AN INVESTIGATION INTO THE BIOLOGICAL PERTURBATIONS OF PREMATURITY.

Kenneth John Aitken

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Department of Psychology.

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PROLEGOMENON

"..the determination of time-periods is of fundamental importance in the progress of development, and just this matter has been least observed. I grant that what has here been observed cannot be taken as a general law, since children, just like adults; progress variously, the one with speed, the other more slowly; but at least it informs us of one among the possible rates of progress and allows us to put some determination upon the previously indefinite subject. When we shall have several such records it will be possible by means of comparison to strike an average for the common order of nature."

Dietrich Tiedemann (1787)

"During the first seven days various reflex actions, namely sneezing, hickuping, yawning, stretching and of course sucking and screaming were well performed by my infant. On the seventh day, I touched the naked side of his foot with a bit of paper and he jerked it away, curling at the same time his toes, like a much older child when tickled. The perfection of these reflex movements shows that the extreme imperfection of the voluntary ones is not due to the state of the muscles or the coordinating centres, but to that of the seat of the will. At this time, though so early, it seemed to me that a warm, soft hand applied to his face excited a wish to suck. This must be considered as a reflex or an instinctive action, for it is impossible to believe that experience and association with the touch of his mother's breast could so soon have come into play."

"The movements of his limbs and body were for a long time vague and purposeless, and usually performed in a jerking manner; but there was one exception to this rule, namely, that from an early period, certainly long before he was forty days old, he could move his hands to his own mouth."

Charles Darwin (1887)

"The baby, assailed by ears, eyes, nose and entrails at once, feels that all is one great blooming, buzzing confusion."

William James (1890)

CONTENTS

ABSTRACT

This thesis is an investigation into the effects of premature birth on the developing behaviour of both infant and caregiver.

A neonatal assessment procedure sensitive to both the neurological and the interpersonal aspects of development and to obstetric complications was developed. This assessment was validated on a total sample of 62 premature and fullterm infants.

In a further study utilising 30 infants from the first part of the thesis, the effects of a maternally-administered manual-based intervention for premature infant-mother dyads were evaluated as compared to fullterm and premature diary controls. This focussed on a variety of early interactional activities designed to enhance mutual parent-infant responsiveness in preterm dyads. The results of the study are discussed in terms of the possible clinical utility of such an approach in reducing the liklihood of dysfunctional parenting of the "High-Risk" newborn.

The thesis is set in the context of a review of the pertinent literature on the development of special care facilities for the premature infant, neonatal assessment procedures, mother-infant interaction and intervention research.

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I declare that this thesis has been completed by myself and that the work is my own.

Signed:

UNTERSUCHUNGEN

ÜBER DAS

SEELENLEBEN

DES

NEUGEBORENEN MENSCHEN

VON

DR. ADOLF KUSSMAUL,
O. Ö. PROFESSOR DER MEDICIN IN ERLANGEN.

Programm
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Fig. 1.1

We shall now briefly review the work of some of the more important theorists, including Darwin and those following him, who have influenced the development of infancy research and had a direct impact on the development of this thesis:

1.1.2) <u>Charles Darwin:</u>

Charles Darwin (1809-1882) can be seen as the first, and in many ways the most perceptive, of researchers to investigate the the development of infant expressive capabilities. He made detailed descriptive accounts, often using photographs, of facial, gestural and vocal acts in adults and their early development in the child (Darwin 1872, 1877). He viewed early expressions of emotion as innate patterns, morphologically similar to the signals used by adults and by other animals in the regulation of social behaviour. Over a hundred years after their publication, Darwin's descriptions have been largely corroborated by Harriet Oster and Paul Ekman using the Facial Action Coding System (FACS) for the analysis of movements of facial muscles (Oster 1978, Oster & Ekman 1977). These researchers have clearly demonstrated the morphological similarity of infant and adult emotional expressions, and the differentiation and muscular coordination in such expressions of emotion from the early weeks of life. Darwin's detailed observational approach has been adopted by a variety of researchers working in the field of neonatology, and direct parallels can be seen with the more recent work of Eibl-Eibesfeldt (1970), Freedman (1970) and of many others. The evolutionary function of infant and adult behaviours has also developed into an important research area, with, in particular, considerable controversy arising over the adaptive biological functions, if any, of *certain parental actions leading to abuse and neglect of infants (see Gelles & Lancaster 1987).*

1.1.3) James Baldwin:

James Mark Baldwin (1861-1934), often spoken of as the father of modern developmental psychology, stressing in his writings the importance of imitation in development, and also the development of reversible operations. Both of these concepts were to be developed and researched by Piaget. Piaget had, indeed, heard Baldwin lecture on development in Paris during Baldwin's 'exile' there from 1908 and openly admitted his debt to Baldwin as a precedent to, and influence on, his own thinking. The central role of imitation has also been recognised by other developmental models such as the analytic model of Henri Wallon, one of Piaget's contemporaries (see Voyat 1973), and Bandura's social learning theory (Bandura 1977). Baldwin's model of development, both as it applies to the individual and the evolutionary process is best exemplified in his books Social and Ethical Interpretations (1897) and Development and Evolution (1902).

1.1.4) George Herbert Mead

George Herbert Mead (1863-1931) is an important figure in early 20th century psychology. While though holding a chair in Philosophy, he was strongly influential on the development of psychological models of human action. His theoretical approach was termed 'Symbolic Interactionism', or, alternatively,'sociological behaviourism'. He proposed a developmental model which, as with Baldwin's, antedates and has much in common with a Piagetian *framework. For Mead, development can be broken down into several discrete stages:*

> *Primary Socialization, an active developmental process occurring through childhood which is further subdivided into three:*
>
> *a) Preparatory, during which simple experiences were seen as leading to the development of knowledge of social contingencies - Crying leads to the appearance of mother.*
>
> *b) Play, during which the child is able to take on the perspective of one other person, usually as a fantasy or roleplay activity.*
>
> *c) The Game Stage in which the child progresses to being able to take the perspectives of more than one other person*
>
> *Secondary Socialization, which is the process of change in self through changes in ones physical and or social world, and which continues throughout the life of the individual.*

The basic tenet of Mead's approach was that all human interaction is mediated by shared meanings or symbols. The only material for psychological research is directly observable behaviour, but it is the socially derived meaning rather than the behaviour itself which is of primary importance to the subject. Another important emphasis in Mead is on the distinction which he draws between 'I' and 'Me', I being the biological tendencies and predispositions of the person, while Me is the reflective, socially derived self-as-object. There are obvious parallells to be drawn with the Ego - Superego distinction in Freudian models of self.

One of his best known students was John Watson, who adopted much of Meads model in his later work. Watson, however, denied, using the principle of Occam's razor, that it was necessary to postulate anything more than the overt behaviour in our hypothesising about human behaviour.

The move away from focussing on internal processes has been *redressed in recent decades by workers who make open acknowledgement of a historical debt to Mead in their considerations of human interaction. In particular, the recent work of Antaki, Brewin and their colleagues on the importance of the concept of "Metacognition" for the understanding of social communication relies heavily on a Symbolic Interactionist framework (see Antaki & Lewis 1986). An important theoretical question which remains, however, and which will be addressed in this thesis is the extent to which Mead's assertion that what he refers to as "Me" is wholly a socially derived phenomenon. The author would support the "I" - "Me" distinction, but see the reflective, social aspects of self embodied in Mead's "Me" as a biologically derived but socially triggered aspect of the person.*

1.1.5) John Watson and the Rise of Extreme Empiricism:

John Watson (1878-1958) (Watson, 1925), pioneered the use of filmed recordings of mother-child behaviour in a standardized setting as a method of analyzing in detail the patterns that could be observed. As Professor of Psychology at Johns Hopkins University, he was able to embark, in 1916, on a research programme which involved detailed behavioural observation of infants from birth. His research was curtailed by enforced resignation over a scandal concerning his divorce, and the fruits of this early attempt at systematic observation were never to mature. Watson was 'the' extreme empiricist, who as the 'father' of modern behaviourism, made many grand claims for the plasticity of early infant functioning; for example:

"Give me a dozen healthy infants, well formed, and my own, specified world to bring them up in, and I'll guarantee to take any one at random and train him to become any type of specialist I might select - doctor, lawyer, artist, merchant-chief and, yes, even beggar-man and thief, regardless of his talents, penchants, abilities vocation and race of his ancestors."

J.B.Watson (1925)

Despite his overly-enthusiastic view of the potential for plasticity in human development, Watson can be seen as important in having provided a methodology which would allow subsequent researchers to investigate early infant behaviour and development without prejudice, using methods which are rigorous and quantified, allowing for inter-rater reliability to be calculated and for blind scoring of interaction sequences to eliminate experimenter biases.

1.1.6) Lev Semeonovich Vygotsky

"What children can do with the assistance of others might be in some sense even more indicative of their mental development than what they can do alone...."

Vygotsky (1978)

Lev Vygotsky (1896-1934) through his short but prolific career made a major impact on developmental psychology as practiced in both Russia and the West (see Wertsch 1985). His students included A.R.Luria, and A.N.Leont'ev who did much to make Vygotsky's ideas accessible to a Western audience. In retrospect, his principal of "extracortical organization of complex mental functions", illustrated in the above quotation, was to have far reaching implications. As proposed by Vygotsky, this view of the child's world developing through interaction with others was seen as relying on an internal and essentially linguistic scaffolding. The pre-linguistic infant was, as a direct consequence, seen as of *little interest and playing a minor role in development. This view retains its force in some areas. To give one example, the selection criteria for the Conductive Education approach to cerebral Palsy as practiced in Hungary (Cottam & Sutton 1986) still uses language comprehension as a core feature.*

A variation of Vygotsky's viewpoint could be proposed which argued for the importance of social context in the development of self-awareness, where this process antedates the emergence of language and is available to the child at least from birth. Such a model would have close parallells to those of Baldwin, Mead, and most recently, to that of Trevarthen.

1.1.7) Jean Piaget

The next major figure in the development of our current understanding of infant behaviour and development is Jean Piaget (1896-1980). He attempted to provide a complete theoretical model of child development based on epigenetic principles - the infant is born with expectations of the world which are strengthened through experiences which either corroborate them ("assimilation"), or modify them to fit events which run counter to what is expected ("accommodation"). Piaget's research on infant development, which he describes as 'Genetic Epistemology', began in 1925 with his detailed studies of the motor coordination and perception of his own first child Jaqueline (Piaget 1936). Piaget, in line with his earlier research with Simon on the origins of errors in 4-6 year olds performance on psychometric measures, focussed his interrogative or 'clinical' observations largely on the development of cognitive or object-conceiving skills.

In the first stage of development - the sensori-motor coordination stage, his investigations were focussed on the development of hand-eye coordination and of the child's memory for consequences of moving to perceive or to grasp objects. Piaget largely ignored the development of interpersonal communication in the child, keeping his attention almost entirely on object perception and problem solving; that is, on the epistemological aspects of early development. Piaget's approach is often seen as the converse or complement to Sigmund Freud's whose own work, whilst also epigenetic, focussed on the development of the emotional and interpersonal being. Freud, for his part, largely ignored the performatory aspects of early behavioural development directed to mastery of physical objects.

Piaget has been instrumental in shifting the focus of research on infant development away from emotional aspects, in consequence of the vast body of research which he and his followers have amassed with a pure cognitivist bias. However, Piaget has also been important in the development of logical sophistication in observational studies of early development. He stressed accuracy of observation, and empirical testing of theoretical predictions against infant responses. There is now a rich tradition of developmental psychology research within a broadly Piagetian framework (see, for example: Butterworth 1981, Meadows 1983). As the Piagetian framework is a strongly epigenetic one, it lends itself well to explanations of behavioural development which relate changing psychological function to evolving neural structure (see, for example, Gibson 1981).

It must also be noted that work deriving from this tradition has resulted in revision of some of its basic postulates *to differ from Piaget's initial ideas (see, for example, Donaldson 1978). The subject directed experiences which Piaget felt necessary as a driving force for development were also called into question by the research of Decarie who established that children with severe limb deficiencies secondary to thalidomide had the same sequence of development, albeit at a slower rate, as motorically unaffected children despite the fact that a strictly Piagetian prediction would have been of developmental difficulties brought about by limited chances for the child to confirm or confound expectations.*

In parallel with the development of Piagetian approaches to the unfolding of cognitive processes, a variety of other research strategies were developed to investigate discrete aspects of early functioning.

1.1.8) Overview

The above researchers were all seminal figures in their respective ways for the development of research orientations with potential utility in the study of clinical issues related to child development. Darwin developed the ethological/observational approach; Baldwin stressed the importance of imitation and circularity; Mead the importance of intersubjective understanding; Watson of objectivity and corroboration; Vygotsky of the importance of extrapersonal structuring; Piaget of the epigenetic nature of the process of normal development.

None, however, with the exception of Vygotsky in his researches on 'defectology' studied "ecological experiments". Decarie a student of Piaget addressed similar issues in her studies on the effects of 'Thalidomide' (DeCarie 1969).

The term "ecological experiment" was coined by Selma Freiberg to describe atypical patterns of development (such as prematurity, growth retardation, and postmaturity) and pathology (such as blindness, deafness, and physical malformations). The systematic study of these phenomena could help clarify many of the issues to which most of the great developmentalists applied their minds. 'Observation without manipulation' can lead to models that are inductively corroborated without being correct; that are reliable, although not necessarily valid.

1.2) Assessing Discrete Aspects of Infant Functioning:

As a parallel to the development of embracing models of human infant function, considerable effort has been expended in the analysis and understanding of discrete components of the neonate's abilities and comparative deficits.

Many different models and methodologies have been adopted in recent years to investigate the capabilities and early development of the neonate and young infant. These different approaches reflect the theoretical perspectives of researchers and specific aspects of functioning, and can be broadly divided up into the following categories of assessment:

1. *Reflex Functions*
   (Capute, Palmer, Shapiro, Wachtel, Ross & Accardo, 1984) ,
2. *Sensory Capabilities*
   (Haith, 1977)
3. *Cognitive Functioning*
   (Miranda & Hack 1979),
4. *Interactive Capabilities*
   (Trevarthen 1977,1985, Stern 1986)),

5. *The Relationship of Neonatal Behavioural Repertoire to Cerebral Electrical or Metabolic Activity (Chugani & Phelps 1986, Duffy & Als, 1983),*

1.2.1) Reflex Functions of the Human Neonate:

Many research workers in the field of neonatology have argued the view that the developing neonate is in essence a reflex organism which has yet to develop cortical control over behaviour:

> *"The newborn infant may be described as a tonic animal with oropharyngeal and other automatisms and neuro-vegetative mechanisms."*
>
> *Polani & MacKeith (1960)*

The question of cortical versus subcortical control of behaviour is one which will not be directly addressed here, however, the assumption that subcortical structures are only able to mediate simple reflex responses needs to be called into question. There is now a considerable breadth of evidence that infants with no cortical function are able to engage in complex activities (see, for example, Watson 1944, Aylward, Lazzara & Meyer 1978).

The reflex model of neonatal and early infant functioning has led to a variety of studies which have taken as an initial premise the view that these aspects of infant functioning are all that will be found and therefore are all that need to be assessed. Despite the limitations which such a model of infant functioning imposes, there have been many valuable insights into the development, in particular of motor coordination, through the detailed study of reflex functions (see Connolly 1981).

Recent work by Capute and his coworkers in Baltimore (Capute, Palmer, Shapiro, Wachtel, Ross & Accardo 1984) shows that there is *a developmental progression over the first year of life in the maturation of nine primitive brainstem reflexes and that assessment of such functioning may be a valuable adjunct to other types of neonatal assessment in the prediction of later motor disabilities. The basis for much of the neurological assessment of the neonate is the assessment of simple reflex functioning, which will be discussed in detail later in the thesis.*

1.2.2) Sensory Capabilities of the Neonate:

Investigation of the sensory capabilities of the neonate has been the focus of much sophisticated research, and is an area which deserves more than passing mention at this point.

1.2.2.1) Vision:

There is now a considerable research literature on visual function in infancy. The interested reader is directed to several major reviews for more detailed coverage than is possible here, in particular, to those of Banks and Salapatek (1983), Gibson and Spelke (1983) and of Aslin (1987).

