

ASSOCIATIONS BETWEEN MOOD STATES IN HIGH-RISK INFANTS  
AND LATER NEURODEVELOPMENTAL OUTCOMES

by

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### Abstract

This retrospective study examined the possibility of associations between two variables: "neurodevelopmental outcome" (cerebral palsy, developmental delays and non-handicapped) and "mood states" (fussy/skittish, calm, sunny, and too variable to rate) in a sample of 208 high-risk infants. It was based on the premise that predominantly negative or variable moods (i.e., "fussy/skittish" or "too variable to rate") among high-risk infants might be considered neurobehavioural markers for later neurodevelopmental disabilities, such as cerebral palsy. The main hypothesis of the study expected the two variables to be related, that is, that there would be an overall association between "neurodevelopmental outcome" between the ages of 3 to 8 years and "mood states," at 4 months' corrected age. Should the main hypothesis have been confirmed, four subsequent hypotheses predicted specific associations between the outcome category of cerebral palsy and irritable and labile "mood states," as well as specific associations between the outcome category of developmental delays and irritable and labile "mood states". A chi-square analysis conducted to test the overall association between "neurodevelopmental outcome" and "mood states" showed no association between them. For that reason, specific associations were not tested. Because more sensitive statistical analyses could not be used, some caution is necessary in drawing final conclusions. However, interesting tendencies were observed in the distribution of the ratings of "mood states" among the categories of "neurodevelopmental outcome," which call for further evaluation in the testing of the distribution. Therefore, in spite of the fact that the main research hypothesis was rejected, the results of the present study suggest the need for additional research. The fact that no significant relationships could be found is an important finding, and suggests the need for prospective longitudinal research on this topic.

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**Dedication**

**I dedicate this thesis to my companions and professors at U.C.A.B.,  
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## CHAPTER 1

### Introduction

Early bonding between infants and their mothers or caregivers is an intricate process in which affect and temperament play major roles. Bonding between parents and infants is made more difficult when the infant's predominant mood is negative (DeGangi, Craft, & Castellan, 1991). A similar situation is reported when infants are intolerant to changes, because of difficulties in emotional regulation (Downey & Bidder, 1990; van den Boom, 1989). Lack of consistent signal behaviour creates tension and anxiety for both parents and infants, and often leads to a reduction of playful, spontaneous interactions (Field, 1983; van den Boom, 1989).

Reduced interactions have been associated with specific temperamental traits that have been observed among infants at high-risk due to prematurity or other medical conditions. A study of temperament by Thomas, Chess, Birch, Hertzog and Korn (1963) suggested that there are significant temperamental differences between high-risk preterm and healthy full-term infants.

Thomas and Chess (1977) defined temperament as "the how of behaviour... the way an individual behaves" (p. 8) and characterized the infant's temperament in nine categories, which are also called temperamental dimensions or temperamental traits. These are: activity level, rhythmicity, approach-withdrawal, adaptability, intensity of reaction, threshold of responsiveness, distractibility, attention span, persistence and quality of mood.

*Activity level* is the motor component of the temperamental dimensions, and refers to the proportion of active and inactive periods of the infant. Its frequency and intensity is described in terms of "high," "moderate" or "low." *Rhythmicity* is the infant's regularity in relation to physiological cycles: sleeping-wakefulness, hunger, feeding, and elimination.

The terms "regular" and "irregular" are used to describe rhythmicity traits. *Approach-withdrawal* describes the infant's positive-negative initial responses to stimuli and to various situations. *Adaptability* refers to how the child responds to new or altered situations. The terms "good" and "poor" are used to describe adaptability traits. *Intensity of reaction*, or "*reactivity*," is defined in terms of the vigour of the infant's response. *Threshold of responsiveness* is the intensity level necessary to evoke a "discernible response." *Distractibility* refers to the ease with which an infant's attention can be diverted from an ongoing activity. *Attention span* and *persistence* refer to how long an ongoing activity lasts, and whether or not the infant continues the action when confronted by an obstacle. The terms "high," "moderate" and "low" describe intensity of reaction, threshold of responsiveness, distractibility, attention span and persistence in terms of their frequency or intensity. *Quality of mood* refers to the amount of smiling or laughing behaviour by the infant compared to the amount of crying or fussy behaviour. The terms "positive," "negative" and "variable" are used to characterize predominant quality of mood (or simply, "mood") traits. Positive mood refers to mood states in which the infant is described as being predominantly "calm" and even "sunny." Negative mood refers to the infant being frequently "fussy" or "irritable," often crying, (Thomas & Chess, 1977) and difficult to soothe (Rothbart, 1986). Dramatic mood fluctuations are reported when the infant's mood is variable (Thomas & Chess, 1977), that is, labile or unpredictable; the infant shifts from sunny to fussy in the absence of observed environmental or internal changes. Bates, Freeland and Lounsbury (1979) included "labile" or "unpredictable" moods among their descriptors of negative emotionality for "difficult" infants.

Mood is an important variable which can affect infants' interactions and early bonding with their caregivers. The overly quiet infant is often left alone for long periods of time. The extremely labile infant is often too fussy to participate in calm or playful

interactions. Infant responses to parental handling influence the responses of the adult (Field, 1983). For example, parents may not pick up the infant who seems content to be quiet (Buss & Plomin, 1984; Chess, 1967). Predominant mood states of the infant can reinforce or diminish responsiveness of both infant and caregivers (DeGangi et al., 1991; Donovan & Leavitt, 1989).

Not only do infants' mood states (and temperamental traits in general) provide cues for their parents and caregivers during the bonding process, but they also reveal some of the nature of the infants' neurobehavioural organization, or their regulatory and adaptive capacities (Brazelton, 1980; Gorski, Davison & Brazelton, 1980; Medoff-Cooper, 1986). Specific activity level, threshold of responsiveness, intensity of reaction, rhythmicity and mood traits may reveal the infants' capacity to effectively act on the environment, and to successfully initiate and maintain interactions with their parents or caregivers (Beckman, Thiele, Pokorni & Balzer-Martin, 1986; Field, 1983). Observing how infants adapt to external stimuli and regulate their internal needs has become important in studies of the at-risk infant population (Astbury, Orgill, Bajuk & Yu, 1990; Hawdon, Hey, Kolvin and Fundudis, 1990; Szatmari, Saigal, Rosenbaum, Campbell & King, 1990). The present study was concerned with mood qualities in high-risk infants. The main objective of the study was to explore negative emotionality, or a predominance of irritable mood, or labile, unpredictable mood based on the premise that there is a significant incidence of negative emotionality among high-risk infants (Medoff-Cooper, 1986; Szatmari et al., 1990; Turecki & Tonner, 1985), and particularly among those with cerebral palsy and other neurodevelopmental disabilities.

The current study utilised data from previous retrospective studies conducted by Harris (1985,1987,1988,1989). These studies were based on data collected in two previous grant-funded projects from 1976 to 1985. The second project (1984-85) conducted longitudinal follow-up of high-risk infants who were first assessed at 4 months' corrected

age, or the age computed for the infants' due date rather than their birth date (Siegel, 1983) and followed-up to ages 3 to 8 years (Harris, 1985). Based on the children's latest developmental follow-up assessments, between 3 and 8 years of age, they were categorized into three groups: 1) cerebral palsy, 2) developmental delays, and 3) non-handicapped, that is, developing typically. The Infant Behavior Rating Scale (IBRS)-Form IV (Robinson, 1975a) rated the behavioural performance of the infants, observed during the evaluation sessions at 4 months', 1 and 2 years', corrected age. Ratings from Item # 2 of the IBRS-Form IV, (or "Predominant Mood during the Exam") at 4 months' corrected age were included as part of the data entered on the 1984-85 data sheet of the NIHR funded project, along with data from developmental assessments between 4 months' corrected age to at least age 3 years. The present study specifically concentrated on the ratings of Item #2, "Predominant Mood during Exam," at 4 months' corrected age. Item #2 rated predominant mood using four descriptors ("fussy"/"skittish" , "calm," "sunny" and "too variable to rate"), and six different numerical ratings, to assess the infant's predominant mood during developmental assessment. (Note: in order to avoid unnecessary repetition of terms, the instrument Infant Behavior Rating Scale-Form IV will be referred as to the IBRS-Form IV throughout this study).

### **Statement of the Problem**

The need to study mood within an early diagnosis context has been highlighted by reports of a possible tendency for irritability or lability among infants who are later diagnosed with developmental disabilities (Stjernqvist & Svehngisen, 1990; Taft & Barabas, 1982). Based on her previous clinical observations, similar comments have been made by S. R. Harris (personal communication, September 18, 1991; October 7, 1991), as well as by Denhoff (1976), and by Mysak, (1980). These clinical authorities have suggested that irritability and lability may be early indicators or markers of future developmental disabilities, such as cerebral palsy, in young at-risk infants.

The question of whether or not predominant mood states vary among infants at-risk for neurodevelopmental disabilities has not been sufficiently addressed. By looking at mood states (as assessed by Item #2 of the IBRS-Form IV) in a group of high-risk infants, most of whom were premature and low birthweight, this study examined the problem of whether or not irritable or labile moods were associated with those high-risk infants who were subsequently diagnosed with neurodevelopmental disabilities. More specifically, the study questioned whether descriptors of irritability ("fussy"/"skittish") and lability ("too variable to rate") were more prevalent among those infants who were later diagnosed with cerebral palsy or categorized as developmentally delayed, as compared to infants who developed typically .

### **Importance of this Study**

Several studies have addressed the issue of difficult neurobehavioural organization among high-risk infants. Results have shown that difficult neurobehavioral organization has an effect on most temperamental traits (Brazelton, 1980; Szatmari et al., 1990). The relationships between risk factors, temperamental dimensions and dyadic interactions have been well documented and demonstrated that, because high-risk infants tend to be

temperamentally more negative or irregular than full-term healthy infants, the quality of parent-infant interactions is affected (Field, 1983). In addition, interdependence among the different developmental domains, such as cognitive, motor, language and behavioural, and how these domains are affected by high-risk factors has been discussed by Bennett (1988), Field, Dempsey and Shuman (1983), Hawdon et al., (1990), Lasky et al., (1983), and Sostek, Davitt, Renzi, Smith Born and Kiely, (1982). A study of the relationships of mood states to later neurodevelopmental outcomes was considered important because it acknowledged the impact of risk factors on neurobehavioural and affective/emotional development (Bennett, 1988; Field, 1983; Medoff-Cooper, 1986; Stjernqvist & Svenningsen, 1990; Szatmari et al., 1990).

#### Research Questions

The following research questions were addressed:

1. Are categories of "neurodevelopmental outcome" between 3 and 8 years of age related to "mood states" at 4 months' corrected age?. In other words, is there an overall association between neurodevelopmental outcome, (cerebral palsy, developmental delays or non-handicapped) between 3 and 8 years of age and predominant "mood states" (as assessed by Item # 2 of the IBRS-Form IV) at 4 months' corrected age in high-risk infants?
2. If there *is* an overall association among the three categories of "neurodevelopmental outcome" and "mood states" at 4 months' corrected age, between which categories of neurodevelopmental outcome and which "mood states" does this association exist?

a) Would an association exist between the "neurodevelopmental outcome" of cerebral palsy and irritable ("fussy"/"skittish") "mood state"?

b) Would an association exist between the neurodevelopmental outcome of cerebral palsy and labile ("too variable to rate") "mood state"?

c) Would an association exist between the "neurodevelopmental outcome" of developmental delays and irritable ("fussy"/"skittish") "mood state"?

d) Would an association exist between the "neurodevelopmental outcome" of developmental delays and labile ("too variable to rate") "mood state"?

### Definition of Terms

The following section defines the terms used in the study. Both medical and developmental terminology are defined .

#### Medical Terms

The general term *at-risk* applies to infants who are born under stressful biological, social and/or environmental conditions. Degrees of risk (high or low) are determined by both the severity and the combination of risk conditions. These infants may require intensive emergency care immediately after birth in order to assist them to breathe and to feed (Ensher & Clark, 1986). Infants who suffer from one or more of the above conditions are *at-risk* for later developmental disabilities, such as cerebral palsy and mental retardation .

