD are not certain. Controversy clearly exists. Some believe that ADHD is a biologically based dysfunction of the central nervous system caused by such things as oxygen deprivation, genetics, or inhibition of brain neurotransmitters (Johnson,1989; Zametkin,1989). Others believe that a combination of factors, both psychological and biological, are responsible for ADHD (Munoz-Miller and Casteel,1989). While no consensus has been reached, it appears that many risk factors have been found to correlate with increased risk of attentional disorders.

The child who is prenatally exposed to drugs is likely to experience multiple risk factors that might lead to attention problems and later learning difficulties. There is consensus in the substance abuse literature that the development of the drug-exposed child is best understood by considering a multifactorial model consisting of interrelated prenatal and postnatal factors (Tronick and Beeghly,1992; Zuckerman and Bresnahan,1991).

Prenatal drug exposure has been shown to have an indirect effect on the developing fetus by decreasing maternal nutrition or vasoconstriction of the placenta, resulting in hypoxia and decreased prenatal growth (Zuckerman and Bresnahan,1991). Since psychoactive drugs cross the placenta and blood-brain barrier, the developing brain is directly effected also. Significant structural effects on the brain, such as smaller head circumference, and neonatal neurobehavioral disturbances illustrate biological risks to which the opioid-exposed child is subjected. These prenatal biological risk factors might decrease the infant's ability to use his nervous system efficiently to take in, organize and encode information, leading to decreased attentional abilities.

The immature brain,however, has a significant potential for adaptation. Recovery, or plasticity, is greater in the newborn than in the adult, and is facilitated by a favorable caretaking environment (Zuckerman and Bresnahan, 1991). Observations suggest that perinatal factors exert their influence primarily in early infancy, whereas, social or environmental factors predominate in later development (Bee, Barnard, Ayres et al.,1982). For example, methadone-exposed infants had poor motor coordination at 4 months of age, compared to non-drug-exposed infants; this difference, however, almost disappeared at 12 months of age except among infants from families at high social risk (Marcus, Hans and Jeremy, 1982). Also, Lifschitz et al. (1985) found that for infants exposed to opiates in utero, the quality of the postnatal environment and not the amount of drug use appeared more important in predicting developmental outcome.

If a mother abuses drugs, the probability of a disordered, chaotic environment is increased. Drug and alcohol abuse is associated with suboptimal caretaking including child abuse and neglect (Bays, 1990). This suboptimal caretaking would likely lead to dysfunctional interactions between mother and child. Thus, the biologically vulnerable child, who requires optimal caretaking to recover from his prenatal drug exposure, instead may experience dysfunctional interactions which further compound the problem.

A common problem for infants prenatally exposed to drugs is difficulty regulating arousal. Caregivers ideally provide appropriate levels of stimulation when the infant is underaroused, and reduce stimulation when the infant is overexcited. Drug-using women have been shown to interact less contingently with their infants (Householder,1980), therefore, they may not appropriately assist their infants in regulating arousal levels.

Thus, the combination of poor arousal, caused by the direct effects of prenatal drugs, combined with less sensitive caregiving may adversely effect this biologically vulnerable infant and contribute to attentional difficulties such as distractibility and restlessness (Zuckerman and Bresnahan, 1991). The potential risk for attentional difficulties in the opioid-exposed child is best explained by the transactional model of development in which developmental outcome is determined by the dynamic interaction of the child and his social environment.

CHAPTER II

THE NATURE OF DEVELOPMENTAL RISK

As a foundation for the discussion of the risk status of opioid-exposed children it is important to discuss the conceptual framework behind the nature of developmental risk. Developmental outcomes are neither a function of the child alone (his biological or constitutional characteristics) nor based on experience alone (the developmental environment). Rather, development unfolds through a complex interaction in which both biological regulation and experiential influences are substantial. A child's outcome at any point in time is not a function of the initial state of the child nor the initial state of the environment but a complex function of the interplay of child and environment over time (Sameroff and Fiese, 1990). Sameroff's transactional model of developmental regulation illustrates this interaction well (see Figure 1). In this model developmental outcome is a product of the interaction between the phenotype (the actual child), the environtype (his external experience) and the genotype (his biological organization).

First, consider the biological element as it relates to developmental outcome. The immediate and long term

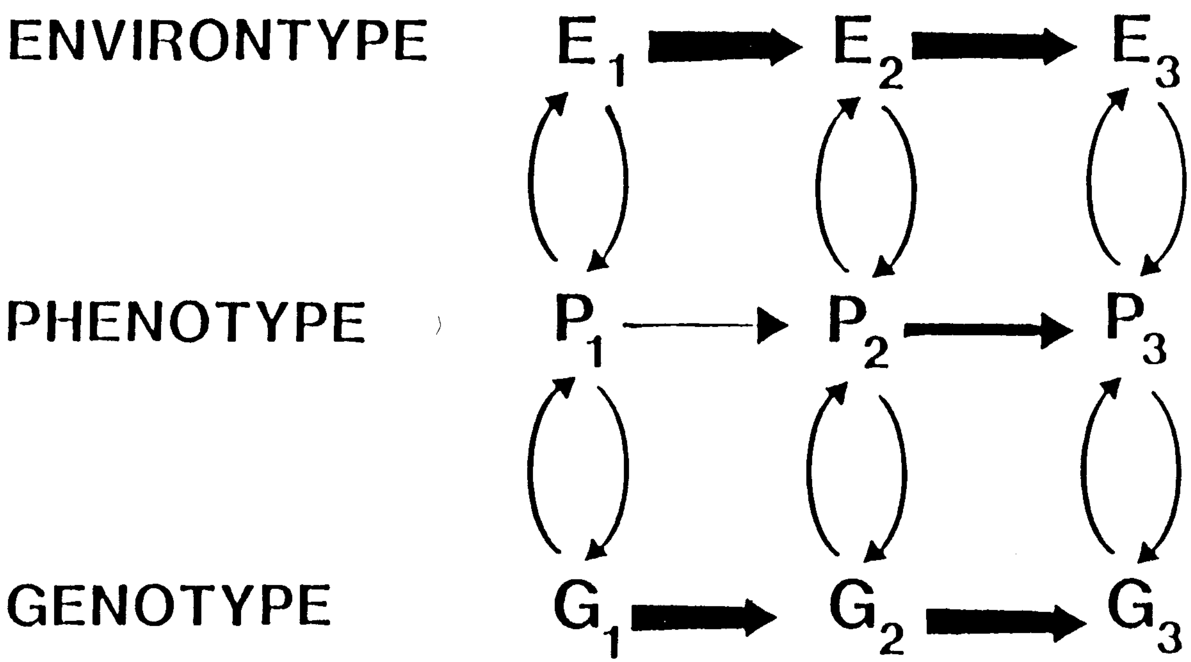


Figure 1 Regulation model of development with transactions among genotype, phenotype, and environtype (Sameroff, 1985)

consequences of biological insults, especially as they affect the developing brain have been extensively studied (Gabriel & McComb, 1985). We have come to recognize the teratologic effects of specific agents and the critical periods in development when biologic insults are most likely to occur (Moore, 1985). Neurologic insult causing injury to the brain can result from infection, exposure to a toxic substance, malnutrition or an hypoxic-ischemic event (Shonkoff and Marshall, 1990). But biologic insults to the central nervous system have variable effects on the developing child. For example some newborns may be quite resilient and survive birth asphyxia without sequelae, while others who experience a comparable degree of oxygen deprivation may manifest signs of cerebral palsy within the first year of life (Nelson and Ellenberg, 1979, 1981). This diversity in outcome reflects both individual differences in constitutional resilience of children and the critical influence of the caregiving environment on early childhood development (Shonkoff and Marshall, 1990).

The effects of environmental risk also appear to be quite powerful. At birth as few as 1 or 2 percent of children are identified as having developmental problems (Knutson,Biro and Padgett, 1987), yet by school age 10% of children require special education. This rate increases to 20% by 8th grade and is doubled again for children from improverished inner city communities (Bernstein, Hans & Percansky, 1991). Much of the increase in developmental morbidity with increasing age can be attributed to the effect of environmental risk on the developing child. For example, low birth weight premature infants often suffer from intraventricular hemorrhage (IVH) (Vaucher, 1988). IVH has been associated with developmental problems such as delayed development, cerebral palsy and learning disabilities, yet the severity of the hemorrhage has not been predictive of developmental outcome, except in cases where massive damage resulted from the IVH. In fact at 3 years of age the cognitive status of premature infants with IVH correlates more highly with socioeconomic status (SES) than with the severity of hemorrhage (Te Kolste, Bennett and Mack, 1985). Prematurity, low birth weight and other indicators of health status are not necessarily predictors of poor developmental outcome per se. Rather, they may place the infant at risk for neurodevelopmental problems and may place more demands on an already stressed caregiving environment (Sameroff, 1986). For example, while most premature infants do not show neurodevelopmental problems, those raised in poverty stricken, stressful environments show a higher incidence of neurodevelopmental deviations (Escalona, 1982).

Several researchers have studied the effects of biological risk factors in the development of infants of minority groups. Field, Widmayer, Stringer and Ignatoff (1980) evaluated preterm infants of teenage parents from a lower SES African-American population. Being premature alone did not affect developmental outcome, however, those premature infants with teenage mothers had lower mental indices at 8 months of age than preterm infants born to adult women.

Although biological risk can interact with social risk to negatively affect developmental outcome, social risk appears to be as strong a predictor of developmental deviation as biological risk (Garcia Coll, 1990). This is illustrated by the work of Bakeman and Brown (1980) who found that preterm infants from low-income African-American families scored lower than full-term infants from the same SES and racial backgrounds at 3 years of age on the Stanford Binet. However, children of mothers who were most responsive (both verbally and emotionally) during a home visit at 20 months exhibited more cognitive and social ability at 3 years of age regardless of birth status. These results highlight the importance of social interactions in the early developmental years.

It is currently accepted that in early dyadic social interactions there is active participation of both partners (infant and mother). Stern (1985) has presented a model for the dyadic system in which the interaction serves as a bridge between two potentially separate subjective worlds (Figure 2). Stern's theoretical view of the infant's development of subjective sense of self leads to the development of an internal working model of himself and of those with whom he interacts. Stern proposes that the

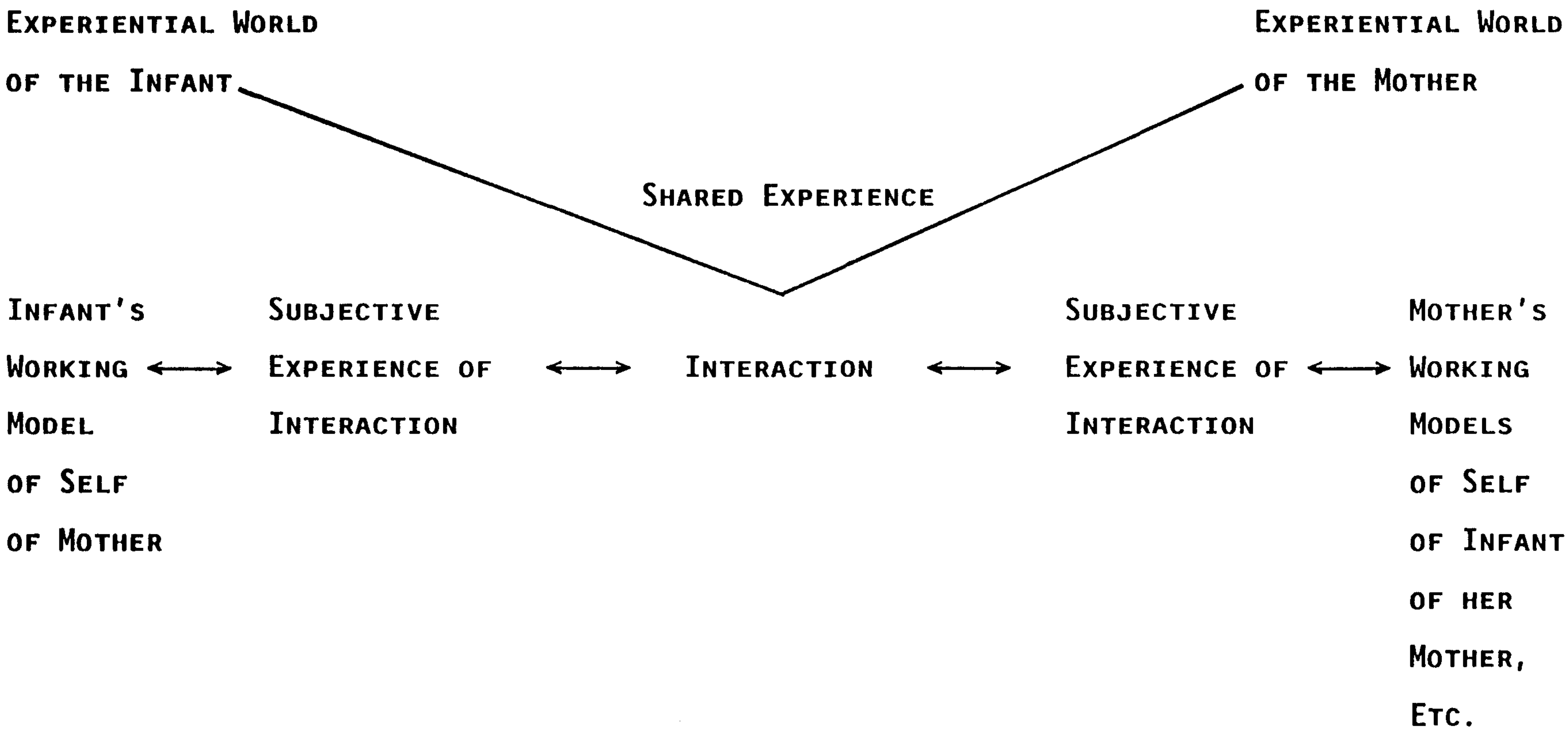


Figure 2. Model of Dyadic Interaction Adapted from D.A. Stern.

infant's internal working models constitute his subjective experience of his interactions. Stern's model of interaction is not symmetrical. One reason for the lack of symmetry is the amount of personal history that the mother versus the infant bring to the interaction. Despite this fact, productive interactions and social growth of the infant depend on active participation of both partners. The infant is not a passive participant but sends lots of cues about his affective state as well as responding to cues from his mother. The rhythm of the dyadic dance is largely regulated by the mother as she helps to shape her infant's responses to allow longer, more complex interactions.

Clearly, an imbalance on either side of the dyadic interaction places the developmental status of the child at risk. It is important to remember, however, that rarely if ever does a risk factor occur in isolation. For example, poor prenatal care and poor nutrition are usually found concurrently with poverty and limited parental education (Bernstein, Hans, and Percansky, 1991; Garcia Coll 1990). In addition, it is the interaction of specific risk factors that ultimately determines outcome for a particular infant. Interaction of multiple risk factors were documented in the following study by Sameroff et al. (1987). In this study of 215 4-year-old children, Sameroff and colleagues assessed a set of 10 environmental variables that are correlates of SES but not equivalents of SES. They wanted to test whether poor development was a function of low SES or the compounding of environmental risk factors found in low SES groups. The variables studied included chronicity of maternal mental illness, maternal anxiety, parental perspectives of their child's development, maternal-child interactions, occupation of the head of household, maternal education, disadvantaged minority status, family support, stressful life events and family size. The results found that the number of risk factors was the prime determinant of outcome within each SES level, not the SES level itself (Sameroff, 1987). It was not any single variable but the combination of multiple variables that was associated with reduced intellectual performance. In addition, the same outcomes were the result of different combinations of risk factors. No single factor was regularly related to either poor or good outcome (Sameroff and Fiese, 1990).

In summary, based on the nature of developmental risk, a multivariate model of development is necessary. The modifying and potentiating effects of the risk factors on any developmental outcome must be considered. The complex pattern that these factors weave cannot be understood by examining the thread of any single variable. It is from this viewpoint that the risk factors of the opioid-exposed child will be examined.

CHAPTER III

LITERATURE REVIEW

The Opioid-Exposed Child

The use of opioids (natural and synthetic forms of opium) dates far back in history. The danger of opioids to the unborn was even mentioned by Hippocrates as 'uterine suffocation', alluding to the toxic effects of opium during pregnancy (Zagon and McLaughlin, 1984). The more addicting effects of opioid drugs during pregnancy were recognized during the nineteenth and twentieth centuries, when women who had taken patent medicines containing opium gave birth to already addicted infants. Since the middle of this century, heroin has been the opioid drug most widely used by Americans, including pregnant women (Hans, 1992). Despite the rise of cocaine use in the 1980's, heroin remains a frequently abused drug during pregnancy.

Starting in the early to mid 1970's, treatment of heroin addiction has been through the daily administration of oral methadone, a synthetic opioid (Hutchings, 1985). Methadone is usually administered in a controlled clinical setting which has provided the opportunity for better prenatal care for pregnant addicted women (Kaltenbach & Finnegan, 1989; Hans 1992). Regardless of the reduced medical risks associated with methadone maintenance during pregnancy, infants exposed prenatally to an opioid substance exhibit a number of biological and behavioral differences from non-drug exposed infants. There are many, many physical and behavioral effects that have been noted in the opioid-exposed infant. This review will attempt to highlight those that are related to general developmental outcome or might be pertinent to the child's attentional abilities.

Newborn Period

A number of studies of infants born to heroin-addicted mothers have found these infants to have decreased birth weights compared to non-exposed infants (Finnegan, 1976; Fricker & Segal, 1978; Kandall, Albin, Lowinson, Berle, Eidelman & Gartner, 1976; Lifschitz, Wilson, Smith & Desmond, 1985; Reddy, Harper & Stern 1971; Stone, Salerno, Green & Zelson, 1971; Wilson, Desmond & Verniaud, 1973; Wilson et al., 1981; Zelson, Ja Lee & Casalino, 1973). Some of these studies compared methadone-exposed infants to controls, while some studies made comparisons between heroin, methadone and non-exposed infants.