Assessment of the visual capabilities of the newborn was limited by practical difficulties until the introduction in the late 1950's of the Fantz visual preference paradigm (see Miranda & Hack 1979 for a review of this early research). Fantz used a simple apparatus in which the seated infant was presented with two panels bearing different stimuli; for example, one grey and the other of progressively narrower stripes. The limits to visual acuity were determined by observing the width of stripe for which the infant no longer showed a preference over the grey panel, it being the case that infants show a spontaneous preference for *looking at a more complex pattern ,in this case for stripes over a plain panel of matched luminance. Acuity in the infant of under two months has been shown to be in the range 15 to 40 minutes of arc using this method known as Forced Choice Preferential Looking (FPL). The Fantz paradigm has been used to establish that the premature infant is able to make clear visual preference responses at least as early as 32 weeks post-conception (Dubowitz, Dubowitz, Morante & Verghote, 1980), however the level of acuity shown by these infants was not clearly established.*

Lewis and Maurer (1975) developed a different technique for assessing visual acuity using behavioural responses. In their task, the infant fixated on a light display, followed by presentation of a line in the same position. The experimental measure was the amount of time for which the line was fixated. A series of progressively thinner lines was presented. Using this method, infants of under two months were found to fixate lines of down to 8 seconds of arc, with lines of 4 seconds elliciting no more response than when no line was presented.

Marshall Haith has developed an approach to assessment of visual function which involves direct analysis of the patterns of visual scanning of the neonate in response to a variety of animate and inanimate stimuli (Haith 1977). The infant lies in a simple cradle, looking up towards a 45 degree one-way mirror on which he sees the the stimuli being presented to him. Behind the mirror is a video camera ringed with a series of small infra-red lights which are oriented to reflect off the infants eye and record its movements. This method provides a reliable assessment of eye displacement. It has been used, for example, to analyse patterns of eye movement during conversation with mother, establishing *that eye contact is made in response to maternal speech (Haith, Bergman & Moore, 1977).*

Several techniques have been developed for gross assessment of visual functioning, which are useful in assessment of the infant who does not show reliable responses to the techniques outlined above. Large moving dot patterns that fill the infants visual field ellicit Optokinetic Nystagmus (OKN) (Atkinson, 1986). OKN allows the investigator to establish that there is a degree of visual response, but its reliability as a measure of acuity is questionable (Kiff & Lepard, 1966) . Visual Evoked Potential (VEP) measures can be used to ascertain both visual acuity and contrast sensitivity particularly in children who exhibit limited control of eye movement. Typically, phase reversal grating patterns of between 2 and 10 Hz are used, and both latency and amplitude components of the VEP can be used to assess the level of visual function at a neural level (Marg, Freeman, Peltzman & Goldstein, 1976; Pirchio, Spinelli, Florentini & Maffei, 1978; Atkinson, Braddick & French, 1979; Tyler, 1982).

The most important developments in the area of neonatal and infant visual and perceptual development in general are concerned with the active use of sensory information in human interaction. Work on the development of imitation (Fontaine, 1984; Kugiumutzakis, 1985; Lewis, 1979; Meltzoff & Moore, 1977), and on the differential interest shown by infants for human as opposed to inanimate or animate non-social stimuli (Packer & Rosenblatt, 1979) argues that the validity of much research into the physical limitations on and perceptual capacities of the neonate and infant that has been based on responses to inanimate or animate but non-social stimuli must be questioned. Detailed discussion of these *areas will be presented later in the thesis.*

1.2.2.2) Hearing:

Many studies have now been conducted which suggest that the newborn infant is selectively responsive to speech-like auditory input. The behaviour of an infant will alter in response to being played a tape recorded human voice, specifically with increased eye opening, mouthing and hand movements (Alegria & Noirot, 1978). The newborn infant will orient towards an auditory stimulus within the same range as the human voice (Wertheimer, 1971), and away from a louder auditory stimulus (Butterworth & Castillo, 1978). Infants have been shown to be most responsive to stimuli of speech-like pitch and volume (Hutt, Hutt, Lenard, Bermuth & Muntjewerf, 1973), and this responsiveness has been shown to be diminished if Pethidine has been given to the mother during the labour (Turner & MacFarlane, 1978).

It has been claimed that the infant will move in patterns which show synchrony with adult speech, irrespective of the language being spoken (Condon & Sander, 1974). Although widely accepted, the validity of this finding has recently been questioned by research using lag sequential analysis of 3-D coordinates taken from videotaped recordings of six infants aged 2 to 10 weeks who were not observed to make movements interdependent with maternal speech (Dowd & Tronick, 1986). Differences in the methodology employed make interpretation of the differing claims problematic, however the discrepancy with respect to the broader claims being made warrant further research on this point.

The human foetus is behaviourally responsive to sound from the third trimester of pregnancy (Birnholtz, Stephens & Faria, *1978). The newborn will show a preference for mothers voice over that of other females (DeCasper & Fifer, 1980) , and a preference for female over male voices (DeCasper & Prescott, 1984). Exposure to mothers' voice in utero may be the basis for preference over the voice of other females. It is possible that the differential responsiveness to males and females is also a function of prenatal exposure as there is greater attenuation of male speech by maternal tissue antenatally (Querleu & Renard, 1981).*

It has been established that prenatal exposure to specific speech patterns, for example, to a particular recited passage read by the mother, results in increased interest shown within the first days of life for that passage over others also read by mother (DeCasper & Spence, 1986). Missing out on such exposure by the premature infant may have an effect on that infants ability to engage in early interaction with mother as he may be less selectively responsive to maternal speech patterns.

1.2.2.3) Proprioceptive Responses:

Proprioceptive-Vestibular stimulation of the infant results in quieting and alerting (Korner & Thoman, 1970; Gregg, Hafner & Korner, 1976). It is also likely, as labarynthine responses are present in the last trimester of pregnancy, that the infant will have become attuned to movement patterns of the mother antenatally and that this attunement will in part account for differential interest in maternal movement patterns as seen and felt by the newborn infant.

1.2.3) Cognitive Functioning in the Neonate:

The assessment of cognitive functioning in the neonate is a recently revived research area. Much of the earlier work on cognitive functioning in early life having been discontinued in the face of results which seemed to show negligible predictive validity. A variety of recent research studies have revived interest in the possible predictive power of certain infant abilities such as cross-modal matching (Rose, 1981), attention decrement and recovery tasks (see: Bornstein & Sigman, 1986, for a review) and caregiver-infant interaction (Sigman & Parmelee, 1979). A general review of this area is provided by Oates and Sheldon (1987).

1.2.4) Interactive Capabilities of the Neonate:

As mentioned in the above section, caregiver-infant interaction is an important focus for research in the prediction of subsequent functioning of the infant. Early interaction is also an important focus for analysing a host of other factors such as impact of postpartum depression (Murray, 1987), the importance of infant behavioural repertoire for caregiver-infant interaction (Aitken, 1980) and many others. There is now a rich literature on interactional assessment in the early postpartum period (see, for examples, Tronick (Ed.), 1982; Trevarthen, Murray & Hubley, 1985).

1.2.5) The Relationship of Infant Behaviour to Psychophysiological Measures:

A recent development has been the attempt by Heidelise Als and Frank Duffy in Boston to relate the neurological and behavioural repertoire of the infant to patterning of whole brain *electrical activity (Duffy & Als, 1983). To date, they have established, on small numbers, that psychological assessment (Als, Lester, Tronick & Brazelton, 1982), using measures of motor activity and autonomic stability, and a measure of brain electrical activity (Duffy, Burchfiel & Lombroso, 1979) using two evoked response features (V60SRO and V90SRT) will both reliably group and discriminate between neurologically intact and suspect infants when the data is analyzed using significance probability mapping (Bartels & Subach, 1975). This type of approach offers much promise for detailed investigation of brain-behaviour relationships in the developing neonate and infant and for methods of monitoring developmental progress.*

1.3) Conclusions and Summary

There is a clear historical structure which affords the researcher a method of and rationale for the investigation of 'at risk' infant functioning. This structure is available to both the clinician interested in 'ecological experiments' and their implications for practice, and to the theoretician interested in discrete aspects of functioning and their response to compromise through prematurity. This conceptual and methodological framework has been widely applied in the area of 'normal' development (see: Osofsky 1987), and is beginning to find application in our work with the premature and other 'at risk' populations (Davis, Richards & Roberton 1983; Goldberg & DiVitto 1983; Smeriglio 1981; Friedman & Sigman 1981).

In this thesis, the 'ecological experiment' of prematurity is investigated as it affects the infant and his caregiver. Both gross and discrete aspects of functioning of the infant and the *dyad are examined. The plasticity of interaction in response to an intervention approach calculated to optimise maternal involvement is investigated.*

Chapter 2

THE HISTORY OF SPECIALISED CARE FOR THE "AT RISK" INFANT

2.1.1) The Beginnings of Care for the Premature

Care of the young child as a medical specialism, separate from the care of the adult is, like the scientific study of infant psychology, a relatively recent development. Specialised care for the premature infant is an even more recent and almost exclusively 20th Century phenomenon.

The first paediatric textbook to be published was Thomas Phaire's 'The Booke of Children' (1545). It was not, however, until 1701 that the first childrens hospital in Europe was established, in Halle in Germany, (Tanner, 1985), while the first such facility in Britain was established in 1741 by Thomas Coram in Lamb's Conduit Fields - near to the site of the present day Great Ormond Street Childrens Hospital. The mortality amongst children admitted to the hospital in Lamb's Conduit Fields was staggeringly high:

> *"Of 15,000 infants admitted to the hospital during this time, 10,000 died, but this great wasteage was calmly attributed by many worthy citizens to 'the profuse waste and imperfect workmanship' of nature and in any case it was regarded as a suitable fate for the offspring of harlots since it prevented them from perpetuating the sins of their mothers."*
>
> *I.G.Wickes (1953) (of the period 1741-1756).*

The reasons for this level of mortality are varied, but, in large part a reflection of the extremely deprived group of usually unwanted infants who constituted the hospital's population, and who frequently 'arrived on the doorstep in a moribund state' (Wickes 1953).

There were many innovations in the medical care of the neonate at this time, most of which revolved around attempting to provide adequate nutrition and warmth to the infant. For example, Alphonse le Roy introduced at Aix in 1775 the direct suckling of foundling infants by goats:

> "Each goat which comes to feed enters bleating <into the ward> and goes to hunt the infant which has been given to it, pushes back the covering with its horns and straddles the crib to give suck to the infant. There is in milk, besides the different nutritious principles, an invisible element, the element of life itself, a fugitive gas which is so volatile that it escapes as soon as the milk is in contact with the air. This is why it is impossible to rear infants with animal milk or with milk which has been expressed from the breast."
>
> Alphonse le Roy (Quoted in Drake, 1930)

The care of the premature, or low birthweight infant can be said to have begun in earnest with the development of the incubator as a means of providing thermoregulation. Prior to the development of the incubator, the chances of survival for the premature infant were slim, although there were cases reported, particularly in the Scottish medical literature, of extremely premature infants surviving, from as early as 1815.

Dr. Rodman of Paisley reported the following case in volume eleven of the Edinburgh Medical and Surgical Journal:

"It is common if there is much apparent weakness to feed a child the first twelve hours after birth very frequently, yet, in this instance, although the child was weak, no feeding was attempted till beyond that time; the nourishing heat with the mother in bed was relied on ... The child was kept reliably and comfortably warm by the mother and two females alternately lying in bed with him for more than two months."

Rodman (1815) (This infant weighed under 2lbs at 3 weeks postpartum and was reported as the "Case of a Child born betwixt the Fourth and the Fifth Month and brought up.").

An even smaller infant, believed by Cone (1985) to be the smallest child reported to have survived before the 20th century, is reported in the Scottish Medical Literature of 1850 by Dr. Barker of Dumfries Royal Infirmary:

""She was delivered (by a midwife) of her second child, a female, on the 14th of May 1847 - on the hundred and fifty-eighth day of gestation. The child had only rudimentary nails, and almost no hair except a little, of slightly reddish colour at the lower part of the back of the head. It weighted one pound <454 grams>, and measured eleven inches. It was merely wrapped up at first, laid in a box about a foot long, used by the father (who is a slater) for carrying nails, and set on the kitchen fender, before the fire, to keep it warm. It came on very well and was subsequently treated very much the same as the other children, except perhaps, that it was a little more looked after than usual, being considered a curiosity. She is still of small make, but is quite healthy and takes her food well."

Barker (1850)

There are a large number of 19th Century clinical case reports, the majority from Scottish medical practitioners (see those above, and, eg. Annan, 1847), of premature infants surviving apparently intact without the use of specialised neonatal care procedures. It is certain, however, that these cases are reported because they are atypical in their course rather than as would have been expected. Annan states of the six month foetus: "..there *have been instances, though most rare, of its continuing to live, if born at so premature a period." (Annan, 1847).*

2.1.2) Modern Beginnings - The Development of Special Care Technology:

The first incubator was introduced in 1835 (Cone, 1981), by Johann Georg von Ruehl the Physician in ordinary to Czarina Feodorovna, the wife of Czar Paul I, in his work at the Moscow Foundling Hospital. The incubator which he introduced was essentially a double walled metal bath into which the baby could be placed, filling the space between the two walls with warm water to maintain a stable, warm environment. By the end of the 19th century, incubators were in common use throughout Europe for the care of the premature infant,and the development of special care for the premature or otherwise low birthweight infant had begun in earnest.

It was not, indeed, until 1872 that prematurity was first described as a condition of the infant which could be related to birthweight (Gueniot, 1872). Limited basic information on normal birthweight had been published as early as 1753 by Johann Georg Roederer who reported a series of 27 apparently normal, full-term infants of whom the 18 males had a mean birthweight of 6 lb 9oz and the 9 females had a mean birthweigh of 6 lb 2.5 oz. It is likely that birthweight had not been used as a criterion as many of the accepted early sources quoted what today would be seen as grossly inaccurate estimates of expected birthweights. As an example, William Smellie (1697-1763) in his Treatise on the Theory and Practice of Midwifery (1752) quotes 10-12 lb as typical for *fullterm birth but up to 16 lb as being unremarkable.*

In 1895, the first Premature Baby Unit was established by Pierre Budin (1846-1907) at the Port Royal Maternity Hospital in Paris. The basic ideas which Budin espoused were (a) maintaining of adequate body temperature and prevention of hypothermia, (b) ensuring adequate feeding of the infants, where possible with human milk, and (c) the isolation of sick from healthy premature infants, stated as follows:

> *"With weaklings we shall have to consider three points: 1) Their temperature and their chilling; 2) Their feeding; 3) The diseases to which they are prone."*
>
> *P.Budin (1907)*

Budin was also well aware of the importance of monitoring outcome and development in his charges and set up the first growth clinic at the Port Royal - his "Consultation de Nourissons". Budin was a firm advocate of the use of breast milk with infants, where possible, and he maintained a permanent staff of wet nurses at the Porte Royal. After a severe outbreak of respiratory tract infection amongst the premature infants in his charge in 1896 at the Porte Royal, Budin designed and set up a special unit for premature infants, allowing for separation of healthy from sick infants, gowning and scrubbing up of staff, daily disinfection of incubators and sterilization of utensils. This was the first, true special care baby unit in the world.

It is to one of Budin's pupils, Martin Couney (1870-1950), that the credit for publicising the effectiveness of special care of the premature must go (see Klaus & Kennell 1976/1982). Couney demonstrated Budin's techniques at the Berlin exposition of 1896,

shortly after at Covent Garden in 1897 (where as many as 3,600 visitors each day toured the exhibition), and then from 1902 at a variety of venues in the U.S.A., finally setting up a permanent exhibition at Coney Island, New York, where the premature infants in his charge were on display to a paying public alongside fairground exhibitions (where the exhibitions takings were second only to Sally Rand, a famous "exotic dancer") , and he continued this venture on a regular basis until as late as 1940.
Though this method of exhibiting infants seems bizaare today, it was a common practice, resulting from the expense involved in purchasing and operating the Lion incubators, whose use would otherwise have been restricted to a very few hospitals or wealthy individuals. Other parallel s could be drawn with the exhibition of "Human Curiosities",(as, for example, in P.T.Barnum's American Museum), which were also a popular 19th and early 20th century form of exhibit (see Bogdan 1986).