*High-risk* medical conditions include a combination of biologically-related factors such as premature birth and low birthweight, small for gestational age, and associated pre- and peri-natal medical risk factors (Bennett, 1988; Harris, 1987, 1988, 1989; Taft & Barabas, 1982).

*Premature birth* refers to birth at less than 37 weeks of gestation. Infants born prematurely are also called preterm infants. For purposes of follow-up assessment , corrected or adjusted age is computed for preterm infants.

***Corrected or adjusted age*** for prematurity is the age computed for the infants' due date rather than their birth date (Siegel, 1983). For medical and developmental assessment purposes, age is corrected for prematurity during at least the first two years of life (Parmelee & Schulte, 1970).

***Low birthweight*** refers to birthweight below 2,500 grams. ***Very low birthweight*** is birthweight below 1,500 grams. ***Extremely low birthweight*** is birthweight below 1,000 grams (Wolke, 1991) .

***Small for gestational age*** refers to intrauterine growth restriction or intrauterine growth retardation for either preterm or full-term infants (Vohr, 1991) .

***Prenatal risk factors*** include maternal physical, medical or social conditions which may have a detrimental effect to the fetus.

***Physical or medical conditions*** may be related to pre-existing medical problems (such as heart disease and cancer), to medical problems acquired during pregnancy (such as toxemia of pregnancy), or to drug or alcohol abuse before and during pregnancy, among others .

***Social conditions*** refer to low socioeconomic status (SES), which may affect nutrition and health-care during pregnancy. A higher incidence of prematurity and low birthweight has been reported among low SES mothers (Ensher & Clark, 1986).

***Perinatal risk factors*** may be related to lesions in the central nervous system (CNS) caused by bleeding (haemorrhage) or to lack of blood supply (ischaemia) which may in turn cause damage in the motor pathways or in sensori-neural functions.

***Neonatal hypoxia or asphyxia*** refers to a condition of too little oxygen reaching the brain (Lozano, 1985) .

*Intracranial haemorrhage* is "bleeding into the brain tissue" (Ensher & Clark, 1986, p. 8), and it may take the form of subependymal haemorrhage, intraventricular or periventricular haemorrhage (Ensher & Clark, 1986).

*Subependymal haemorrhage* refers to bleeding in the ependymal plate or in the subependymal layer due to an immature or fragile vascular bed (Wigglesworth, 1984).

*Periventricular or intraventricular haemorrhage*, is bleeding adjacent to or inside the lateral ventricles of the brain (Ensher & Clark, 1986; Wigglesworth, 1984).

*Cerebral palsy* refers to "...a persistent, but not unchanging disorder of posture and movement caused by a non-progressive disorder of the brain, first evident from a time of rapid brain development" (Hughes & Newton, 1992, p. 80). Another recent definition of cerebral palsy was provided by Bennett (cited by Harris, 1991, p. 215), and it refers to cerebral palsy as "a nonprogressive disability resulting from damage or defect in the brain that occurs during the period of rapid brain growth -either prenatally, perinatally or up to 3 to 5 years following birth."

A common *classification scheme for cerebral palsy* refers to the character of the disordered movement or postural patterns, and to the topographic distribution of limbs affected (Alberman, 1984).

*Degrees of severity of cerebral palsy* range from mild to severe. Criteria for degree of severity include mobility and physical dependency (Jarvis & Hey, 1984). Cerebral palsy can include sensorimotor, perceptual, behavioural, and language or speech disorders (Mysak, 1980), and it may or may not coexist with other pervasive disorders, such as mental retardation.

**Developmental Terms**

***Mental retardation*** has been defined in terms of a "significantly subaverage general intellectual functioning accompanied by significant deficits or impairments in adaptive functioning, with onset before the age of 18 (American Psychiatric Association, 1987, p. 28).

***Specific developmental disorders*** refer to academic skill disorders, language and speech disorders and motor skill disorders that are diagnosed during preschool or school ages. These disorders may or may not coexist with other pervasive conditions such as mental retardation or cerebral palsy (Rapoport & Ismond, 1990).

In the following chapters, a review of the literature is presented, followed by the methods used in the present study , the results obtained and a discussion of the findings and limitations of this study.

## CHAPTER 2

### Literature Review

The literature reviewed included studies of early interactions between infants and their caregivers; studies of temperament and mood of infants at-risk for developmental disabilities; and studies which examined developmental outcomes for high-risk infants.

#### The Bonding Process, Early Interactions, Temperament and the At-Risk Infant:

##### An Overview

Healthy bonding is the result of both infant and caregiver efficiently following each other's cues and coordinating their interactions. Attachment, emotional regulation and attunement play significant roles in the bonding process. Brief descriptions of these constructs are included in this section. *Attachment* describes the affective bond between mother and infant, and it is framed in the context of separation from and reunion with the mother (Ainsworth, Blehar, Waters & Wall, 1978). *Emotional regulation* is the infants' capacity to detect and adequately respond to features of the structure of the mother's behaviour and to regulate their own expressions in a way that can be felt by the mother as particular emotions (Murray & Trevarthen, 1985). *Attunement* refers to the feeling of a shared affective state within the infant-mother dyad during these early interactions. There is a flow of behaviours (and not imitation) between infant and mother, which reflects the dyad's inner state (Stern, Hofer, Haft & Dore, 1985). Within the context of mutually contingent positive responses, the infant develops secure and independent patterns of attachment (Thompson, Connell & Bridges, 1988).

Successful early interactions are characterized by a feeling of "effectance," or accomplishment, for both infant and mother during actual behavioral exchange, as they relate and respond to each other, i.e., through visual and auditory signals and through physical contact. These early interactions are eventually internalized by the infant

(Brazelton, 1986; Murray & Trevarthen, 1985; Stern et al., 1985). Because high-risk biological and medical conditions tend to affect the infant's neurobehavioural organization (Brazelton, 1980; Gorski et al., 1980), they may negatively shape the infant's temperamental nature. Infants with these behavioural characteristics are generally labelled "temperamentally difficult" by parents or caregivers.

A final impact of such high-risk conditions may be felt in the nature and quality of the bonding process. With fewer opportunities for the infant and mother to have successful behavioural exchanges (Sepkoski, Garcia Coll & Lester, 1982), and to engage in meaningful interactions, the final impact is felt in the nature and quality of the bonding process. van den Boom (1989) has examined aspects of difficult early dyadic relationships, focusing on the relationship between internal and external factors during interactions. This study of the relationship between temperament and parental responsiveness during interactions has proved helpful in order to understand and describe conditions which have a negative impact in the bonding process.

Specific biological, social and emotional variables have been identified in order to test whether or not they stand out as significant predictors of difficult, or "at-risk," dyadic relationships, in which temperament plays a major role (Field, 1983; Gunnar & Mangelsdorf, 1989; Medoff-Cooper, 1986; Vohr, 1991). In examining the interaction between variables that relate to what has been described as "easy" or "difficult" temperamental clusters in high-risk infants, Medoff-Cooper (1986) predicted that there would be a high proportion of difficult temperamental clusters among the extremely high-risk, low birthweight infants. Results showed that the combination of neurological and social/emotional risk variables (including low socioeconomic status and familial instability) were found to be better predictors of temperamental difficulties than neurological risk factors alone. Similar

findings were reported by Minde et al. (1989) and by Vohr (1991). The following paragraphs describe what characterizes "easy" or "difficult" temperamental nature in the infant.

Thomas et al. (1963) and Thomas and Chess (1977) described the "Easy Child," the "Difficult Child" and the "Slow to Warm-Up Child." These definitions were developed according to predominant temperament clusters of traits observed for a large number of subjects who participated in their research. Such descriptors were conceived in terms of a broad reference, and not as labels of infant temperament, since the authors concluded that temperamental nature is unique. The Easy Child was characterized in terms of predominantly positive mood, moderate activity level, moderate to high attention span and persistence, moderate to low distractibility, moderate threshold of responsiveness, regular rhythmicity and predominantly approaching behaviours. The Difficult Child, on the other hand, was described in terms of a predominantly negative mood; extremely high or low activity level and intensity of reaction; extremely high or low attention span and persistence, distractibility and threshold of responsiveness; irregular rhythmicity and predominant withdrawing behaviours. The Slow to Warm-Up Child was described in terms of "mild intensity of reactions, whether positive or negative and by less tendency to show irregularity in biological functions" (Thomas & Chess, 1977, p. 23 ). The Slow to Warm-Up Child shows mildly negative reactions when first encountering new stimuli, as well as slow adaptability after repeated encounters with the same stimuli.

In terms of influencing the infant-caregiver relationship, the "Easy Child" is seen by parents/caregivers as lovable and easy to cuddle, someone who invites significant others to interact. In addition, the "Easy Child" is perceived as one whose signals can be easily read during behavioural exchanges.

The Difficult Child, on the other hand, seems unable to exhibit positive or inviting behaviours to the caregivers. In contrast to the easy-going nature of the Easy Child, the

Difficult and, to a certain extent, the Slow-to-Warm-Up Child give equivocal signals to their parents (Chess, 1967). Parents find it difficult and frustrating to "read" their infant's behaviours, and may tend to avoid frequent interactions. For these reasons, Slow to Warm-Up and Difficult infants may not get the parental responses they need, and this may affect the nature of the infant-caregiver relationship. High-risk infants have often been reported as showing a tendency for difficult temperamental traits (Beckman et al., 1986; Medoff-Cooper, 1986; Field, 1983). This is why the literature reviewed in the present study was particularly concerned with "Difficult" infants, in comparison to "Easy" or even "Slow to Warm-Up" infants.

#### Caregivers and Difficult Infants

When infants are predominantly fussy, skittish, or labile, the emotional regulation of social interactions within the mother-infant dyad can be deeply affected (van den Boom, 1989). Such states tend to diminish the positive parental responses (Field, 1983). When parents are unable to ease or comfort, they feel frustrated and uneasy. They may even feel inefficient. Donovan & Leavitt (1989), van den Boom (1989) and Beckman et al. (1986) discussed the importance of intervention for mothers and infants whose interactions are affected by the infant's mood swings and fussiness. Intervention consists of providing caregivers with strategies to interpret their infants' signals, in order to enhance the caregivers' sensitive responsiveness as well as to help the caregivers avoid inconsistent responses to their infant (van den Boom, 1989).

DeGangi et al. (1991), Downey and Bidder (1990), and Turecki and Tonner (1985) reported on research of "difficult infants." Quality of mood appeared to be affected by rhythmicity traits among these infants. Terms such as "regulatory disordered," "unresponsive," "difficult in their emotional regulation" or "irritable" characterized the infant's predominant state, in terms of overall neurobehavioural organization. Regulatory (or

rhythmicity) disorders included difficulties in transitions from sleep to wakefulness, as well as hunger and feeding cycles. Quality of mood appears to be affected by rhythmicity traits.

Feeding and sleeping cycles tend to be regularized between the third and fifth month of life, and are stable by the end of the first year in infants who develop typically (Downey & Bidder, 1990; Michelson, Rinne & Paajanen, 1990). Many one-year old high-risk infants continue to be irregular, which makes it difficult for their caregivers to adequately respond to them. These infants tend to be fussy even after being fed or after sleep time (DeGangi et al., 1991). Irritability has also been related to infants' lower threshold of responsiveness and higher "intensity of reactions." Some hypersensitive infants have been reported to vigorously reject their caregivers while being held and cuddled (DeGangi et al., 1991). Parental responses vary according to their own perceptions of why their infants cry (Donovan & Leavitt, 1989). However, there is a wide range of tolerance for crying among parents (Michelson et al., 1990).

The interdependence between physiological functions and temperamental traits such as arousal, intensity of reaction, activity and approach-withdrawal has been examined by Kagan, Reznick and Snidman, (1992) and by Krafchuk, Tronick and Clifton (1983). The results of these studies suggest that arousal is controlled by the reticular activating system (RAS) and linked to physiological functions such as heart rate and acceleration. Other studies have found that innate bio-physiological conditions play an important role in shaping the internal organization of the infant's activity/reactivity state, (Gunnar and Mangelsdorf, 1989).