While methadone-exposed infants are smaller than control infants, they are generally larger than infants exposed to heroin (Chasnoff, Hatch & Burns, 1982; Finnegan, 1976; Harper, Solish, Purow, Sang & Panepinto, 1974; Jeremy & Hans, 1985; Kaltenbach & Finnegan, 1987; Kandall et al., 1976; Newman, Bashkow & Calko, 1975; Stimmel, Goldberg, Reisman, Murphy & Teets, 1982-1983; Wilson, Desmond & Wait, 1981; Zelson et al., 1973). This increase in birth weight for methadone infants is thought to be due primarily to better prenatal care for this group and better supervision of the mothers' non-methadone drug use (Finnegan, 1976; Green, Silverman, Suffet, Taleporos & Turkel, 1979; Stimmel et al., 1982-1983; Doberczak, Thorton, Berstein & Kandall, 1987; Kandall et al., 1976). Another interesting finding is that rates of prematurity are relatively the same for the methadone-exposed and control infants (Doberczak et al., 1987), indicating that prematurely does not account for differences in birth weight.

In addition to a decrease in birth weight, opioid-exposed infants were also found to have smaller head circumferences (Doberczak et al., 1987; Chasnoff et al., 1982; Kaltenbach & Finnegan, 1987; Lifschitz et al., 1985; Rosen & Johnson, 1982; Wilson, Desmond & Wait, 1981; Wilson, Desmond & Verniaud, 1973).

Doberczak et al. (1987) state that the low birth weights and decreased head circumferences represent the symmetrical type of fetal growth retardation resulting from an insult early in pregnancy affecting fetal cell growth. This premise is supported by Naeye et al. (1973) who found reduced brain and body weight due to reduced cell number in heroin-exposed fetuses studied at gestational ages 30.4 $\pm$ 5.3 weeks.

Intrauterine growth retardation is a risk factor for opioid-exposed infants. First, infants who are not premature but simply small for their gestational age (SGA) have higher mortality rates than appropriately grown infants of similar gestational ages (Koops, Morgan & Battaglia, 1982). Infants who are SGA have a higher prevalence of suboptimal neurobehavioral outcomes and school failure compared with infants whose growth was appropriate for their gestational age (AGA) (Doberczak et al., 1987). For example, a follow-up study of 51 SGA and 51 AGA infants at 5 years of age found the SGA group to score lower on the General Cognitive Abilities (Harvey et al., 1982). The SGA children had more problems on the Perceptual-Performance and Motor subscores. On other measures they had more difficulties understanding and carrying out instructions as well as difficulties with tests of balance and coordination. The documentation of proportional growth retardation of weight and head circumference in opioid-exposed infants poses a potential biological risk to their future neurodevelopmental outcome.

Infants who are exposed to either heroin or methadone are generally born passively addicted. Within one to seventy-two hours after birth, 60-90% of opioid-exposed infants will begin to show withdrawal signs called Neonatal Abstinence syndrome (Finnegan, 1984; Desmond & Wilson 1975). Neonatal Abstinence is a generalized disorder characterized by signs and symptoms of central nervous system hyperirritability, gastrointestinal disturbance, respiratory distress and vague autonomic symptoms that include yawning, sneezing, mottling and fever (see Table 1 for a complete

TABLE 1

SIGNS AND SYMPTOMS OF NEONATAL ABSTINENCE

Hyperirritability

- Increased deep tendon reflexes
- Exaggerated Moro reflex
- Increased muscle tone
- Tremors
- High-pitched cry

Increased rooting reflex

Uncoordinated and ineffectual sucking and swallowing reflexes

Regurgitation

Loose stools

Tachypnea

Yawning

Sneezing

Mottling

Fever

list of signs and symptoms). Withdrawal may occur in a spectrum of severity (Desmond & Wilson 1985). It may be mild and brief, delayed in onset, have a stepwise increase in severity, be intermittently present or have an acute phase followed by subacute withdrawal (Finnegan, 1988). Initially the infant with Neonatal Abstinence may only appear restless. Tremors may begin only when the infant is disturbed and progress to the point where they occur spontaneously. A high-pitched cry and increased muscle tone signal increased irritability. When they are examined, these infants show increased reflexes and a strong rooting reflex. The withdrawing infant can often be found ravenously sucking his fists or thumbs but when fed has extreme difficulty because of uncoordinated and ineffective sucking and swallowing patterns (Finnegan, 1988). As might be imagined interactions with caregivers or their environment in general would be very difficult for these infants.

A number of researchers have documented the neurobehavorial abilities of opioid-exposed infants using the Brazelton Neonatal Behavioral Assessment Scale (BNBAS) (Brazelton, 1973). The main body of the BNBAS consists of 26 behavioral items scored on a nine point scale. Most of the scales are set so that the mid point (5) is considered the average score. The 26 items have been analyzed by many different research samples (Sameroff, 1978) and items have clustered to differentiate eight different factors:

arousal, quieting, hand-to-mouth, motor control, tone, defensive movements, alertness and response decrement.

Seven different research groups have compared opioid-exposed vs. non-drug exposed neonates during the first week of life on the BNBAS. These groups are: (1) Soule, Standley, Copans & Davis (1974); (2) Strauss, Lessen-Firestone, Starr & Ostrea (1975), Strauss et al. (1976); (3) Kron, Kaplan, Finnegan, Litt & Phoenix (1975), Kron, Kaplan, Phoenix & Finnegan (1977); (4) Lodge, Marcus & Ramer (1975); (5) Chasnoff et al. (1980, 1982); (6) Marcus, Hans & Jeremy (1982a), Jeremy & Hans (1985); and (7) Lesser-Katz (1982). These studies have been heterogeneous in their application of methodologic controls. For example, in group #5 (Chasnoff et al.), the methadone-exposed and comparison groups were matched or controlled on background variables such as race, socioeconomic status, gestational age, birth weight and amount of prenatal care. With the exception of #6 (Marcus, Hans & Jeremy) matching of drug and comparison groups, if present at all, was less vigorous. Despite the differences in design, the results between researchers are fairly consistent. Hans (1992) has conducted an in-depth comparison of these studies (see Table 2) and their assessment of opioid-exposed infants on the eight BNBAS factors mentioned previously. The results are summarized as follows:

TABLE 2 Effects of Opioid Exposure on Neonatal Behavior

Authors	Opioid (n)	Comparison (n)	Arousal	Quieting	Hand-to-mouth	Motor control	Tone	Defensive movements	Alertness/orientation	Response decrement
Soule et al. (1974)	19	42	Higher			Poorer	Higher		Poorer	Slower
Strauss et al. (1975, 1976)	46	46	Higher		Better	Poorer			Poorer	Slower
Kron et al. (1975, 1977)	23	10	Higher	Poorer		Poorer				
Lodge et al. (1975)	29	10	Higher		Better		Higher		Poorer	
Chasnoff et al. (1980, 1982)	39	27	Higher	Poorer	Better	Poorer			Poorer	
Jeremy and Hans (1985)	27	44	Higher	Poorer	Better	Poorer	Higher			
Lesser-Katz (1982)	10	14	Higher	Poorer		Poorer	Higher		Poorer	Slower

1. Arousal. This category would include how quickly the infant becomes upset during the course of the examination, how many changes in state are noted and spontaneous activity. There was total agreement among researchers who found the opioid-exposed infants to be more aroused during testing and more easily aroused by less noxious stimuli than control infants.
2. Quieting measures the infant's ability to self-quiet or to be calmed down through a variety of sequential procedures by the examiner. Three of the studies (# 3, 5 & 7) reported that the drug-exposed neonates required higher levels of intervention than the comparison newborns. This is in contrast to two groups (# 1 & 6) who characterized the opioid newborns as demonstrating good consolability and were quick to calm to being held, using a pacifier or swaddling. When examining the range of means on the consolability items, (5.9 for Jeremy & Hans 1985 vs. 4.5 for Chasnoff et al. 1980, 1982) the majority of opioid-exposed neonates could be quieted by being picked up or rocked.
3. Hand to mouth. This item is generally related to self-quieting abilities, but in the opioid-exposed infant is often part of the withdrawal syndrome and associated with frantic sucking. The studies (# 2, 4 & 6) reported an increase in hand-to-mouth actively in the study group. Hand-to-mouth followed by fist sucking appears to be a frenetic almost involuntary activity in

opioid-exposed infants as opposed to an organized attempt at self-regulation (Hans, 1992).

4. Motor Control measures the smoothness and coordination of an infant's movements. In all but one case (#4) the movements of opioid-exposed newborns were noted to be jerky and tremulous.

5. Tone reflects the child's posture relative to the effects of gravity and his muscular response to handling. The majority of studies (# 1, 4, 6 & 7) found the opioid-exposed infants to have increased muscle tone (tending towards hypertonicity) when compared with non-drug-exposed neonates.

6. Defensive maneuver measures the infant's ability to remove a cloth placed over his face and partially occluding his nose (Brazelton, 1973). There were no reported differences between infants in any of the studies indicating that opioid-exposed infants can call forth that automatic protective response elicited by the cloth over the face as well as non-drug exposed infants. This is an important survival mechanism for all infants.

7. Alertness. These items measure the degree of orientation to auditory and visual stimuli as well as the quality of the infants alertness during the examination. Four of the studies (1, 2, 4 & 5) reported a poorer alert response from the opioid-exposed infants. Four groups (1, 2, 4 & 7) reported

that the opioid-exposed infants had more difficulty responding to visual stimuli vs. auditory stimuli. This is not surprising since the visual sensory system is a very strong system that often overrides input from other systems (ie. visual stimuli will predominate over vestibular or tactile/proprioceptive input given simultaneously). As such, visual stimuli may be too potent for the fragile nervous system of the opioid-exposed newborn to handle. It is interesting to note that one group (Jeremy & Hans 1985) found no differences in alertness or orientation to stimuli but they also reported higher levels of missing data for the orientation items. Since these items cannot be administered when the infant is not awake or when he is crying, it is likely that their high levels of missing data reflect the opioid-exposed infant's inability to remain in a quiet alert state.

8. Response decrement assesses the infant's ability to quickly shut out disturbing stimuli (light, sound, pinprick). This ability to habituate quickly is considered an adaptive, protective response. Three studies (1, 2 & 7) found that opioid-exposed infants were slower to habituate to a light stimulus but showed a normal response to the other stimuli.

In summary, the results of the BNBAS indicate that opioid-exposed infants are easily aroused and become upset quickly. Without outside adult intervention to help them calm down, their poor state control and high irritability make them less likely to be able to respond to orientation to environmental stimuli (especially visual) (Jeremy & Hans, 1985). In addition their increased muscle tone and poor motor control might make it difficult for them to move well or respond appropriately to handling by a caregiver.

It is important to note that while some of these studies did not employ tight statistical controls, sound methological controls were carried out by one group. Jeremy and Hans (1985) selected their sample so that drug-exposed mothers and controls were comparable for SES, age, education and parity. All mothers in their sample were receiving good, regular prenatal care and SGA or premature infants were excluded from the study. Examiners were blind to the mothers' drug use and background and the child's perinatal history. Multiple analysis of covariance were run to determine the effect of birth weight, obstetrical and perinatal problems, delivery medication, sex or drug exposure on the neonates behavior. In conjunction with the stringent design and statistical controls, only opioid exposure was found to have a significant effect on neonatal behavior.

Only two research groups have reported the BNBAS at one month of age to document any changes in behavior and/or the continued presence of the withdrawal syndrome. Strauss et al. (1976) reported that opioid-exposed infants still exhibited significant tremors at one month compared to non-drug exposed infants. Jeremy and Hans (1985) reported that methadone-exposed infants are not unlike comparison infants except for the continued increased muscle tone and a continued tendency toward greater arousal, poorer state control and greater motor dysfunctioning.

While the BNBAS provides a subjective assessment of muscle tone, Marcus and Hans (1982a) used EMG recordings as an objective measure of muscle tone. EMG recording from the limbs of 18 opioid-exposed neonates were compared with 26 comparison infants. Higher EMG recordings from both the arms and legs of the opioid-exposed infants were found both at rest and during limb movements.

In addition to EMG, another analysis of activity level can be interpreted from sleep studies done with opioid-exposed infants. Shulman (1969) monitored 8 opiate-exposed newborns and 8 comparison infants during 45 minutes of sleep. Results showed that unlike comparison infants, opiate-exposed neonates rarely entered a quiet sleep state. During active sleep, the opiate-exposed group showed greater REM and body movements than comparison infants. Dinges, Davis and Glass (1980) also investigated sleep patterns in 28 opioid-exposed and 30 comparison newborn infants. Drug-exposed infants averaged significantly less quiet sleep and significantly more active REM sleep than their unexposed counterparts. Also those infants who were exposed to higher doses of methadone had less quiet sleep, more active sleep and were more likely to awaken during testing.

Given the physiological similarities between wakefulness and active REM sleep, the increase in both states reflects elevated activation of the nervous system in babies born with opiate withdrawal (Dinges, Davis & Glass, 1980). As such, studies of sleep states in opiate-exposed infants reflect the state of the nervous systems integrity following prenatal opiate exposure.

Another reflection of nervous system integrity can be seen in brain electrophysiology (EEG). Lodge et al. (1975) examined auditory and visual evolved potentials from 29 opioid-exposed and 10 comparison infants. Both visual and auditory evoked potentials (EEG) from opioid-exposed newborns were more irregular and unreliable than those of the comparison group. Even during quiet sleep, evoked responses showed dysfunctionalized high frequency activity. CNS irritability was thought to be reflected by the early, sharp, high amplitude components seen in auditory and visual evoked responses. The opioid-exposed infants showed a decrease in vertex arousal response to visual stimulation that would correspond to the diminished visual attention noted behaviorally in opioid-exposed infants (Lodge et al., 1975). The infants showed an adequate auditory processing response, however. The regional response pattern to the visual stimuli is suggestive of poor modulation of arousal features of visual input rather than a deficit in sensory processing abilities.

In summary the behavioral patterns of the opioid-exposed neonate are worrisome. These infants are irritable and easily aroused. Their state control problems are also noted by their small proportion of quiet versus active sleep. They demonstrate poor motor control (increased tremors and jerkiness) and increased muscle tone that was confirmed by both subjective ratings (BNBAS) and more objective EMG findings. They appear to orient more easily to auditory vs. visual stimuli. Again this finding was confirmed by laboratory findings of abnormal EEG visual processing that implicated modulation of arousal rather than sensory processing as the source of difficulty. While these problems of state control, motor control and visual orientation may be primarily related to the effects of withdrawal it is important to keep them in mind as later developmental outcomes of opioid-exposed children are reviewed.

Infancy

The Bayley Scales (Bayley, 1969) are the most widely used research tool to chart developmental outcomes up to two years of age. The Bayley Scales consist of three parts the Mental Scale, from which a Mental Developmental Index (MDI) is derived; a Motor Scale which yields a Psychomotor Developmental Index (PDI), and an Infant Behavior Record

(IBR) which provides a more qualitative assessment of the child's behavior during the assessment session.

Six research groups have compared opioid-exposed to non-drug exposed infants using the Bayley Scales. These research groups are: (1) Strauss et al. (1976), (2) Kaltenbach and Finnegan (1986), (3) Kaltenbach and Finnegan (1987), (4) Wilson et al. (1981), Wilson (1989), (5) Rosen and Johnson (1982), Johnson, Diano & Rosen (1984), and (6) Hans (1989), Hans, Marcus, Jeremy and Auerbach (1984), Hans and Jeremy (1984).

Despite the fact that these researchers studied infants of various age groups, from 3 months to 23 months of age, their research findings are remarkably similar. For the opioid and comparison groups, PDI and MDI scores decrease with age. There were few significant differences between the two groups of infants, yet across all six studies, opioid-exposed infants had lower mean scores (though not significantly lower) in all but two cases. Despite the lack of statistical significance, a trend exists for opioid-exposed infants to perform more poorly on both mental and motor skills as measured by the Bayley Scales of Infant Development.

Of perhaps more interest than the MDI and PDI, which provide quantitative data on skills achieved, are the IBR findings. The IBR assesses the quality of behavioral responses, e.g., how a child responds during a test situation. On the IBR, characteristics such as activity level, attention span and coordination can be rated. Only two of the research groups cited above have reported IBR data. Wilson et al (1981) compared 29 heroin-exposed infants vs. 35 methadone-exposed vs. 55 comparison infants at 9 months of age on the IBR. They found that fine motor coordination of the methadone infants was similar to the heroin infants but significantly worse than the drug-free controls. Also the methadone-exposed infants were rated as less attentive than the comparison infants but were similar in decreased attention to the heroin-exposed infants. Wilson et al (1981) point out that while these subtle signs of neurodevelopmental dysfunction may not interfere with the functioning of a one-year old child, they may be indicators of potential learning or behavioral problems at school age.

The other group to report IBR findings is Marcus, Hans and colleagues (Marcus et al., 1982b; Hans and Marcus 1983; Hans et al., 1984). Rather than analyze the IBR on each of its 30 items, they have chosen to organize items that represent certain areas of neurobehavioral functioning into three groups: attention, activity level and motor coordination. The items selected to represent each category include: Attention, responsiveness to objects (Item No 8); goal directedness (Item No. 11); attention span (Item No. 12) and reactivity (Item No. 15): Activity level, activity (Item No. 14) and energy (Item No. 25): and Motor Coordination, gross motor coordination (Item No. 26) and fine motor coordination (Item No. 27). Sums of these items for the areas of attention, activity level, and motor coordination were reported for opioid and comparison infants at 4, 8, 12 and 18 months of age. Activity level, motor coordination and attention increased with age for both groups of infants (Hans, 1992). At four months of age, the opioid-exposed infants were more active than comparison infants, but this difference was not present at older ages. At all ages, opioid-exposed infants had poorer mean scores for motor coordination. Only at 4 months did the differences in motor coordination reach significant levels. At all ages, opioid-exposed infants had lower mean levels of attention (but only significantly so at 12 months).

In addition to standard developmental assessments, Johnson, Diano and Rosen (1984) administered neurological assessments to 46 methadone and 22 comparison infants at 12 months of age and 39 methadone and 21 comparison infants at 24 months of age. There was a greater incidence of abnormal neurological in findings at both 12 and 24 months of age. The abnormal findings included nystagmus and/or strabismus, tone and coordination abnormalities.