In contrast to Budin, Couney would not allow mothers to help in the care of their premature infants; they were, however, allowed free access to the exhibit. As Couneys exhibitions were the model on which many of the premature nurseries throughout the USA and Europe were established, this practice, of denying mothers the opportunity to care for their infants, was often adopted. Couney found on many occasions that it was difficult to get mothers to accept their children back once they had reached a viable weight, but did not make the connection between the early experiences of the mother and infant and this lack of acceptance.

2.1.3) *Recent Developments in the Medical Provision for Preterm Infants*

Since the introduction of special care units and incubation, there have been many important practical advances in the medical care of the preterm infant.

The introduction of ventilators, apnoea alarms, phototherapy, nasogastric tube feeding, transcutaneous oxygen monitoring (see: Cone, 1985, for a thorough historical review of technical developments in neonatology) and neonatally triggered ventilation (Mehta, 1987) have all led to significant improvements in the quality of neonatal care.

Increasing knowledge of the metabolic requirements of and limitations on the premature neonate has also led to improvements in quality of care (see, for example, Roberton, 1984).

In her description of the development of one unit in Nashville Tennessee, over the past three decades, Mildred Stahlman (1984) documents this steady improvement in microcosm:

> *"In 1950....Our approach to premature infants, even sick ones, was studied neglect, and most sick infants and very-low-birth-weight infants with any problems died without vigorous attempts at investigation or intervention, except antibiotics for suspected infection, exchange transfusions for hyperbilirubinaemia and the administration of oxygen."*

> *"...A major change occurred in late 1961, when we began to admit distressed infants of all weights to the premature nursery...measured blood gas values and pH with modern electrodes, sampling from indwelling arterial catheters, monitored heart and respiratory rates...administered buffers for metabolic acidosis and glucose for calories from birth, and administered mechanical ventilation for infants with respiratory failure, sometimes successfully."*

"...around 1971..two new and important treatment techniques: constant distending airway pressure added to assisted ventilation or used alone with nasal prongs, and the development of a satisfactory protein containing solution for parenteral alimentation of sick infants who could not tolerate enteral feedings. Intravenous fat solutions followed shortly therafter, so that adequate calories could be given to every infant with medical or surgical problems regardless of size."

Stahlman (1984)

These improvements have had three important consequences - firstly, an increase in the rates of survival of preterm infants of any given gestational age or birthweight, secondly a progressive lowering of the age and weight limits on viability, and lastly a decrease in the rates of problems experiences by surviving infants of any gestational age or weight.

In the late 1960's and early 1970's there was considerable concern that improvements in the perinatal care of the low birthweight infant was having the direct effect of increasing the numbers of handicapped children entering long term hospital or community care (Drillien, 1964; Holt, 1972). Drillien, in her study found that 83% of infants weighing less than 1250gm at birth were abnormal developmentally at followup. The ethics and practice of intensive neonatal care were called into question:

"...those looking after the smallest infants have been faced with a dilemma similar to that which relates to the management of infants with severe congenital malformations: is it worthwhile using sophisticated methods of treatment to preserve life if the ultimate prognosis is so questionable ?"

Stewart & Reynolds (1974)

Many of the developments in neonatal care and the survival of *the premature have brought in their wake complex problems and abnormalities:*

Increasing survival of the hypoxic infant has been seen as the main reason for the increase in Necrotising Enterocolitis, itself now a major cause of death in small infants who survive for more than 36 hours (Herbst & Book 1980).

Respiratory distress syndrome (RDS), or hyaline membrane disease (HMD) is the most common cause of death in all newborns resulting from immature lung function. It has a particularly high incidence in prematures, which rises steeply with decreasing gestational age: 0.7% at 36 weeks, 20% at 34 weeks rising to 66% by 28 weeks (Hodson & Guthrie 1984). Successful treatment of RDS carries the associated risk of bronchopulmonary dysplasia (BPD), affecting 12% of all treated infants and as many as 38% of prematures (Tooley 1979). BPD has been attributed variously to the distress of mechani cal ventilation, oxygen toxicity and fluid overload.

The use of oxygen enriched air was introduced to combat hypoxia in the premature. It brought with it a greatly increased risk of retrolental fibroplasia with consequent blindness, first described in the 1940's by Terry (1942). Recognition of this problem led to a reduction in the use of oxygenation which in turn caused an increase in perinatal mortality within this group:

"while the policy of restricting the amount of oxygen in incubators has diminished the number of cases of retrolental fibroplasia (RLF) in the U.K., it has currently increased the number of deaths in the first 24 hours of life. A rough estimate suggests that for each case of blindness prevented there is an excess of 16 deaths."

Cross (1973)

The 'iatrogenic' problems described above have been used to argue for the scaling down of neonatal care endeavours - there seem to be steadily diminishing returns with ever increasing expenditure as we are able to maintain the viability of ever smaller and more fragile infants. Most of the disorders described above occur as a result of the survival of infants who would almost certainly have died perinatally until a few decades ago.

There has been a steady improvement both in survival and reduction in morbidity (Barson, Tasker, Lieberman & Hillier 1984; Bloom 1984; Kitchen & Murton 1985; Knobloch, Malone, Ellison, Stevens & Zdeb 1982; Stahlman 1984; Stewart & Reynolds 1974). It is not unusual to see reports of very small infants surviving and apparently developing well. Pleasure, Dhand and Kaur (1984), for example, document a 440g female infant born at 25.5 weeks, developing normally at age 2 years. As a consequence, many of the ethical questions concerning survival and quality of life are being addressed to smaller and smaller infants.

In 1938, Peckham suggested 1500g. as the lower limit of viability, by 1945, Henderson was suggesting 1250g., while the smallest infant in Drillien's (1965) cohort was 800g. Today, relatively high numbers of 500-1000g. infants are surviving, many *with no abnormalities of development.*

2.2.1) The Human Environment of the Premature Infant

Taking care to minimise the risks to the infant of infection had the additional effect of increasing separation of parents and infant. Initially, through complete separation of the infant (Klein & Stern, 1971), and more recently through gowning and sterile procedures and the physical restrictions imposed by incubators, apnoea alarms and heat shields. There is little evidence, however, for any effect of gowning on infant mortality, infection rate or bacterial flora (Agbayani, Rosenfeld, Evans, Salazar, Jhaveri & Braun, 1981).

Handling of special care infants has been shown to produce distress, and in particular, hypoxaemia (Long, Philip & Lucey, 1980). This finding has been used as a justification for 'minimal handling' both by staff and by parents, however, the evidence suggests that it is seldom parental handling which results in distress, and, indeed, that parental handling can be relaxing to the infant (eg Adamson-Macedo, 1984). In a recent study (Murdoch & Darlow, 1984), the handling of five very low birthweight infants was continuously recorded with each infant receiving a mean of 234 handling procedures in every 24 hours, lasting in total some 4.3 hours. Parental handling accounted for 35% of the contact time, however on only one occasion (of the 83 observed) did an infant become hypoxic on parental handling. This is in contrast to the wide range of nec essary medical procedures which resulted in such an effect - invariably on the 22 instances where endotracheal suctioning was monitored, but also with "peripheral arterial and venous sampling, intubation, chest radiographs, position changes, blood pressure cuff placement, axillary temperature measurement and nappy changes."

The evidence that parental handling of the neonate results in increased levels of distress is thus extremely limited, while the evidence for distress secondary to staff handling, albeit in most cases to effect necessary medical procedures is considerable (see Wolke, 1987 for further examples).

These findings on early handling can be used to argue (a) for increased access for parents to their premature infants as neither the handling itself, nor risk of infection has been shown sufficient to warrant limitations on gentle sensitive handling of other than the severely compromised infant, and b) that increased attention should be directed to ways of minimising distress to infants in neonatal care caused by medical procedures. To some extent this second process of investigation has been begun by Field and her colleagues in their investigations of the effects of nonnutritive sucking on distress caused by heelstick blood sampling (Field & Goldson, 1984), and nasogastric feeding (Field, Ignatoff, Stringer, Brennan, Greenberg, Widmayer & Anderson, 1982), and the work of Wolke on the stressful effects of different types of ambient noise in the NNICU, relating TCPO2 levels to noises caused during a range of ward activities (Wolke, 1987).

As the primary goal of neonatal units was seen, of necessity, as the medical care and biological survival of the infant, *the importance of establishing early relations between parents and infant was often treated as of secondary importance. This situation has gradually changed as a number of interactional problems have been highlighted in this population.*

2.2.2) A link between early separation and interactional failure

The discovery of a link between early separation of human infants from their parents and early difficulties in interaction was not clearly demonstrated until Klein and Stern in Montreal showed that there was a marked increase in the likelihood of non-accidental injury related to special care admission and early separation (Klein & Stern, 1971). Klein and Stern made a retrospective study of the birth records of 51 children who had been physically abused and who were subsequently presented at the Montreal Children's Hospital. They found that there was a significantly raised probability of abused infants having been born prematurely (12/51, or 23.5% of the sample), and, also, of their having experienced lengthy perinatal separations from their biological caregivers (mean length of separation 41.4 days). A slightly later study, carried out at the Park Hospital in Oxford by Margaret Lynch and her colleagues (Lynch, Roberts & Gordon, 1976) produced similar findings in a retrospective analysis of the birth records of a sample of 50 abused children - 59% of abused as opposed to 24% of controls matched for sex and birth on the first day of the same week as the abused child had been through the special care baby unit, and, perhaps of more significance, in 72%

of cases as opposed to 15% of controls there was noted hospital concern over mothering prior to discharge home.

Several subsequent studies helped to strengthen the association which had been found. Of particular note, the prospective series of special care baby unit admissions to North Carolina Medical Center studied by Rosemary Hunter and her coworkers (Hunter, Kilstrom. Kraybill & Loda, 1978) found at one year of age, 3.9% (10) of their series (N = 255) had appeared on the state register for abuse and neglect - approximately eight times the expected rate from state birth figures for that year. A retrospective study carried out on non-accidental injury register case statistics for 80 children under 5 years resident in Cardiff over the period 1970-1976 (Murphy, Jenkins, Newcombe & Sibert, 1981) found several significant features when compared to control children matched on date of birth and sex, in particular :

	No. of Abused	*No. of Controls*
Maternal Age <20yrs.	*30*	*16*
NNICU Admission	*23*	*11*
Gest.Age <37 Weeks	*14*	*4*
Birthweight <2500g.	*16*	*7*

Thus the available data seem to support a link between early delivery, low birthweight, special care unit admission with consequent separation of parents and infant and subsequent occurrence of child abuse or neglect.

It is clear that the special care infant is at biological risk from a variety of quarters. There is greater physical fragility (Dubowitz, 1975), with weaker neck musculature and, in *relative terms a larger head. As a result of such factors, the special care infant is more likely to sustain physical damage, particularly to the CNS (Guthkelch, 1971) from any given physical insult. A considerable body of animal research has been conducted on differential risk of CNS damage from acceleration-deceleration and rotational shearing injuries as related to size and muscle strength which supports the view that fragility is a significant risk factor (Ommaya, Faas & Yarnell, 1972).*

The literature on physical child abuse in the neonate and infant also lends support to a fragility model inasmuch as the types of injuries most commonly reported in severe physical non-accidental injury, graphically described by Caffey in his accounts of 'Whiplash Shaken Infant Syndrome' (Caffey, 1946, 1974), are consistent with this model - pinpoint bleeds on the surface of the cortex, rotational shearing of cortical tissue, and retinal detatchment.

There are many physical hazards such as intraventricular haemorrhage, apnoeic attacks, hearing loss and visual impairment to which the premature infant is more likely to succumb (Keller 1981). Such increased physical morbidity is likely to further increase the vulnerability of the infant to any physical insult.

A further area of difference is that between the available behavioural repertoire of the typical special care infant and fullterm equivalent. Premature and/or low birthweight infants have been reported as differing consistently in their responsiveness to adults when compared to fullterm infants both neonatally *and at expected date of delivery (see for example, Als, Duffy & McAnulty 1988a, 1988b).*

It has been argued by some authorities that the 'stimulus characteristics' of the premature infant are important contributary factors to the increased risk of abuse. Characteristics such as increased gaze avoidance, higher pitched crying and poorer consolability differentiate premature infants and are more likely to result in physiological arousal (Frodi, Lamb, Leavitt, Donovan, Neff & Sherry 1978). Leonard Berkowitz (1974) has argued that in other situations such arousal can result in aggressive outbursts, and his model has been used by Ann Frodi (1982) to account for increased risk to the premature.

A variety of factors may thus contribute to the increased rate of abuse and neglect reported in the special care baby unit population. In all of the above studies, in addition to early separation, increased physical fragility, increased perinatal difficulty, differences in infant behaviour, and parental group differences in factors such as antenatal care, drug and alcohol use and maternal age would need to be taken into account before concluding that separation per se was the factor which produced the observed increase in interactional failure. In most instances, the effects of these various factors have been considered independently, the evidence on their relative, additive, subtractive or interactive contributions is limited.

2.2.3) Prematurity - the Overdetermined Basis for Increased Risk

It can be seen from the foregoing review that there have *been major changes in the likelihood of successful survival for the premature infant over the past century. Initially, the emphasis was placed, of necessity, on increasing the prospects for survival through improving the physical conditions in which the premature infant was raised, ensuring minimal risk of infection, appropriate oxygenation and adequate and appropriate nutrition. With major drops in mortality for the healthy premature infant, there has been an increasing emphasis on psychosocial morbidity. A particular focus has been on interactional failure and the increased rates of abuse and neglect to which the premature infant appears prone. Systematic investigation of interactional factors which differentiate between the premature and the fullterm population, and the extent, if any to which these factors are amenable to manipulation is the subject of this thesis.*

CHAPTER 3

CURRENT METHODS IN EARLY INFANT ASSESSMENT, WITH CRITICAL EVALUATION

This chapter will review early infant assessment under three headings :

(a) assessments which provide a basic screening function for neurological morbidity;

(b) assessments of neurological function;

and, (c) assessments of the infants behavioural repertoire and interactive capability.

A brief overview of the merits, demerits and range of application of each approach will then be given with specific emphasis on its relationship to other aspects of early infant functioning. Various questions will be addressed concerning the focus of such assessments, and the conclusions which can be drawn, for example concerning structure-function relationships.

The field of neonatal assessment and observation has, over the past 20-30 years, found itself progressively divided into these three areas. Paediatric epidemiology has predominantly adopted the first approach, neurology the second, and developmental psychology the last. Recent work on the behavioural effects of medication (see, for example, Amiel-Tison et al 1982) and medical procedures such as phototherapy (see, for example, Nelson & Horowitz 1982) has led to greater collaboration between the professional disciplines working on early assessment methods, and a progressive increase in the similarity of their frames of reference.

A number of papers have appeared which give overviews of both the historical development and current aspects of neonatal assessment. The reader is refer r ed to four such reviews for more detailed treatment of many of the methods discussed below (see: Brown 1978, Frances, Self & Horowitz 1987, Prechtl 1982, St. Clair 1978).

INTRODUCTION:

Neonatal assessment is a relatively recent specialism within the field of infancy research and clinical practice, despite having some notable early enthusiasts (Kussmaul 1852). Our current models and practice in this field can effectively be dated back to Peiper's seminal manuals on early neurological assessment: Die Hirntatigheit des Saughlings (The Brain Action of Infants, Peiper 1928) and Die Eigenart der Kindlichen Hirntatigheit (Cerebral Function in Infancy and Childhood, Peiper 1956). Screening examinations for potential neurological difficulties can be dated to the Apgar score, introduced by Virginia Apgar in 1953. The first systematic neurological exam for use in neonates is probably that of Andre-Thomas and his colleagues, which was developed in France shortly after the Second World War and was not widely recognised until published in English in 1960 (Andre-Thomas, Chesni & Saint-Anne Dargassies 1960). Neurobehavioural assessment is a more recent development and can be said to begin in earnest with the publication in 1971 of the Cambridge Neonatal Behavioural Assessment Scale (Brazelton & Freedman 1971).