Beckman et al. (1986), Field (1983), Gorski et al. (1980), Medoff-Cooper (1986) and Stjernqvist and Svenningsen (1990) studied the effects of prematurity and low birthweight on parent/child interactions. These studies reported dramatic effects, including severely reduced child/adult interactions in dyads with high-risk, low birthweight infants when

compared to dyads with healthy, full-term infants. In the case of high-risk dyads in which the caregiver attempts to initiate interactions, it appears that the infant's inability to promptly respond to the caregiver's verbal and physical cues makes it difficult for the adult to be guided by the infant.

### Temperamental Differences Between High-Risk Premature

#### Infants and Healthy Full-Term Infants

High-risk premature infants have a tendency to show extreme temperamental traits (Szatmari et al., 1990; Beckman et al., 1986). Temperamental differences between preterm and full-term infants include more negative mood, more irritability and less adaptability to change (Bennett, 1988). Such temperamental traits may deeply affect adult/infant interactions (Beckman et al., 1986; Medoff-Cooper, 1986).

Predominantly negative mood may in turn interfere with the infants' early explorations of the environment. Thompson et al. (1988) reported that infants with such moods show predominantly insecure or anxious patterns of attachment with their caregivers, and showed less exploratory behaviours. Plunkett, Cross and Meisels, (1989) reported on preterm and full-term infants' temperamental differences. Their results showed high variability within the preterm population, but failed to show significant differences between preterm and full-term infants, solely on the basis of prematurity. However, there were significant differences within the preterm population in terms of high and low risk infants, in that the degree of risk seemed to affect soothability and activity level, according to parental perceptions. High-risk premature infants were generally rated "intermediate" or "difficult" to soothe, and extremely high or low in their activity level by both parents, and especially by their mothers. These results confirmed the findings of Minde et al. (1989) that very high-risk premature infants were also rated difficult by their parents.

Other behavioural difficulties of high-risk premature infants and children have been documented. Szatmari et al. (1990) hypothesized that a link exists between certain extreme behavioural traits, such as levels of activity, mood, intensity and attention, in young infants at-risk, and problems of social and emotional adjustment during the preschool years. Their results supported this hypothesis, by confirming that, by age five, many high-risk infants demonstrated attentional problems and hyperactivity. Similar findings were reported by Hawdon et al. (1990) who assessed eleven year-old boys, born prematurely with very low birthweight, and who had been rated as difficult infants. Their study showed a significant number of subjects were later diagnosed with attention deficit disorder with hyperactivity (ADDH). Similar results in studies conducted by Walther and Raemakers (1982) and Walther (1988) show a tendency for ADDH among the high-risk, low birthweight population. The interdependence between external risk variables, the infant's neurobehavioural organization, and developmental outcomes will be examined throughout the literature review of the present study.

#### High-Risk Infants and Later Neurodevelopmental Disabilities

Many high-risk infants are born prematurely or with low birthweight. Premature and low birthweight live births account for 5.5 to 7% of annual births in countries such as Canada, England and the U. S. (Statistics Canada, 1991; Wolke, 1991). Concerns have frequently been expressed about the large number of surviving premature and small for gestational age infants who will have disabilities or developmental delays (Alberman & Stanley, 1984; de Vonderweid & Nordio, 1988; Luther, Edmonds & Fitzgerald, 1990; McCormick, 1985; Papile, Munsick-Bruno & Schaefer, 1983; Vohr, 1991). The risk is significantly higher for those infants who live in environmentally restricted conditions, such as extended hospitalization (Sameroff & Chandler, 1975; Vohr, 1991).

In considering prenatal and perinatal risk factors, Nelson and Ellenberg (1986) reported that premature and low birthweight infants were more vulnerable for intrapartum damage. Previous studies by Wigglesworth (1984) had reported post-natal haemorrhagic and ischaemic lesions in 40 to 50% of very low birthweight infants. However, both sets of authors stressed the importance of pre-natal risk factors. Wigglesworth (1984) suggested that respiratory-circulatory abnormalities increase the likelihood of haemorrhagic-ischaemic lesions during the pre-, peri- or post-natal stages. Nelson and Ellenberg (1986) identified a combination of pre-pregnancy factors (such as maternal mental retardation and third trimester bleeding), and pre-and peri-natal factors (such as malformations, breech presentation, gestational age < 32 weeks, and birthweight <2000 grams), as being more significant predictors of cerebral palsy, than a combination of only peri- and early post-natal risk factors. Reports of the identification of pre-natal and genetically-linked factors leading to cerebral palsy support these findings (Hughes & Newton, 1992; Paneth, 1986).

Parmelee and Cohen (1985) predicted that 10 to 20% of premature very low birthweight newborns are likely to be diagnosed with cerebral palsy during their early childhood years. Harris (1985) noted that about one-third of children with cerebral palsy are the result of premature births. Spastic diplegia, followed by spastic hemiplegia and quadriplegia are prevalent forms of cerebral palsy among premature low birthweight infants (Alberman & Stanley, 1984; Harris, 1987, 1989).

Several recent longitudinal studies of low birthweight infants have confirmed that the risk of moderate to severe deficits is not limited to the first days and months of infancy, but may continue throughout the early childhood years (Astbury et al., 1990; Hawdon et al., 1990; Siegel, 1985; Vohr, 1991). Individual or biological differences and social and environmental factors have been highlighted as the main contributors to the final outcome. The combination of biological and environmental variables account for the diversity of

neurodevelopmental outcomes of infants born under similar bio-medical conditions (Beckman et al., 1986; Siegel, 1985; Vohr, 1991). The combination of prematurity and other bio-medical factors, as well as environmental factors, has been documented by de Vonderweid and Nordio (1988) and by Luther et al. (1990), for the purpose of examining possible relationships between these risk factors and later developmental disabilities. de Vonderweid and Nordio's study (1988) reported that, of the 92.2% very low birthweight infants who survived post natal intensive care, 16.2% had sensori-motor disabilities.

Lasky et al. (1983) reported significantly different performances between groups of high-risk, premature, very low birthweight infants and their full-term, healthy controls, who were assessed at 92 weeks, post-conceptual age (equivalent to 1 year old). The high-risk infants received lower scores than their non-risk counterparts on the developmental indexes of the Bayley Motor and Mental Scales (Bayley, 1969). Moreover, differences between the two groups were found on the Bayley Infant Behavior Record. High-risk infants had less desirable ratings than the control infants. A previous study by Field et al. (1983) comparing high-risk preterm infants and post-term infants (born at or past 42 weeks of gestation) who were followed to 5 years of age, also reported significantly lower social interaction skills among the preterm infants.

A combination of risk factors affects motor, cognitive, language and socio-emotional domains during the preschool and early school years, and may have a negative impact on the child's overall performance at school (Astbury et al., 1990; Grunau, Kearney & Whitfield, 1990; Hawdon et al., 1990; Klein, Hack & Breslau, 1989; Minde et al., 1989). Significant relationships were found between high-risk bio-medical conditions and later motor and language delays among premature low birthweight infants (Aebi, Nielsen, Sidiropoulos & Stucki, 1991; Klein, et al., 1989; Minde et al., 1989; Williamson, Wilson, Lifschitz & Thurber, 1990). Grunau et al. (1990) reported significant delays in cognitive and language domains

among 3-year-old children who were born both prematurely and with extremely low birthweight.

As birthweight and gestational age decrease, the risk for developmental disabilities increases (Bennett, 1988; Carr-Hill, Fraser & Russell, 1984; Fraser, 1984; Klein et al., 1989; Taft & Barabas, 1982; Vohr, 1991). Luther et al. (1990), citing studies which compared performances between full-term and preterm infants, showed that the percentage of school academic and behavioural problems increased with decreasing birthweight. In comparison to full-term infants, twice as many very low birthweight infants (<1500 grams) needed special support, while extremely low birthweight infants (<1000) needed almost three times as much support as full term infants. Related studies reported difficulties in visual-motor integration at age 5 years to be common among the very low birthweight and extremely low birthweight population (Klein et al., 1989). Previous studies by Hunt (1981) and Hunt, Cooper and Tooley (1988) had reported similar findings among young children with very low birthweight, as well as difficulties in social adjustment and temperamental intensity.

#### Description of Related Previous Studies Utilizing the Same Data Set

##### 1. Longitudinal Follow-up: 1976-1985

The current study utilized data gathered by Harris and colleagues on a sample of 399 high-risk infants who were part of a follow-up program from 1976 to 1985, at the Neonatal Intensive Care Unit (NICU) Follow-up Clinic, at the University of Washington (Harris, 1985). The program examined developmental outcomes of high-risk infants, most of whom were born prematurely and with very low birthweights (Harris, 1985). The subjects in the sample resided primarily in King County in Washington State, where the University Hospital is located. Several subjects came from other states such as Oregon and Alaska. Entry criteria for the subjects were one or more of the following variables: birthweight of 1500 grams or less; history of idiopathic respiratory distress syndrome (IRDS); history of central nervous

system (CNS) infection or insult or any other high-risk condition. Evaluation of the sample of high-risk infants included assessments in the physical, motor, cognitive, vocabulary and social domains. Infants were first assessed at four months' corrected age, and scheduled for follow-up visits at 1, 2, 3, 4 1/2, 6 and 8 years', corrected age (Harris, 1987). From the original sample of 399 infants, 171 of them did not continue in follow-up beyond age 12 or 24 months. A total of 229 infants were actually followed to age 36 months (year 3) or older (Harris, 1985).

Several assessment tools were used in the follow-up program. The Movement Assessment of Infants or MAI (Chandler, Andrews & Swanson, 1980) was administered at 4 months', corrected age. The Mental and Motor Scales of the Bayley Scales of Infant Development (Bayley, 1969) were administered at ages 4, 12 and 24 months' corrected age. In addition, other cognitive measures and pediatricians' and occupational therapists' ratings were used between the ages of 36 months (or year 3) to 96 months (or year 8), age corrected for prematurity, as described by Harris (1989):

"Developmental pediatricians assessed the children using the Denver Developmental Screening Test and a nonstandardized neurological examination that evaluated muscle tone and motor and speech development. Developmental psychologists used various standardized psychometric tests according to the child's corrected age: The Stanford-Binet Intelligence Scale, the Wechsler Intelligence Scale for Children-Revised, and the Peabody Picture Vocabulary Test. At the 54-month visit, occupational therapists assessed the children's motor development and coordination using an assessment protocol that included the gross motor portion of the Peabody Developmental Scales, the Frostig Eye-Motor Coordination subtest, and portions of the Southern California Sensory Integration Test. All examiners

were aware of the child's previous developmental test scores; no attempt was made to blind them to the child's developmental history" (Harris, 1989, p. 1357).

The Infant Behavior Rating Scale (IBRS)-Form IV (Robinson, 1975a, unpublished) was used to record the infants' behavioural characteristics during the assessment conducted at 4 months' corrected age, and in subsequent visits at one and two years' corrected age (L. S. Chandler, personal communication, November 2, 1992; N. M. Robinson, personal communication, October 14, 1992). Between 1976 and 1981, the examiners were to complete the IBRS-Form IV and to enter all ratings on the IBRS-Form IV recording form (see Appendix A) after administering the Bayley (Bayley, 1969) and the MAI (Chandler et al., 1980) at 4 months' corrected age. Considering that the variable described as mood states which was used in the present study is defined "as assessed by Item #2 of the IBRS-Form IV," a full description of this instrument is important.

#### Infant Behavior Rating Scale- Form IV

The IBRS-Form IV is a brief, behavioural scale which was developed by Robinson (unpublished, 1975a) so that members of the interdisciplinary assessment team of the University of Washington's NICU Follow-up Clinic could record information that would suggest whether a given evaluation might be considered more or less valid, according to the infant's predominant behavioural traits observed during the assessment (N. M. Robinson, personal communication, March 13, 1992; see Appendix A). The form was to be used in conjunction with the Bayley Scales of Infant Development (Bayley, 1969) (N. M. Robinson, personal communication, October 14, 1992). The IBRS-Form IV was intended to substitute for the Infant Behavior Record of the Bayley Scales of Infant Development (Bayley, 1969). By using less technical language, it was hoped that the IBRS-Form IV would be accessible to all members of the assessment team (N. M. Robinson, personal communication, March 13, 1992). General instructions for scoring and interpreting this instrument were standardized

(Robinson, 1975b; see Appendix B). No inter-rater reliability data were provided for this scale, however.