In summary, the research studies during the infancy period of opioid-exposed children repeatedly confirm trends for small but non-significant developmental lags as measured by standardized developmental assessments. Qualitative measures of behavior point to consistent difficulties for opioid-exposed infants in poor motor coordination, high activity level and poor attention. The differences in motor coordination and activity level are detected early in the first year of life and may reflect subtle signs of continuing withdrawal (Hans, 1992). The attentional difficulties which are detected later may signal a more permanent syndrome in some children perhaps similar to an attention deficit disorder (Hans et al., 1984).

Early Childhood

As we move from the period of infancy to early childhood, studies of opioid-exposed children become more sparse. Five research groups have reported on the cognitive, neurobehavioral and social functioning in early childhood: (1) Wilson et al., 1979; (2) Strauss et al., 1979; (3) Johnson et al., 1987; Rosen & Johnson, unpublished; (4) Kaltenbach & Finnegan, 1987; (5) Lifschitz et al., 1985. The results of the groups are somewhat mixed. Kaltenbach and Finnegan (1987) found no significant difference on the General Cognitive Index (GCI) of the McCarthy scales or any of the six subscales for a sample of 27 methadone-exposed vs 18 non-drug-exposed preschool-aged children. Strauss et al (1979) studied 33 opioid-exposed children and 30 comparison children. They again found no significant difference between the groups on the GCI of the McCarthy or any of the subscales. The more subjective clinical ratings of the children, however, indicated that the drug-exposed children had tendencies toward poorer fine motor coordination, greater activity during testing and more task irrelevant behavior.

Lifschitz et al (1985) examined 3 groups of children, 25 heroin-exposed, 26 methadone and 41 comparison, at a mean age of 3.5 years. The groups had been matched prior to birth for maternal age, parity, SES and marital status. The mean of the McCarthy GCI were similar for all groups (85.3 ± 15.7 heroin group, 90.4 ± 13.0 methadone group, 89.4 ± 10.8 comparison group). However, there were significantly more scores greater than one standard deviation below the mean (i.e. < 84) in the heroin group (14 children, 56%) than in the comparison group (9 children, 22%). Nine children in the methadone group (35%) scored 1 SD below the mean. Variables shown to have predictive value for intellectual performance were prenatal care, prenatal risk score and Caldwell's HOME Score. The GCI score did not correlate strongly with either head circumference or narcotics usage score. Johnson et al (1987) tested children at 3 years of age on the Merrill-Palmer scale of mental tests (Stutsman, 1931). Thirty-nine methadone-exposed children and 23 non-drug-exposed children showed no significant difference in cognitive test scores although there was a trend for lower scores in the methadone group (51% vs 58%). Suspect and abnormal neurological evaluations were more frequent in the methadone groups (Johnson et al., 1987). The authors did not specify the nature of these abnormalities. A later follow-up of this same sample at age six (N=31 methadone-exposed, N=15 comparison) found significant differences on the perceptual, quantitative and motor McCarthy subscales, with the opioid-exposed children scoring more poorly. The GCI score for the drug-exposed children was 89; for the comparison children, 94.5 (Hans, 1992). Again, Rosen and Johnson (unpublished) found neurological abnormalities in tone, motor coordination, balance and hyperactivity with poor concentration in 45% of the methadone vs 20% of the unexposed children. Ratings on the School Behavioral Checklist found a higher need for achievement, more aggressiveness and school disturbances among the methadone-exposed children. The methadone-exposed groups also had a higher incidence of referrals especially for child developmental and emotional needs (34% vs 0%).

Finally, Wilson et al (1979) conducted a follow-up study of 77 children: 22 heroin-exposed, 20 who lived in a drug-using environment but were not drug exposed; 15 medically high-risk based on factors like Intrauterine Growth Retardation (IUGR); and 20 children with normal pre- and postnatal histories but from non-drug using environments of the same SES as the drug-exposed group. On psychomotor testing, the heroin-exposed group scores were within normal ranges, but they often scored significantly poorer than the comparison groups. On the Illinois Test of Psycholinguistic Abilities, the heroin-exposed and drug environment groups scored more poorly on the auditory memory subtest, while the heroin-exposed and high-risk groups were below group means on visual closure. Heroin-exposed children scored more poorly on the GCI and perceptual performance, quantitative and memory subscores of the McCarthy Scales. On a perceptual test battery, the heroin-exposed group performed more poorly than the combined control groups on measures of visual, tactile, and auditory perception. Behavior problems noted to be significantly different for heroin-exposed children, as rated by parents, included uncontrollable temper, impulsiveness, poor self-confidence, aggressiveness and difficulty making and keeping friends. The examiner ratings of the groups found the heroin-exposed children to be more active but they did not differ on ratings of attention, cooperation or alertness.

In summary, the studies of preschool-aged opioid-exposed children show little difference from comparison children on general cognitive abilities; however many studies indicate they appear to have difficulties with perceptual processing. This difficulty does not appear to be related to a specific sensory deficit but rather to a general processing problem (Wilson et al., 1979). Further, opioid-exposed children frequently display a number of behaviors (high activity, impulsivity, poor motor coordination, and poor performance on cognitive tests that require focused attention) that are characteristics related to an attention deficit disorder (Hans, 1992).

School-Aged Children

Little information is available on the development of older opioid-exposed children. Funding for longitudinal studies is very difficult to obtain and maintain and samples are difficult to retain. Only one, reseach group was able to follow their subjects to school age. Despite a cut in funding, Wilson (1989) followed subjects from previous samples (Wilson et al., 1973, 1979) to elementary school ages. Reports of school performance were obtained for 40 heroin-exposed children. The children were tested on a variety of IQ tests such as the Weschler Intelligence Scale for Children-Revised (WISC-R) or the Wide Range Achievement Test (WRAT). At the time that the school reports were obtained, 70% of the heroin-exposed children were in first or second grade; the remaining 30% were in grades three through five. The school reports showed that an astounding 65% of the heroin-exposed group had repeated one or more grades or required special education services. The mean IQ for the 40 subjects was 87.5 ± 16.8, with 40% of the heroin-exposed children scoring greater than one standard deviation below the norm. The Bender Gestalt Test of visual-motor performance was administered to 27 of the 40 children. Twenty six percent (7 of 27) had standard scores greater than 2 SDs below the mean on this test.

Behavior reports from school and parental reports and from psychologist's and pediatrician's observations found that two-thirds of the 40 heroin-exposed children were judged to have problematic behavior. School ratings on classroom performance of 31 children reported lack of self-discipline and inattention for half of the sample. Low self-confidence and poor peer relations were also noted.

All the studies reviewed thus far indicate that opioid-exposed children do differ from non-drug exposed children at least in some regard. As a group, opioid-exposed infants are smaller in weight and head circumference and exhibit dramatically altered behavioral responses related to opioid withdrawal. Past the neonatal period, opioid-exposed infants are more likely than non-drug exposed infants to exhibit neurological signs including hyperactivity, motor incoordination and attention problems (Hans, 1992). By school age these same children often are at risk for academic and behavior-related difficulties.

Many of the standardized assessments used, however, have failed to detect differences between drug-exposed and non-drug exposed children. Developmental differences have been mainly detected by more subjective and qualitative ratings of blind examiners indicating that developmental problems of drug-exposed children many be more subtle ones. Hans (1992) suggests that 'sensitive measures of psychological processes might reveal differences between these groups of children' and 'measures of specific attentional and motoric processes would seem to be good candidates for future studies' (p41).

Multivariate Analysis of Risk

Unfortunately many of the studies reviewed thus far implicitly or explicitly relate problems in developmental outcome to the direct teratologic or toxicologic effects of the opioid substance (heroin or methadone). As was discussed earlier, rarely, if ever, is one risk factor the cause of a developmental problem. The cause and effect relationship in development is not a linear one. Certainly the behavioral problems of the neonate that are related to signs of neonatal withdrawal suggest a more direct biological cause of developmental problems. But beyond the signs of neonatal abstinence which are highly specific and time-limited, any later developmental outcome must be related to the interaction of drug abuse variables and the child-rearing environment. To investigate these relationships, one must move away from a univariate model to multivariate models of analysis. Confounding variables must either be matched between groups or accounted for by statistical analysis.

The Wilson et al. (1979) study provides a good example of a multivariate model of analysis. The four groups of preschool children in that study (heroin-exposed, drug environment, high risk and SES-control) were matched for age, sex, ethnic group and SES. Additional variables of prenatal care, educational level and occupation of parent or parent substitute, physical condition of the home and parental attitudes did not differ between the groups. The one factor that did differentiate the heroin group from the comparison group was that the heroin-exposed group commonly lived with a substitute mother (50% were in foster care by the newborn period). Wilson (1989) contends that important factors such as the child's age and developmental stage at the time of separation, number of times the primary caregiver has changed, and quality of life with the substitute parent would be important to determine the impact of separation from mother. Wilson et al. (1979) found that while the heroin-exposed group fell within the normal range, they performed more poorly than the comparison groups on physical, intellectual, perceptual and behavioral measures. The drug environment and high-risk comparison groups, subject to sociocultural and perinatal risk factors, fell between the heroin and control group indicating that these two variables may contribute but do not account entirely for the low performance of the heroin-exposed group. Wilson et al. (1979) concluded that the functional deficits noted in heroin-exposed children appear to be primarily related to maternal heroin use rather than other extraneous variables. One caveat noted by Wilson and confirmed by many is that opioid using women, including those on methadone maintenance are frequently simultaneous users of nicotine, alcohol, marijuana, barbiturates, benzodiazepines or cocaine (Hans, 1992). Therefore the effects of polydrug use on developmental outcome must be considered.

Results that oppose maternal drug use as the prime factor in determining developmental outcome are presented in a multivariate analysis by Lifschitz et al. (1985). Their regression analysis failed to find a relationship between intellectual function at age 3.5 years and maternal narcotic score, birth size or severity of neonatal abstinence.

Instead, amount of prenatal care, prenatal risk score, and home environment were most predictive.

Another approach to multiple variables is illustrated in the study reported by Hans (1989). In this study 30 methadone-exposed and 44 comparison 24-month-old children and their mothers were matched for race, SES, educational level and marital status. There were differences between the groups for maternal psychiatric functioning. On DSM-III ratings of severity of psychosocial stressors and highest level of adaptive functioning, the methadone mothers showed much poorer functioning than comparison mothers. The methadone mothers also had more pregnancy and birth complications (excluding methadone use). An initial analysis of growth parameters, and mental and motor behavior found the drug-exposed infants to be functioning more poorly. Next, three factors that represent nonteratologic aspects of risk (SES, maternal intelligence, and pregnancy and birth complications) were used to dicotomize the sample into high and low risk groups for each factor. The interaction between high and low risk groups and drug use on developmental outcome was examined. Both high and low risk methadone-exposed infants scored more poorly than high and low risk non-drug exposed infants on head circumference, motor coordination, body tension and acquisition of motor milestones. This suggests that there may be a small direct teratologic effect of opioids on these measures. Most interesting was that only the high risk methadone-exposed infants scored more poorly on cognitive measures. This suggests that in the cognitive domain, methadone-exposure may not have a direct effect but instead create a vulnerability in children reared in extremely poor environments that make that make them more susceptible to cognitive deficits (Hans, 1989). Hans and her colleagues have presented a good example of variable levels of risk factors that may differentially affect developmental outcomes.

A final example of multivariate analysis with opioid-exposed children is from the work of Johnson et al (1987). This group employed a path analysis of variables to explain outcome at 36 months of age in a sample of 39 methadone-exposed and 23 drug-free children. From the path analysis, it is possible to distinguish one variable's direct effect upon another from its indirect effect, mediated by intervening variables. Their goal was to clarify the impact of perinatal, maternal, and environmental variables on developmental status at age three. Much information on the mother-infant pair was gathered and grouped into six factors for analysis. The factors were Maternal medical history (MATHIST), Adverse maternal practices (ADVPRAC), Maternal functioning (MFUNC), Complication of labor and delivery (LABDEL), Neonatal complications (NEONATE), and Chaotic living conditions (SDISORG). [See Table 3 for definitions of the six variables.] First, the results of their study as discussed previously, found a higher incidence of suspect or

TABLE 3

COMPOSITION OF FACTORS IN THE PATH MODEL

Factor Name	Content of Factor Sample Variables
Maternal history (MATHIST)	Maternal medical history and complications of past pregnancies, e.g. gravida, hypertension, neonatal anomalies or death.
Adverse practices (ADVPRAC)	Maternal adverse practices during this pregnancy, e.g., alcohol, amphetamines, barbiturates, cigarettes, cocaine, dalmane, elavil, hallucinogens, heroin, methadone.
Maternal functioning (MFUNC)	Maternal functioning, e.g., level of education, employment history, history of mental illness.
Labor and delivery (LABDEL)	Complications of labor and delivery, e.g., augmented labor, maternal fever, prolonged labor (> 12 hours).
State of the neonate (NEONATE)	Neonatal complications, e.g., heart murmur, birthweight < 5 1/2 pounds, narcotics abstinence syndrome, neurological abnormalities, premature (<36 weeks), sepsis.
Social disorganization (SDISORG)	Chaotic living conditions, e.g., frequent moves (> 3 in 6 months), family violence, crowding (> 4 people in single bedroom dwelling).

abnormal neurological findings for methadone-exposed infants at 36 months of age. The path analysis found that both neonatal complications and chaotic living conditions showed significant direct effects at 36 months. Also, chaotic living conditions was significantly affected by adverse maternal practices and maternal functioning. The authors conclude that maternal adverse practices (i.e. drug abuse) did influence developmental outcome but much of this influence occurred through the indirect influence of adverse practices on the child's family and home life, and then indirectly on the child's status at 36 months. Therefore maternal drug abuse per se is not the most discriminating indicator of risk, rather family characteristics and functioning are important determinants of developmental outcome in this high-risk group.

Parent-Child Interactions

The last risk factor to be discussed that might have an impact on the development of the opioid-exposed child is the area of parent-child interactions. As discussed in Chapter II, early social interactions have an effect on the developmental status of the child. It is important to have a parent who is able to support the competence and developing sense of self in the child. This support encourages the child to continue to seek and master increasingly complex problems. In this way, the foundation of basic trust, exploration, interaction and learning between parent and child will be established (Bernstein, Hans and Percansky, 1991; Emde, 1983; Erikson 1963; White 1959). A nurturing relationship with an adult has been shown to be a critical protective factor in the lives of children who experience multiple risks. This nurturing relationship has enhanced their resiliency and had a positive impact on their developmental outcome (Werner, 1988).

Limited information is available on the parenting behaviors of drug-using mothers. Wellisch and Steinberg (1980) conducted a parenting attitudes survey of four groups of 25 women each consisting of 1) addicted mothers 2) addicted non-mothers 3) non-addicted mothers, 4) women who were neither addicts nor mothers. The results found that the addicted mothers were extremely high on a factor labeled "authoritarian overinvolvement." This factor included such subscores as Intrusiveness, Breaking the Will, and Avoidance of Communication.

Bauman and Dougherty (1983) compared 15 methadone-maintained mothers (MM) and their preschool children with 15 non-drug addicted mothers (NDA) and their preschool children on the mother's personalities and parenting attitudes, the mother-child interaction and on the children's developmental levels. The results showed that there was no difference on parenting attitudes between the groups. The MM mothers however performed less adaptively on measures of personality and parenting behavior. The MM group showed higher levels of impulsivity, irresponsibility, immaturity and selfcenteredness. When interacting with their children, the MM mothers exhibited a more threatening disciplinarian approach and provided more negative feedback than the NDA mothers. The NDA mothers in addition to using more positive feedback, seemed to foster more autonomy in their children by allowing them to experiment more than MM mothers did with their children. In this study, the children of MM mothers performed more poorly on intelligence tests, had shorter attention spans and less perseverance than children of NDA mothers.

Householder (1980) reported on the interactions of opioid-exposed and drug-free mother-infant dyads at three months of age. The opioid-using mothers demonstrated more physical activity and less emotional involvement in communicating with their infants. The drug-using mothers appeared either unresponsive, distant and uninvolved or intrusive and unable to allow their infants time alone.

Fitzgerald, Kaltenbach and Finnegan (1990) evaluated patterns of interaction in 21 drug-dependent women (DDW) and their infants and 28 non-drug exposed dyads. The dyads were videotaped at birth and at four months of age. DDW and their newborns scored lower in quality of dyadic interaction and poor in social engagement on the Greenspan, Lieberman Observational System (Greenspan et al., 1983). DDW showed less positive affect and greater detachment, while drug-exposed newborns showed fewer behaviors promoting social involvement. At four months of age there were no differences in interactions between the two group; yet DDW had higher levels of negative affect and detachment that correlated with stressful life events.

Johnson and Rosen (1990) also videotaped mother-child interaction from 75 drug-exposed dyads (no comparison groups) at 2, 4, and 6 months. They also included maternal and observer ratings of infant attention and intensity of maternal drug abuse. The results showed the following: There was little agreement between mother reports at 9-months of age and observer ratings of infant temperament at the earlier ages. There was relationship between maternal ratings and drug abuse. As drug abuse scores increased, maternal reports of negative infant characteristics increased. There was no relationship between intensity of drug abuse and maternal responsiveness. The authors report that overall levels of interacting and vocalizing were very low with little variability and may have resulted in a floor effect. Finally maternal ratings of infant temperament and maternal responsiveness were related such that mothers who rated their infants as positively responsive were rated similarly by observers.

Bernstein, Jeremy and colleagues (Bernstein, Jeremy Hans and Marcus, 1984; Bernstein Jeremy & Marcus, 1986; Jeremy and Bernstein, 1984) also rated interactions with 4 month-old infants and their mothers. The observations were made on 17 methadone-exposed dyads and 23 comparison dyads. Mothers were rated for their psychological and psychosocial resources for maternal functioning, irrespective of drug use. Infants were rated using the Bayley scales including the IBR. In regard to communicative functioning in dyadic interaction, mothers who performed more poorly were likely to have poor maternal resources. Thus level of maternal resources, not drug use per see, was predictive of maternal interactive performance. Infants with poor communicative interactions were likely to show motor dysfunction as noted on the IBR related to greater tension and poorer coordination relative to activity level. Neither mothers dosage or length of methadone use, nor obstetrical risk scores, birthweight or gestational age correlated significantly with the infants' interaction scores.