3.1) NEONATAL ASSESSMENT TECHNIQUES

3.1.1) SCREENING ASSESSMENTS:

A wide range of screening assessments has been developed over the past 35 years for the detection of "at-risk" groups (Parmelee & Haber 1973). Most of those discussed below give a simple measure of risk, of perinatal morbidity, of "non-optimality" or of effects of procedures such as obstetric anaesthesia on infant behaviour. The desired features of screening assessments for clinical use are that they be easy to use, easy to learn, reliable, and clinically effective in detecting potential difficulties at a level of accuracy which makes their routine administration worthwhile (achievement of the last depends on factors such as levels of service provision and state of knowledge about what constitute useful intervention strategies).

3.1.1.1) The Apgar Score:

The Apgar is perhaps the best known and most widely used neonatal assessment technique. It was introduced in 1953 by Virginia Apgar as a simple procedure which could "be used as a basis for discussion and comparison of the results of obstetric practices, types of maternal pain relief and the effects of resuscitation."(p260). The assessment itself uses five signs: heart rate, respiratory effort, reflex irritability, muscle tone and colour, all of which are rated on a three point scale as absent (0), intermediate (1) or optimal (2), and all of which can be rated at 1, 3, 5 and 10 minutes after birth.

Apgar and her colleagues have reported on large samples of infants asessed using this instrument (1,021 by Apgar in her 1953 paper, and a further 15,348 by Apgar et al in 1958), and it has been shown to be a useful predictor to risk of perinatal mortality. Its usefulness as a scale for prediction of later cognitive morbidity, or neurological status has, however, proven to be much more limited (see, for example, Shipe, Vandenberg & Williams, 1968). At the present time, the Apgar remains a useful index to be used in conjunction with others in collecting samples of infants with comparable medical status at birth. It is a routine assessment measure, collected on virtually all infants born in the UK, and most infants born in the Western Hemisphere. Though a gross instrument, it is valuable to the developmental researcher in providing a simple method by which more severely impaired infants can be screened out or actively selected from a sample collected on strict criteria of weight, gestational age or other parameters.

3.1.1.2) The Dubowitz Gestational Age Assessment

Another widely used screening instrument is the Dubowitz Gestational Age Assessment (Dubowitz & Dubowitz 1977, Dubowitz, Dubowitz & Goldberg 1970). This instrument is used in the early postpartum to give a fairly accurate gauge of the infant's age post-conception at birth. The assessment is based on 11 external (physical) criteria rated variously on a 3 to 5 point scale: oedema, skin texture, skin colour, skin opacity, lanugo hair, plantar creases, nipple formation, breast size, ear form, ear *firmness, and genitals together with 10 neurological criteria again on a 3 to a 5 point scale: posture, wrist flexion ("square window"), ankle dorsiflexion, arm recoil, leg recoil, popliteal angle, the heel to ear manoeuvre, the scarf sign, head lag and ventral suspension. This assessment is of established reliability and validity, and has a U.K. normative database (see Dubowitz, Dubowitz & Goldberg, 1970). In their original 1970 paper, 167 newborns were studied, all within the first 5 days postpartum, by the same assessor, and the neurologic and external criteria were matched, both singly and together, against the mothers dates. All mothers included in the study were certain of the date of their last menstrual period, had a regular 28 day cycle (± 2 days) and had had no subsequent bleeding. No mothers had been on oral contraceptives during the year before conception, and the gestational age of the infants, from mothers dates varied from 27.5 to 42 weeks. All infants meeting the above criteria were included during the study period, even where uterine size was felt to be incompatible with mothers dates, explicitly to incorporate infants with intrauterine growth retardation, as such infants had been excluded from earlier studies by Farr and others. The correlation coefficient for the total scores was 0.93, using external characteristics alone 0.91, and neurologic criteria alone 0.89. From the regression formula computed on this sample, the likely error on any single score was ± 1.02 weeks.*

Several other screening assessments of this type have been developed which correlate well with the Dubowitz and are marginally simpler to administer (see, for example, Ballard, Novak &

Driver 1979), however as they essentially duplicate the same type of screening measure, these do not warrant further discussion here.

The usefulness of this assessment procedure for the clinician is that it provides an apparently accurate measure of gestational age. The fact that the criterion measure against which the Dubowitz was compared is itself subject to high measurement error may make us more skeptical about the accuracy with which gestational age can be ascertained using this method. The use of correlational procedures in estimating the validity of such measures has recently been subjected to considerable criticism in the statistical literature (see: Altman & Bland 1983).

There is now a large body of literature attesting to the importance of time post conception as an influence on likely infant responsiveness. As with the Apgar, this is a commonly administered assessment, at least in special care infants and thus information on large populations can be obtained. With the increased use of serial ultrasound scanning, however, it is likely that the Dubowitz will become less widely used as scanning gives a marginally more accurate assessment of estimated date of delivery not subject to the methodological problems alluded to above.

3.1.1.3) The Prechtl Obstetric Optimality Scale (Prechtl 1968)

The concept of obstetric optimality was introduced by Heinz Prechtl, at Groningen in the Netherlands, in 1968 when he published a 42 item scale focussed on quantifiable aspects of *obstetric and perinatal status, which fall into 7 broad areas: Social background, obstetric and nonobstetric features of the current pregnancy, past obstetric history, diagnostic and therapeutic measures, parturition and neonatal condition in the immediate postpartum. Several theoretical papers have appeared which argue for the applicability of the concept (Prechtl 1980, Touwen, Huisjes, Jurgens-v.d. Zee, Bierman van Eendenburg, Smrkovsky & Olinga 1980). In essence, Prechtl argued that it was simpler to define the best possible pregnancy and conditions than to accurately delineate possible pathological situations, and that, therefore, an optimality scale was easier to delineate and standardise that a pathology based scale.*

The scale has been modified three times - an extension by Touwen and colleagues to a 74 item scale, and a less extensive 62 item revision by Prechtl in 1982. The published data on consistency and reliability of all three versions show a similar picture with normally distributed scores. The initial scale has standardization data published on 1378 infants (Prechtl 1977), and the Touwen et al revision on 3162 infants. Touwen et al found that the seven cateory subscores all correlated significantly with the total optimality score.

Optimality scores have been used in studies which attempt to relate a variety of neonatal characteristics to obstetric status - for example, in relation to Brazelton and Bayley scores (Coll, Sepkowski & Lester 1982), neurological examination (Kalverboer 1979, Touwen et al 1980), and neonatal visual behaviours (Caron, Caron & Glass 1983). The scale has thus *been used primarily in studies where the main focus has been on the interrelationship between basic functions in large populations of infants, and not as demographic information in its own right for routine collection and analysis.*

3.1.1.4) The Obstetric Complications Scale (Littman & Parmelee 1974)

Drawing on the obstetric optimality scale, Littman and Parmelee at UCLA medical center developed the Obstetric Complications Scale (OCS) to measure obstetric difficulties rather than their converse. This consisted of 41 items (see appendix IV), rated as either present or absent. The aim, though broadly the same as the optimality scale described above is to look more at morbidity than adequacy of functioning. The scale has been used in research principally to screen out infants with obstetric and perinatal complications of more than a certain degree from research studies where these would be felt to introduce confounding effects. Littman and Parmelee (1978) attempted to correlate the OCS and the Postnatal Complications Scale with Gesell and Bayley followup scores at 4, 9, 18 and 24 months - no relationships were found.

3.1.1.5) The Postnatal Complications Scale (Littman & Parmelee 1974)

As a complement to the Obstetric Complications Scale, Littman and Parmelee developed a 10 item Postnatal Complications Scale (PCS). This was an attempt to monitor potential aspects of morbidity over the first month of life and provide a crude *measure of early postnatal status. The items included in this scale, scored merely as present or absent, are as follows:*

Postnatal Complications Scale Items

1. *Respiratory Distress*
2. *Ventilatory Assistance*
3. *Infection*
4. *Noninfectious Illness (Anomaly, hemorrhage)*
5. *Metabolic Abnormality*
6. *Convulsion*
7. *Hyperbilirubinaemia or exchange transfusion*
8. *Temperature Disturbance*
9. *First feeding within 48 hours of birth*
10. *Surgery*

The only published data on the utility of this scale appears to be a 5 year followup study (Field Dempsey & Shuman 1983) of respiratory distress syndrome preterm infants which found a correlation between the PCS and the McCarthy Motor Scale at 5 years of age.

A further scale - the Pediatric Complications Scale was also developed for use between 4 and 9 months, but no published information is available on its use to date.

3.1.1.6) The Early Neonatal Neurobehavioural Assessment (ENNS): (Scanlon, Brown, Weiss & Alper 1974)

This is essentially a simplified version of the Brazelton NBAS (described below), with minor modifications. The scale was developed with the specific aim of investigating the behavioural effects of epidural anaesthetic. It is a 10 item assessment, using 4 point rating of each item, which covers the following:

1. *Response decrement to pinprick*
2. *Resistance to passive movement*
   for: a) pull-to-sit, b) arm recoil, c) truncal tone and d) general body tone

4. Sucking
5. Moro response
6. Habituation to light
7. Habituation to sound
8. Placing
9. Alertness
10. General assessment

The scale has been employed in a large number of studies of perinatal procedures. Data on several thousand neonates is now available. The reader is directed to Dailey et al (Dailey, Baysinger, Levinson & Schinder 1982) for a comprehensive review of its uses.

3.1.1.7) The Neurological and Adaptive Capacity Scale (NACS): (Amiel-Tison, Barrier, Schinder, Levinson, Hughes & Stefani 1982)

This is a simple, 20 item scale with all items scored on a three point rating. The first 5 items - response and habituation to sound and light, together with consolability are taken to indicate 'adaptive capacity', while the other items are grouped into passivbe tone (6 items), active tone (3 items), primary reflexes (3 items), and general (3 items).

In their initial paper, the authors report on 61 infants assessed on this scale and on the ENNS. The NACS achieved a reported interobserver reliability of 92.8% over 3660 discrete observations, and took 4.36 ± 0.1 minutes to carry out. The

ENNS had an interobserver reliability of 88% over 2074 observations and took 7.2 $\pm$ 0.1 minutes to carry out. Given recent concerns over the utility of interobserver reliability ratings particularly with simple coding systems such as this (Bakeman & Gottman, 1986), Cohen's Kappa might have been a more useful way of comparing these measures as regards their reliability.

The NACS is advocated by its devisors as a quick, simple assessment which should be effective in identifying infants with drug depression, birth asphyxia or perinatal trauma. A companion paper, presumably on the same reported sample (Stefani, Hughes, Shnider, Levinson, Abboud, Henriksen, Williams & Johnson, 1982) compared three different types of inhalation analgesia administered during labour as they affected scores on the NACS and ENNS. The study found no group differences across the reported sample of 61 infants.

3.1.1.8) Overview of Screening Assessments

Assessments such as those outlined above can be helpful for ongoing 'quality assurance' as with the ENNS and NACS, and in research work for allowing a population to be filtered on perinatal characteristics. Basic aspects of development or morbidity can be selected for or selected out, for example ensuring comparable gestational age, and levels of obstetric complications, in collecting a research cohort. None of the above, taken *alone, however, would provide sufficient information for systematic investigation of perinatal characteristics.*

3.1.2) NEUROLOGICAL ASSESSMENTS OF INFANT FUNCTIONING:

The systematic neurological assessment of the infant, though antedating the screening measures outlined above has a considerably shorter history than the behavioural one to be outlined below and in Chapter 4. This relative recency can be accounted for in two main ways. Firstly, the explicit acceptance within the neurological tradition of Lloyd Morgan's Canon -

> *"In no case may we interpret an action as the outcome of the exercise of a higher psychical faculty, if it can be interpreted as the exercise of one which stands lower in the psychological scale."*
>
> *Morgan (1894)*

This principle, has been used by leading paediatric neurologists such as Myrtle McGraw (McGraw 1943) and Albrecht Peiper (Peiper 1961) to argue for the progressive cortication or cerebration of function. These authors drew in support on the histopathological work of Tilney, Langworthy, Conel and others (Conel 1939;1941, Langworthy 1933, Tilney & Riley 1921). The basic argument running as follows:

(a) the cortex is virtually unmyelinated at birth, and,

(b) myelination is necessary for any complex functions subserving behaviour >

(c) the cortex is therefore not implicated in neonatal behaviour.

and,

(d) subcortical structures have not been shown to mediate complex functions in behaviour

thus:

(e) the neonate is only capable of simple reflex patterns and responses.

The relationship between myelination and function is still a contentious one. While it is clear that deposition of myelin does give an index of normal maturation, it is not the case that unmyelinated axons belong to prefunctional elements. The work of Oster (Oster 1978, Oster & Ekman 1977) which appeared to demonstrate convincingly that neonatal smiling is muscularly distinct and similar to adult smiling and of Meltzoff (Meltzoff 1981, Meltzoff & Moore 1977) on neonatal imitation have both been dismissed on the argument that they could not occur as they are cortically mediated in the adult and such structures are not available to the developing neonate. This places a quite unjustified reliance on provisional and incomplete understanding of the interrelationship between neurological structure and psychological function.

The main reason for the slow development of a rational neurological assessment has been the limited range of techniques available to the neurologist allowing him access to information on the structure and function of the CNS. With the development of techniques that allow in vivo access to brain function this is becoming less and less a problem. Computerised axial tomography (see Redshaw, Rivers & Rosenblatt 1985), nuclear magnetic resonance scanning (Lauterbur 1973), and ultrasound (see Redshaw, Rivers & Rosenblatt 1985), *continuous EEG monitoring (Eyre, Tizard & Wilkinson 1984), positron emission tomography (Chugani & Phelps 1986, Chugani, Phelps & Mazziotta 1987), and brain electrical activity mapping (Duffy & Als 1983) permit the neurologist to build up a clearer picture of function as it occurs within the intact, working newborn brain. We have now reached a stage where the neonatal neurologist has access to complex knowledge of both the structure and function of the brain in both normal and dysfunction states. The survival of more and more infants with immature but functionally intact nervous systems gives us a marvellous opportunity to explore the development of human structure and function through natural experiment.*

Neonatal neurological assessments have been developed in a number of centres, and for a variety of reasons. The following quote from Parmelee and Michaelis (1971) covers the basic reasons for such assessments quite well:

> *"The neurological examination of the newborn must serve three major purposes, each requiring a slightly different technique and mode of analysis: (1) the immediate diagnosis of an evident neurological problem...to determine what therapy to institute, (2) The evaluation of the day to day changes of a known neurological problem to determine the evaluation of a pathological process... (3) The long term prognosis of a newborn who is recovering from some neonatal neurological problem or is considered at risk due to abnormalities of the pregnancy, labor or delivery." (p7)*

While the purpose of neonatal assessment is clear enough, what structure it should have is uncertain. A number of protocols have been developed (see, for example, Andre-Thomas, Chesni & Saint-Anne Dargassies 1960), with a large degree of overlap in *content. Several common components constitute a standard neurological assessment of the infant. These can be classified essentially into three principal areas -*

1) *'Tonus' - typically a series of assessments of power and tone in major muscle groups.*

2) *Primary or Automatic reactions - a variety of simple reflex responses which can typically be ellicited in decorticate infants.*

3) *Sensory Testing - basic tests of visual, auditory, tactile, gustatory, olfactory and proprioceptive function.*

The development of neurological assessment of the newborn can be divided into three major historical phases - the 'classical' approach of the 1940's and '50's best characterised by Peiper and Andre-Thomas, who believed in clinical examination and the impossibility of standardised examination, the development of structured assessment protocols through the '60's and '70's by the Dutch school - Prechtl, Caesar, Touwen and Beintema, and most recently, through the '70's and '80's, the development of systematic assessments, such as the Dubowitz Neurological Assessment, based on the general principles of reliability and trainability utilised in neonatal behavioural assessment.