The IBRS-Form IV consists of 10 items:

1. Predominant State During Exam
2. Predominant Mood During Exam
3. Goal Directedness
4. Visual Interest in Surrounding Objects
5. Clarity of Response
6. Verbal-Vocal Performance/Strength
7. Activity Level
8. Fine Motor
9. Test Adequacy
10. General Evaluation of Social/Behavioral Development

All items were rated on a 5-point ordinal scale. In addition, items 1 thru 7 included a rating of 6, as a non-ordinal category, to describe performance considered "too variable to rate," or unpredictable/very labile behavioural states. Items 1 thru 7 included four descriptors of the behaviours to be rated, while items 8 and 9 included three descriptors. Item #10 provides a general evaluation of the infant's social/behavioural development with the categories of seriously deviant (rated 1), deviant (rated 2), questionable (rated 3), normal (rated 4) and superior (rated 5). This item includes a section for written comments to describe the "basis for a 1-3 rating" (see Appendix A). The distribution of the IBRS-Form IV's ratings was expected to resemble the normal curve. Although variability of ratings was expected due to normal conditions of hunger and fatigue or other stress in the infant, the examiners did expect a "stable period when the baby seems to be at the best level or state which the examiner can elicit" (Robinson, 1975b, p. 1; see Appendix B). For most items in the scale, significant periods of about 5 minutes of general responsiveness in the 4-month-old infant were expected. (Note: Robinson's instructions for scoring items of the IBRS-Form IV are consonant with the instructions provided by the Bayley's Infant Behaviour Record or

IBR (Bayley, 1969). Some comparisons between the Bayley's IBR and the IBRS-Form IV were explored in Appendix E).

Rating procedures for Item # 2 are described next. Mood was rated 1 and 2 for predominantly "fussy"/"skittish" mood traits, 3 and 4 for predominantly "calm" mood, 5, for predominantly "sunny" mood and 6 for "too variable to rate." The standardized "Instructions for Use of Child Behavior Rating Scale" (refer to IBRS-Form IV, Robinson, 1975b) were utilized for the description of rating procedures, and are described in Appendix B. The only instruction specifically related to Item #2 was that this item should rate the infant's predominant mood during the whole exam period, and not only during a specific 5, 10 or 15 minute period. The author of the current study attempted to retrieve additional background information in reference to overall assessment conditions of infants and children. Some particular details in the administration of the IBRS-Form IV, and specifically for Item #2 were also obtained. However, it is to be taken into account that information retrieved was derived from personal communication based on recollections that were more than 5 years old, in the absence of other specific instructions.

Follow-up assessments were conducted at the Follow-Up Clinic of the Neonatal Intensive Care Unit of the University Hospital, at the University of Washington, in Seattle. The Follow-Up Clinic is a separate unit, adjacent to the University Hospital, and located at the Child Development and Mental Retardation Center. When possible, assessments were scheduled so that the testing session did not overlap with feeding or sleeping periods. Scheduling sick infants was generally avoided. Although it was necessary for at least one of the parents/caregivers to be present during assessment, there was no data collection regarding whether one or *both* parents/caregivers attended the session. During the assessment session, the examiner would pose open-ended questions to the parent(s)/caregiver(s) in reference to their infants' predominant behavioural traits at home,

i. e., mood. This procedure was thought to ensure the validity of the predominant mood rating, in terms of the extent to which the infant's predominant mood during assessment was consistent with the general or predominant mood at home. Additional comments regarding behavioural differences between what was observed during assessment and what parent (s) reported of the infant's predominant behaviour at home were included. The effect that the length of the testing session (approximately 40 to 45 minutes long) might have on the infant's behaviour, particularly on the infant's mood, was also considered. Slight changes towards negative mood could have been expected towards the end of the session. Only infants who would usually maintain their bright and alert state until the final testing activity would have been rated "sunny" (K. Washington, personal communication, June 24, 1992).

In reference to the information regarding assessment procedures, it is important to add that at least four different clinicians (trained as physical therapists) conducted the developmental assessments across infants who were assessed at 4 months' corrected age. In reference to the use of the IBRS-Form IV, clinicians were "... simply asked to summarize the baby's behavior" (N. M. Robinson, personal communication, March 13, 1992). No inter-rater reliability procedures were followed for the testing sessions. In terms of data collection, no systematic procedures were retrieved to have been followed when the tester's judgement and the parent's anecdotal report differed. For these specific cases of "conflictive" information regarding the infant's predominant behaviour it cannot be assured whether or not ratings from Item # 2, "Predominant Mood during Exam" were solely based on what was observed during assessment, or if ratings also were based on parental reports of their infants' typical performance at home.

NIHR Project Form: 1984-1985

During the years 1984 to 1985, the rating which had been recorded on Item #2 of the IBRS Form IV, "Predominant Mood during Exam" at 4 months' corrected age, was entered

on the 1984-1985 NIHR project form. Other 4-month assessment data were entered also, as well as outcome data at 3 to 8 years of age. Although the IBRS-Form IV was administered during both year 1 and year 2 evaluations, only the 4-month-data for Item # 2 of the IBRS-Form IV were subsequently entered on the data recording form for the 1984-85 funded project (see Appendix C). (Note: ratings from Item #2 of the IBRS-Form IV were recorded under the heading "Infant Behavior Rating Scale (4 months): Irritability-----," on the data sheets used in the NIHR Research Project (Harris, 1985, see Appendix C). In order to use more correct terminology in the present study, the terms "Item # 2 of the IBRS-Form IV" or "Predominant Mood during Exam" were substituted for the term "Irritability." The term "ratings" was used instead of "scores").

The outcome groups representative of the three categories were defined after chart reviews which were conducted for the 229 children who were followed up to at least the 36-month-old visit (Harris, 1987). Infants were categorized in diagnostic outcome groups of typical development (non-handicapped), developmental delay or cerebral palsy, based on their latest medical and psychological assessment data, at ages 3 to 8 years (Harris, 1987, 1988, 1989). The non-handicapped group (N. H.) included infants who developed typically according to standardized developmental tests (Harris, 1987) as well as according to the pediatrician's report at their last follow-up visit (Harris, 1989). Infants in the category "developmental delays" comprised a heterogeneous group who exhibited mild to moderate delays in one or more of the following domains: motor, cognitive, language or social-emotional skills (Harris, 1987, 1988, 1989). Infants diagnosed with cerebral palsy were grouped in a third category. Cerebral palsy was diagnosed on the basis of the clinic pediatrician's assessment.

**2. Retrospective Studies (Harris, 1985, 1987, 1988, 1989)**

Between 1985 and 1989, Harris conducted several studies using the data gathered during the years 1976 to 1985. The final sample used for retrospective studies (Harris, 1985, 1987, 1988, 1989) was selected based upon the completion of medical and psychological evaluations that were conducted at 36 months of age (year 3) or later, as previously mentioned. Selection at age 3 years (as a minimum), and not at an earlier age, was based on reports stating that a reliable diagnosis of cerebral palsy is difficult at age 1, and sometimes even at age 2 (Illingworth, 1965; Taft, 1984) particularly with infants who tend to exhibit transient neurological signs (Harris, 1988, 1989). Approximately 80% of the infants who were not followed beyond age 2 years had appeared normal when last evaluated, whereas approximately 20% of these infants had been labelled either "questionable" or "abnormal" (Harris, 1987). In comparison, of those infants who were followed until 36 months or later, slightly more than half were actually considered normal, while the rest of them were categorized as developmentally delayed (approximately 32%) or diagnosed with cerebral palsy (approximately 16%). Table 1 shows the distribution of subjects in each of the outcome groups.

Table 1

**Outcome Groups Representative of the Categories of Neurodevelopmental Outcome at Year 3 to Year 8 for the Sample of 229 High-Risk Infants (Harris, 1987)**

Cerebral Palsy	n= 36
Developmental Delays	n= 75
Non-Handicapped	n=118
<b>N=229</b>	

Harris' studies retrospectively examined relationships between certain risk variables in early infancy and later neurodevelopmental outcome, such as cerebral palsy. These studies discussed different aspects of the developmental assessment and follow-up of high-risk infants, an important one being the early diagnosis of cerebral palsy. Important findings in the identification of early neuromotor predictors of later cerebral palsy were reported, and their clinical implications were discussed (Harris, 1985, 1987, 1988, 1989).

#### The Current Study: Rationale

The data from the ratings of Item # 2 , or "Predominant Mood during Exam," had not been examined previously as a possible neurobehavioural marker for different diagnostic outcomes. In the present study, mood states was one of the two variables examined, as measured by ratings of Item #2. The main hypothesis expected an overall association between the variables "neurodevelopmental outcome" (cerebral palsy, developmental delays or non-handicapped), between 3 and 8 years of age and mood states at 4 months' corrected age. Two specific hypotheses expected irritable and labile mood states to be more prevalent among subjects in the category cerebral palsy. This would mean that, should overall associations be found between "neurodevelopmental outcome" and "mood states," a specific association between the cerebral palsy category and the "fussy"/"skittish" mood state, as well as a specific association between the cerebral palsy category and the "too variable to rate" mood state, might prove significant. These expectations were based on previously cited reports by clinical authorities. In addition, a third specific hypothesis expected an association between the developmental delays category of neurodevelopmental outcome and the "fussy"/"skittish" mood state, and a fourth hypothesis expected an association between the developmental delays category of neurodevelopmental outcome and the "too variable to rate" mood state. Several articles which reported both neurobehavioural and developmental differences between healthy full-term and high-risk

**low birthweight infants seemed to support these expectations (Bennett, 1988; Lasky et al., 1983; Sostek et al., 1982).**

**The current study utilised the same data gathered by Harris and colleagues between the years 1976 and 1985 (Harris, 1985), which were included also in Harris' retrospective studies (Harris, 1985, 1987, 1988, 1989).**

## CHAPTER 3

### Methodology

#### Research Hypotheses

Research hypotheses were stated parallel to the research questions presented in Chapter 1.

#### Hypothesis 1:

The categories of neurodevelopmental outcome between 3 and 8 years of age are related to mood states at 4 months' corrected age.

#### Hypothesis 2a:

There is an association between the neurodevelopmental outcome category of cerebral palsy and the irritable ("fussy"/"skittish") mood state.

#### Hypothesis 2b:

There is an association between the neurodevelopmental outcome category of cerebral palsy and the labile ("too variable to rate") mood state.

#### Hypothesis 2c:

There is an association between the neurodevelopmental outcome category of developmental delays and the irritable ("fussy"/"skittish") mood state.

#### Hypothesis 2d:

There is an association between the neurodevelopmental outcome category of developmental delays and the labile ("too variable to rate") mood state.

#### Subjects

The sample consisted of 208 subjects, a subsample of the 229 subjects in one of the original studies (Harris, 1987). As previously reported, entry criteria for subjects in the grant-funded project (1976-1985) had been one or more of the following variables: birthweight of

1500 grams or less; history of idiopathic respiratory distress syndrome (IRDS); history of central nervous system (CNS) infection or insult or any other high-risk condition. To be included in the current study, all subjects had to: 1) have complete data on ratings for Item #2 of the IBRS-Form IV, or "Predominant Mood during Exam"; 2) complete medical and psychological follow-up assessments up to age 3 years; and 3) have been categorized in one of the three categories of neurodevelopmental outcome at 3 to 8 years of age: cerebral palsy, developmental delays or non-handicapped. Because information on one or more of these criteria was not retrievable for 20 subjects, these subjects had to be dropped. (Details on the subjects dropped, as well as their final distribution among the outcome groups, are given in the Procedures section).