In summary there is evidence that the child-rearing environment of opioid-exposed infants may be different from that experienced by non-drug exposed infants. Drug-exposed mothers typically appear to have poorer resources than non-drug exposed mothers, thus they appear less able to support competence and a developing sense of self through positive interactions with their children. Similarly opioid-exposed infants through the combined effect of biologic and environmental factors may not be primed to interact positively.

Attention

Early interactions set the tone of the child's approach to the world (Sroufe, 1978) as well as his ability to focus and sustain attention and effort on learning (Matas, Arend &

Sroufe, 1978). How might disordered interactions as well as the additional biological and environmental risk factors mentioned in this section effect the opioid-exposed child's abilities to attend? In order to understand this possible impact a brief discussion of the determinants of attention is warranted.

Attention is an entity that is commonly recognized as an important factor in learning. Attention has long been recognized as a primary requisite in all learning, yet the child's ability to attend is a process that has been developing since birth. The following is a brief overview not of the neurophysiologic models of attention but of the behavioral requisites of attention in the developing child.

The development of attention is both an internal (biological and behavioral) process and an external environmentally organized one. Biologically, the process of attention demands that the infant must be neurophysiologically capable of taking in, organizing and encoding environmental stimuli. Stern (1985) helps us understand the behavioral part of the development of attention as part of the infant's development of his sense of self. From birth to two months of age, Stern believes the infant is forming an emergent sense of self. The infant is experiencing the organization of sensory perceptions and experiences in the world within and around him. For example, the infant may respond to an auditory stimulus (clicking sound) by turning his head (proprioceptive input) in order to find the sources of the sound (visual orienting). The ability to take information received from one sensory modality and translate it into another sensory modality has been termed "amodal perception." The early ability appears to allow the infant to "yoke together" a number of sensory experiences that prepare the infant to begin to participate in unconsciously organized interactions with his caregiver which further enhances his emergent sense of self. The infant's world of emerging organization forms the foundation for the subsequent development of the other domains of sense of self. The other senses of self (core self, subjective self and verbal self) will be outgrowths of this original organizing process called emergent sense of self.

Now that the organization process has begun, from two months on, infants begin to develop an integrated sense of themselves as distinct and coherent bodies. The development of this "core sense of self" includes the development of self-history (memory), which provides the infant with continuity in his experiences. As the infant develops, he has the capacity for episodic memory which allows actions, perceptions and affects of an event to be remembered.

There are two physiologic attentional processes, habituation of visual attention and recognition memory, that can be seen in the context of Stern's development of a sense of self. As the infant is exposed to an increasing number of environmental stimuli his emergent sense of self develops, which helps him organize his perceptions, and he shows habituation -- that is, a decrement in attention to a stimulus that is repeated or displayed continually (Bornstein & Ruddy, 1984). Also, through his developing core sense of self, his expanding self-history includes recognition memory -- that is the reduced attention an infant shows to a familiar stimulus vs. a novel one.

In addition to these internal attentional processes, Stern's development of sense of self also helps us understand the interactions of internal and externally motivated aspects of attention. Stern believes that beginning at about seven to nine months, the infant next develops a sense of subjective self. Now that the infant has a strong sense of physical and sensory distinction of self from other (core self), he is able to experience shared feelings, shared meanings and intentions. He experiences a kind of psychic intimacy, such that being able to share feeling with another helps him define those feelings for himself. The infant participates in this phase of intersubjective relatedness and communicates by pointing, facial gestures, and visual contact that, without language, show that the infant is sharing an affective state.

The gesture of pointing and the act of following another's line of vision are among the first overt acts that permit inferences about the sharing of attention or the establishment of joint attention (Stern 1985). Collis and Schaffer (1975) have shown that mothers' ability to follow an infant's line of vision, constantly following and monitoring where her infant looks, is an important feature of inferring the focus of his attention. They found a general tendency for mothers and infants to look toward the same object, rather than toward different objects. They frequently noted that mothers not only looked toward the same object as their infants, but would then elaborate on their mutual interest by pointing (to the toy), verbally labelling it and talking about it, thus potentially expanding their infants' visual attention to that object.

But infants also participate in the establishment of joint attention. Scaife and Bruner (1975) have shown that an infant as young as 4 months can follow an adults line of vision when the adult turns away from the infant after having established eye contact. Murphy and Messer (1977) found that nine-month-olds could detach their gaze from a pointing hand and follow an imaginary line to a target. This ability of the infant and mother to share joint attention, and the mother's capacity to extend her child's visual attention illustrate the environmental influence on the early development of attention.

Attention and Learning

There is research available that link the factors of attention and learning. Especially in infancy, however, when development does not always occur in a linear fashion, and the motor requirements of infant tests may obscure cognitive abilities, predictability is often poor (Bornstein and Ruddy, 1984). However the attentional processes of habituation and recognition memory, mentioned earlier, have shown some predictive validity to more mature cognitive functions.

Habituation reflects efficiency in encoding environmental information by showing a decrement in attention to repeated stimuli. Miller and colleagues (Miller, Spiridigliozzi, Ryan, Callan & McLaughlin, 1980) found significant correlations between the amount of habituation in four-month-old infants and their performance at 14 months on measures such as object permanence, language comprehension, paired-associate memory and visual discrimination. Further, discriminate analysis found that the rate of visual habituation predicted performance on the cognitive measures. The authors suggest that children characterized as fast habituators may be somewhat cognitively advanced compared to slow habituators.

Recognition memory, is defined as reduced attention to familiar objects and increased attention to novel objects. Lewis and Brooks-Gunn (1981) found that recognition memory at 3 months correlated with Bayley Scale scores at 2 years. While these attention scores at 3 months were significantly related to later cognitive functioning, the cognitive measures at the same point in time were not predictive of performance at 24 months. This relationship between recognition memory and cognitive function was reported for two different samples (n=22, n=57) who were tested at different times, 5 years apart. Lewis and Brook-Gunn (1981) conclude that individual differences in attentional abilities may relate to CNS function and as such may be useful measures of intellectual capacity. Further, they propose that attentional ability (especially response recovery, the return of attention to novel stimuli) may represent one of the earliest components of intellectual functioning and may have predictive usefulness for later intellectual abilities.

Fagan and McGarth (1981) studied recognition memory as a measure of attention in 93 children from 3 different samples. Each child was tested on recognition memory during infancy (between 4 and 7 months) and later tested on the Peabody Picture Vocabulary Test (at 4 to 7 years of age). With each sample Fagan and McGarth (1981) found a significant relationship between an infant's visual preference for novel stimuli and later vocabulary tests of intelligence. The results were not influenced by sex or SES. Fagan and Singer (1983) summarize the findings of predictive studies of early visual recognition memory and later intellectual functioning as follow: "There is a reliable association between early recognition memory and later intelligence. The association.... seems to hold for each sex, across differences in socioeconomic status, for a variety of early recognition memory tasks, across different paradigms for assessing infant memory, for initial tests made between 3 and 7 months and for intelligence measured from 2 to 7 years" (p 65). These findings were corroborated in a recent meta-analysis of 23 habituation and recognition memory studies. For risk and non-risk samples alike, results from early attention measures predicted later IQ assessed between 1 and 8 years of age (McCall and Carriger, 1993).

Kopp and Vaughan (1982) studied 76 preterm infants on measures of sustained attention at 8 months of age. Four exploratory schemes (looking without contact, holding and looking, manipulating/examining, and mouthing) were summed and used to measure sustained attention (EXPLORE). Non-exploratory attention to mother or to the environment was also summed and treated as a variable (LOOK). Multiple regression analysis found that the EXPLORE variable but not the LOOK variable contributed significantly to the prediction of the score on the Bayley MDI at 2 years. The authors suggest that individual differences in sustained attention can be useful predictors of cognitive functioning as early as the first year of life. They speculate that these early differences in sustained attention may be predictive of later attentional processes associated with educational difficulties.

Focused Attention

Unfortunately as noted by Kopp and Vaughan (1982) the development of sustained attention has rarely been examined in young children (under age 5). The work of Ruff and colleagues (Ruff, 1986; Ruff, 1988; Parrinello and Ruff, 1988; Ruff and Lawson 1990; Ruff, Lawson, Parrinello and Weissberg, 1990) stands as an exception to that statement. Ruff et al. have attempted to distinguish focused attention from more casual attention in infants and young children. Ruff (1986) believes that attention plays an important role in learning by enhancing selectivity, and maximizing the intake and encoding of information.

Focused attention at one year of age is much the same as examining behavior, that is, it usually includes looking while fingering or turning the object around with an intent expression on the face (Ruff, 1986). In infants, examining is distinguished from mouthing and banging. In older children focused attention includes deliberate manipulation of an object with an intent facial expression while looking at the object (Ruff and Lawson, 1990). Attention was not considered by Ruff to be focused if a) the child was talking even when looking at the toys, b) the child's eyes scanned the toy collection, or picked up toys in succession, c) the child played in a stereotyped repetitive manner (i.e. rapidly pushing a car back and forth, d) the child was laughing and smiling or e) the child was only looking at one of the toys without engaging in any activity (Ruff and Lawson, 1990).

Discussions of attention in the literature differentiate two components of attention. Although these components are often identified by different terminology they appear to be addressing similar constructs. Berlyne

(1970) differentiates the intensive aspect of attention from the selective aspect. The intensity, or degree to which attention is concentrated on something, is distinguished from the direction of attention to certain aspects of a stimulus rather than others. Cohen (1972) has similarly differentiated between the attention-getting and attention-holding aspects of attention. His research suggest that the two processes are affected by different stimulus characteristics. That is, certain salient features relate to getting attention to an object, while other characteristics help in maintenance of attention. Finally Porges (1974) has discussed a reactive component, a short-lived response to a stimuli, versus a sustained component that involves a more long-term alteration in state. These different components have been demonstrated by phasic and tonic heart rate changes during attention.

Ruff also identifies 2 different aspects of attention in her work. The amount of time it takes for an infant to begin examining an object (latency to examine) and duration of examining, (total time in focused attention) were thought to represent two different attentional constraints. To test the hypothesis, Ruff (1986) conducted a number of studies. In the first study, 24 7-month-old and 18 12-month-old full-term infants were videotaped while sitting on their mother's lap. Each infant was presented with six objects, one at a time, for one minute each. Examining, mouthing and banging were recorded. The results showed that examining but not mouthing and banging decreased as the children became more familiar with the objects. Ruff proposes that examining (focused attention) involves the active intake of information and decreases as the child habituates to the object. Examining occurs before other behaviors. Older infants had shorter latencies to examine, indicating that youngers infants take a longer time to organize an exploratory response to novel objects. In this study duration of examining was not different between the 7 and 12- month olds.

In the second study, Ruff (1986) attempted to support the premise that latency and duration represented two distinct processes. Ruff hypothesized that if latency to examine reflects the time it takes to organize a response, then it shouldn't be affected by familiarity, whereas duration would be so affected. To examine this hypothesis, 20 7-month-olds and 20 12-month-olds were presented with one object for three familiarization trials, and then with a second object that differed from the first in one structural detail. As predicted, latency to examine did not decrease over the trials but did decrease with age. Duration of examining did decrease over the trials but was longer in the 12-month-olds. The author concludes that length of examining was more affected by the particular objects used than by age.

The results of the first two studies were confirmed in a third study of 6, 9, and 12-month-old infants. The results showed a significant difference in latencies to examine between the different-aged infants, but no significant difference in duration to examine.

Finally Ruff (1986) attempted to demonstrate the different constructs of latency and duration of examining by correlating them with related aspects of attention in older children. It was hypothesized that latency to examine at 9 months of age would be related to reaction time at 3 1/2 years, since both behaviors relate to the time required to activate a response to an object or signal. Duration of examining at 9 months would be related to the number of times out of seat at 3 1/2 years, as a measure of ability to sustain attention to a task. Thirteen 9-month old infants were again tested at 3 1/2 years of age. At this later testing the Stanford Binet was given (and times out of seat recorded) as well as a reaction time task. The results did show that latency to examine at 9 months did correlate to reaction time but not times out of seat at 3 1/2 years. Also duration of examining at 9 months was significantly correlated with time out of seat but not reaction time.

Ruff (1986) states that these four studies suggest that two different attentional processes are involved. Length of examining involves sustained attention and encoding of information, while latency to examine reflects the time it takes to activate attention and the information gathering system. As such, the latency measure is a more phasic response related to arousal, alerting and orienting.

Latency, therefore, could be referred to as preattentive. The duration of examining, representing the active intake of information, would appear to be a good index of infant attention. The duration of examining rather than being preattentive, represents a more tonic change in state and involves behavior that may have longer-term effects such as learning (Ruff 1986).

Ruff and Lawson (1990) have attempted to document the development of sustained attention in young children during free play. Sixty-seven children were videotaped at 1, 2 and 3.5 years of age during free play situations where they were presented with a tray-full of toys while seated at a table. The time for free play was increased from 2 to 5 to 7 minutes as the children got older. Dependent measures were focused attention (as defined earlier) and casual attention defined as the total time with eyes on toys minus the duration of focused attention. Studies indicate that when children concentrate intensely, they may be less distractible (Richards, 1987; Anderson, Choi & Lorch 1987); therefore, distinguishing between focused, more effortful attention and more casual attention is considered important (Ruff & Lawson, 1990). The results of the longitudinal study showed that the total duration of focused attention increased linearly with age. Both the frequency and mean duration of episodes of focused attention increased with age. Casual attention was found to be higher in 1 year olds but did not differ at 2 or 3.5 years of age.

Ruff and Lawson (1990) followed the development of focused attention using a cross-sectional sample of children at 2.5, 3.5 and 4.5 years of age. Sixteen children of each age were videotaped during a 10 minute free play situation similar to the previous study. Dependent measures included focused attention, quiet inattention (duration of time at the table with eyes off the toys), and type of play (inspection, manipulation, construction, pretend, problem solving and unnesting the barrels). The results showed that total duration of focused attention increased with age while active inattention decreased with age. There is a difference in focused attention vs. attention in general, however, since focused attention increased 98% from 2.5 to 3.5 years but total duration of orientation to toys increased only 7% during those years. Episodes of focused attention were almost always preceded by orientation to the same object vs. active inattention, orientation to a different object, or quiet inattention. This indicates that focused attention requires some time to organize. That is, a child may orient to a toy but needs a few seconds to mobilize more concentrated involvement with it (Ruff and Lawson, 1990).

The types of play during focused attention changed with age. While there was little difference across age in the amount of focused attention during inspecting and manipulating, 4.5 year olds focus more attention on construction and 3.5 and 4.5 year olds showed more focused attention in play with the nesting barrels than did 2.5 year olds. While Ruff's earlier studies (1986) showed no increase of focused attention with age (7 to 12 month olds) these later studies showed increases of focused attention with age. Ruff and Lawson (1990) suggest that the increase of focused attention may be due both to more interest in what can be done with the toys (noted by increasingly complex play in the older children) and by general increases in self-control as noted in the marked decrease in active inattention (getting up from the table) in older children.

Ruff (1988) has investigated attention in high-risk infants in a number of studies. The first involved 24 full-term infants and 18 very low birth weight infants (<1500 gms). At 7 months corrected age, these infants were rated for examining, mouthing and banging behaviors during a one minute presentation for each of six toys. The results showed that the preterm infants examined less than the full-term infants. The full-term infants showed the shortest latency to examine while the preterm infants did not show different latencies for examining, mouthing or banging. This indicates that preterm infants demonstrated attention behaviors typical of younger infants.

In a second study of attention behaviors in high-risk infants, Ruff (1988) studied 30 very low birth weight 9-month-olds and 20 full-term infants of the same age. There was initially no difference in examining between the groups. When the preterm infants were divided into high-risk and low-risk groups, however, according to early history and early neurobehavioral functioning, the high-risk group showed significantly less examining. Twenty-four of the 30 preterm 9-month-old infants were evaluated at 3 and 4 years of age using the Stanford-Binet. The correlation of duration of examining and Stanford-Binet scores was significant and positive. That is, the longer the duration of examining at 9 months the higher the IQ at 3 and 4 years. The author concludes that duration of examining is very much related to risk status.

In a final study of high-risk infants, Ruff (1988) studied 65 preterm infants at 12 months corrected age. Again the groups were divided into high and low risk. The low-risk infants were faster to examine, showing better organization of attention, even when differences in the Bayley MDI scores were accounted for. Ruff (1988) has demonstrated that low birth weight preterm infants may have early attentional difficulties. These difficulties may be found either in their selectivity to stimuli (seen by a longer latency to examine) or in the intensive aspects of attention (seen in their decreased duration of examining).

Ruff and colleagues (Ruff, Lawson, Parrinello & Weissberg, 1990) have examined the predictive nature of early measures of attention and later attentiveness by following 91 full-term infants and 63 preterm infants from 1, 2 to 3.5 years of age. The pre-term infants were seen at their corrected ages and were an average of 1200 gms at birth and 31 weeks gestation. The children were tested in a similar manner to the previously reported free play studies as well as a more structured manner (administration of Bayley Scales at 1 and 2 years, and Stanford-Binet at 3.5 years). Dependent measures included: focused attention, quiet and active inattention during free play and structured tasks, a delay task, task with mother, reaction time (3.5 only), rating on Conner's hyperactive subscale (3.5 only). These above measures constituted the quantitative measures. Qualitative ratings of attentiveness based on general attentiveness of the child on a three point scale were made from videotapes of the child's performance during the free-play, mother-child interaction and delay tasks. Multiple canonical analyses were done with this myriad of data. A summary of the results showed that for the group as a whole, and the full-term infants separately, the quantitative measures of inattention at 2 years were predictive of the same measures at 3.5. For the preterm infants only, quantitative measures at 1 year were predictive of behavior and mothers rating on the Conner Scale at 3.5 years. For full-term infants separately, and the group as a whole, the qualitative ratings of attention at 1 and 2 years were predictive of the mother's ratings on the Conner Scale, but also predictive of the quantitative measures of behavior at 3.5 years. There appears to be some stability in behavioral measures of inattention from 2 to 3.5 years especially for full-term infants. Also qualitative and quantitative measures of attention provide different but useful information about preterm and full-term toddlers of different ages (Ruff et al 1990). Ruff's work, both longitudinal and cross-sectional, with full-term and preterm infants, has set the stage for application of this measure of attention to other high risk groups.