3.1.2.1) Albrecht Peiper's Contribution to Neonatal Neurological Assessment:

Cerebral Function in Infancy and Childhood (Peiper (1961)(in English 1963)) is an important landmark in paediatric neurology, which can be seen as the first systematic approach to infant neurological assessment. In his introduction, Peiper makes some assertions which could be called into question today concerning *firstly his assertion that there are no higher cerebral functions at this stage:*

> *"...cerebral function in the newborn, in whom an extensive and important portion of the brain - the cerebral hemispheres - is not yet functioning,.."*
>
> *(Peiper, p.v, 1963)*

and, secondly, the potential role of the developmental psychologist in the investigation of early infant development:

> *"Child psychology, too, has been completely unproductive in this area of knowledge. No psychological theory can make provable assertions on the newborn or on still earlier phases of development because the neurological characteristics, when compared with the adult, are the most conspicuous in these early stages. It would be a rewarding task for a child psychologist to demonstrate how, with increasing brain development, phenomena gradually appear which can be attributed with more certainty to processes of consciousness going beyond the purely neurological events."*
>
> *(Peiper, p.vi, 1963)*

Overall, his view of the neonate was as a preconscious entity which would later develop human attributes and abilities:

> *"We have to assume that a consciousness similar to our own and therefore understandable to us does not exist in the child before the end of the first year of life."*
>
> *(Peiper 1963)*

He did, however, acknowledge that the young infant was not entirely a 'simple reflex organism':

> *"Since a great number of reflexes can be ellicited in the young infant while "higher" brain activity cannot yet be observed, the conclusion has been drawn that the infant's brain activity consists only of reflexes. This opinion does not at all do justice to the facts. At each stage of development there exist functions that occur without external stimulation."*
>
> *Peiper (1963)*

Peiper provides a thorough review of the literature to 1961 pertaining to early infant functioning and to his own observations on the neurological capabilities of the infant. Infant capabilities are covered under ten basic sections: sensory function, development of facial expression from sensory functions, reflexes of position and movement, locomotor abilities, movements, clinically significant reflexes, respiration, food ingestion, sleep, and conditioned reflexes. There are supplementary chapters covering neurological characteristics from embryo through to infancy, and the impact of environmental deprivation There are also two chapters devoted in essence to Peipers view that infant neurological functioning is much more closely allied to and would gain a more scientific knowledge base from the study of physiological animal psychology than to the study of either human child psychology or adult neurology.

Peiper's approach is dydactic, stating features of and facts about neurological functioning in the infant, without giving detail of the basis for his assertions other than in his reference to published research.

Much of the knowledge base on which conventional neurological assessment in the neonate has subsequently been developed derives from Peiper's systematic coverage of neonatal reflex and simple motor function. He did not, however, develop a routine method of assessment for the neonate. He paid little attention to standardization and operationalization of procedure, or to definition of responses, and this is reflected in his belief that a clinical neurological assessment could never be a developed (an *opinion expressed in a letter written by Peiper to Touwen in 1957).*

The infant has been seen on the basis of the Peiper type model as a concatenation of discrete functions which are qualitatively distinct from later human abilities:

> *"The newborn infant may be described as a tonic animal with oropharyngeal and other automatisms and neurovegetative mechanisms."*
>
> *Polani & MacKeith (1960)*

3.1.2.2) Andre-Thomas and Saint-Anne Dargassies

Several groups of workers have published systematic attempts to provide assessment protocols for the newborn infant. Foremost in this field has been the work of Andre-Thomas and his coworkers - most notably Saint-Anne Dargassies and Chesni. Their work, published in French of Etudes neurologiques sur le nouveau-né et le jeune nourisson (Andre-Thomas & Saint-Anne Dargassies 1952) became better known to the English speaking world with the publication in 1960 of The Neurological Examination of the Infant (Andre-Thomas, Chesni & Saint-Anne Dargassies 1960). They provided a considerable body of data on the first standardised and systematically administered neurological assessment of the newborn.

One problem which faced the neurologist working in this area was the apparent lack of predictive ability which the neurological examination appeared to be capable of providing:

"It is not difficult to compose long lists of reflexes which can be ellicited from infants, or devise detailed schemata of examinations by scratching, thumping, spinning or otherwise invading their privacy. It is a good deal harder to find signs which reliably predict lasting CNS damage."

Clark (1964)

3.1.2.3) The Dutch School of Paediatric Neurology - A Change of Focus

Despite its historical importance, however, the model of the infant as an essentially preconscious, reflex organism has recently come under heavy criticism for the artificial constraints which it has placed on the development of neurological models of developmental processes in the infant:

"...Neural functions were considered to consist of a bundle of reflexes. According to this reasoning, only with the later development of the cortex and voluntary motility do these reflexes become incorporated into more complex mechanisms, but they can still reappear as primitive reflexes in the adult if higher brain areas are damaged. Hence, adult brain pathology was seen as a model for normal brain development.

This approach became obsolete when the neural functions of healthy infants were studied in their own right and in more detail. The complexity, variability and gracefulness of the infant's behaviour are so fundamentally different from those of animal preparations or brain damaged adults that these pathological reflexes appear merely as artificial fragments of normal functions than as homologies of responses to the normal young nervous system."

Prechtl (1981)

" It seems that the reflex paradigm determined not only the interpretation of phenomena observed in the infant, but also the phenomena that could be looked for. This must be the reason why the spontaneous activity of the unborn and newborn infant was interpreted so often on a reflexological basis.

(continued overleaf)

....Nowadays, the reflex paradigm tends to have lost something of its lustre. The infant's nervous system is recognised as being too complex to be explained merely on the basis of reflexes and reactions, however useful these may be for a neurological examination. But most importantly, the infant's brain is recognised as a primarily active organ system, besides its capacity to react to stimulation."

Touwen (1984)

It is this change to viewing the neonate as a complex, variable, graceful and active person, rather than as a simple, invariant, reflex and reactive organism which is amongst the most important changes in the neonatal neurological conceptualization of function. To date, however, there has been little reflection of this acknowledgement in the structuring of assessment procedures to allow for neonatal participation - the neonate is viewed as passively responding in the majority of current examinations, which still focus heavily on reflex assessment. A major practical difficulty in the development of assessments of these more complex aspects of neonatal functioning being that of marrying the ability to describe subtle individual differences with the provision of a practicable tool for clinical use.

3.1.2.4) A Neurological Study of Newborn Infants (Beintema 1968)

This monograph, published by David Beintema describes a reasonably comprehensive, 30 item neurological examination carried out on 49 fullterm infants over the first 9 days of life. In total, this study generated 364 separate and complete examinations thus allowing changes in function over this time to be assessed. Despite its limitations in terms of the range of items administered (the scale is primarily focussed on power, *tone, and reflex responses) this is the first systematic assessment procedure to appear in English. The scale is clearly laid out, with administration criteria, and with details of the standardization of both the external conditions in which assessment can be conducted and the range of infant state over which reliable administration can be performed.*

It for its contribution to the standardization of assessment technique that the Prechtl and Beintema scale will be best remembered. The promulgation of a replicable systematic approach to practice taking neurological assessment for the first time from being an art to a science.

3.1.2.5) The Dubowitz Neurological Assessment (Dubowitz, Dubowitz, Palmer & Verghote 1980, Dubowitz & Dubowitz 1981).

The Dubowitz neurological assessment was developed in an attempt to combine a standardised neurological assessment based on those of Saint-Anne Dargassies, Prechtl and Parmelee with an assessment of 'higher neurological function' drawing on components from the Brazelton BNBAS. It is seen as an assessment which incorporates tests of visual and auditory responsiveness exclusively as tests of higher neurologic function, not as tests of ability to engage in interaction. The examination was designed to be "applicable to preterm as well as full-term infants within 24 hours of birth.." (Dubowitz, Dubowitz, Palmer & Verghote 1980, p3). It was seen as a practical and replicable means by *which junior hospital staff, with little training in neonatal neurology could monitor neurological function. The examination is divided into four sections - Habituation (2 items), Movement and Tone (16 items), Reflexes (6 items), and Neurobehavioural (9 items).*

This scale has attempted to extend the range of convenience of neonatal neurological assessment beyond the standard functions advocated since Peiper, in order to incorporate 'higher neurological functions'. This attempt, although interesting in application, is limited in its theoretical justifiability, as many of the 'higher' functions which it taps seem most likely to be subserved by subcortical systems at this point in development (see the discussion of anencephaly and hydranencephaly which is presented in chapter 4). In using this assessment as one which examines 'higher' (as in cortical) function, the above points may prove to be a major limitation. That the scale may prove a framework for the analysis of more complex <u>*function*</u> *than was hitherto possible in neurological examination is of greater theoretical and practical interest. It may allow us to build up a greater understanding of the complexity, variability and grace-fulness of neonatal action and interaction to which Prechtl has drawn our attention (Prechtl 1981).*

3.1.2.6) <u>*Overview of Neurological Assessments*</u>

The brief overview of neurological assessments given above shows the 'classical' neurological assessment exemplified by *assessments developed by Prechtl's group address the problems of reliability and training, while the Dubowitz neurological assessment has provided an initial attempt to incorporate measures of 'higher' functioning into the neonatal neurological examination. As assessments of the reflex, gross motor and sensory aspects of neonatal functioning, the above neurological approaches have much to offer. To date, however, there are no systematic or validated methods within the neurological assessment armamentarium for the examination of the neonatal alteroceptive progenitors to later cognitive and alteroceptive skills. These skills are, arguably, the most important aspects of neonatal ability.*

3.1.3) BEHAVIOURAL ASSESSMENTS OF INFANT FUNCTIONING:

3.1.3.1) The Brazelton Neonatal Behavioural Assessment Scale (BNBAS):(1973)

The Brazelton Neonatal Behaviour Assessment Scale (BNBAS) is the most widely used neonatal behavioural assessment. It attempts to investigate and quantify the interactional capabilities of the fullterm newborn infant. Originally, the scale was developed as a method of assessing the effects of a variety of perinatal events, in particular, of obstetric medication on the developing newborn (see Brazelton & Robey 1969). It was first published as the Cambridge Neonatal Behaviour Assessment Scale by Brazelton and Freedman in 1971. After a number of changes and refinements had been made, the scale was published by Spastics International Medical Publications as Clinics in Developmental Medicine, Volume 50, in 1973.

Since its introduction as an available standardised test in 1973, the Brazelton has been widely adopted across the world as a research tool for the evaluation of the infant, and effects on the infant of medical procedures, perinatal environment and a host of other factors. To give some examples, the work in Sweden of Ingemar Leijon on the effects of elective induction and of vacuum extraction (Leijon, 1980); the work of Chuck Nelson whilst *at Lawrence in Kansas on the effects of jaundice and of phototherapy (Nelson & Horowitz, 1979); and the Nashville work of O'Connor, Vietze and others on prediction to NOFT and physical child abuse. There are many others, some of which look at the possibility of using the Brazelton as an intervention to provide parents with knowledge of their infants capabilities (see Brazelton, 1987 for a recent review).*

The scale has often been criticized as if it were a neurological assessment proforma, however, this was never the intension of its developers. The BNBAS was developed explicitly as:

> *"..a clinical instrument to assess the wide behavioural repertoire of the newborn, ranging from relatively simple reflex responses to active, complex social interactive capacities. The scale was conceptualised as an interaction between the neonate and an examiner and attempts to highlight the neonatal behaviours that are likely to be most salient for interaction with the parents."*
>
> *Lester (1979)*

Confusion would appear to have arisen as the assessment contains a range of standard neurological items which are seen as a framework within which to examine neonatal interactive behaviour - habituation, Moro, pull-to-sit, praxic vigilance (hand/cloth on the face)(André-Thomas & Autgaerden, 1966), and a variety of others.

In order to achieve its desired goal of assessing the likely components salient for early interaction, the BNBAS assesses the responses of the infant to six broad packages of items which, as far as possible are given in an ascending then descending order of intrusiveness:

1. Habituation to distal stimuli - light, rattle, bell heelprick.

2. Response to physical stimuli - uncovering, moving from prone to supine.

3. Low tactile physical stimulation - freeing feet /hands, touching heel, plantar grasp, babinski, ankle clonus, palmar grasp, palmar mental grasp, passive arm movement, passive leg movement arm/leg differentiation, glabella, rooting, sucking.

4. Medium Tactile/Vestibular - Undress, pull-to-sit, standing, walking, placing, incurvation (Galant), crawling, cuddling, tonic neck reflex, defensive reaction.

5. High Tactile/Vestibular - Rotation, Moro.

6. Attention/Interaction - Animate Visual & Auditory, animate visual, animate auditory, inanimate visual & auditory, inanimate visual, inanimate auditory.

A number of features can be seen as possible weaknesses in the Brazelton scale -

1) It is a complex instrument with a large number of items all of which are scored on a nine point rating, making reliability time consuming and expensive to obtain.

2) As such reliability of response is difficult to obtain in experienced neonatal staff, the likelihood that this will correspond closely to any consistent repertoire of responses which can be ellicited by the parents seems slight.

3) As it is the infant's interactive repertoire for use with the caregivers which the BNBAS explicitly sets out to investigate, a potential for disparity between obtained responses and actual behaviour with caregivers is problematic.

4) The BNBAS looks at the best response which the infant is able to make on any item. As the best response in ideal circumstances seems unlikely to reflect the day-to-day repertoire of behaviour in the infant, this is a potential source of difficulty in extrapolating from BNBAS scoring to actual behaviour.

3.1.3.2) <u>The Brazelton Neonatal Behaviour Assessment Scale - Revised (1984):</u>

In 1984, a revised version of the BNBAS was published which incorporated a number of substantial changes from the original assessment. In part, the revisions to the original scale dealt with objections which had been raised - for example, recording the average response in some instances rather than the best response. Several other items were added to extend the summary ratings of behaviour through the examination.

3.1.3.3) <u>The Assessment of Preterm Infant Behaviour (APIB) (1982):</u>

The Assessment of Preterm Infant Behaviour is a scale which is "broadly derived and adapted from the Brazelton Neonatal Behavioural Assessment Scale" (Als, Lester, Tronick & Brazelton 1982). The sequence of the examination is very similar to the Brazelton Scale, beginning with the infant in sleep, and working through six 'packages' of items which are progressively more intrusive:

1. Habituation to distal stimuli - light, rattle, bell.

2. Response to physical stimuli - uncovering, moving from prone to supine.

3. Low tactile physical stimulation - freeing feet /hands, touching heel, plantar grasp, babinski, ankle clonus, palmar grasp, palmar mental grasp, passive arm movement,passive leg movement arm/leg differentiation, glabella, rooting, sucking.

4. Medium Tactile/Vestibular - Undress, pull-to-sit, standing, walking, placing, incurvation (Galant), crawling, cuddling, tonic neck reflex, defensive reaction.

5. High Tactile/Vestibular - Rotation, Moro.

6. Attention/Interaction - Animate Visual & Auditory, animate visual, animate auditory, inanimate visual & auditory, inanimate visual, inanimate auditory.

Summary evaluations of physiological status (tremulousness, startles, skin colour and observed smiling), motor parameters (tonus, motor maturity, activity and hand to mouth facility), state (alertness and state regulation), self-regulation (withdrawal/avoidance - approach/groping, quieting, peaks of excitement, rapidity of buildup, irritability, robustness, control over input and facilitation of stimulation), and attentional/interactional functioning are recorded throughout the examination. Three 'system scores' are calculated on this basis - a baseline score prior to examination (b), a reaction to examination score (r), and a post-package status score.

This examination, which has been developed over several years by the Boston group, and, in particular by Heidelise Als, has yet to gain recognition as a clinical instrument. To date, there is little published literature on its use outside of the Boston, group which developed it. To date, two samples have been reported on. The first is a series of eleven cases where a summary measure *of tone, posture and movement, and a second summary measure of autonomic stability were shown to discriminate within the group between neurologically suspect (N = 5) and paediatrician referred non-suspect infants (N = 6), and to relate to neurophysiological differences found on brain electrical activity mapping (BEAM) analysis (Duffy & Als, 1983).*

The second study, presented in two separate papers, documents three groups of infants assessed on the APIB - 33 early-born preterm infants (PPT) 27-32 weeks , 31 middle-group preterm infants (PT) 33-37 weeks and 34 fullterm (FT) infants. In the first part of this study, it was established that there were significant differences between both the PTT and PT groups when group comparisons were made with the fullterm infants at 2 weeks post estimated date of delivery, but not when compared to each other (Als, Duffy & McAnulty, 1988a). Both groups showed significantly more autonomic, motoric, state, attentional and self-regulatory disorganization. This finding was used to discriminate reliably (92.5% success) on APIB scoring between 20 fullterm and 20, 34 week, preterm infants.