There were 118 boys and 90 girls in the subsample of 208 high-risk infants. Data on gestational age were available for 179 subjects out of 208 subjects, 154 of whom (86%) were premature. Of the 154 reported premature infants, 129 (83%) were considered low birthweight (under 2500 grams). Of the 25 subjects reported full-term, three (12%) were considered small for gestational age (under 2500 grams). In reference to singleton, twin or triplet births, the data reported twin and triplet births for 9% and for 3% of the 208 subjects, respectively. The possibility of cases assumed as "singleton" births, who could have actually been the only survivors of twin or triplet births was considered. There was however only one case reported as "sole survivor of triplet birth." Data on the presence and degree of infant respiratory distress syndrome or IRDS was available for 54% of the subjects, 30% of them having been diagnosed with IRDS. The sample included Caucasian, Native American, African American, Latino and Asian American infants, with a predominance of Caucasian infants. According to anecdotal recollections, most of the subjects were born to working-class, two-parent families (K. Washington, personal communication, June 24, 1992).

## Method

### Design

This study was nonexperimental because the independent variables were non-manipulable and subjects/conditions were not assigned at random (Kerlinger, 1979). The study used a two-way 3 X 4 (neurodevelopmental outcome X mood states) design displayed in a contingency table (see Table 6 in Chapter 4).

### Variables

The first independent variable, "neurodevelopmental outcome," between 3 and 8 years of age had three categories: 1) cerebral palsy, 2) developmental delays, and 3) non-handicapped. These categories were described in depth in Chapter 2.

The second independent variable, "mood states," was described as assessed by Item #2, "Predominant Mood During Exam," of the IBRS-Form IV at 4 months' corrected age (Robinson, 1975a, unpublished; see Appendix A). Item #2 rated mood states ("fussy"/"skittish," "calm," "sunny" and "too variable to rate") on an ordinal scale from 1 to 5, with one non-ordinal category, rated 6, for the labile or unpredictable mood state described as "too variable to rate." The instrument IBRS-Form IV was fully described in Chapter 2.

The variable mood states was described in accordance with the four descriptors of Item #2, and it was basically treated as a categorical or nominal variable, with the "states" being in accordance with the four descriptors. Mood states had four descriptors and six numerical ratings, as shown in Table 2. The descriptor "fussy"/"skittish" had two numerical ratings: 1 and 2; the descriptor "calm" also had two numerical ratings: 3 and 4; the descriptor "sunny" was rated 5; and the descriptor "too variable to rate," was rated 6. "Fussy"/"skittish" (1,2) rated predominantly *irritable* mood; while "too variable to rate" (6) rated *unpredictable* or *labile* mood. On the other hand, "calm" (3, 4) and "sunny" (5) were used for predominantly *positive* moods.

Table 2

**Descriptors and Ratings for Item #2, "Predominant Mood during Exam"**

<b>Descriptors</b>	<b>Ratings</b>
<b>Fussy/Skittish</b>	<b>1,2</b>
<b>Calm</b>	<b>3,4</b>
<b>Sunny</b>	<b>5</b>
<b>Too Variable to Rate</b>	<b>6</b>

**Procedures**

Data for the subjects in the present study (1991-1992) were taken from data sheets from the 1984-1985 study (Appendix C) and from disks including data entered between 1976-1981 and 1984-85. All 229 infants had met the original criteria needed to participate in the longitudinal study (1984-85); however, data from one subject who was later categorized as developmentally delayed was not retrievable. From the sample of 228 subjects, 20 records could not be included in the current study because they did not include the ratings from Item #2 of the IBRS-Form IV (n = 13), or medical or psychological follow-up data (n = 7). The final sample consisted of 208 subjects. Table 3 shows the distribution of the sample of 208 subjects among the three categories of neurodevelopmental outcome. While the outcome group representative of the category cerebral palsy only lost one subject, the outcome group representative of the category developmental delays lost 11 subjects, and the outcome group representative of the category non-handicapped lost 9 subjects, when compared to the distribution of 229 subjects shown in Table 1, and re-displayed in Table 3 (Harris, 1987).

**Table 3**

**Distribution of the 208 Subjects into Outcome Groups Representative of the  
Categories of Neurodevelopmental Outcome at Year 3 to Year 8**

	<b>Original n's (Harris, 1987)</b>	<b>Current n's (Pighini, 1993)</b>
<b>Cerebral Palsy</b>	<b>(<u>n</u>= 36)</b>	<b><u>n</u>= 35</b>
<b>Developmental Delays</b>	<b>(<u>n</u>= 75)</b>	<b><u>n</u>= 64</b>
<b>Non-Handicapped</b>	<b>(<u>n</u>= 118)</b>	<b><u>n</u>= 109</b>
	<hr/>	<hr/>
	<b>(N= 229)</b>	<b>N= 208</b>

The counts of the ratings of Item # 2 were transcribed into a list for the final sample of 208 subjects. Because Research Hypothesis 1 predicted an association between neurodevelopmental outcome and mood states, ratings of Item # 2 of the IBRS-Form IV were counted and then categorized according to the four descriptors of mood states (see Table 4 in Chapter 4). This procedure was completed for all subjects represented in each outcome group, according to the neurodevelopmental outcome (cerebral palsy, developmental delays, non-handicapped).

The Research Hypotheses stated at the beginning of this chapter were re-formulated as Null Hypotheses for testing purposes. The Null Hypotheses are followed by a description of how the Hypotheses were tested.

## **Data Analyses**

### **Null Hypotheses**

#### **Hypothesis 1:**

The categories of neurodevelopmental outcome at 3 to 8 years of age are independent of mood states at 4 months' corrected age (as assessed by Item # 2 of the IBRS-Form IV).

#### **Hypothesis 2a:**

There is no association between the neurodevelopmental outcome category of cerebral palsy, and the irritable ("fussy"/"skittish") mood state.

#### **Hypothesis 2b:**

There is no association between the neurodevelopmental outcome category of cerebral palsy, and the labile ("too variable to rate") mood state.

#### **Hypothesis 2c:**

There is no association between the neurodevelopmental outcome category of developmental delays, and the irritable ("fussy"/"skittish") mood state.

#### **Hypothesis 2d:**

There is no association between the neurodevelopmental outcome category of developmental delays, and the labile ("too variable to rate") mood state.

To test Null Hypothesis 1, an overall chi-square analysis was conducted between the variables neurodevelopmental outcome (with three categories) and mood states (with four descriptors of the states). A contingency table (neurodevelopmental outcome by mood states) was used in the analysis, with expected proportions calculated for each cell (see Table 6 in Chapter 4).

An overall chi-square test of association would only indicate whether or not there is an overall association between the variables, that is, whether the variables are dependent or

not. However, it would not indicate whether a certain category of neurodevelopmental outcome was associated with a specific mood state should the overall association prove significant. If it was necessary to test Null Hypotheses 2 a,b,c, and d (specific associations between the cerebral palsy and developmental delays categories of neurodevelopmental outcome and irritable and labile mood states), post hoc *multiple comparisons* tests would be carried out. Marascuilo's method of multiple comparisons among proportions would then be used for analyzing these comparisons (Glass & Hopkins, 1984).

## CHAPTER 4

### Results

Results of the chi-square test of association failed to reject Null Hypothesis 1 which predicted the variables neurodevelopmental outcome and mood states to be independent. This means that there is a lack of an overall association between neurodevelopmental outcome and mood states. The lack of an association prevented the testing of Null Hypotheses 2 a-d, which predicted a lack of specific associations between the cerebral palsy/developmental delays categories of neurodevelopmental outcome and, respectively, "fussy"/"skittish"/"too variable to rate" mood states. Descriptive and inferential statistics were used in analyzing the data.

#### Descriptive Statistics

The six numerical ratings were combined into four descriptive categories as defined in the IBRS-Form IV. Combining the ratings was necessary because it was not possible to determine the variability between ratings 1 and 2, for "fussy"/"skittish," as well as between ratings 3 and 4, for "calm." Again, these categories were operationalized as follows: "fussy"/"skittish" (ratings of 1 and 2); "calm"(ratings of 3 and 4); "sunny, (a rating of 5); and "too variable to rate," (a rating of 6). Table 4 shows the distribution of counts of the ratings of Item #2 , combined into four descriptive categories for subjects grouped according to their neurodevelopmental outcome. It is observed that that the most frequent ratings corresponded to "calm" and to "fussy"/"skittish" mood states. Ratings of "calm" represented more than half of the frequencies for subjects in all three categories of neurodevelopmental outcome. Ratings for "fussy"/"skittish" represented approximately one-third of the frequencies for subjects in the category of cerebral palsy, and about one-fourth of the frequencies in the category of developmental delays. (Note: frequencies

entered in Table 4 were later re-entered in Table 6, the 3 X 4 contingency table, in order to carry out the inferential analyses).

Table 4

**Frequencies of Ratings of Mood States, as Assessed by Item #2 of the IBRS-Form IV, and Combined According to Four Descriptors, for the Three Categories of Neurodevelopmental Outcome**

	Mood States				Total
	fussy/ skittish (1 ,2)	calm (3 ,4)	sunny (5)	too variable to rate (6)	
<b>Categories of Neuro- developmental Outcome</b>					
<b>C. P. n=35</b>	11	20	2	2	35
<b>D. D. n=64</b>	16	38	2	8	64
<b>N. H. n=109</b>	18	70	7	14	109
<b><math>\Sigma X</math></b>	<b>45</b>	<b>128</b>	<b>11</b>	<b>24</b>	<b>208</b>

**Note** C. P.= Cerebral Palsy  
D. D.= Developmental Delays  
N. H.= Non-Handicapped

Counts of the ratings of Item #2 according to the four descriptive categories were then converted to percentages, by row, for each of the neurodevelopmental outcome groups, and displayed in Table 5. Analyses of the observed frequencies expressed in percentages were conducted, by interpreting the observed distribution of row percentages of mood states among the three categories of neurodevelopmental outcome. Table 5 shows that 31.43% of the cerebral palsy group had ratings of 1 or 2 ("fussy"/"skittish"), as compared to 25% of the developmentally delayed group and 16.51% of the non-handicapped group. "Calm" ratings (3 or 4) were obtained by 57.1% of the cerebral palsy group as compared to 59.4% of the developmental delays group, and 64.2% of the non-handicapped group. A rating of 5 ("sunny") was obtained by 5.7% of the cerebral palsy group, 3.12% of the developmental delays group, and by 6.4% of the non-handicapped group. Finally, the frequencies of children in the developmental delays and non-handicapped groups receiving ratings of 6, or "too variable to rate," (12.5% and 12.8% respectively), were each more than twice that of the frequency of the children in the cerebral palsy group (5.71%).

Table 5

**Row Percentages of Ratings of Mood States, as Assessed by Item #2 of the IBRS-Form IV, and Combined According to Four Descriptors, for the Three Categories of Neurodevelopmental Outcome**

Descriptors	Mood States				Total
	fussy/ skittish	calm	sunny	too variable to rate	
(Ratings)	(1,2)	(3,4)	(5)	(6)	
C. P. $n=35$	31.43	57.14	5.71	5.71	100%
D. D. $n=64$	25.00	59.37	3.12	12.50	100%
N. H. $n=109$	16.51	64.22	6.42	12.84	100%
$\bar{X}$ (%)	24.31	60.24	5.08	10.35	100%

**Note.** C. P. = Cerebral Palsy  
D. D.= Developmental Delays  
N. H.= Non-Handicapped

### Inferential Statistics

The contingency table for 208 high-risk infants (see Table 6) was classified by neurodevelopmental outcome (with three categories) and mood states (with four descriptors of the states). Table 6 shows that the observed counts or frequencies in each cell are very close to the calculated expected frequencies. For "fussy"/"skittish" ratings, for example, in the case of cerebral palsy, the observed frequency was 11, versus an expected frequency of 7.57; in developmental delays, the observed frequency was 16 and the expected frequency was very close at 13.85. For the ratings of "calm," "sunny" and "too variable to rate" observed and expected frequencies were similarly close for the cerebral palsy and developmental delays categories. In the case of "non-handicapped," observed and expected frequencies for "fussy"/"skittish" were more disparate (18 versus 23.58) than for the other ratings.