Parent as Facilitator of Attention

The research on the role of the parent as a facilitator and developer of attention in the infant, and the effect of this facilitation on development, is the last group of studies to be reviewed. The parents' ability to affect the child's attention may provide a means of developing a sense of competence in the child. Parents can encourage a child to participate in cognitive activities of daily life by organizing a task so that the adult can handle the more difficult aspects of the task but involve the child in parts of the activity which are within his/her grasp. Thus, the adult creates supported situations in which the child can extend current skills and knowledge to a higher level of competence (Rogoff, 1990). As the parent helps the child move from his/her actual level of development (as determined by individual problem solving) toward a higher level of potential development (as determined by problem solving with adult guidance), the parent creates for the child his/her "zone" of proximal development (Vygotsky 1978 a and b). The role of adult guidance in this problem solving has been described by Wood, Bruner and Ross (1976) as consisting of these functions:

1) Recruitment - enlisting the problem solver's interest in and adherence to the requirements of the task.
2) Reducing the degrees of freedom - simplifying the task by breaking it down into manageable component parts.
3) Direction maintenance - keeping the child motivated and on target to complete the task.
4) Marking critical features - accentuating certain features of the task that are relevant.
5) Frustration control - making problem solving less stressful.
6) Demonstration - modeling solutions to the task with the hope that the child can imitate or attempt to imitate some portion of the task.

The role of adult guidance in problem solving is however not invariant. For parents whose lives are constantly stressed, there may be few moments when they can focus on their child in a supportive and sensitive manner, since their personal resources are likely depleted (Rogoff, 1990). For example, Tronick and Field (1986) found that depressed mothers were less sensitive in their interactions with their infants by either avoiding interaction or interacting in an intrusive manner that was not in synchrony with their child's behavior.

Riksen-Walraven (1978) proposes that the contingent responsiveness a child receives strengthens exploratory behavior and produces a perception of self-efficacy in the child. This contingent reinforcement creates an expectancy of self-efficacy in future experiences (see Figure 3). On the other hand, the child who experiences very little reinforcement of his behavior will build up the expectancy that he will not be successful and therefore will show less exploratory behavior in new situations. This model of competence defined by exploration, and responsiveness to contingent stimulation by the parent is useful in understanding the role of parent as a facilitator of infant attention.

Riksen-Walraven (1978) attempted to confirm this model by studying 100 9-month-old Dutch infants and their caregivers (primarily mothers). All subjects were from working class families where the amount of stimulation provided to infants, and responsiveness of parents was thought to be relatively low. The parent-infant dyads were divided into 3 groups to evaluate the effects of stimulation and responsiveness on the infants exploratory behavior. Group one (Stimulation group) had a program aimed at enhancing the amount of stimulation provided to the infant's from the caregiver. During a home visit this group received a 50-page workbook and play materials that emphasized providing the infant with a great variety of perceptual experiences (visual, auditory and tactile-kinesthetic). The

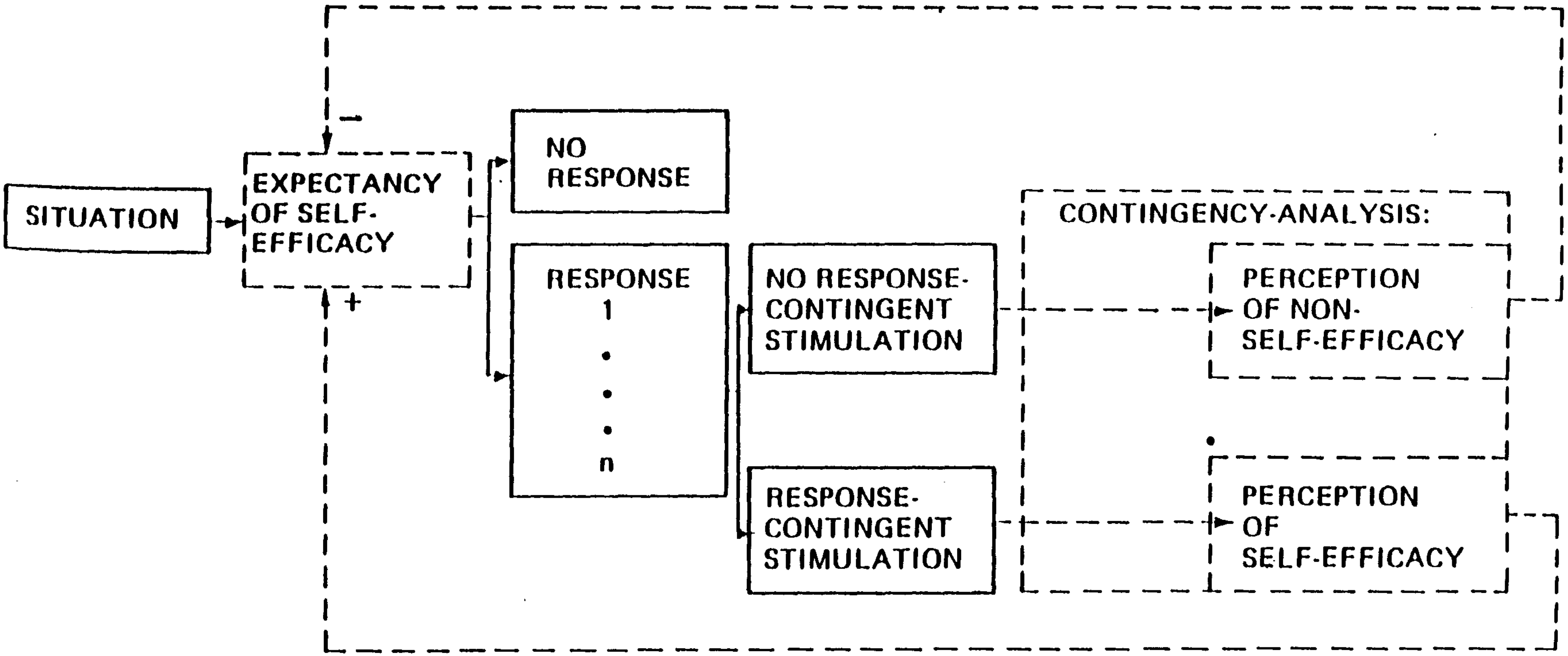


Fig. 3 Schematic representation of how response-contingent stimulation influences exploratory behavior. The dotted arrows and squares represent cognitive, not directly observable, processes.

second group (Responsiveness group) had a program intended to heighten the caregiver's responsiveness toward the infant. They also received a workbook that stressed that infants learn most from the effects of their own behavior. Caregivers were advised not to direct the child's activities too much, but to be responsive to his initiations for interaction. The third group, (Stimulation-Responsive) received a combination of both workbooks in which both principles of stimulation and responsiveness were demonstrated and emphasized. Pre- and post test data were collected during 2 home visits each, on positive stimulation and responsiveness of caregiver, habituation rate and exploratory behavior of the infant, and on contingent reinforcement as measured through an operant conditioning procedure, in which the infant learned to push a button to turn on a lighted slide. Caregivers who received the stimulation program showed higher stimulation scores than those who did not receive the program. Caregivers who participated in the responsiveness program were more responsive toward their infants at the post-test than caregivers who did not receive such a program. Enhancing the amount of stimulation the caregiver provided had a positive effect on the infant's habituation rate but <u>not</u> his exploration and contingency scores; heightening the responsiveness of the caregiver had a positive effect on the infant's exploration and contingency scores, but <u>not</u> on his rate of habituation. These results seem to confirm the model of Riksen-Walraven (1978) that response-contingent stimulation to the infant increases his exploration and learning.

Ruddy and Bornstein (1982) also studied the effects of maternal stimulation and infant attention during the first year of life. They studied 20 term infants at 4 months and again at 12 months of age. The results showed that infants who habituated faster at 4 months had higher Bayley scores and larger speaking vocabularies at 12 months. Babies who frequently manipulated objects or who more frequently vocalized at 4 months had similar positive results. Finally mothers who more frequently encouraged their babies attention to stimuli at 4 months had babies with larger speaking vocabularies at one year of age. Since mother-infant interaction is thought to be bidirectional, the question remained as to whether maternal stimulation fosters cognitive development or whether infants who exhibit more verbal responsiveness elicit more maternal attention. Ruddy and Bornstein (1982) found that maternal stimulation of attention at 4 months reliably predicted infant vocabulary size at 12 months ($r=.55$, $p=.01$). This mother-infant relationship remains substantial even when the effect of 4-month infant vocalization or the effect of 12-month maternal stimulation is partially out.

Bornstein and Ruddy (1984) compared 11 sets of twins to the 20 infants previously described. The twins were all full-term and healthy and similar to the singletons at 4 months on active looking and manipulation, rate of habituation and recognition memory. It is known, that mothers of twins encourage each baby's attention to the environment less than half as often as do mothers of singletons. If maternal encouraging attention in early infancy is a factor in later competence, then speaking vocabulary and Bayley scores would be expected to be lower. Bornstein and Ruddy (1984) found that twins use less than one-half as many words as singletons do at 1 year, and twins pass only three-quarters as many Bayley items.

Landry, Chapieski and Schmidt (1986) investigated the relationship between maternal attention-directing strategies and infant response levels during 12-month old play interactions in 40 preterm infants (subdivided into two risk groups) and 20 full-term infants. Mothers of full terms used questions more often to direct attention than either of the pre-term groups. Mothers of the preterm infants tended to use attention directing verbs more often than mothers of full-term infants; this appeared to be related to the severity of medical complication associated with prematurity. Mothers of the high-risk preterm infants attempted to direct their infant's attention more often than mothers of low-risk preterm or full-term infants. While mothers of preterm infants were found to use different attention-directing strategies than did mothers of full-term infants, these differences did not adversely affect the infants' response to toys. In fact, the mothers of the preterm infants may have been responding contingently to their infants' need for a higher degree of external structuring in order to organize their responses.

Belsky, Goode and Most (1980) studied the relationship of maternal stimulation and infant exploratory competence using a cross-sectional/correlational design. Eight infants at each of these ages (9, 12, 15 and 18 months) and their mothers were observed at home. They found that mothers increased their physical prompts and language to direct their infant's attention during the last quarter of the first year of life. In response to the rapid increase of language in the second year, however, mothers use increasingly more verbal attention-directing strategies. A correlational analysis of the data found that infants who displayed the greatest competence while exploring had mothers who frequently focused their attention on objects and events in the environment.

Belsky, Goode and Most (1980) also attempted to manipulate maternal attention focusing behavior to determine its effect on children's exploration. A sample of 16 1-year olds was randomly assigned to an experimental or control group. The experimental group was visited once a week for 3 weeks. During each visit, the examiner observed the mother-infant pair and pointed out the mother's attention-focusing strategies to make her aware of her own spontaneous stimulating activity. The control group had 3 home visits without intervention. Follow-up visits at one week and two months post-intervention assessed the mother's stimulation level and the infant's exploratory competence. Results demonstrated that experimental mothers stimulated their toddlers significantly more than control mothers at the one-week post-test. Also the experimental infants engaged in more competent play than control infants two months after the intervention. The authors conclude that maternal attention-focusing behavior is causally related to infant functioning. The results support the hypothesis that maternal stimulation teaches the child how to focus his/her own attention and thereby enhances his/her exploratory competence. This is in agreement with Riksen-Walraven's models of the development of competence as stated previously.

Parrinello and Ruff (1988) studied the effects of adult intervention on infant's level of attention to objects by systematically manipulating the amount of adult intervention provided to 84 10-month-old infants during play with objects. It was hypothesized that there would be a curvilinear relationship between degree of intervention and attention, and that infants classified as low attenders would respond better to higher levels of intervention, with the opposite occurring for high attenders. The 84 infants were identified as low or high attenders. All infants were assigned to either a low, medium, or high intervention group, or a no-intervention control group. Levels of intervention were controlled by systemically varying the manner and frequency with which objects were presented, the extent of verbalization by the examiner, and physical proximity. Infant attention was defined as the duration of time spent examining objects. The overall duration of infant attention was increased during medium levels of intervention compared to controls. Infants classified as low attenders attended more during medium and high intervention levels, whereas the high attenders were unaffected by the level of intervention. It should be noted that no level of intervention brought the low attenders to the same duration of attentiveness evidenced by the high attenders either during intervention or at baseline. The results of this study again corroborate the premise that the ability to attend relates to both the child's spontaneous ability to focus on objects and his response to environmental stimulation.

A child's ability to attend, explore and learn is dependent to some extent on the appropriateness of adult-child interactions. Barnard has proposed that two important characteristics necessary for high-quality parent-child interactions are a sufficient repertoire of available maternal behaviors and the ability to produce contingent responses (Huber, 1991). A parent's ability to mediate the environment to foster cognitive and social-emotional growth relies on knowledge of the child's current developmental level, knowledge of the next level of skills the child is working toward, as well as sufficient motivation, energy and ability to engage the child in activities promoting growth (Huber, 1991). A parent's sensitivity to child cues is affected by the parent's ability to "read" and interpret the child's behavior as well as by life stresses (financial, emotional, etc.) that the parent may be experiencing.

Barnard et al (1989a) has developed the NCATS (Nursing Child Assessment Teaching Scale) as one tool to measure parent-child interaction. This scale consists of 73 binary items that measure both parent behaviors (sensitivity to cues, response to distress, social-emotional growth fostering, and cognitive growth fostering) and child behaviors (clarity of cues and responsiveness to parent). The scale is used from birth to age three to rate parents teaching their child an age appropriate skill. Normative data was collected on 922 teaching scales in which 85% inter-rater reliability was achieved. The NCATS has shown moderate concurrent validity to the Caldwell HOME (r=.44, 1-12 months; r=.48, 13-24 months; r=.41, 25-36 months) (Huber, 1991). In addition the NCATS at 4 months has shown predictive validity to expressive language scores at 36 months (R^2=.76) and the NCATS at 10 months (in infants and mothers at social and medical risk) predicted the 24 month Bayley MDI (R^2=.48) (Huber, 1991).

The NCATS has used to assess the interactional environment of children of maternal substance abusers (MSA). The children (age 1-3 years) were black, from low socioeconomic status group, and had mothers who had abused either or both alcohol or cocaine. The scores of the MSA group were compared with the NCATS normative data sample (largely white, middle class women and children). The scores of the MSA group were significantly lower for the NCATS total score and all parent subscale scores (Free, Russell and Mills, 1989). Comparisons were also made to the scores of a sample of black adolescent mothers from the same neighborhood and same SES as the MSA families. There were no significant differences between this sample and the MSA group except that the MSA scored better on NCATS social-emotional growth fostering subscale. Because the MSA group was older and more mature, they may have been more intuned to the social-emotional needs of their children; this might explain the higher scores for the MSA group on this subscale.

In summary, it appears that parents may indeed be facilitators of their child's ability to explore and learn. The NCATS appears to be a valid and reliable scale for documenting parent-child interaction, the parent's ability to be contingently responsive, and indirectly their ability to facilitate learning.

CHAPTER IV

PURPOSE/HYPOTHESES

The previous literature review provides the empirical background behind the premise that opioid-exposed children might be at risk for attentional difficulties. The conceptual framework of this study suggests that drug exposure is only one risk factor that might potentiate problems with attention. Other potentiating factors include, but are not limited to, pregnancy and birth complications, being raised in a drug-using environment, maternal psychiatric functioning and parent-child interaction.

The primary purpose of this study was to describe the focused attention of opioid-exposed toddlers compared to non-drug exposed children. The second purpose was to explore the relationship between focused attention and aspects of the child's behavior such as activity level and attention span. The third purpose was to investigate the relationship between a mother's teaching style and her child's level of focused attention. The following specific hypotheses were tested:

1. Opioid-exposed 24-month-old children will show decreased focused attention during free play compared to non-drug-exposed children of the same age.
2. There is a significant relationship between the child's behavioral characteristics during free play and the amount of focused attention demonstrated.
3. There is a significant relationship between the parent's teaching style and the child's ability for focused attention during independent play.
4. Among opioid-exposed toddlers, those who experience multiple additional risk factors will show greater decreases in focused attention compared to toddlers who experience fewer risk factors.

CHAPTER V

METHODOLOGY

Subjects

The subjects in this sample were part of a larger study of developmental consequences of prenatal methadone exposure (Hans, 1989). The sample consisted of 74, 24-month-old children who were recruited during their mother's pregnancies and involved in longitudinal developmental follow-up at the University of Chicago. Thirty methadone-exposed toddlers and 44 non-exposed toddlers were studied. The opioid-using mothers were all involved in low-dose methadone-maintenance programs for the treatment of chronic heroin addiction; their dosages during pregnancy ranged from 3 to 40 mg per 24-hour period with a mean of less than 20 mg. Most had been involved in methadone-maintenance throughout pregnancy; some had sought treatment during pregnancy. Most of the women occasionally used other drugs in addition to methadone, most commonly alcohol, marijuana, heroin, cocaine, Valium, or Talwin. The mothers selected for this study were between the ages of 18 and 35. Mothers who had chronic medical problems such as diabetes, or obvious mental illness were excluded from the study.

The comparison mothers were recruited from the same prenatal clinics. In addition to the age requirement and illness exclusion criteria used for the methadone group, women were excluded from the comparison group who had any reported history of opioid use or abuse or who consumed more than one drink a day of alcohol. Mother's drug use status was determined both through their self report on the University of Washington Pregnancy and Health Questionnaire and by repeated urine toxicology screening during pregnancy.

The two groups were comparable on key demographic characteristics. The mothers of all of these children were black and from low-income inner city neighborhoods. The mothers from both groups had completed an average of eleven years of formal education (mean IQ over 90) and were typically unmarried. All of the women received good quality prenatal care. All infants remained with their mother's or father's family after birth.