The second part of the study, employing cluster analysis techniques to divide up the sample on parameters of behavioural organization alone (Als, Duffy & McAnmulty, 1988b). This study showed that the total sample could be clearly divided into three groups which were called 'Nimbuloids' on such criteria, but that there was considerable overlap across the three groups as defined on gestational age. Nimbuloid I, the best organised cluster *contained 19 FT, 6 PT and 3 PPT infants, Nimbuloid II 12 FT, 12 PT and 10 PPT, while Nimbuloid III, consisting of the most poorly organised infant at 2 weeks post EDA contained 3 FT, 13 PT and 20 PPT infants. This finding, not predicted on gestational, medical or demographic characteristics of the sample is concluded to show that:*

> *"..the APIB provides a means of grouping newborns based on behavioural competence, independent of the infant's gestational age at birth."*
>
> *Als, Duffy & McAnulty, 1988b*

Thus, although this assessment is derived from one of the most widely used measures of early infant behaviour, the BNBAS, and its having been in use for some years, there is, as yet, limited support for its utility, discriminative power, or clinical validity.

3.1.3.4) The Mothers Assessment of the Behaviour of Her Infant (MABI): (Field, Dempsey, Hallock & Shuman, 1978)

The Mothers' Assessment of the Behaviour of Her Infant (Field, Dempsey, Hallock & Shuman, 1978; Field, Hallock, Dempsey & Shuman, 1978) was developed in Miami by Tiffany Field and her colleagues as a maternally administered scale which provided information designed to be, as far as possible, analogous to that which is obtained from the Brazelton NBAS. The scale consists of 23 items which are scored on a simplified four point scale, as opposed to the nine point rating on the Brazelton, and the neurological reflex items in the Brazelton have been omitted as these require specialist training to administer consistently. In *broad terms, maternal assessments of normal fullterm infants (Field, Dempsey, Hallock & Shuman, 1978), and of both preterm and fullterm infants with respiratory distress syndrome show correspondence to scores obtained on the Brazelton by trained clinicians. In their original paper, (Field, Dempsey, Hallock & Shuman, 1978), Field and coworkers present data on 32 normal fullterm infants and 32 postmature postterm infants where mother had assessed the infant on the MABI and an independent researcher had assessed the baby on the Brazelton. No differences between the two assessments were found for motoric process, state control and response to stress clusters, however, there was a significant difference in rating of interactive process scoring with the researcher being significantly more likely to give the infant optimal scores in this area (ANOVA $F(1,60) = 12.40$, $p < .001$). The four clusters of items examined are similar to the Brazelton scale a priori scoring clusters (see Lester, p88 in: Brazelton, 1984). In their second paper, (Field, Hallock, Dempsey &* Shuman 1978), studied *20 optimally BNBAS scoring full term infants and 20 Respiratory Distress Syndrome infants with a mean gestational age of 32 weeks and non-optimal BNBAS scoring. As with the earlier paper, there were no differences between MABI ratings made by researchers and those made by mothers with the exception that researchers were significantly more likely to rate the social interactive capabilities of the infant as optimal. Both mothers and researchers ratings clearly differentiated between the two groups. Mothers rated their infants on day 2 and again at one month and ratings were significantly higher on the second* *assessment than the first. In both studies, there was a significant correlation between motoric process scored by both researcher and mother, and outcome at 8 months as measured by the Bayley motor scale (this varied between $r = .34$ $p < .05$ and $r = .54$ $p < .01$).*

From the second study, both the BNBAS and the MABI predict significantly to later infant measures of temperament - (assessed using the Carey Infant Temperament Scale at 4 and 8 months) when the social and motor clusters are examined, and in all cases the correlation is stronger with the 4 than the 8 month Carey rating.

The Bayley mental scale was also administered at 8 months in the second study, and it is stated that there is a significant relationship between the MABI ratings and this measure. The paper does not, however, present the data in a way which allows one to see the extent of this relationship.

3.1.3.5) The Neonatal Perception Inventory (NPI1 & NPI2): (Broussard & Hartner, 1970)

The neonatal perception inventory was devised by Broussard and Hartner (1970) as a measure to examine parental perception and prediction of behaviour over the first month of life. Although not strictly a measure of infant behaviour, this scale is presented here as it provides an index of parental perception of both expected and actual infant behaviour, which complements the attempts of scales such as the MABI to examine the mother's ability to ellicit specific patterns of behaviour on request.

The specific items included in the scale are given in Appendix III. Within the first three days postpartum, the mother fills out a six item scale, with each item rated on a five point scale from 'none' to 'a great deal', covering aspects of neonatal behaviour which the authors felt best describe the average infant. The mother then fills out a second sheet on which she rates her own infant on the same items. The two scales are then repeated at one month postpartum. The basic aim of the scales is to assess the anticipatory and actual degree of concern mothers express about their infants. The scale score is derived by subtracting the 'Your Baby' score from the 'Average Baby' score. Mothers who rated their baby as worse than, or the same as, the average baby were viewed by Broussard and Hartner as being at "high risk for subsequent development of emotional difficulty". In their 1971 paper (Broussard & Hartner, 1971) they present data on a sample of 318 primiparae, stating that both of the inventories have high construct and criterion validity. No details are cited in the paper, however, of how such estimates of validity are arrived at.

3.1.3.6) Overview of Behavioural Assessments

The behavioural assessments outlined above are important in that they are systematic attempts to develop psychometrically reliable and valid instruments for the measurement of infant behaviour and responsivity, maternal ability to ellicit such behaviour and maternal perception. A variety of practical and *methodological problems beset all of the measures discussed. These will be elaborated upon in a subsequent chapter when the assessment developed and used in this thesis is presented.*

CHAPTER 4

THE NATURE AND STATUS OF EVIDENCE FOR THE INTERACTIVE CAPACITIES OF THE INFANT

The whole area of standardised neonatal assessment is one which still requires major research input. Many issues such as cross cultural variation in typical and abnormal behaviour (see Niestroj, 1984), the effects of perinatal care and procedure (see Leijon, 1980) the effects of prenatal sensory (see DeCasper & Spence, 1986) chemical/nutritional (Hill, 1984) and teratogenic (Persaud, 1980) influences on development, have yet to receive sufficient attention. Where such confounding variables are present, generalization from the existing database of assessment material (which to a great extent consists of healthy, fullterm, well nourished Caucasian infants) is difficult if not impossible.

A number of important theoretical questions can, however, begin to be addressed. One perennial question is the role of the cortex in neonatal behaviour. The neurological argument outlined in Chapter 3 has been thought to preclude the neonate from active participation in interaction, and would, if accepted, lead one to the conclusion that any apparent interactive sequences which were observed were, in fact, non-interactive and orchestrated entirely by the parent.

This area can be investigated in three principal ways. Firstly by examining the behaviour of infants born without cerebral hemispheres we can look at the repertoire in infants where such structures can be assumed not to exert any effect.

Secondly, by looking for behaviours which in adults are assumed to be subserved by cortical structures. Thirdly, by looking for infant contributions to the orchestration of normal interactions.

4.1) Neurological Underpinnings of Neonatal Behaviour: The Status of Evidence from the Assessment of Infants with Cerebral Agenesis.

The clinical conditions which have, historically, been thought to hold potential answers to the question of cortical function in infant behaviour are anencephaly and hydranencephaly. Both conditions are relatively rare: with improvements in antenatal screening, the incidence of anencephaly in Scotland has fallen from 2.6 per 1000 to 0.2 per 1000 over the period from 1971 to 1982 (Carstairs & Cole, 1984).

Hydranencephaly was first described in 1856 by the French neurologist Cruveilhier, and since that time, there have been several reviews of the evidence concerning the neuropathology of this type of abnormality (Johnson, Warner & Simons, 1951; Watson, 1944). Similar reviews have appeared on the neuropathology of anencephaly (eg. Cassady, 1969).

In terms of simple 'reflex' behaviour, there have been a number of studies of behaviours such as cardiac orienting to auditory stimuli (Graham, Leavitt, Stock & Brown, 1978; Brackbill, 1971), visual evoked responses (Barnet, Bazelon & Zapella, 1966), and the assocition of light and tone stimuli (Tuber, Berntson, Bachman & Allen, 1980; Berntson, Tuber, Ronca & Bachman, 1983). Such approaches have shown that the anencephalic and hydranencephalic child is capable of responses in these areas, though in most cases habituation is grossly impaired. Simple operant conditioning approaches were shown to be possible with a 19 year old girl with hydranencephaly (Deiko & Bruner, 1976), thus demonstrating at least a rudimentary degree of learning ability.

Two studies in particular have focussed on the behavioural repertoire of hydranencephalic infants who appeared to be otherwise physically normal (Aylward, Lazzara & Meyer, 1978; Francis, Self & McCaffree, 1984). In both cases the infant was assessed on the Brazelton Neonatal Behavioural Assessment Scale (Brazelton, 1973). The infants showed poor responses on the orientation sections of the examination and showed limited abilities on the response decrement items, being poor at habituation to noxious stimuli. In most other respects these infants fell within the normal range of infant behaviour. Both showed some degree of quieting to soothing vocalizations, and, in the Aylward Lazzara and Meyer case, some fixing and following on high contrast material. Although direct social responses seemed absent, the infants were not themselves seen as entirely socially 'absent':

> "Perhaps behaviours such as smiling, hand to mouth activity, quieting to sounds and visually following a moving field suggest that, in addition to basic reflexive automatisms, the neonate also possesses socially relevant behavioural automatisms."
>
> Aylward, Lazzara & Meyer (1978)

It is unclear whether these authors view the normal repertoire of the infant as including, or consisting of "socially relevant behavioural automatisms". Whether or not such behaviours *reflect a more complex structure of abilities than these authors credit the infant with, this infant was obviously viewed by them as social, or at least, as "socially relevant". Repeatedly in descriptions in the clinical literature, these infants are reported as acting normally.*

In a number of papers, the inference has been drawn from studies, such as those listed above, that the cortices of the cerebral hemispheres are therefore not necessary structures enabling an infant to express what appears to be intentional or volitional behaviour. The brainstem is seen to be able to generate patterns of behaviour which in many ways appear similar or identical to those of the normal, cortically intact, infant. Watson, for example, captions a photograph of one of the two cases on which he reports as follows:

> *"This normal-appearing infant, G.S. gave no hint by his actions that he lacked cerebral hemispheres. The other infant reported here appears equally normal."*
>
> *Watson (1944)*

On examination of all the above cases, it is evident that the infants on whom detailed post-mortem data is available have a variety of different pathologies. Of some importance in the current argument is the fact that they all appear to have at least some portions of intact cortex:

> *"The cerebral hemispheres were reduced to a small fragment of allocortex."*
>
> *Watson (1944)*

"The brain tissue resembled two halves of a large walnut."

Johnson, Warner & Simonds (1951)

"...the delta scan and arteriography indicated the existence of a very small amount of occipital cortex, the function of which is not known."

Aylward, Lazzara & Meyer (1978)

In the cases which have been examined extensively, there is evidence for the abnormal development of midbrain structures as well as for the presence of varying amounts of quasi-functional or dysfunctional cortical tissue. Given that such findings show that we are dealing with abnormal midbrain neural structures, over and above the partial absence of cortical tissue, it would seem improbable that we could make direct inferences from such findings as have been collected to the relative significance of cortical and subcortical structures in the intact infant CNS. The most that could be claimed from a study of this literature is that grossly abnormal neural systems are capable of generating patterns of behaviour which, with the exception of social responsivity and habituation to distressing stimuli, can be accepted as normal infant behaviour by adults. The case decribed by Aylward et al. was seen initially at 1 and 3 weeks of age, and followed up at 7 months. At followup, he was well, if still irritable, and living at home with his mother.

4.2) Neonatal Behaviours Requiring 'Higher Neurological Functions'

There has been much developmental research concerning *neonatal behaviours that, if observed in adults, would be assumed to be under cortical control. The lack of techniques which would allow us to substantiate the same neural basis as underpinning topographically equvalent infant behaviours such as smiling, imitation and cross-modal matching has been a major obstacle to the development of research in this area, given Morgan's canon (cited above).*

The development of techniques which allow cerebral metabolism to be plotted directly such as 2-Deoxy-2[18F]fluoro-D-glucose positron emission tomography are beginning to allow us to directly address the question. We shall soon be able to state clearly what areas of the brain are actively metabolizing at what ages and under what conditions. This should eventually allow us to delineate the cerebral metabolic conditions which characterise pathology. The recent work of Chugani and Phelps (1986) has been a major advance in this respect, demonstrating clear metabolic differences in infant mental retardation.

Let us briefly consider some of the behaviours, possibly mediated by the cortex, which have been observed in infancy.

4.2.1) Imitation:

In a series of research studies, infants have been shown from as early as a few minutes of age to be capable of imitation of simple movements such as lip pursing, tongue protrusion, and finger movements (Meltzoff, 1976, 1981; Meltzoff & Moore, 1977). Such studies have been replicated, albeit with minor differences, by a variety of workers (see, for example, Fontaine, 1984;

Kugiumutzakis, 1985 a,b,c; Maratos, 1982). The substantive conclusion, that neonates are capable of imitation, whether or not such a process is cortically mediated, has been largely accepted.

A parallel finding by Field (1977) has been that infants are more interested in their mothers when their own behaviour is imitated than at other times.

4.2.2) <u>Cross-Modal Matching:</u>

A second study by Meltzoff and Borton (1979) examined cross-modal matching. In this research, the infant was given, unseen, a shaped dummy to suck. The infant was then shown either a visual representation of the same or of a different dummy shape. Infants were found, as judged by increased visual fixation, to be able to reliably recognise the visual presentation of the shape which they were sucking. This demonstrates cross-modal matching abilities and argues for the coordination of sensory experiences as has been proposed by several theorists (see Aronson & Rosenbloom, 1971).

4.2.3) <u>Smiling:</u>

Research by Harriet Oster (Oster, 1978; Oster & Ekman, 1977), analysed the patterns of facial musculature in infant expressions with particular emphasis on infant smiling. She was able to establish, using the Facial Action Coding System for coding the activity of individual facial muscles that (a) real smiles do occur in infancy which are topographically distinct from 'wind' *smiles, and (b) that these involve the same muscle movements which would be present in adult smiling. In adults, this process is thought to be under cortical control.*

4.3) <u>Evidence for Infant 'Orchestration':</u>

Whether or not extensive myelination of cortical structure is necessary for higher cortical function is an issue of considerable interest for paediatric neurology. The implicit acceptance that myelin is necessary does place certain limitations on our models of infant functioning. However, these limitations in the main are concerned with our ability to relate structure to function and not with our models of function as such. Problems only arise if we see 'higher cortical function' as being synonymous with 'higher structures necessary for psychological/interpersonal functioning'. Our increasing knowledge of the complexity of functions for which midbrain and brainstem structures of the brain are responsible in the adult (see, for example: Naeser, Alexander, Helm-Estabrooks, Levine, Laughlin & Geschwind, 1982) is likely to lead to a revision of the complex = cortical top-down processing model of CNS function which has led to these confusions.

As a separate issue, we can investigate the extent to which the infant appears to play an active, directive part in mother-infant interactions. Is it indeed the case that the infant is able to function directively, irrespective of the neural mechanisms which may or may not subserve this activity ? There is now *abundant evidence on the patterns of early interaction which can be observed in the neonatal period. Three types of evidence for a directive or orchestrating role played by the infant will be mentioned here.*

Firstly, there is evidence from the analysis of normal sequences of interaction that the infant is able, at least by 7 weeks, both to lead and to follow the adult in patterns of turntaking (see Trevarthen, 1983, 1985a). Secondly, in situations where the infant has to adapt his/her interactive strategies to cope with, for example, sensory handicap on the part of the adult interactant, this has been demonstrated to occur (Als, Tronick & Brazelton, 1976). The infant is able to alter patterns and modalities of emotional behaviour to achieve a mutually satisfying exchange with his/her partner. Finally, a number of 'pertubation' experiments have been carried out, in which the infant is presented with unusual feedback from an adult - with a video replay (Murray & Trevarthen, 1985; Trevarthen, Murray & Hubley, 1981; Trevarthen, 1985), where the mother is instructed to highly stimulate or to copy the infant (Field, 1977, 1979), or where the mother is instructed to keep a still face and/or simulate depression (Murray, & Trevarthen 1985; Cohn & Tronick, 1982). In these studies, the infant has been shown to be acutely sensitive to the intersubjective components of interaction and to rapidly sense the inappropriateness of the situations.