Table 6

**Contingency Table for 208 High-Risk Infants Classified by Mood States, with Four Descriptors, and the Three Categories of Neurodevelopmental Outcome: Cerebral Palsy (C. P.), Developmental Delays (D. D.), and Non-Handicapped (N. H.)**

	Mood States				Row Totals
	fussy/ skittish (1, 2)	calm (3, 4)	sunny (5)	too variable to rate (6)	
C. P.	$n_{11}=11$ ( $n_{11}=7.57$ )	$n_{12}=20$ ( $n_{12}=21.54$ )	$n_{13}=2$ ( $n_{13}=1.85$ )	$n_{14}=2$ ( $n_{14}=4.04$ )	$n_{r.}=35$ ( $\pi_{r.}=.17$ )
D. D.	$n_{21}=16$ ( $n_{21}=13.85$ )	$n_{22}=38$ ( $n_{22}=39.38$ )	$n_{23}=2$ ( $n_{23}=3.38$ )	$n_{24}=8$ ( $n_{24}=7.38$ )	$n_{r.}=64$ ( $\pi_{r.}=.31$ )
N. H.	$n_{31}=18$ ( $n_{31}=23.58$ )	$n_{32}=70$ ( $n_{32}=67.08$ )	$n_{33}=7$ ( $n_{33}=5.76$ )	$n_{34}=14$ ( $n_{34}=12.58$ )	$n_{r.}=109$ ( $\pi_{r.}=.52$ )
	$n_{.1}=45$	$n_{.2}=128$	$n_{.3}=11$	$n_{.4}=24$	$208=n_{..}$

**Note.** Expected frequencies are given in parentheses.

Such small differences between observed and expected proportions tend to decrease the probability of any association between the variables. In other words, the value of the chi-square ( $\chi^2$ ) tends to increase with larger differences between observed and expected frequencies (Glass & Hopkins, 1984). The distribution of frequencies for each cell yielded 3 out of the 12 cells with frequencies less than 5 (see table 6). Because the cells were not empty, the analyses included these cells. Therefore, the original 3 X 4 contingency table (see Table 6) was retained for purposes of testing Null Hypothesis 1. Results of the chi-square test of association showed no overall significant association between the variables neurodevelopmental outcome (with three categories) and mood states (with four descriptors of states)  $\chi^2 (6, N = 208) = 5.578, p > .05$ .

A check on the effects of the low counts in these three cells on the chi-square test was carried out by combining ratings, and increasing the cell sizes to a minimum of  $n=10$  counts (Shavelson, 1988). The combined frequencies of the six ratings for the four descriptors of mood states were collapsed into two basic "states": 1) the risk state which included "fussy"/"skittish" (with ratings of 1 and 2) and "too variable to rate" (with a rating of 6); and 2) the non-risk state which included "calm" (with ratings of 3 and 4), and "sunny" (with a rating of 5). Collapsing the mood variable yielded cell sizes of  $n>10$ . In this way, the chi-square tested the relationship between the three categories of neurodevelopmental outcome (cerebral palsy, developmental delays and non-handicapped) and two mood states (risk and non risk). The check on the effects of the low counts in the six cells on the chi-square test showed, again, small differences between observed and expected frequencies of the "risk" and "non risk" states, especially for the cerebral palsy and developmental delays categories of neurodevelopmental outcome. For the "risk" state, the observed frequency in cerebral palsy was 13, versus an expected frequency of 11.61; in developmental delays, the observed frequency was 24, and the expected frequency was very close at 21.23. For the

"non-risk" state, observed and expected frequencies were similarly close. The observed frequency in "cerebral palsy" was 22, and the expected frequency was 23.39; in "developmental delays," the observed frequency was 40, and the expected frequency was 42.77. Observed and expected frequencies were again more disparate in "non-handicapped" for both "risk" and "non risk" states, i. e., 32 versus 36.16 for the "risk" state, and 77 versus 72.84 for the "non-risk" state. The results of the chi-square test checking for the effect of low n cells, ( $1 < n < 5$ ), confirmed the lack of an overall significant association between the variables neurodevelopmental outcome, with three categories, and mood states (with two states, risk/non risk),  $\chi^2(2, N = 208) = 1.1713, p > .05$ .

No further testing was conducted because Null Hypothesis 1, which predicted neurodevelopmental outcome and mood states to be independent, failed to be rejected. That is, the lack of an overall significant association between the two variables shown by results of the first chi-square analysis prevented the testing of Null Hypotheses 2 a-d, which predicted specific associations between the two variables.

The implications of these findings as well as the limitations of this study will be discussed in Chapter 5.

## CHAPTER 5

Discussion

Based on the premise that predominantly negative or variable moods during early infancy might be neurobehavioural markers for later developmental disabilities, this study hypothesized an overall association between neurodevelopmental outcomes between the ages of 3 to 8 years and mood states at 4 months' corrected age. Subsequent hypotheses expected particular associations between: a) cerebral palsy, one of the categories of neurodevelopmental outcome, and irritable ("fussy"/"skittish") mood state; b) cerebral palsy and labile ("too variable to rate") mood state; c) developmental delays, another category of neurodevelopmental outcome, and irritable ("fussy"/"skittish") mood state; and d) developmental delays and labile ("too variable to rate") mood state. These specific associations were to have been tested, had neurodevelopmental outcome and mood states proved to be related. Because results of the chi-square test of association failed to show an overall significant association between the two variables, no specific associations were tested. However, some tendencies in the distribution of the frequencies of mood states among the categories of cerebral palsy, developmental delays and non-handicapped were noted throughout the interpretation of the descriptive analyses. Several considerations highlight the importance of the results obtained, and also suggest possible limitations in the current study .

The predominance of the observed frequencies of "calm" ratings (3,4) as compared to "sunny" (5), "fussy"/"skittish" (1,2) and "too variable to rate" (6) among high-risk infants in all three categories, seemed to confirm Robinson's expectation that the distribution of the ratings would show resemblance to a normal curve (1975b; see Appendix B). Frequencies of the ratings of Item #2 (according to the four descriptive categories), by column, are

highlighted in Table 7. The "calm" mood state was most frequent for all three categories of neurodevelopmental outcome, while the "sunny" mood state was least frequent for all three categories of neurodevelopmental outcome.

Table 7

Sum of Observed Frequency Counts and Average of Percentages, by Column, of Ratings of Mood States for the Three Categories of Neurodevelopmental Outcome

	Descriptors and Ratings of Mood States			
	fussy/skittish	calm	sunny	too variable to rate
	(1, 2)	(3, 4)	(5)	(6)
$\Sigma (f)$	45	128	11	24
$\bar{X} (\%)$	24.31%	60.24%	5.08%	10.35%

If the distribution of these observed frequencies (expressed in percentages) were to be portrayed in a curve, it would show that the greatest frequency of cases (approximately 60%) tended to cluster in the center of the range, as is expected in a "normal" curve (Anastasi, 1982). As anticipated, this tendency was especially noted for the category non-handicapped (64.2%), as shown in Table 5 (Chapter 4).

The observed frequency distribution (in percentages) of the "mood state" "fussy"/"skittish" showed, at first glance, the anticipated or expected tendency across the three categories, with the frequency for cerebral palsy being almost twice that of non-handicapped, i. e., cerebral palsy, 31.43%, developmental delays, 25% and non-handicapped, 16.51% (see Table 5). According to this distribution, irritable mood appears to have been

more prevalent among high-risk infants who were later diagnosed with cerebral palsy, following the premise of this study, i. e., negative mood being a neurobehavioural marker for later neurodevelopmental disabilities. It is important to note, however, that the distribution of observed frequencies was not significantly different than the distribution expected by chance alone.

On the other hand, the observed frequency distribution in the mood state "too variable to rate" did not show the anticipated tendency across the three categories. That is, higher frequencies would have been expected for the cerebral palsy and developmental delays categories, with the category of non-handicapped having the lowest frequencies. Such a distribution would support the premise that variable mood is also a neurobehavioural marker for later developmental disabilities. Instead, the category cerebral palsy had the lowest frequency of "too variable to rate" ratings (5.71%), while both developmental delays and non-handicapped had higher frequencies (12.5% and 12.8% respectively), as shown in Table 5 in Chapter 4.

In light of the fact that this particular mood does not seem to prevail among infants who were later diagnosed with cerebral palsy, this unexpected distribution calls for further evaluation of labile or variable moods among high-risk infants during developmental assessment. In this sense, information could be gathered by observing the distribution of "too variable to rate" ratings for behaviours assessed in other items of the IBRS-IV such as "Predominant State," "Activity Level," or "Threshold of Responsiveness," in addition to Item #2 (see Appendix B).

#### Association between Neurodevelopmental Outcome and Mood States

A hint that the variables neurodevelopmental outcome (with three categories), and mood states (as assessed by Item #2, with four descriptors) would be independent was provided by the displays of observed and expected frequencies in the contingency table (see

Table 6 in Chapter 4). At this point, data revealed only slight differences between observed and expected counts - -for all ratings of mood states in all three categories of neurodevelopmental outcome. Results from the chi-square test of association confirmed the lack of a significant overall association between neurodevelopmental outcome and mood states. Consequently, specific associations between the categories cerebral palsy/developmental delays and irritable ("fussy"/"skittish")/ labile ("too variable to rate") mood states could not be tested.

The selection of a chi-square test of association was based on Tuckman's (1978) description of it as a type of analysis which allows for testing between two nominal or categorical variables, when the data obtained are frequency counts. Given the conditions of the current study in which there were two independent variables which were nominal, and unequal frequency counts in the cells, the chi-square test of association was selected as the most appropriate test. As previously stated, the decision to treat mood states as a nominal or categorical variable was due to the fact that the variability between the gradations of ratings 1 and 2 for "fussy"/"skittish" mood state, and ratings 3 and 4, for "calm" mood state were not explicitly described in the rating procedures (see Appendix B).

The decision to set a significance level at .05 was taken upon consideration and consultation on the relative consequences of risking a Type I error and a Type II error. "...If the Null Hypothesis of no significant association is rejected in error, compensatory steps may be taken that are expensive and useless. On the other hand, if the Null Hypotheses of no association are held tenable, important relationships may be overlooked. At this level of research, the risk of both types of error probably ought to be equal and at the .05 level considering the size of the sample available" (W. Boldt, personal communication, November 12, 1992).

In the next section, some of the limitations of the current study were examined.

### Limitations and Directions for Future Research

This retrospective study was limited to the interpretation of the data available from previous studies: (1) the NIHR funded retrospective study from 1984 to 1985, and (2) the retrospective studies published between 1987 and 1989 (Harris, 1987, 1988, 1989). As with many retrospective studies, some data were lost or were not retrievable. Also, the data were incomplete for some subjects, i. e., gestational age, birthweight, singleton, twin or triplet births, and the presence or absence of infant respiratory distress syndrome (IRDS). Similarly, variables related to ethnic background, prenatal/familial history and geographic location were not consistently entered. Data on family structure and socioeconomic status were unavailable (K. Washington, June 24, 1992).

It is difficult to determine the effects that lost data may have had on the interpretation of the findings in this study. In order to establish how important this type of information may be when measuring specific associations between neurodevelopmental and behavioural variables, further prospective longitudinal research could be carried out. Such research would attempt to collect data on the important biological and social factors listed above for all subjects in the study. The need for this type of research is highlighted by studies which have shown the effects of combining biological and social risk factors on behaviourally related outcomes, such as temperament (Field et al., 1985; Szatmari et al., 1990). Other studies have confirmed the role of socioeconomic status, home, family, biological and environmental factors, on later behavioural and developmental outcomes (Medoff-Cooper, 1986; Vohr, 1991).

It is also important to consider that only one item of the IBRS-Form IV was examined. Previous studies have examined all behavioural items of an instrument or at least, a cluster of items (Beckman et al., 1986; Medoff-Cooper, 1986; Sostek & Anders, 1977; Sostek et al., 1982). Mood appears to have been related to other temperamental traits, and, moreover, all

temperamental traits appear to have been interdependent (DeGangi et al., 1991; Sostek et al., 1982). For these reasons, rating "Predominant Mood during Exam" would appear to reveal only one aspect of the infant's temperament. Considering that results obtained by previous studies were based on scores from an entire test or on "behavioural clusters" (i. e., Beckman et al, 1986; Medoff-Cooper, 1986), it would seem that future analyses should use all items of the IBRS-Form IV. A look at the IBRS-Form IV reveals that other temperamental dimensions, namely arousal, intensity, activity level, and rhythmicity, are included among the 10 items of this instrument (please refer to Appendix D).