There were differences however between the groups of mothers in psychiatric functioning. On the DSM-III ratings of severity of psychosocial stressors and highest level of adaptative functioning, the methadone mothers scored more poorly than comparison mothers (Hans, 1989). Methadone-using women also experienced more pregnancy and birth complications as assessed by the Rochester Research Obstetrical Scale (Zax et al 1977) (with methadone use omitted as a complication).

Procedure

Data were drawn from videotaped sessions of 24-month-old children and their mothers, including a short free play session and a parent-child teaching task. Rodning, Beckwith and Howard (1990) have studied drug-exposed toddlers in both structured and unstructured tasks. They found that unstructured assessments that required the child's initiation, goal setting and follow-through were more revealing of developmental disorganization than were structured assessments such as developmental tests.

The free play session lasted approximately 3 minutes ($X=202.7$ sec $\pm$ 28.3 sec). During this time eight different toys or toy sets were simultaneously placed on the floor for the child to play with (see Appendix A for toy list). The child played a short distance from his/her mother, but the mother was instructed to let the child play alone. From the videotape of this session, a computer program was written to record the following:

1) The total time of the session (seconds).

2) Total focused attention (seconds). Focused attention was defined as the time when a child holds an object and eye and hands are coordinated in examining the object. Attention was not considered focused if a) the child picks up toys rapidly in succession (there is attention for less than one second), b) the child plays in a stereotyped repetitive manner, c) the child's

talking or laughing disrupts his visual concentration.

3) A ratio of focused attention and total play time. This ratio was necessary since not all sessions were of equal length.

4) The number of toy changes. A toy change was defined when a child holds and focuses on a new toy (holding alone is not sufficient).

5) Ratio of toy changes per total play time.

6) Duration of each episode of focused attention (See Appendix B for Sample of Data Collection Sheet).

It was necessary to investigate both the ratio of focused attention and the ratio of toy changes because these two ratios may relate information about different aspects of attention. Ruff (1988) suggests two different patterns of attentional difficulties. The first pattern relates to the child who demonstrates longer latencies to respond to the novelty of an object with examining. This pattern would be expected to result in a shorter duration of total focused attention. The second pattern relates to difficulty with the integrative aspects of attention, that is, the child would have difficulty sustaining attention for very long. With this pattern of inattention the child may satiate more rapidly because he/she is not as sensitive to feedback and reinforcement (Barkley,1985). This pattern shows normal reactivity but unusually fast habituation which might result in a high toy change ratio. Therefore, based on these two different patterns of inattention both focused attention and toy changes were examined.

Qualitative aspects of the child's behavior during the free play session which might be associated with focused attention were rated using selected items from the Infant Behavior Record (IBR) of the Bayley Scales of Infant Development (Bayley 1969). The Bayley IBR consists of 30 items rated on a 2,5 or 9 point scale. Items that reflected the child's comfort in the free play situation, attention and activity level were chosen by two psychologists and the principal investigator. On this basis the following items were chosen to represent each category: Comfort level, Fearfulness (No. 5); general emotional tone (No. 7); Attention, Responsiveness to objects (No. 8); plays imaginatively with materials (No. 9); shows persistent attachment to any toy (No. 10); attention span (No. 12); Activity level, activity (No. 14); and energy (No. 25).

Ruff et al. (1990) found that general qualitative measures of attention at one and two years of age were predictive of more quantitative measures of attention at three and a half. The Bayley items were proposed to provide that same type of qualitative information related to attention in this study.

Finally, the mother's teaching ability was rated from the videotape segment in which she was instructed to help her child play with a shape sorter (twelve plastic blocks, round, square and rectangular shapes fit into a container with a lid having the corresponding shapes). The rating scale contained 23 items that were taken from the Barnard Teaching scale (Barnard, 1989) or were adapted to fit the context of this teaching task. The items investigated the following areas: 1) sensitivity to the child's cues 2) social-emotional growth fostering 3) cognitive growth fostering. (See Appendix C for Scale Items). The first section of the teaching scale, sensitivity to cues, assesses the parent's attention focusing abilities. The social-emotional growth fostering section evaluates the parent's contingent responsiveness toward the child. For example, does the parent smile at the child and praise his successes. Finally, the cognitive growth fostering section evaluates the parent's ability to encourage independent exploration and problem solving in her child. As discussed in the literature review, contingent responsiveness of a parent and attention-focusing behavior have a positive effect on increasing the child's exploration and learning (Riksen-Walraven, 1978). Such maternal stimulation teaches the child how to focus his own behavior, thereby enhancing his attentional abilities.

The child's behavior during the teaching task was also assessed. Again some of the items were taken from the child portion of the Barnard Scale or were developed to investigate the following areas: 1) clarity of the child's cues, 2) responsiveness to parent, 3) problem solving ability (See Appendix C for Scale Items).

In summary, the major variables coded from the videotapes were:

1) Focused attention rate (Focus Rate)
2) Toy change rate (Change Rate)
3) Child's behavior rating (IBR items)
4) Mother's teaching ability - Barnard scale items

Variables 1-3 were coded during the free play session. Variable 4 was coded during the shape sorter task.

<u>Data Analysis</u>

Reliability. Interrater reliability was studied for the dependent measures listed above. The principal investigator and an independent examiner participated in a training session to clarify scoring of the teaching and behavior scales and to learn to use the computer program to score focused attention. Following the training session, ten videotaped subjects were rated independently by the two raters on the three measures. For the behavior scale a weighted Kappa was calculated. This is the statistic of choice with ordinal data like the behavior scale where items are rated on different point scales and when a particular one category disagreement could be rated more heavily than another (Kramer and Feinstein, 1981). The weighted Kappa for the behavior scale was .70. For the teaching scale, reliability was measured using the Kappa statistic, since this statistic is the index of choice when measuring agreement with nominal data (Kramer and Feinstein, 1981). A standard Kappa of .64 was calculated.

Intraclass correlation coefficients (ICC) were calculated for focused attention and toy change ratios. The ICC was chosen over the Pearson r since the ICC accounts for systematic error while the Pearson r does not (Shrout and Fleiss, 1979). A repeated measure analysis of variance (ANOVA) model was used to determine the ICC. An ICC of .93 was calculated for focused attention ratio and .82 for the toy change ratio.

Plan for statistical analysis. In order to test the first hypothesis that infants who were drug-exposed had decreased focused attention, a number of analyses were planned. First, t-tests would be computed to examine the direct effects of drug exposure on the dependent measures of focused attention. If there were simple drug effects, then potential confounding or mediating background variables would be explored. As described in Jacobson and Jacobson (1990) extraneous variables would be considered in data analysis only if correlated both with drug exposure and outcome variables. If no simple drug effects were found, extraneous variables would be analyzed for suppressor effects. Finally, analyses of variance would be run to examine the moderating effects of drug exposure; moderating effects would be reflected in statistical analyses as exposure by background variable interaction effects (Jacobson and Jacobson, 1990).

To test the second hypothesis, Pearson correlations would be computed for the child's behavioral characteristics (IBR items) and rate of focused attention and toy changes to examine the relationship between behavior and focused attention during free play.

To test the third hypothesis concerning a relationship between the parent's teaching style and the child's focused attention a number of analyses would be conducted. First, correlations between the parent's teaching style and the child's focused attention would be computed. Path analyses (various multiple regressions) would be run to clarify the relationship between parenting variables and the child's attentional abilities.

To examine the final hypothesis regarding the effect of multiple risk factors on focused attention a new variable would be created that combined risk factors including background variables and parent's teaching ability. Correlations of this multirisk variable and focused attention would be computed.

CHAPTER VI

RESULTS

Hypothesis I: Drug Effects

First, differences based on prenatal exposure to drugs were examined for all measures of focused attention using t-tests (see list of variables p. 85). There were no significant differences in focused attention, number of toy changes during free play, behavior of the child, or mother's teaching ability based on prenatal drug exposure (Table 4). Therefore, there appeared to be no direct effects of prenatal drug exposure on the dependent variables measured.

Second, variables were examined for possible suppressor effects (Cohen and Cohen, 1975). That is, if some extraneous variable or variables were correlated both with drug exposure and focused attention, these variables might suppress or obscure the exposure-attention relationship and lead to a Type II error, ie. that no effects of prenatal drug exposure on focused attention would be found when in fact a relationship exists. Hans (1989) previously identified several background variables and child outcomes that were significantly different for the drug-exposed infants including: ROS scores (pregnancy and birth complications), mother's adaptive functioning (AdFunct) and stressors (both measured prenatally), infants birth weight (BW), and Bayley PDI scores at 24 months (See Table 5).

TABLE 4

DIFFERENCES BASED ON PRENATAL DRUG EXPOSURE

	Drug-Exposed Mean S.D.	Comparison Mean S.D.	t	p
Focus rate	0.31 0.13	0.35 0.15	1.36	.18
Change rate	1.6 0.82	1.6 0.94	0.13	.90
Behavior ratings				
Fearfulness	2.6 2.1	2.3 1.9	0.83	.41
Emotional tone	6.1 1.4	6.0 1.2	0.52	.60
Responsiveness to objects	5.2 0.68	5.1 0.97	0.59	.56
Plays imaginatively	2.0 0.18	1.8 0.39	1.94	.06
Persistent attachment	1.7 0.45	1.7 0.48	0.67	.51
Attention span	4.4 1.1	4.4 1.5	0.22	.83
Activity level	4.9 1.5	4.9 1.6	0.19	.85
Energy level	2.9 0.89	2.8 0.81	0.30	.77

TABLE 4 (continued)

Maternal Teaching Scale				
Sensitivity to cues	1.8 0.22	1.7 0.27	1.44	.15
Social-emotional growth fostering	1.8 0.22	1.8 0.19	0.10	.92
Cognitive growth fostering	1.9 0.20	1.9 0.18	0.62	.54
Clarity of cues	1.4 0.32	1.4 0.28	0.05	.96
Responsiveness to parent	1.2 0.23	1.3 0.29	1.73	.09
Problem solving ability				
Quickly successful	1.2 0.43	1.3 0.45	0.38	.71
Assistance < half of the session	1.2 0.38	1.3 0.44	0.85	.40
Assistance > half of the session	1.5 0.51	1.4 0.50	0.85	.40

TABLE 5

VARIABLES SHOWING SIGNIFICANT DRUG-USE EFFECTS

	Drug-Exposed Mean S.D.	Comparison Mean S.D.	T	P
PDI	100.8 12.7	108.5 14.6	2.3	.02
ROS	5.3 2.9	3.6 2.4	2.8	.006
Adaptive Functioning	4.8 0.82	3.3 0.78	8.0	.0001
Stressors	4.7 0.70	4.3 0.42	3.6	.001
Birth Weight	2862.4 605.2	3230.6 395.5	3.2	.002

None of these extraneous variables, however, were also related to the attention variables and thereby could not be acting to suppress any drug effects (Table 6).

The moderating effect of background variables was also investigated. If a background variable could be found to delineate a differentially vulnerable subgroup it would qualify as a moderating variable. For example, if only male children were affected by drug exposure, then sex of the child would be considered a moderating variable. Statistically, a variable would have a moderating effect if it interacts with drug exposure in predicting a dependent variable. Because Hans (1989) had found moderating effects of certain risk factors on developmental outcome with this same sample, it was important to look for the interaction of certain dependent variables with drug exposure, in affecting attention. Sex was chosen as a moderating variable to evaluate any differential male/female effects on focused attention or toy changes. The variables of SES, IQ and ROS were chosen as moderating variables since these had been previously used by Hans to dichotomize this same sample. These three variables represent non-teratological aspects of risk. Low SES environments might represent a more chaotic environment that might be expected to have a negative effect on attention. Likewise, mothers of low IQ might be expected to interact less contingently with their infants, thus differentially affecting their attention spans. Those with higher pregnancy and birth complications (ROS scores) might

TABLE 6

CORRELATIONS BETWEEN DRUG EXPOSURE AND EXTRANEOUS VARIABLES WITH ATTENTION MEASURES

	Drug status	ROS	BW	Ad Funct	Stressors	PDI
Focus rate	-.16	.12	-.04	.04	.02	.07
Change rate	-.02	.15	-.03	.01	.07	.19

be at higher risk for biologically induced attention difficulties. Finally, stress, adaptive functioning and Barnard scale scores were chosen to represent maternal functioning that could affect the child's ability to attend. Based on the risk groups examined, there were no significant drug by other variable interaction effects on rate of focused attention or toy changes. No differentially vulnerable subgroup could therefore be identified.

Thus, based on the examination of direct drug-use effects, and moderating variable effects, there is no support for the hypothesis that prenatal opioid-exposure would affect the focused attention of 24-month-old children during free play.

Hypothesis II: Behavioral Characteristics

The second hypothesis to be tested in this study was that a significant relationship existed between the child's behavioral characteristics during free play and the amount of focused attention demonstrated. To test this hypothesis, Pearson correlations were run between the behavioral characteristics (IBR items) and rate of focused attention and rate of toy changes. Table 7 presents the Pearson correlations. These correlations show a number of significant relationships between the child's behavior and ability to focus attention during free play. Children who were more fearful had lower attention rates and fewer toy changes. Children rated as more responsive to the toys had longer focused attention. Those children rated as

TABLE 7

PEARSON CORRELATION MATRIX:

ATTENTION MEASURES WITH IBR ITEMS

IBR items	Focus rate	Change rate
# 5 Fearfulness	-.296**	-.281*
# 7 Happiness	.026	.200
# 8 Responsiveness	.553**	-.020
# 9 Imaginative play	-.056	.082
#10 Persistent attachment (low score=more attachment)	-.046	.339**
#12 Attention span	.604**	.028
#14 Activity level	-.269*	-.127
#25 Energy level	-.239*	-.171

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

persistently attached to a specific toy changed toys less often. Longer focused attention was noted in those children who were rated high in attention span. Finally, the higher a child's activity level and energy rating, the lower his focused attention. These significant correlations between the child's behavior ratings and focused attention rates support the hypothesis that qualitative aspects of a child's behavior and quantitative measures of attention are interrelated and also validates the measures of attention used in this study.

Hypothesis III: Parental Teaching

The third hypothesis to be tested examined the relationship between the parent's teaching style and the child's ability for focused attention during independent play. Table 8 presents the correlations between mother's ratings on the adapted Barnard Scale and focused attention. Both the mother's social-emotional growth fostering ability (SE) and her cognitive growth fostering (COG), but not sentivity to cues, are related to higher rates of focused attention and toy changes. Since SE and COG are related to higher focused attention but also significantly correlated to one another ($r=.32$), a multiple regression was used to determine which of these factors was more strongly related to the attention measure. Results of the regression indicate that when the correlation between SE and COG is accounted for only COG is significantly related to rate of focused attention (std. coef. =.26, $p=.03$). Thus the

TABLE 8

PEARSON CORRELATION MATRIX:

ATTENTION MEASURES WITH ADAPTED BARNARD SCALE

Adapted Barnard Scale	Focus rate	Change rate
Sensitivity to cues	.213	.184
Social-emotional growth fostering	.246*	.297**
Cognitive growth fostering	.308**	.243*
Barnard Scale Mean	.267*	.188

mother's cognitive growth fostering skills are more strongly (and significantly) related to her child's focused attention.

The mother's cognitive growth fostering abilities were significantly correlated with certain background variables such as maternal IQ ($r=.35$, $p<.01$) and maternal education (EDUC) ($r=.27$, $p<.05$) which therefore required further investigation. The possibility remained that the mother's cognitive growth fostering behavior was really an artifact of one of these background variables and that one or the other of these (IQ or EDUC) was the true cause of the variability in the child's attentional abilities. The path analysis used to investigate these relationships is found in Figure 4. The first step of the path analysis was to compute a regression of EDUC and IQ on COG. The results indicate that when the correlation between EDUC and IQ is accounted for, only IQ is significantly related to COG (std coef =.29, $p=.018$). Because EDUC, IQ and COG all have direct correlations on FOCUS RATE a second regression was run of these three variables on focus rate. The results show that when intercorrelations are accounted for, only COG and IQ remain significantly related to FOCUS RATE. (COG std coef .27, $p=.03$; IQ std coef .24, $p=.05$) Since education has been eliminated from the model, a newly derived model is represented in Figure 5. This regression model was used to test whether the mother's cognitive growth fostering (COG) is a real contribution to the child's focused attention or

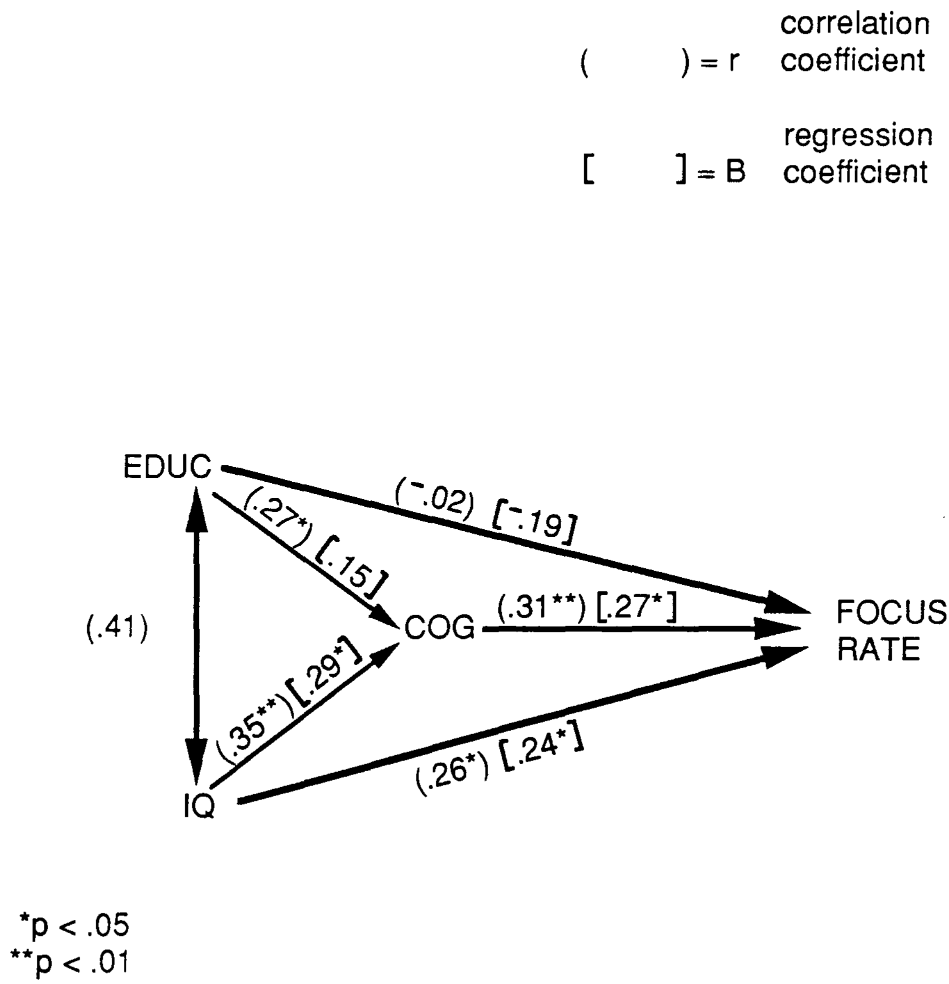


Figure 4 Path analysis of the contribution of background and maternal behaviors on focused attention.