The above studies clearly illustrate the important role which the infant plays in regulating the nature and extent of his/her interactions with significant others whatever the state *of development of cortical tissue. In doing this, they strongly question the notion, which has been with us since Peiper, that as they could not be present, such abilities are not worthy of research.*

4.4) <u>Chapter Summary and Conclusions:</u>

From the above review, there are a number of strands of evidence which, taken together, provide strong support for the complexity of early infant communicative capabilities and the limitations imposed by the acceptance of an intersubjective = cortical model.

The evidence from anencephaly is that the anencephalic infant typically has problems with habituation and responsivity, however is often surprisingly motorically normal. It seems, therefore, that the cortex is an important structure in the modulation of habituation and social response in the neonate despite its lack of myelination.

From adult neuropsychology, and in particular the study of subcortical lesions, there is an increasing realization of the important role in communication played by many subcortical structures. To date at least, this seems to be particularly with respect to both expressive and receptive affective capabilities.

Research on early interactive abilities of the normal neonate shows a surprising complexity of 'skills' such as cross-modal recognition, smiling and imitation. These are important components of interaction, some of which have also been shown to predict to later psychological functioning.

CHAPTER 5:

AN IMPROVED ASSESSMENT INSTRUMENT FOR EARLY NEUROBEHAVIOURAL INTEGRITY AND INTERACTIVE COMPETENCE: THE NEONATAL NEUROBEHAVIOURAL ASSESSMENT (NNA).

An important component of this dissertation has been the refinement and validation of a scale for the assessment of neurobehavioural integrity and interactive competence in the neonate. This chapter details the background to this assessment and the reasons for its development, its structure and its content.

The scale draws historically and philosophically on a number of well established measures which have been reviewed and described in Chapter 3. Of particular influence in its development have been the Brazelton NBAS (Brazelton, 1973), the Dubowitz neurological scale (Dubowitz & Dubowitz, 1981), and the APIB (Als, Lester, Tronick & Brazelton, 1982). The author has trained in the administration and scoring of all of these assessments with the clinicians responsible for their inception and development, and acknowledges a considerable theoretical and practical debt.

A variety of conceptual, practical and methodological limitations are, however, inherent in all of the above measures, as assessments of both neurobehavioural function and interactive competence (see, for examples, Sameroff, 1978). It was felt that a new assessment measure was needed to tap into a wider range of neonatal abilities, one that could be administered without lengthy training, and, while drawing on these earlier assessment methods could hopefully circumvent some of their more *significant problems.*

5.1) PROBLEMS WITH THE EARLIER APPROACHES:

5.1.1) The Brazelton Scale

The BNBAS in its various forms, is the most widely used measure of neonatal behavioural status. It has, however, been criticized for a variety of reasons (see, for example, Sameroff, 1978). Some of the criticisms: of its poor test-retest reliability, and of the impossibility of ascertaining interrater reliability on non-visually coded items such as clonus, for example, identify problems that have to be accepted as inevitable for all behavioural assessments of the neonate. Rapid changes in infant behavioural responses for a variety of causes, from maturation to delayed effects of obstetric medication, may account for a poor test-retest reliability. The lack of reliable methods of quantification for aspects of functioning which rely on examination of tactile and other qualitative aspects of response by the examiner explains the relatively poor inter-rater reliability on such items.

Several of the criticisms identify problems which are, however, more difficult to answer. Features of the scale, such as its reliance on optimal as opposed to modal responses, and its lack of concurrent validation against the supposed criterion variable of caregiver-infant interaction, raise concerns for which its proponents seem unable to provide a clear and satisfying defence.

5.1.2) The Dubowitz Neurological Scale

The Dubowitz neurological scale is a simply administered assessment of neonatal neurological functioning and it has been shown to be a useful indicator of change in gross neurological function but to have a limited role in assessment of 'higher' cortical or alteroceptive functions. As was discussed in Chapter 2, alteroceptive abilities need not necessarily involve a cortical component. There are several benefits to such a scale, as with the Prechtl and Beintema scale (Beintema, 1968) which preceded it, when it is compared to standard neurological assessment along the more traditional lines advocated by Peiper. Principal amongst these, are the ease of training, administration, and scoring by relatively inexperienced clinicians, and ease of establishing acceptable levels of reliability.

Criticisms to which the BNBAS is prey concerning poor test-retest reliability are escaped by the Dubowitz scale, and interrater reliability is also good. The problem of agreement on non-visual items, such as clonus, remains, however. Although useful for neurological screening, the Dubowitz would not prove adequate for the purposes of my study as it does not address the issue of alteroceptive skills and interactive potential. This should not be seen as a flaw as the scale was not developed with the intention of providing an index of interactive capabilities.

5.1.3) The Assessment of Preterm Infant Behaviour

The APIB is a complex, well-designed measure, that is proving to be a useful instrument in both neurological research (Duffy & Als, 1983) and neurobehavioural discrimination between preterm and fullterm newborns (Als, Duffy & McAnulty 1988a, 1988b). There are, however, several major problems with this scale as a clinical measure. First, the scale is difficult and time consuming to learn. It is also considerably more laborious to establish reliability of administration and scoring than on simpler scales such as the BNBAS. It requires considerably more time for both administration and scoring than any of the other available measures. Last, there is little in the way of criterion validation of the instrument and it remains most applicable as a research method.

The APIB has not, as yet, been adopted outside of Boston as a neonatal assessment tool for work with the premature infant.

5.2) THE NEONATAL NEUROBEHAVIOURAL ASSESSMENT (NNA)

5.2.1) The Aims of the Assessment

The current assessment was constructed with the aim of producing a measure that was sensitive to individual differences across the range from gross neurological to complex alteroceptive abilities. It was designed to be simple to administer, with acceptable administration reliability and to be used at or around estimated date of delivery with neurologically intact infants.

It was hoped that by broadening the range of behaviours assessed to include social responsivity, a scale could be developed which provided a measure of alteroceptive function rather than of alteroceptive potential.

The relationship of the NNA results to several aspects of early development would be investigated. In particular, it would be asked whether the overall NNA, or specific clusters of items related in a systematic fashion to other parameters of neonatal functioning such as obstetric complications assessed on the OCS (Littman & Parmelee, 1974), maternal age, gestational age or birthweight. Both trends across and group differences within the study cohort of premature and fullterm infants would be examined.

5.2.2) The Structure of the NNA

The scale was developed to incorporate useful features from the aforementioned assessments: The scale incorporated the simplicity of administration of the Dubowitz scale with its 5 point ratings of response and pictographic scoring key. The state scoring system adopted in the APIB was used in place of the five state coding used in the BNBAS and Dubowitz scales. A simplified version of the orientation section of the BNBAS with 5 in place of 9 point rating was incorporated in order to give an, albeit crude, measure of infant alteroceptive ability - a feature which is absent from the Dubowitz scale. Five point rating was felt to be easier to use than the nine point ratings used on the BNBAS, and, as had been established by earlier studies on the MABI (Field, Hallock, Dempsey & Shuman, 1978), should allow for *adequate discrimination between infant groups.*

A number of the more distressing manoevres present in other examinations such as habituation to heelprick were excluded from this assessment, as it was felt they would lend little to the overall assessment picture, and would likely prove distressing to the mothers. The Moro was retained as a single measure of response to high tactile/vestibular stimulation. Many simple reflex items such as the Galant and Chvostek were also omitted as they were not felt to be useful for the purposes of the current assessment given its focus on general status and alteroceptive ability.

The administration criteria adopted were those recommended by Prechtl in his critical review paper on neonatal assessment techniques (Prechtl, 1982):

1.) the assessment be conducted at a standard postprandial time, ideally midway between feeds,

2.) in conditions optimised and standardised as far as possible for lighting level and ambient temperature,

3.) that the assessor be consistent in his administration procedures,

4.) that, as far as possible, the order of administration of items should be kept constant.

Although Prechtl's comments are directed at the standardization of neurological assessment, the points raised are equally applicable to the standardization of all forms of neonatal assessment procedure.

Detailed directions for administration and scoring of this *assessment, together with a listing of the materials required are appended in a comprehensive manual. A full description of the individual items is thus not included in this chapter.*

As with the BNBAS and the APIB, this assessment consists of a series of 'packages' of items. The items are administered, as far as possible, in the sequence in which they are outlined on the scoring sheet. The only exception to this being the administration of those items which examine sensory and social responsivity. These items are administered when the infant is in the appropriate state of arousal as judged by the examiner. This could be at any point in the course of the assessment. The items break down into 6 basic packages for administration:

1. *Habituation to Distal Stimuli* -

   To Light,
   To Rattle.

2. *Low Tactile Physical Stimulation* -

   Observation of quiet posture,
   Response to Arm Recoil,
   Muscle tone maintained during Arm Traction,
   Response to Leg Recoil,
   Muscle tone maintained during Leg Traction,
   Muscle tone maintained during Popliteal Angle,
   Palmar Grasp Response,
   Rooting Response,
   Sucking Response.

3. *High Tactile Stimulation* -

   Response to being Undressed,
   Muscle tone and head control maintained during pull-to-sit,
   (cont.)

Head Control (anterior),
Head Control (posterior),
Head Control in Prone,
Arm Release in Prone,
Walking and Stepping,
Cuddling,
Defensive Reaction.
Moro Response.

4. *Orientation* -

Inanimate Auditory,
Inanimate Visual,
Animate Auditory,
Animate Visual,
Animate Visual & Auditory.

5. *Social Responsivity* -

Animate Auditory,
Animate Visual,
Animate Visual & Auditory,
Consolability,
Cuddliness.

This package is grouped for analysis and cuts across items found in packages 4 and 6.

There are a number of summary measures which describe the behaviour of the infant over the course of the examination:

6. *Summary Items:*

Body Movement during Examination,
Abnormal Movements,
Tremors,
Startles,
Alertness,
Peaks of Excitement,
Irritability,
Consolability,
Self-Consolability,
Crying,

Some of these items may never be observed if the infant does not reach a state where the behaviour can be observed - for example, although ellicited in most instances, consolability and *self-consolability can only be observed if the infant becomes sufficiently distressed to require consolation.*

To establish a standard sequence for administering the assessment it is advisable to begin with the infant in a light sleep. Gradually, through administration of the items in packages 1 and 2 the infant should become more aroused and responsive. The items in package 3 are then administered, usually resulting in a progressive increase of alertness, with some state 6 distress allowing consolability to be assessed. When the infant is in an appropriate state - ideally in state 3, 4(I), 4(II), or 4(III), which could be at any point from the beginning of package 3 to the end of the examination - the orientation and social items (package 4 and 5) are administered.

The administration of the responsiveness items when the infant is in an appropriate state rather than in strict predetermined sequence with the other items accords with the practice of the BNBAS and the APIB, but differs from the Dubowitz scale, and from Prechtl's advice on test construction. It does, however accord with Prechtl's view that many responses can only be elicited consistently and interpreted meaningfully when the infant is in an appropriate state:

> *"...The optimal behavioural state for each test item is that one in which a response of medium intensity is consistently found, but, not the one in which a response is most intensive, 'best', or otherwise maximally expressed.... It is essential for an examinatiion technique to indicate for each item the optimal state of the infant in which the examiner should carry out the testing, and for which states this is contra-indicated."*
>
> *Prechtl (1982)*

5.2.3) Scoring of the NNA

A simplified scoring system was adopted for the analysis used in this thesis. Given that a rating of C on each item was judged to be an optimal response following the rationale of Prechtl which has been stated above, with B and D less so and A and F abnormal, C was scored 3, B or D as 2 and A or F as 1. This allowed a simple figure to be obtained for cluster scores on each of the groups above, and also a total NNA score, with a higher overall score being judged to be closer to optimal.

5.3) Validation of the Neonatal Neurobehavioural Assessment

5.3.1) Subject Selection

All subjects included in this evaluation were selected on a number of criteria aimed at minimising confounding influences on neonatal function. The following inclusion criteria were adopted:

1.) All infants were Caucasian;

2.) All infants had fewer than 35% of the items on the Obstetric Complications Scale scored as suboptimal;

3.) All infants were given explicit clearance for inclusion in the study by the ward or special care nursery medical staff, who had the right to veto study inclusion if there were specific medical concerns;

4.) In all cases the nursing staff were consulted as to the advisability of approaching the mother. Mothers who were felt to be exhibiting high levels of distress or depression were not approached;

Infants were considered for inclusion in the study where all of the above criteria were met. Each mother was first approached, had the study briefly explained to her and was given a consent form if considered for inclusion in the assessment group only or an information + consent form (see Appendix II) if for inclusion in the interaction study. She was given a short period, normally 24 hours, to decide whether to take part. If she agreed to her infant being included in the assessment part of the study, the consent form was completed, witnessed by the experimenter and a member of the nursing staff, and the infant was then examined. A flowchart illustrating the sequence for subject identification, obtaining informed consent and data collection is shown below.

5.3.2) Method

All infants were examined under conditions which met with those outlined earlier in the chapter :- as close to midway between feeds as possible, in a warm room with low ambient light and no loud noises or bright light sources. In all cases, the mother was present during the administration of the assessment and was informed of her infants responses and their significance as this was appropriate through the course of the procedure.

For the fullterm infants, examination was usually carried out in the demonstration room adjoining the nursing station. This area is normally used for showing routine care procedures, such as bathing the infant, to mothers prior to discharge home.

For the preterm infants, assessment was carried out under similar conditions, in the Maternity Hospital, the Psychology

Department at the Royal Hospital for Sick Children, or in a small number of cases, in the family home.

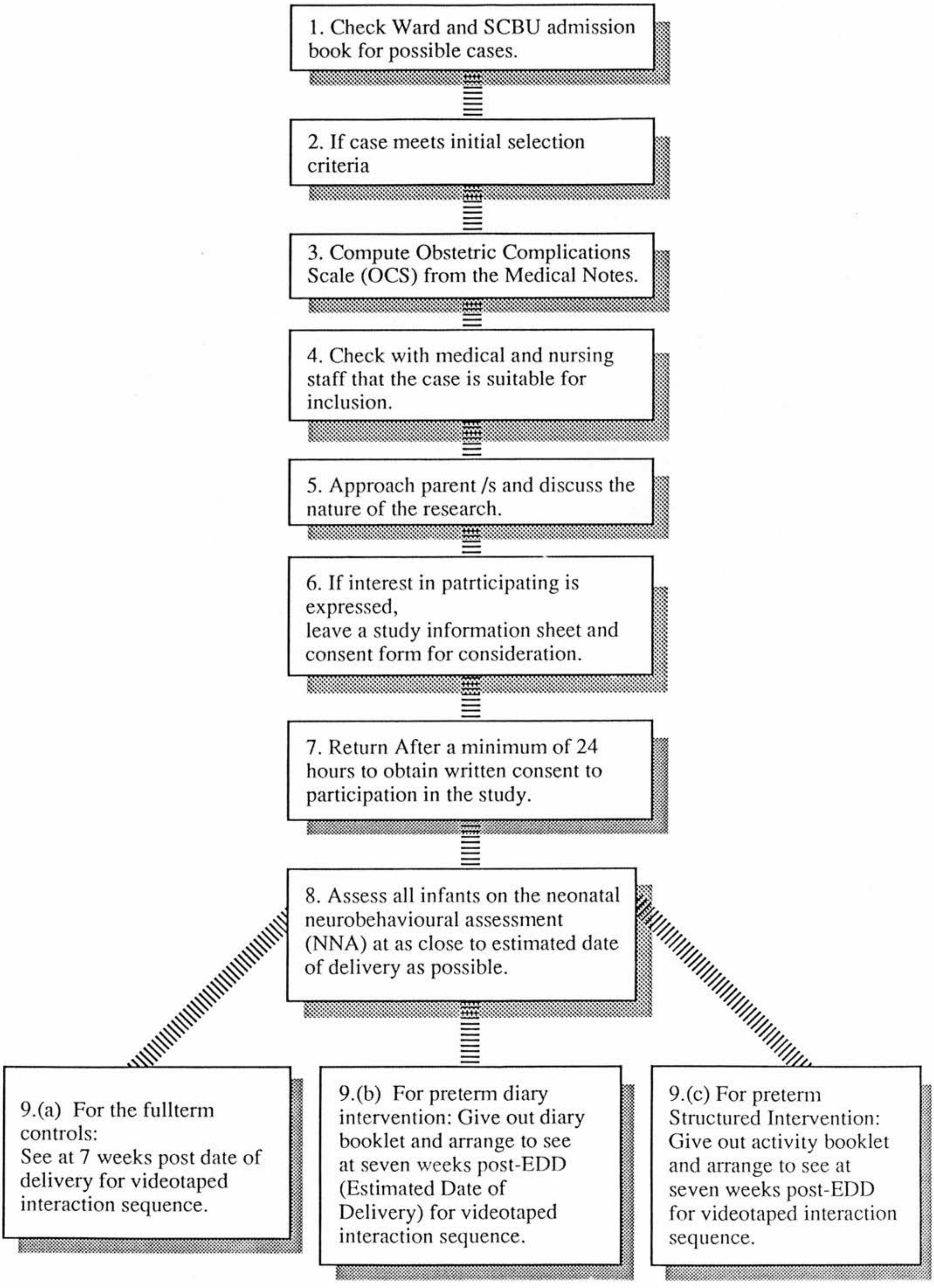
The examiner (KA) was gowned in all cases, and had washed forearms and hands thoroughly with an antibacterial surgical scrub (povidone iodine USP 7.5% w/v 'Betadine') prior to handling the infant. There was no obvious effect of the taste or smell of the scrub on the infant's responses to rooting and sucking items, with all of the fullterm infants showing regular sucking and no reluctance to engage.