In addition, the interpretation of descriptive analyses may have been limited by the characteristics of the data obtained from the ratings of Item #2, i. e., the item being treated as a nominal or categorical measure. Therefore, the interpretation of descriptive analyses could only be based on the distribution of counts or frequencies of descriptive categories, some of which included combined scores. Although interesting tendencies were observed in the distribution of observed frequencies, i. e., ratings of "fussy"/"skittish" mood state representing almost one-third of the ratings for the category of cerebral palsy, the type of data obtained did not allow for further calculations, such as measures of central tendency and of variability, which precede the testing of a distribution. Consequently, it was not possible to determine if the observed tendencies actually represented significant trends in the distribution.

Moreover, the data available for the current study limited inferential analyses to the use of a chi-square test of association. For instance, a factorial design, under appropriate conditions (i. e., equal cell sizes) might have given a more sensitive analysis of the differences in mood states among the three categories of neurodevelopmental outcome. However, this was not possible because unequal cell sizes yielded a non-balanced factorial design, which would have seriously affected the interpretability and violated the

assumptions of this type of analysis. A partial explanation for unequal cell sizes could be the unevenness in the distribution of subjects among the three categories of neurodevelopmental outcome. Unfortunately, this unevenness in the distribution of subjects can hardly be avoided in a field study of this nature, where subjects from all three categories of later neurodevelopmental outcome were part of an initial, larger sample. In other words, it is expected that infants who develop typically will outnumber infants with developmental disabilities, and the sample in this study was no exception.

Finally, the loss of 21 cases from the original sample of 229 subjects (one subject lost from the cerebral palsy group, 11 from the developmental delays group, and nine from the non-handicapped group) could have eventually affected the cell sizes. Three out of the 12 cells had n's < 5. In order to avoid cells with n's < 5, ratings were combined to represent two categories: risk and non-risk. In the end, similar results were obtained by inferential analyses conducted with and without combined "states." However, considering that 13 of the 21 missing cases were excluded because they did not have the rating for Item #2 entered in the 1984-85 NIHR Project Form, limitations regarding this aspect of the inferential analyses were difficult to evaluate. Without the information regarding the predominant mood state for those subjects, it was not possible to determine how significant, if any, the loss of 21 cases was in terms of the results obtained.

#### Related Studies

Related studies, many of them cited previously, were concerned with temperamental differences between high-risk and non-risk infants (Beckman et al., 1986; Medoff-Cooper, 1986; Plunkett et al., 1989; Sostek et al., 1982; Telzrow, Kang, Mitchell, Ashworth & Barnard, 1982), or with relationships between behavioural and developmental aspects in high-risk infants during their first year of life (Lasky et al., 1983). None of these studies, however, examined possible associations between behavioural aspects in young, at-risk infants and

their *later* developmental outcomes, in terms of specific diagnostic categories - -which makes the current study unique.

Previous studies concerned with temperamental differences in high-risk infants specifically examined relationships between risk factors and temperamental traits at early ages; long-term developmental outcomes were not assessed. For this reason, these findings do not allow for direct comparisons with those of the current study. Nonetheless, it is important to highlight that mood differences between high-risk and non-risk infants were reported. For example, Sostek et al. (1982) and Telzrow et al. (1982) showed significant mood differences between high-risk and non-risk infants, at ages 0-2 months, when mood-related items such as irritability, rapidity of buildup, and lability of state were singled out from other temperamental traits. Both of these studies used the Neonatal Behavioral Assessment Scale or NBAS (Brazelton, 1973) to assess behavioural dimensions in the newborn infant. A study conducted by Medoff-Cooper (1986) reported that "difficult" temperamental clusters, i. e., irregular rhythmicity, withdrawal, low adaptability, high intensity and negative mood, prevailed among high risk infants at age 6 months' corrected age. Medoff-Cooper' study (1986) compared mean scores of high-risk very low birthweight premature infants to mean scores of the published standards of the Infant Temperament Questionnaire, or ITQ (Carey & McDevitt, 1978) - - which was standardized on a sample of non-risk, full-term infants 4 to 8 months of age.

In summary, direct comparisons between the above cited studies and the current study are difficult to establish. While studies conducted by Medoff-Cooper (1986), Sostek et al. (1982), and Telzrow et al. (1982) expected (and found) significant relationships between *temperament clusters* (which included mood) and the presence or absence of *high -risk factors* in month-old infants, the current study expected a long-term relationship between

*mood* (a temperamental trait), at 4 months' corrected age, in a sample of high-risk infants, and their later *neurodevelopmental outcomes* between 3 and 8 years of age.

Other related studies examined relationships between behavioural aspects, such as temperament and social orientation, and developmental aspects, such as cognition and motor development in young infants (Lasky et al., 1983; Sostek & Anders, 1977). Lasky et al. (1983) examined these relationships at the time of assessment, but did not make any predictive associations. High-risk, low birthweight premature infants, and healthy full-term infants at age 1 year, corrected age, were assessed with the Bayley Scales of Infant Development and rated with the Infant Behavior Record (Bayley, 1969). Results showed that high-risk infants had some developmental lags and were more difficult, i. e., uninhibited, with high energy, short attention span and short endurance, when compared to their full-term counterparts.

In studying full-term, healthy infants, Sostek and Anders (1977) found that some temperamental dimensions, such as distractibility, at approximately 13 days of age, were correlated with earlier NBAS' dimensions such as state control, at 5 - 12 days of age, as well as later performance in the Bayley Mental and Motor Scales between 51 and 94 days of age.

The findings reported by studies cited are important because they highlight the relationships found between temperamental and other behavioural dimensions and developmental aspects in young infants. However, these relationships were either examined at the time of assessment, when the performances of high-risk infants and non-risk infants were compared (Lasky et al., 1983), or based on very short-term predictions in a sample of full-term, healthy infants (Sostek & Anders, 1977). For these reasons, these results do not allow, again, for direct comparisons with those of the current study.

### Summary and Conclusions

This study tested the association between neurodevelopmental outcomes at 3 to 8 years', corrected age, and mood states at 4-months' corrected age in a sample of 208 high-risk infants, most of whom were born prematurely and with very-low birthweight. The study expected predominantly negative (i. e., "fussy"/"skittish") moods or variable (i. e., "too variable to rate") moods to be prevalent among those infants who were later diagnosed with cerebral palsy or categorized with developmental delays, when compared with those infants who developed typically, and were categorized as non-handicapped. Along with the hypothesis of an overall association between neurodevelopmental outcomes and mood states, the study hypothesized specific associations between the neurodevelopmental outcome of cerebral palsy and the behavioral ratings of "fussy"/"skittish" and "too variable to rate"; and the neurodevelopmental outcome of developmental delays and the behavioral ratings of "fussy"/"skittish" and "too variable to rate."

The study did not find a significant overall association between neurodevelopmental outcomes and mood states. Therefore, specific associations between each of the three categories of neurodevelopmental outcome and the irritable or labile mood states were not tested. However, interesting tendencies were noted in the distribution of mood ratings in the different diagnostic categories. In particular, the distribution of "fussy"/"skittish" ratings among infants in the cerebral palsy and developmental delays outcome groups were consonant with some of the expectations of this study, that is, "fussy"/"skittish" ratings would be more prevalent among high-risk infants later diagnosed with cerebral palsy or categorized with developmental delays. There were limitations in the ability to use more sensitive statistical tests, which could have yielded evidence on the significance of this distribution. For this reason, based on the analyses that were used, it is safe to regard the observed distribution as what would have been expected by chance alone. Considering the

**limitations of the current study, a final statement regarding the associations between neurodevelopmental outcomes and mood states is still premature - -until further prospective research is conducted in this subject.**

**The findings of this study suggest that mood states in high-risk infants are important to include in neonatal and follow-up assessments. The difficulties of assessing mood states in the very early months and years may be an important factor to consider. The lack of sensitive measures of mood states tend to obscure their importance. This study calls attention to the need for careful observation of at-risk infants, in terms of their neurobehavioural organization, that is how they respond and adapt to changes. The study also suggests the importance of the availability of support and guidance of families, especially when predominantly negative or variable mood states are observed in high-risk infants. Specific intervention strategies would help caregivers to read and follow their infants' signals, at the infant's own pace - -frustrating interactions giving way to successful interactions, where calm, enjoyable moments are shared between caregiver and child.**

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APPENDICES

- Appendix A**            **Infant Behavior Rating Scale (IBRS)-Form IV (Robinson, 1975a)**
- Appendix B**            **Instructions for Use of Infant Behavior Rating Scale  
(Robinson, 1975b)**
- Appendix C**            **NIHR Research Project Form (S.R. Harris, 1984-1985)**
- Appendix D**            **Parallel Comparisons Between Items 1,2,3,4,5,& 7 of the IBRS-  
Form IV and the Nine Temperamental Dimensions (Thomas et  
al., 1963; Thomas et al., 1977)**
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(Bayley, 1969) and Items of the IBRS-Form IV (Robinson,  
1975a)**

**APPENDIX A**

**Infant Behavior Rating Scale (IBRS)-Form IV (Robinson, 1975a)**

INFANT BEHAVIOR RATING SCALE - FORM IV

Infants Name: \_\_\_\_\_ BD: \_\_\_\_\_  
 UH Number: \_\_\_\_\_ Chronological Age: \_\_\_\_\_  
 Date of Exam: \_\_\_\_\_ Corrected Age: \_\_\_\_\_  
 Rater: \_\_\_\_\_

1. PREDOMINANT STATE DURING EXAM

1	2	3	4	5	6
Sleepy		Awake		Alert	Too variable to rate

2. PREDOMINANT MOOD DURING EXAM

1	2	3	4	5	6
Fussy "Skittish"		Calm		Sunny	Too variable to rate

3. GOAL DIRECTEDNESS

1	2	3	4	5	6
No directed effort		Few attempts at goal-not interested in completion		Persistent or repeated attempts at goal	Too variable to rate

4. VISUAL INTEREST IN SURROUNDINGS, OBJECTS

1	2	3	4	5	6
Disinterested apathetic		Easily interested; generally not sustained		Alert Wide eyed Into environs	Too variable to rate

5. CLARITY OF RESPONSE

1	2	3	4	5	6
Questionable may be due to interfering behavior		Average		Clear prompt response	Too variable to rate

6. VERBAL-VOCAL PERFORMANCE/STRENGTH

1	2	3	4	5	6
Verbal/ vocal stronger		Equal strength		Perfor- mance Stronger	Too variable to rate

7. ACTIVITY LEVEL

1	2	3	4	5	6
Inactive		Moderately Active		Excessively Active	Too variable to rate

8. FINE MOTOR

1	2	3	4	5
Abnormally delayed		Average		Finesse for age

9. TEST ADEQUACY

1	2	3	4	5
Minimal		Average		Excellent

10. GENERAL EVALUATION OF SOCIAL/ BEHAVIORAL DEVELOPMENT

1	2	3	4	5
Seriously Deviant	Deviant	Question- able	Normal	Superior

Basis for a 1-3 rating \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

(Transcribed from N.M.Robinson's mimeographed copy;1993)

**APPENDIX B**

**Instructions for Use of Infant Behavior Rating Scale-Form IV**

**(Robinson, 1975b)**

**"INSTRUCTIONS FOR USE OF CHILD BEHAVIOR RATING SCALE/ DATA SHEET  
FOR EXAMS TO TWO YEARS"**

We are trying to use a single reporting sheet for behavioral data up to 24 months. We have tried to pick behaviors meaningful across age levels. However, keep in mind that you are to compare the child with norms appropriate to his/her corrected CA; we are not using an absolute scale. (There is one exception: Item 10, Social/Behavioral Development, should be in terms of the child's developmental level, if this is below corrected CA.)

The distribution of our ratings should show some resemblance to the normal curve, i.e., a piling up toward the middle rather than the extreme. When in doubt about two points on the rating scale, err toward the middle rather than the extreme. Extreme scores should designate the unusual when compared with a normal population. (For example, we may have more children with performance strength greater than verbal/vocal strength in our sample than would be true of an unselected population). That is, keep in mind a bell-shaped curve when making your ratings, but a curve roughly reflective of a normal population.