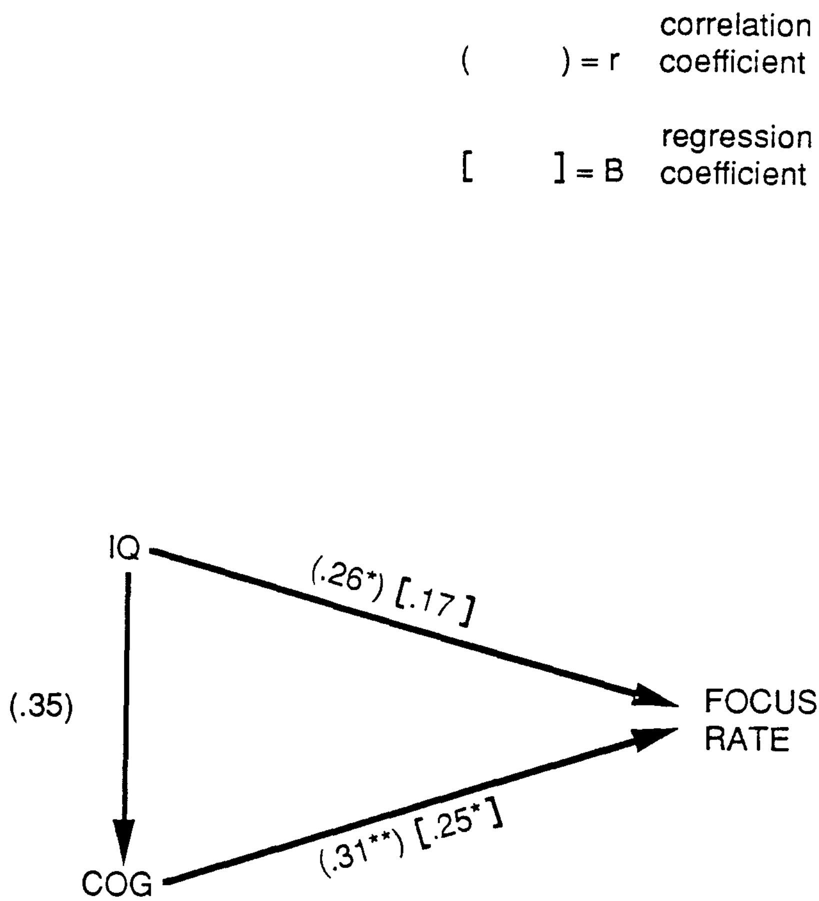


Figure 5 Modified path analysis of background and maternal behavior on focused attention.

is an artifact of the mother's general intelligence (IQ). The results of this regression indicated that when controlling for the relationship between IQ and COG, only COG remained significantly correlated with FOCUS RATE (std coef =.25, p=.04). The results of these regressions and path analyses indicate that there is a true relationship between maternal cognitive grow fostering abilities and her child's focused attention abilities that is independent of the mother's own cognitive abilities. This finding supports the third hypothesis that there is a relationship between the parent's teaching style and the child's ability for focused attention.

Hypothesis IV: Multiple risks

In order to examine the final hypothesis that drug-exposed toddlers who have experienced multiple developmental risks will show decreased focused attention compared to toddlers who experience fewer risks, a new dependent variable was created. Based on Hans' (1989) findings regarding background variables, as well as the previous findings of this study, the following variables were dicotomized into high- vs. low-risk status: sex, SES, education, IQ, stress and adaptive function of mother, and mean of maternal scores on the adapted Barnard Scale.

For the variable of sex, males were designated as high-risk. Studies of sexually dimorphic behavior suggest that males may be more vulnerable to the effects of prenatal substance exposure than females (Hans, in press). It has also been argued that males are more vulnerable to environmental stressors, in particular to the effects of non-optimal childrearing conditions or family disruption (Rutter, 1970). Socioeconomic status was dichotomized such that the lowest SES families were those at Hollingshead level 5; higher SES families were at Hollingshead levels 4 or 3. The Level 5 mothers typically were on public aid, lived in public housing or in the worst slums of the city and had possibly completed some high school. The best of the Level 4 and 3 mothers had finished high school, had some work skills or lived with men who did and lived in poor but not the worst neighborhoods in the city. Since the average number of years for formal education was 11 in both groups of women, education was dichotomized so that women with less than 11 years of education were considered high risk. The high risk IQ group mothers were those with IQs less than 85; the low-risk mothers were those with IQs greater than or equal to 85. Mothers with psychosocial stressor ratings of greater than "moderate" as rated by the DSM III-R (Axis 4) manual (American Psychiatric Association, 1987) were considered high risk. Adaptive function of the mothers rated by DSM III-R (Axis 5) as "poor", "very poor" or "grossly impaired" were placed in the high-risk category. Finally, if the mean of the maternal scores on the adapted Barnard Scale were less than 1.7, they were designated as high-risk.

The new variable, Multirisk, represented the sum of risk factors for the above variables with higher scores being equal to higher risk. Multirisk was then correlated with focus rate and change rate for the whole sample (n=74). A significant but negative correlation was found between multirisk and focus rate (r=-.220; p=.03, one-tailed), but not with change rate. This indicates that those children with higher numbers of risk factors have lower rates of focused attention. Figure 6 represents the scatterplot of multiple risk by focus rate with the corresponding linear regression line. When the multirisk variable is examined separately for the drug-exposed vs. comparison toddlers, a stronger negative correlation is found for the drug-exposed toddlers such that as the number of risk factors increase, focused attention rate declines (r=-.389; p=.017, one-tailed) (Fig. 7). The same finding is not evident for the non-drug-exposed toddlers (r=.019; p=.45, one-tailed) (Fig. 8). These findings support the final hypothesis that multiple risk factors for opioid-exposed toddlers have a differentially negative effect on their focused attention compared to non-drug-exposed toddlers who experience fewer risk factors.

Additional Findings

The number of toy changes during free play was recorded in this study, because it was hypothesized that some children might show a high rate of habituation as a pattern of inattention, and change toys frequently. In that case,

Figure 6. Correlations: Entire Sample

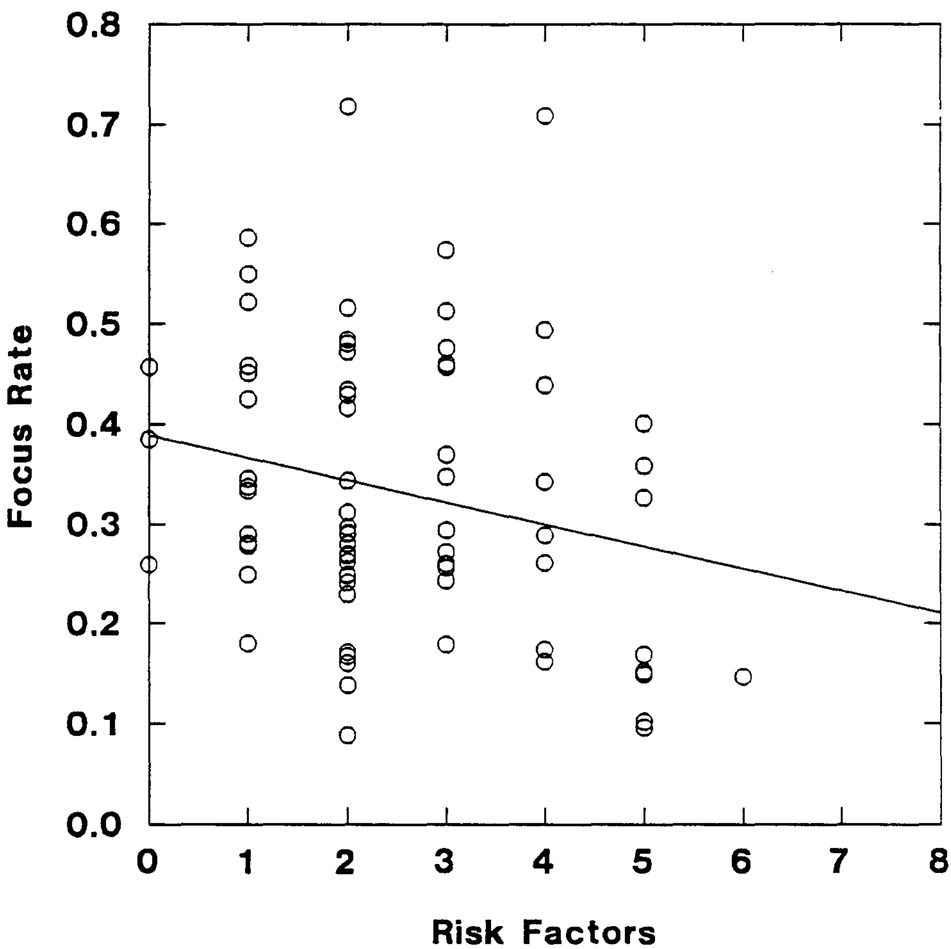


Figure 7. Correlations: Drug Group Only

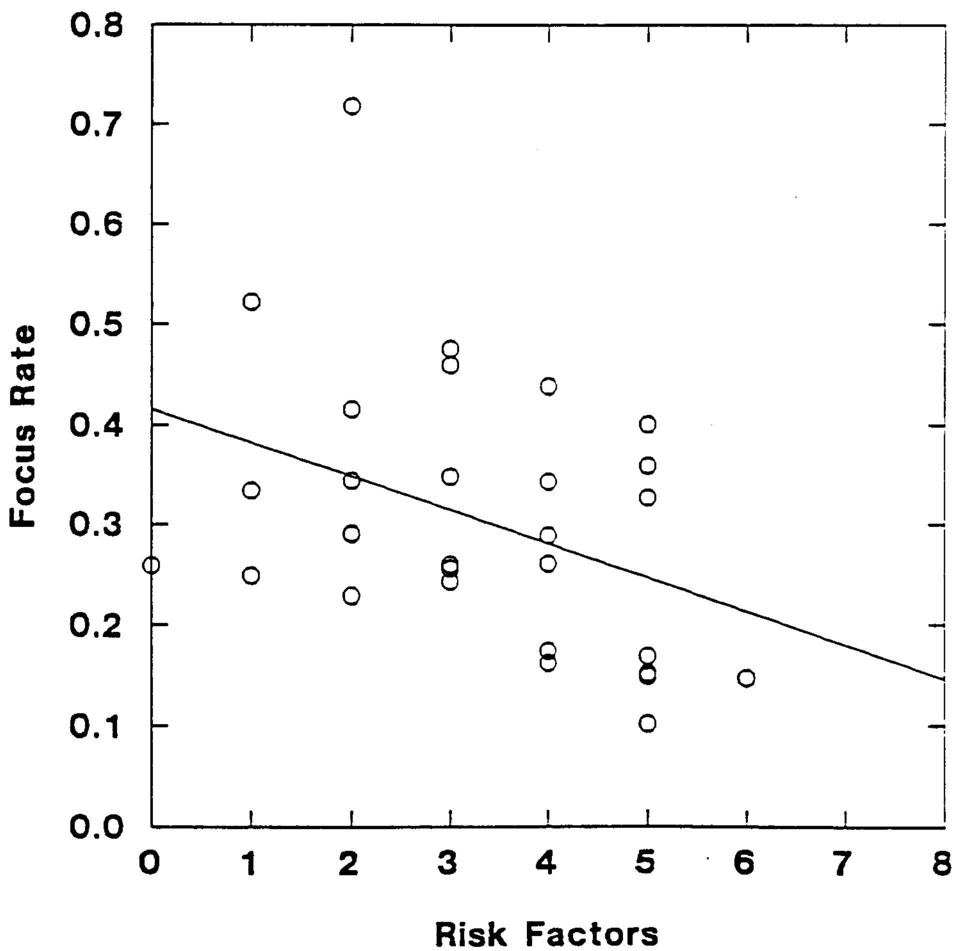
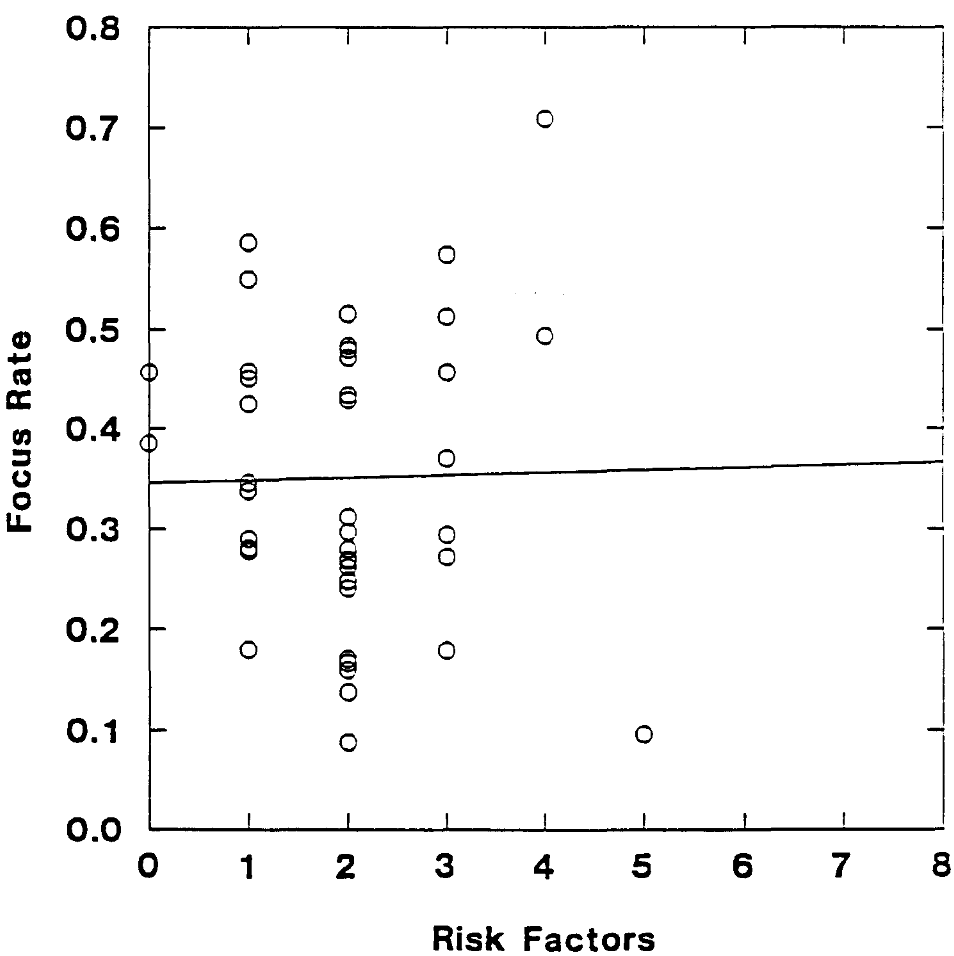


Figure 8. Correlations:
Comparison Group Only



the change ratio would probably have been negatively correlated with focused attention. In this study, an increased rate of changing toys was related to an increased rate of focused attention ($r=.25$, $p<.05$). Changing toys frequently, therefore, did not relate to a pattern of inattention for these children. The average number of toy changes for the sample was 5.5 ± 3.1 during the 3-minute play session.

Toy changes may have been a function of novelty, especially for children who had not experienced an object-rich environment. The rate of toy changes, however, was significantly related both to the background variables of SES ($r=.26$, $p<.05$) and the child's 24 month Bayley mental developmental index (MDI) ($r=.37$, $p<.01$). This indicates that the brighter the child and the better his socioecnomic status, the more frequently he changed toys during the free play session. The fact that toy changes were significantly positively related to both SES and MDI, however, suggests that frequent toy changes may reflect a child with a curious, inquisitive nature who is used to and takes advantage of a stimulating environment.

Other interesting correlations were noted between the parent's social-emotional growth fostering abilities and the child's problem solving ability during the shape sorter activity. There was a significant positive correlation between the mother praising her child's successes or partial successes once during the task and the child being quickly successful at placing blocks in the shape sorter ($r=.24$, $p<.05$). There was a similar positive correlation between the child requiring some assistance to place blocks successfully and the parent praising the child more than once during the teaching task ($r=.30$, $p<.01$). Conversely there was a significant negative correlation between poor problem solving and praise such that those children who required much assistance to place blocks had parents who praised them little ($r= -.27$) or not at all ($r= -.28$) during the task.

In summary the results of this study indicate that: 1) There was no difference in the focused attention of the toddlers during free play based only on prenatal drug exposure. 2) Behavioral characteristics during free play correlated with rate of focused attention. 3) Ratings of maternal cognitive growth fostering behavior correlated with the child's ability to focus attention. 4) Children who experience multiple risk factors have decreased focused attention. This effect is greater for opioid-exposed vs. non-drug-exposed children. 5) Parents' reinforcement of their child's efforts is significantly correlated with the child's problems solving ability.