There may be considerable variability during the testing session in many of the behavior rating scales, due to the baby's fatigue, hunger, initial wariness, or other stress. In most sessions, however, there comes a stable period when the baby seems to be at the best level or state which the examiner can elicit, a state one might assume to be characteristic when then the baby is awake and at ease at home. We are not interested in only fleeting periods of high interest or responsivity, but a significant period of time (5 minutes minimum for a 4-month old, perhaps 10-15 for an older infant) which is the baby's generally responsive state (for him or her). The behavioral rating scales can be limited to that period if the baby seems disturbed at other times; if there does not seem to be that kind of fluctuation, then of course your rating would be based on a longer period. Please note, however, that the ratings for Items 1 and 2, predominant state and predominant mood, do not refer to the subperiod but rather the entire examination.

**ITEM 1. PREDOMINANT STATE DURING EXAM.** How would you characterize the infant's overall state during the testing? (Disregard "down times" when the baby is being fed, changed, or is asleep.) Remember that "alert" is an exceptional rating to refer to truly extraordinary receptivity. There is some overlap at the top end of this scale with Item 4 (interest in surroundings), although this scale refers to the whole period while Item 4 may refer to a subperiod, and the bottom ends of the scales reveal different dimensions.

**ITEM 2. PREDOMINANT MOOD DURING EXAM.** Self-explanatory.

ITEM 3. GOAL DIRECTEDNESS. This item may give particular difficulty because attention span and purposiveness increase so much with age. At 4 months, for example, some babies will be reaching repeatedly for an object, while others may show visual alertedness and undirected hand motion which seems purposive. At 12 months ordinarily a considerable amount of goal directedness is observed --e.g., pegboards, formboards, beads in hole, etc. The item has something to do with a sense of completion of tasks within the child's developmental repertoire. For example, for a child for whom inserting a peg was difficult, just getting a peg in the pegboard would seem purposive; for a child easily capable of that task, then inserting all pegs in a directed way would reflect persistence. Sometimes one encounters children who are very purposive with one toy but not with others. Basically, a child who is "hooked" (even passionately) by only one or two toys or activities could not receive a 5. (A child who rejects one or two completion items could, however, receive a top score, provided that he showed purposiveness generally on other items.) Perseveration in a given type of behavior is not, alone, evidence of goal direction.

ITEM 4. VISUAL INTEREST IN SURROUNDINGS, OBJECTS. Ignore the "visual." Otherwise, descriptions seem self-explanatory. Remember, again, that "wide-eyed" children are exceptional. We are most worried about apathetic children.

ITEM 5. CLARITY OF RESPONSE. This item is in some ways better judged from the examiner's behavior than the child. Ignoring "warm up" items (many children do not respond in an organized fashion to the first few items presented, whatever they are), one looks here at how difficult it was to judge whether a child did or did not pass items. Generally speaking, children who are not compliant, or who are not under good control in the situation, need many repetitions and management. Children who give clear, prompt responses are usually in exceptionally good rapport, alert, and tuned in to the nature of the problems being presented them. At the other end of the scale, children whose successes are questionable may show interfering behaviors such as mouthing or throwing toys, or do not seem to sense the nature of tasks. The main problem comes with inventive children who have to run through their own schemes (generally, a number of different activities) with the materials before they get around to those the examiner has in mind. Generally speaking, such children come around to clear responses to the tasks within their developmental range (at least average). Children who score high on this item usually take less than the average time for the test; low scorers usually take more.

This item was included because it seems that there are significant number of "marginal" babies whose development indices in a sense overestimate their ability, being a better index of the ability of the examiner to elicit a marginal response than an index of their habitual functioning. Such babies often give a sense of being disorganized, with "soft" signs of dysfunction.

ITEM 6. VERBAL/PERFORMANCE STRENGTH. Look at the child's pattern of successes and failures on the Mental Scale (or the DDST). Is there a difference between vocal/verbal behaviors and object-based problem-solving? You may find qualitative differences as well as quantitative ones, and these should be allowed to influence your rating. You may, for example, find that a child uses language very effectively, but does not have exceptionally advanced language, or conversely, that a child has language equal to his/her performance level but seldom uses it. You probably will shade your ratings accordingly. Ratings of 3 and 5 usually reflect both quantity and quality.

There is some possibility we are getting at hemispheric brain differences even at this young age, or perhaps some discrepancies in children who will later show either verbal or fine motor problems. Or the discrepancy may be a passing thing, as in a baby preoccupied with learning to walk whose verbal skills don't expand very much for a while.

ITEM 7. ACTIVITY LEVEL. Children given a 5 rating are at or close to what one could call "hyperactive"; children given a 1 rating seem lethargic. Grossly involved spastic quadriplegics would receive a 1, but other CP children might show other activity levels.

ITEM 8. FINE MOTOR SKILLS./ This item is not very hard to rate.

ITEM 9. TEST ADEQUACY. Minimal test adequacy is seen when the child is fussy or noncompliant, tired, or otherwise seen under poor conditions. Excellent adequacy occurs when the examiner is convinced that the child's very best efforts have been elicited.

ITEM 10. SOCIAL/BEHAVIORAL DEVELOPMENT. Social/behavioral development is judged with respect to developmental level. If negative behaviors are seen during the session but are reported by parents to be unusual, a "questionable" rating is usually appropriate. A 1 rating reflects serious disturbance (withdrawal, psychosis). A child who is "spoiled" and manipulative that the test is ruined or painful for everyone would receive a 2 or 3 rating, depending on the degree. And so on.

ITEM 14. DEGREE OF CONCERN FOR MENTAL DEVELOPMENT. this item will generally reflect the Bayley MDI, but it need not correspond precisely. You may want to shade your rating by qualitative features. For example, a child might obtain a score in the normal range but show poor verbal behaviour that "questionable" would be appropriate. Unless there are qualitative shadings, however, one would go by the following ranges of MDI: Superior 120+; Normal 84-119; Questionable (borderline) 68-83; Deviant (mild retardation) 52-67; Seriously deviant (moderate retardation or below), below 52.

ITEM 18. DEGREE OF CONCERN FOR MOTOR DEVELOPMENT. Similar to Item 14. Feel free to give a 3 rating even if the child's score is in normal range, if you note qualitative soft signs that give concerns

[incomplete]

ITEM 19. (12 and 24 months only) VARIETY OF SCHEMAS. This item relates to the variety of approaches a baby uses, or the degrees of his/her constructive inventiveness. Often you will see a baby who has to run through numerous schemas before settling down to the ones you had in mind. Given the Buzzy Bee to play with, the baby may, for example, twang the antennae, turn the wings, mouth and bang, swing it by a string, roll it on the table, etc. Truly inventive ("creative") babies would receive a 5 rating; those who perseverate (e.g. mouthing, throwing) in one or two predominant schemas for relating to objects would receive a 1 rating. Ordinarily, a high rating will be attained only by babies who are at or above their developmental level (but there may be exceptions).

7/25/77

(Transcribed from N.M.Robinson's mimeographed copy; 1992)

**APPENDIX C**

**NIHR Research Project Form (S.R. Harris, 1984-1985)**

\_\_\_\_NORMAL\_\_\_\_CP\_\_\_\_DEV. DELAY/OTHER

NIHR Research Project (S.R.Harris)

Name\_\_\_\_\_UH#\_\_\_\_\_B.D.\_\_\_\_\_

I. Information from raw data

Corrected age at first MAI\_\_\_\_\_ Total risk score\_\_\_\_\_

Neurological exam:

Motor development:

one year\_\_\_\_\_

one year\_\_\_\_\_

two years\_\_\_\_\_

two years\_\_\_\_\_

three years\_\_\_\_\_

three years\_\_\_\_\_

4 1/2 years\_\_\_\_\_

4 1/2 years\_\_\_\_\_

six years\_\_\_\_\_

six years\_\_\_\_\_

Infant Behavior Rating Scale (4 months):

Irritability\_\_\_\_\_

CP onset (age of dx.)\_\_\_\_\_ Type of CP and Code #\_\_\_\_\_

II.

Information from narrative (M.D.)

one year\_\_\_\_\_

two years\_\_\_\_\_

three years\_\_\_\_\_

4 1/2 years\_\_\_\_\_

six years\_\_\_\_\_

Additional Comments:

(Transcribed from S.R. Harris mimeographed copy; 1993)

## APPENDIX D

Parallel Comparisons Between Items 1,2,3,4,5 & 7 of the IBRS-Form IV  
(Robinson,1975a) and the Nine Temperamental Dimensions  
(Thomas et al.,1963; Thomas & Chess, 1977).

Upon review of the description of the items of the IBRS-Form IV (Appendix 2), the present study established parallel comparisons between items 1,2,3,4,5,and 7 and Thomas and Chess' (1977) description of the temperamental dimensions. The first 7 items of the IBRS-Form IV (Appendix A) were compared to the temperamental dimensions (Thomas & Chess,1977).

	<u>IBRS-FORM IV</u>	<u>TEMPERAMENTAL DIMENSIONS</u>
	<i>Item 1 "Predominant State during Exam"</i>	<i>"rhythmicity"</i>
Descriptors:	sleepy, awake, alert, too variable to rate	regular, irregular
	<i>Item 2 "Predominant Mood during Exam"</i>	<i>"quality of mood"</i>
Descriptors:	fussy/"skittish," calm, sunny, too variable to rate	positive, variable, negative
	<i>Item # 3, "Goal Directedness" and item #4, "Visual Interest in Surroundings/Object"</i>	<i>"attention span and persistence" and "distractibility"</i>
Descriptors:	Item #3: no directed effort, few attempts at goals-not interested in completion,persistent or repeated attempts at goal, too variable to rate. Item #4: disinterested-apatetic, easily interested-generally not sustained, alert, wide eyed into environs, too variable to rate	for both traits: high, moderate and low in terms of frequency/intensity
	<i>Item# 5: "Clarity of Response"</i>	<i>"threshold of responsiveness,"</i>
Descriptors:	questionable-may be due to interfering behavior, average, clear-prompt response, to variable to rate	high, moderate or low, in terms of frequency/intensity
	<i>Item # 7: "Activity Level"</i>	<i>"activity level."</i>
Descriptors:	inactive, moderately active excessively active, too variable to rate	high, moderate or low, in terms of frequency/intensity

## APPENDIX E

Interpretations of and Comparison between Items of the IBR (Bayley (1960)  
and Items of the IBRS-Form IV (Robinson, 1975a).

Should the IBRS-Form IV be considered an instrument measuring both the infants' self-capacity to organize and their individual behavioural traits, then extreme variability of behaviour could represent an indicator of behavioural disorganization.

A rating of 6, "too variable to rate" would have a similar meaning not only for Item #2, but also for items #1, #3, #4, #5, #6, #7 and #8 (see Appendix 1).

Information gathered through descriptive statistical analysis of data in the current study seemed to confirm some expectations regarding frequency and intensity of mood responses (as assessed by Item #2, "Predominant Mood during Exam"), re: predominantly irritable or labile mood being prevalent among high risk infants who are later diagnosed with neurodevelopmental disabilities.

Robinson's (1975b) scoring instructions for the IBRS-Form IV (see Appendix 2) commented on a tendency for the infants to show more "usual" versus "unusual" behaviour. "Usual" mood states, at 4 months' corrected age, were interpreted as "calm" (with two gradations, 3 and 4). On the other hand, "sunny," "fussy/skittish" and "too variable to rate" were considered less usual or "unusual" mood states. This interpretation of which mood states were more or less "usual," specifically at age 4 months, was confirmed by Bayley's description of the predominant behaviour of 4 months-old infants in the Infant Behavior Record of the Bayley Scales of Infant Development.

The Infant Behavior Record (Bayley, 1969) described typical or "characteristic" behaviour patterns for infants aged 1 thru 30 months. The four month-old is described as:

"...characteristically happy, and still more interested in people than in objects. Although he shows awareness of the difference between familiar and strange persons and places, he is not fearful of them. He is interested in listening and, to a lesser extent, in vocal play. He shows greater proclivity for manipulating objects in his hands, as well as more mouthing of toys" (Bayley, 1969, p.104).