CHAPTER VII

DISCUSSION

The human capacity for attention is present at birth. The nervous system initially organizes the intake and encoding of environmental stimulation to facilitate arousal, orienting and attending in the human infant. The environment also plays an important role in the attentional abilities of the child. Attention-directing strategies are used by the child's caregiver to recruit interest in the task, and keep the child motivated to solve the problem and learn. In this way, attention and learning are intimately linked. Thus, in conjunction with the child's innate abilities, adult guidance helps the child to maximize his attention to the task, and mobilize sufficient effort for problem solving and learning.

Attention and learning are not school-age phenomenon, but rather part of the developmental process from birth. Unfortunately, opioid-exposed children are born at-risk for attentional difficulties. Their prenatal drug exposure has created a potential biologic vulnerability for attentional disorders. Factors such as poor maternal nutrition, or vasoconstriction of the placenta can cause intrauterine growth retardation or fetal hypoxia. These biologic sequelae of prenatal exposure may create neurobehavioral disturbances which might decrease the infant's ability to organize and encode incoming stimuli resulting in state regulation and attentional difficulties. The child's difficulties with state control and attention may compromise interpersonal relationships and the development of human bonds putting the future of the child at risk.

The opioid-exposed infant is placed in double jeopardy because, not only is he prenatally exposed to drugs, but he is also frequently raised in a substance-abusing environment that is chaotic and disorganized. Substance abuse undermines normal patterns of interaction and alters conventional parental priorities (Howard, Beckwith, Rodning & Kropenske,1989). Many times, the parent is not available to the child, either physically or emotionally. The child who lives in a substance-abusing household is often deprived of an adult who can negotiate the environment for him, and provide the contingent responsiveness necessary for continued attention and learning. Thus, the attention of the opioid-exposed child is potentially affected both by biological vulnerability and a dysfunctional environment. Either may contribute separately, or both may interact to determine the child's attentional abilities as development proceeds.

Because of the proposed teratogenicity of prenatal drug exposure, one of the primary hypotheses of this study was that there would be differences in focused attention of toddlers based on the direct effect of drug exposure. This study found no differences in focused attention of opioid-exposed toddlers compared to non-drug-exposed toddlers during free play.

There is some evidence in the literature, however, that suggests attentional difficulties are present in drug-exposed children. A number of plausible explanations exist that might explain the finding of no attentional differences between the groups in this study. First, no extreme attentional differences may have existed in this experimental situation. The inattention exhibited by many drug exposure children has been proposed to be related to a low threshold for stimulation (Rist 1990; Chasnoff et al. 1990; Griffith 1992). As such, these children may show attention difficulties that are situation specific. It is possible that the free-play situation in this study did not provide the overstimulation necessary for the children to demonstrate differential levels of attention. The free play situation was conducted in an enclosed environment to which these toddlers had been exposed on numerous, previous assessments. The room was generally set up in a structured way with a couch and table, and the child's mother sitting on the couch. The toys were on the floor, on a mat or rug, which provided boundaries for the situation. Noise was kept to a minimum. As such, this test situation may have masked some of the self-regulating difficulties of these children, that might have been seen in a more novel, less structured setting.

A second explanation for lack of attentional differences may be related to the age of the children in this study. Developmentally, 2-year-old children are not expected to show long periods of concentration or attention. Adults are expected to provide structure and focus for children of this age. Furthermore, based on the observations of the children in this study, there appears to be a wide range of attention that is quite variable in this age group. The subtleties of attention are possibly not well developed at this age, and therefore, group differences would be difficult to document in a free-play situation.

It is notable that Ruff and Lawson (1990) were able to document developmental differences in focused attention between 2 and 3.5 year-old children. Their methodology for "free play," however, consisted of children playing while seated at a table, with toys presented on a plastic tray. Also Rodning, Beckwith and Howard (1990), were able to document differences between 18-month-old, drug-exposed infants, and premature infants of the same age during free play. They found that play for the drug-exposed children was disorganized, and characterized by scattering, batting, picking up and putting down toys rather than sustained combining of toys, fantasy play or curious exploration. Problems with this study have been cited, however, including small sample size, and testers that were not blind to the infants' experimental group (Tronick and Beeghly, 1992).

It is also possible that by age 2 effects of prenatal drug exposure that might have influenced attention are no longer manifest. It has been suggested that perinatal factors have their primary influence in early infancy, while environmental factors may have more impact later in development (Bee et al., 1982). Assuming this to be so, early perinatal drug exposure may have less relevance to developmental outcome than current environmental factors.

In summary, it is possible that either by age 2 no attentional differences existed; or the nature of the free play situation used in this study or the age of the children may have masked attention differences between the groups. Because attention differences based on drug exposure were not found at age 2, in a free play situation, this provided no indication or assurance that differences would not be found at school-age, with more demanding or complex attentional tasks.

The conceptual foundation for this study was based on the transactional model of developmental regulation. In this model developmental outcome is a function of the interaction between the biological and environmental influences on the child. Since this broader perspective suggests that attention might be affected by multiple risk factors, a cumulative social-environmental index of risk was developed for the study sample. The negative correlations between the multiple risk factors and focus rate indicate that there are many environmental influences that, taken together, can have a negative impact on attention. The separate comparisons in Figure 7 and 8 would indicate that the drug exposed infants experienced more risk factors than the comparison infants. For the drug-exposed children only, their decrease in focused attention was related to the increasing number of risk factors. A closer look at Figure 8, however, indicates that there were a number of comparison children with low attention rates (below the mean of .35). One reason that focus rate does not correlate with multiple risk factors for this group may be the small range of risk factors. While there is a wide range of focus rates (below .1 to above .7) the majority of risk factors are between one and three. It is possible that with a larger sample, a greater range of risk factors would occur. The correlation between focus rate and risk factors might then be similar to the drug-exposed children.

As hypothesized, certain behavioral characteristics of the children (as rated by the IBR items) correlated with the more objective, timed measures of focused attention used in this study. This is an important finding for a number of reasons. First, it supports the work of Ruff et al. (1990) who found that qualitative ratings of attention at 1 and 2 years of age were predictive of quantitative measures of attention at 3.5 years. The positive correlations found between behavioral items and the rate of focused attention, serve as a validity check on the measures of attention developed for this study. These measures were able to document the variation in attention and attention-related behaviors in this sample of toddlers. The measures appear sensitive to the attentional differences in this age group and could be recommended for future studies.

The majority of children in this study did not appear fearful, and readily entered into play. The few children who were fearful, however, did not spend much time in focused attention. It was not surprising, therefore, that fearfulness correlated negatively with focused attention. Since attention is related to learning ability, perhaps fearfulness may inhibit that ability to attend and learn. To enhance learning, children need to be comfortable in their environments. One is led to wonder about the numbers of inner-city children who grow up in stressful, fear-inducing environments. Does this nearly constant state of vigilance and fear prohibit their attentional abilities and lead to decreased learning? Fearfulness and its possible impact on attention and learning should be considered when designing educational interventions.

Activity and energy level correlated negatively with attention; that is, the higher the child's energy and activity during free play, the lower his rate of focused attention. It is important to remember that being active and having energy are important characteristics of normal development. These characteristics occur along a continuum and a broad range of activity and energy levels are represented in normal child development. When the levels become too high, however, as discovered in this study, they interfere with the child's ability to attend.

In this study, certain aspects of the parent's teaching ability correlated with the child's focused attention. This finding confirms the importance of the parent's role as a significant environmental factor in regulating a child's attention. It is noteworthy that the parent's teaching ability influenced the child's attention during an independent task (free play), upon which the parent had no direct input. This demonstrates the potential strength of parental instruction to influence a more distal event in the child's life.

Both the social-emotional growth fostering (SE) and cognitive the growth fostering (COG) sections of the adapted Barnard Scale were positively correlated with higher rates of focused attention. When intercorrelations were accounted for, however, only the mother's cognitive growth fostering skills were related to her child's focused attention. This is not an unexpected finding, since the items in the SE section related more to approval and motivational issues. While approval is important for many aspects of development in general, it would appear to relate less directly to attention. The items in the COG section relate to the parent's ability to promote increased exploration and problem solving. These characteristics relate very directly to increased attention and would explain the positive correlation between COG and rate of focused attention. It was interesting to note that the effect of the mother's cognitive fostering abilities on the child was independent of her own cognitive abilities (IQ). It appears that the mother's behavioral characteristics, not her level of intelligence as measured by an IQ test, are of greater importance in promoting the attentional abilities of her child.

The cognitive growth fostering items evaluated the parent's ability to demonstrate appropriate use of the toy, not take over the task from the child, and allow the child to explore and problem solve during the teaching task. Wertsch (1978) explains that joint problem solving (like the kind required in this shape sorter task) is characterized by adults orienting children to the overall goal and focusing the child's attention and actions on the steps required to complete the task.

Wood, Bruner and Ross (1976), in describing the adult's role as a tutor in "scaffolding" a child's learning, list one of functions of the tutor as demonstrating an idealized version of the act to be performed. While many mothers in our sample did demonstrate appropriate use of the shape sorter (by putting the top on and putting blocks through the hole) some mothers either demonstrated incorrect use of the toy or gave no demonstration at all despite their child's inability to use the shape sorter correctly.

One of the most difficult parental tasks is to avoid helping the child too much. Effective structuring of a child's learning requires monitoring the child's need for assistance and need to work more independently (Rogoff, 1990). Those parents who did not take over the task of putting the blocks in the shape sorter allowed their children more time to explore and learn during the task. This parental behavior was correlated with increased focused attention in the child. This is not surprising, since either too much or too little parent intervention has been shown to lead to less than optimal levels of attention in the child (Parrinello and Ruff, 1988).

There were significant correlations between the SE items related to praise and problem solving ability of the child. In this study, the child's problem solving ability was rated as either quickly successful, successful with some assistance (i.e. moderate success of problem solving), or needing assistance for more than half the session in order to successfully place blocks (i.e. poor problem solving). (See Appendix C, items 21-23) It may seem paradoxical that praising the child only once during the task correlated with quick problem solving and praising the child more than once correlated with the moderate success of problem solving. These levels of parent motivation and child performance, however, show that the parents were able to interpret the amount of reassurance their children needed and reinforce them appropriately. Those children who were successful problem solvers needed less external motivation and were given less by their mothers. The mothers of the moderately successful problem solvers were attuned to their children's needs and increased their verbal reinforcement accordingly. The contingent responses the children received to their problem solving behavior served to reinforce their problem solving abilities (Barnard et al, 1989; Riksen-Walraven 1978). The correlation between poor problem solving and little or no praise may be explained as a failure of the parent to take the lead and mediate the problem solving task for the child who was signalling his difficulty. Maintaining pursuit of the goal, through motivation of the child and direction of the activity is one of the functions of the tutor as described by Wood, Bruner and Ross (1976) that was not accomplished by some of the parents in our sample.

It appears that some of the mother-infant dyads in this study were participating in mutual problem solving. That is, bidirectional communication was occurring between mother and child; the toddler was able to signal the amount of assistance he needed, and the mother responded contingently to her child's needs, supplying what the child needed but no more.

In summary, the findings of this study provide new information about the attention of toddlers (both opioid-exposed and non-drug-exposed) during free play. The finding of no direct drug effects is consistent with longitudinal studies of drug-exposed children (Chasnoff et al., 1992; Hans, 1989;). The results of this study are also consistent with a transactional model of developmental risk, that is, increasing numbers of risk factors were associated with decreasing rates of focused attention. While this study explored only the cumulative effect of risk on focused attention, it is believed that risk factors may synergistically interact with the child's inherent strengths and vulnerabilities to shape developmental outcome. (Parker, Greer and Zuckerman, 1988). In future studies, larger sample size would allow investigation of the relative strength of the risk factors to predict outcome.

This study was able to identify characteristics of toddlers during free play that correlated with attention. These findings may assist individuals involved with helping toddlers to attend and learn. For example, since high energy and activity correlated with decreased attention, it may be necessary to allow young children time for high activity , free play before expecting them to decrease their activity levels and attend. Finally, the importance of the parent in regulating her child's attention was confirmed by this study. Attention related to learning is not an entity that appears at school-age, but rather is a developmental characteristic that can be nurtured by the parent from birth onward.

Taken together, the results of this study are very consistent with drug-related studies of developmental outcome in the 1990's. While drug-exposed children are no longer seen as part of the "biological underclass," neither should those children be considered entirely unscathed by their prenatal exposure. The childrearing environment might be expected to mitigate the impact of prenatal drug exposure to some degree but not eliminate the effects entirely. Opioid-exposed toddlers frequently experience a number of risk factors that cumulatively may be detrimental to their ability to attend. Future studies should investigate the drug-exposed child's differential vulnerability to specific risk factors relative to attention.

Intervention with this population should focus on facilitating positive parent-child interactions aimed at increasing the attention and learning potential of each child. The first step of this intervention should be to provide drug rehabilitation for the drug-addicted mother. Unfortunately drug-addicted mothers have a primary commitment to their chemicals and not to their children. They are unable to have it be otherwise. This often results in neglect or disregard of the child's needs. Yet clinical experience has shown that once a mother has gotten some control over her addiction, she is then able to reorder her priorities. The mother who is a recovering addict is generally very interested in being a good parent. If stereotypes regarding drug-addicts are not permitted to blind the intervention personnel, they will frequently discover that the recovering-addict mother does possess the knowledge and personal resources to be a good parent. The mother may require help in identifying her abilities, and reassurance in using them.

Unfortunately, treatment programs for pregnant drug-addicts are few in number. The 1989 Select Committee survey found that women who seek help during pregnancy cannot get it; two-thirds of hospitals surveyed had no place to refer substance-abusing pregnant women for treatment (Select Committee Hearing,1989). The challenge to the field is to design programs that are preventative in focus and comprehensive in design, that provide prenatal care, drug treatment, and parent-infant support (Weston, Ivins, Zuckerman, Jones, and Lopez,1989).

Researchers and clinicians alike need to view the addicted mother-infant dyad from a transactional risk model rather than a deficit model. In a deficit model, the drug-exposed child is viewed as "damaged goods". The complexities of the impact of drugs on the parent-child relationship are often deemed beyond understanding, beyond prevention, and beyond professional help. The deficit model can be used as a rationale to give up on the drug-exposed infants and mothers (Weston et al.,1989). The risk model, however, recognizes that prenatal exposure to drugs jeopardizes developmental processes, but that organismic and environmental forces can contribute to a positive developmental outcome (Weston et al.,1989). Using the transactional risk model, the clinician can help drug-exposed infants with compromised capacities to fully develop their potential, while supporting parents in creating an environment in which that potential can flourish.

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Appendix A

Toys Used in Free Play Situation

Doll bed, blanket, pillow, doll, baby bottle

Dump truck

Dial telephone

Bucket and shovel

Blocks

Mop

Comb

Baseball-type cap

Appendix B

Data Collection Sheet-Focused Attention

0263a
05 05 05 01 02 05 05 03
02 02 02 02 02 02 02 02 01 01 02 02 02 02 02 02 02 01 02 01

Period 1 focus time = 3.180 sec.

Period 2 focus time = 3.180 sec.

Period 3 focus time = 3.020 sec.

Period 4 focus time = 1.100 sec.

Period 5 focus time = 12.850 sec.

Period 6 focus time = 19.891 sec.

Period 7 focus time = 2.250 sec.

Period 8 focus time = 1.540 sec.

Period 9 focus time = 7.140 sec.

Period 10 focus time = 2.140 sec.

Period 11 focus time = 4.500 sec.

Period 12 focus time = 1.920 sec.

Period 13 focus time = 33.560 sec.

total session = 194.330 sec.

total play = 96.268 sec.

focus rate = 0.495

change times = 5

change rate = 1.544

Appendix C - Revised Teaching Scale - Adapted from Barnard Scale

All items rated as Yes or No

Sensitivity to Cues

1) In nearly all cases parent gives instructions and demonstration only when child is attentive (90%).
2) Parent notices and adjusts if child loses attention.
3) Parent uses additional strategies besides demonstration, verbal and pointing to teach task if necessary.
4) Parent changes volume or tone of voice to gain attention.

Social-emotional growth fostering

5) Parent does not make negative comments or yell at the child.
6) Parent does not use abrupt movements or rough handling.
7) Parent laughs or smiles at child during the teaching task.
8) Parent praises child's successes or partial successes once during the task.
9) Parent praises child's successes or partial successes more than once.
10) Parent attempts to teach task but allows for child's independent use of the toy (doesn't force compliance).
11) Parent helps the child succeed at placing blocks at least twice (if necessary).

Cognitive growth fostering

12) Parent does not take over the task but allows it to be the child's task by placing no more than 3 blocks.

13) Parent demonstrates appropriate use of the toy (top on, blocks through hole) if needed.

14) Parent allows child to explore and problem solve at some time during the teaching task.

Clarity of Cues

15) Child smiles or laughs during the episode.

16) Child grimaces or frowns during the teaching episode.

17) Child displays potent disengagement cues during the teaching interaction.

18) Child displays subtle disengagement cues during the teaching interaction.

Responsiveness to parent

19) Child smiles at parent within 5 seconds after parent's verbalization.

20) Child physically resists or responds aggressively when parent attempts to intrude physically in child's use of the task material.

Problem solving ability

21) Child is quickly successful at placing blocks in the shape sorter.

22) Child requires some assistance for approximately half the session in order to successfully place blocks.

23) Child requires some assistance for more than half of the session in order to successfully place blocks.

DISSERTATION APPROVAL SHEET

The dissertation submitted by Jane W. Schneider has been read and approved by the following committee:

Frances M. Stott, Ph.D.
Professor and Director of Doctoral Program
Erikson Institute

Linda Gilkerson, Ph.D.
Professor Erikson Institute

Sydney L. Hans, Ph.D.
Research Associate
University of Chicago

Carol Harding, Ph.D.
Professor, Counseling and Educational Psychology

The final copies have been examined by the director of the dissertation committee and the signature which appears below verifies the fact that any necessary changes have been incorporated and that the dissertation is now given final approval by the Committee with reference to content and form.

The dissertation is, therefore, accepted in partial fulfillment of the requirements for the degree of doctor of philosophy.

3/15/93
Date

Frances M. Stott
Director's Signature