The examination was carried out as described in detail in the manual appended to this dissertation (Appendix I), and the results were analysed using the method for scoring outlined in section 5.2.3 and analysing the results in terms of the 6 item clusters and the total examination score. The posture and Moro response scores were also analysed individually to look for any group differences on these items.

5.3.3) Results:

In analysing the data, two separate assumptions were made - firstly, that there is a "continuum of reproductive casualty" which spans the whole sample, and secondly, that the premature infants examined would differ significantly as a group, from their fullterm normal controls. Two types of data will therefore be presented - the relationships between variables treating all subjects as part of a continuum, and differences between the premature and fullterm infants, treating these as separate groups.

Subject Selection and Data Collection Sequence for all groups.



5.3.3.1) NNA Results - Whole Cohort

In total, a cohort of 62 infants was assessed on both the NNA and the OCS. These comprised 33 premature and 29 fullterm infants. Details of birthweight, gestational age and maternal age were also examined, to allow investigation of any systematic relationships between these factors. The raw data set for the total group is appended to the thesis (Appendix IV).

A total group correlation matrix for the following sixteen variables was computed:

1. Maternal Age
2. Obstetric Complications
3. Birthweight
4. NNA Habituation
5. NNAPosture
6. NNA Low Tactile Responses
7. NNA High Tactile Responses
8. NNA Vestibular Reaction
9. NNA Orientation
10. NNA Summary Items
11. NNA Overall Score
12. Gestational Age
13. NNA Social Responsivity
14. Whether resuscitation was required
15. One Minute Apgar Score
16. Five Minute Apgar Score

On analysis, the matrix (displayed as Table 5.1 below), showed a number of statistically significant interrelationships, the most interesting of these are shown graphically in figures 5.1 through 5.27 below.

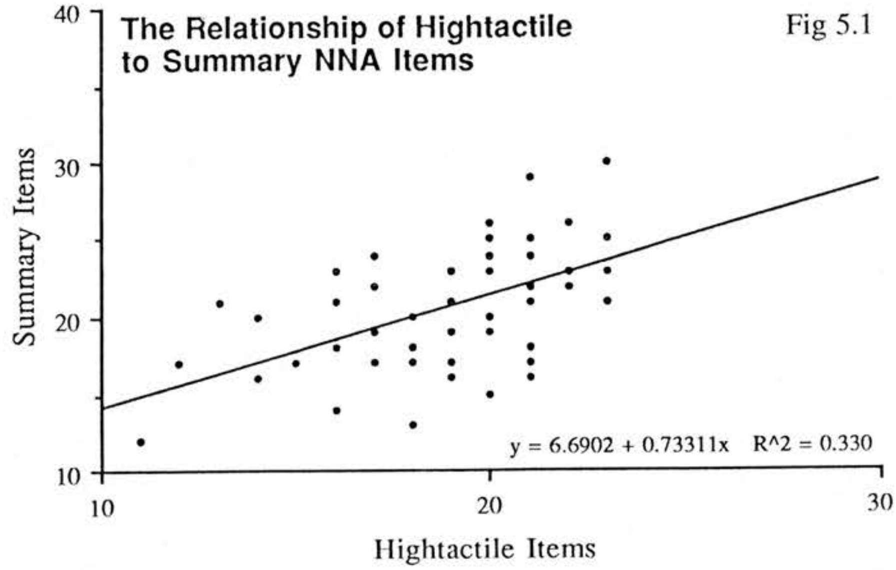
Table 5.Ï Total NNA Sample Correlation Matrix

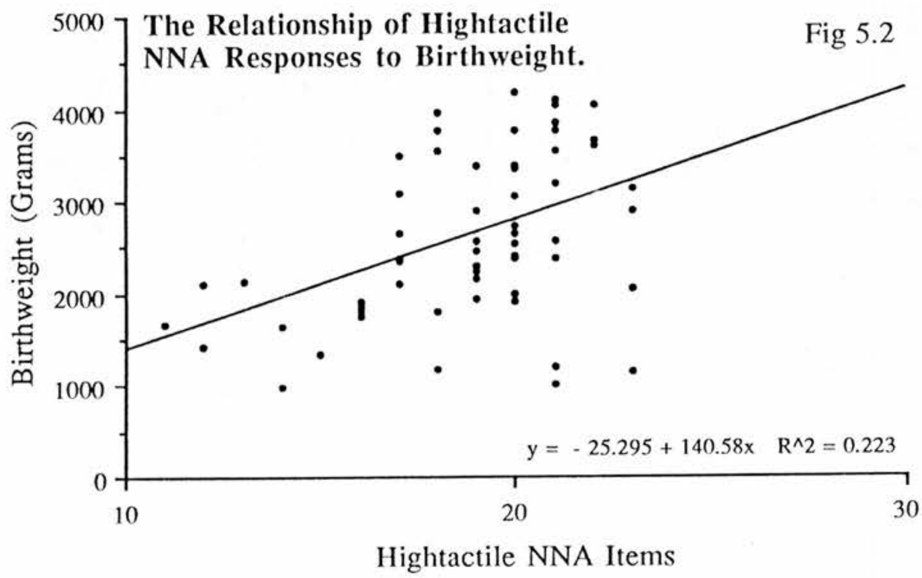
Correlation Matrix for Variables: $X_1 \ldots X_{16}$

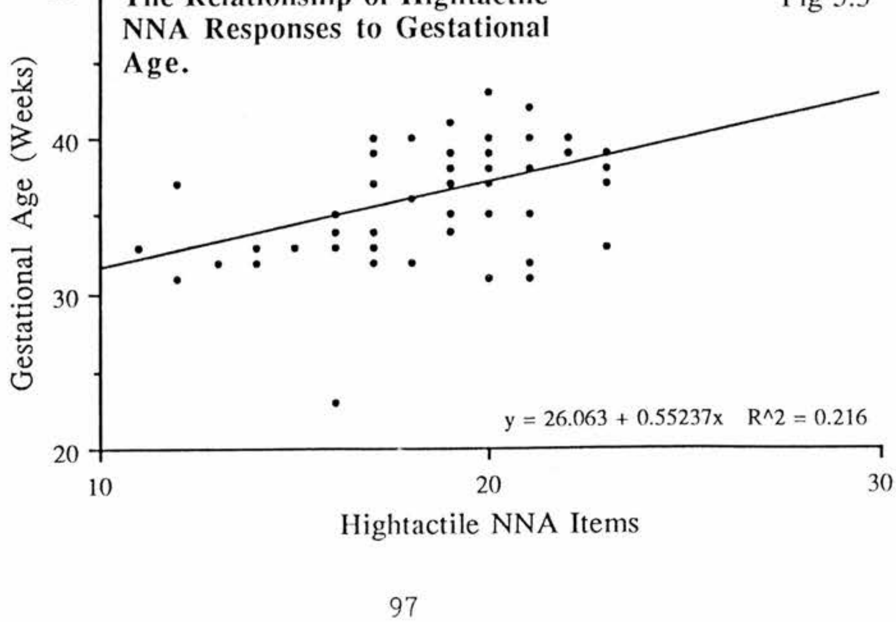
	MATAGE	OCS	BWT	HABIT	POSTURE	LOWTACT	HIGHTACT	VESTIB
MATAGE	1							
OCS	.24	1						
BWT	.008	-.482	1					
HABIT	-.039	-.195	.354	1				
POSTURE	-.048	-.035	.031	-.236	1			
LOWTACT	.124	-.2	.212	.098	.104	1		
HIGHTACT	.133	-.248	.472	.199	-.092	.425	1	
VESTIB	-.024	-.138	.026	.144	.055	.158	.293	1
NNORIENT	.116	-.434	.601	.421	.032	.192	.431	-.08
SUMMARY	.134	-.002	.339	.235	-.074	.445	.574	.383
OVERALL...	.099	-.296	.583	.461	-.003	.591	.762	.266
GA	.096	-.566	.802	.435	.094	.22	.464	.084
SOCIAL I...	.047	-.331	.559	.4	.011	.137	.419	.094
Resusc.R...	-.048	.271	-.219	-.06	-.073	-.261	-.235	.093
Apgar 1	-.123	-.348	.393	.022	.05	.224	.143	.024
Apgar 5	-.01	-.326	.534	.094	.16	.137	.151	-.186

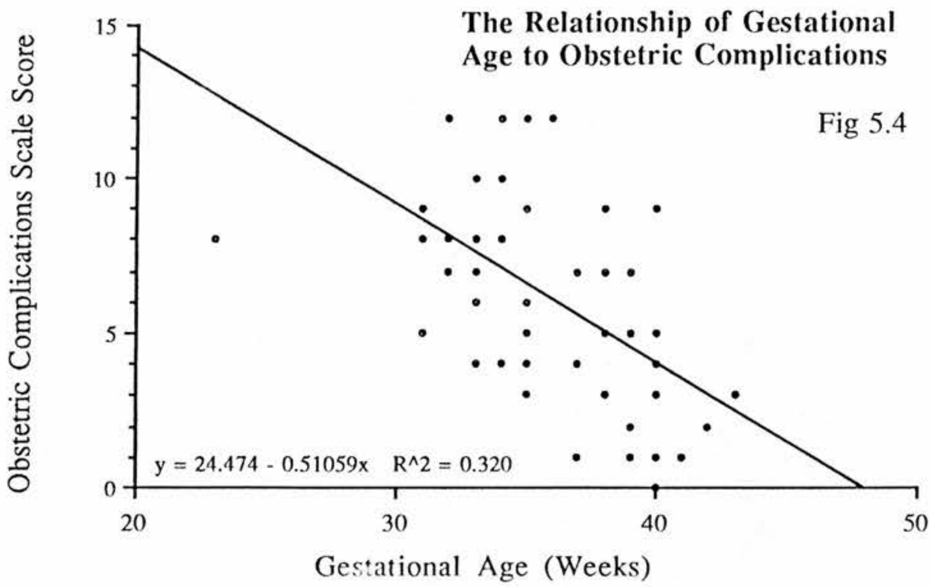
Correlation Matrix for Variables: $X_1 \ldots X_{16}$

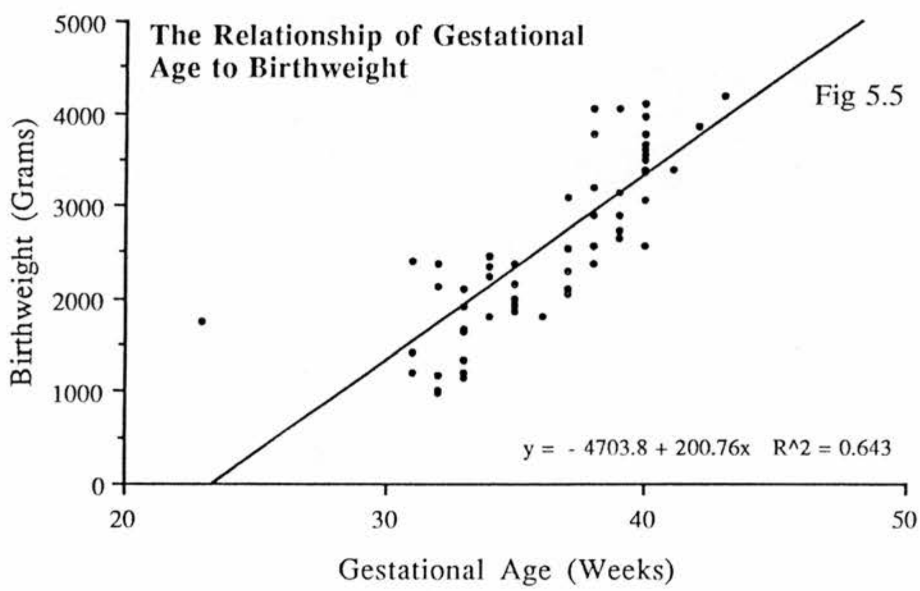
	NNORIENT	SUMMARY	OVERAL...	GA	SOCIAL I...	Resusc....	Apgar 1	Apgar 5
NNORIENT	1							
SUMMARY	.284	1						
OVERALL...	.686	.775	1					
GA	.59	.322	.587	1				
SOCIAL I...	.758	.343	.657	.594	1			
Resusc.R...	-.226	-.142	-.243	-.236	-.302	1		
Apgar 1	.204	.15	.244	.245	.27	-.422	1	
Apgar 5	.356	.012	.248	.29	.242	-.158	.558	1

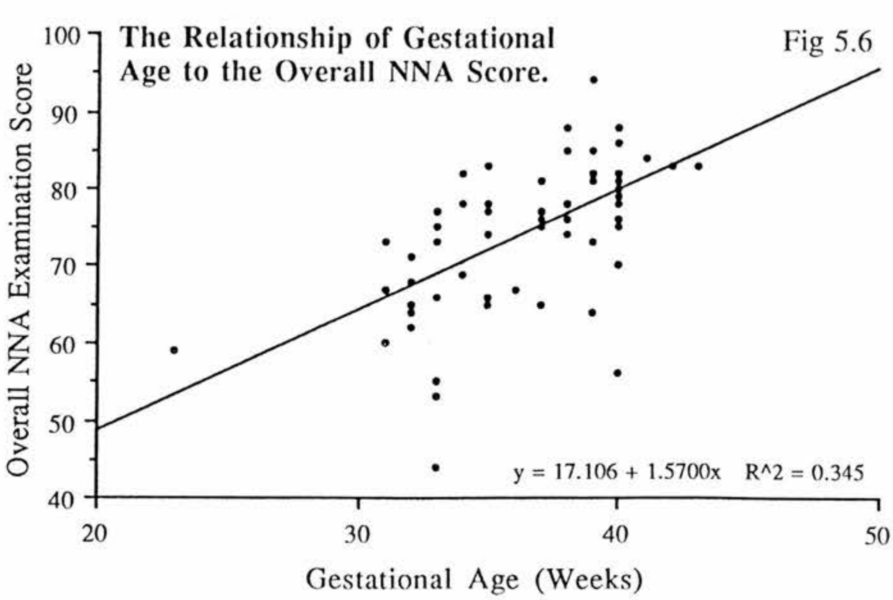

The Relationship of Hightactile to Summary NNA Items
Fig 5.1
Summary Items
40
30
20
10
10
20
30
Hightactile Items
y = 6.6902 + 0.73311x R^2 = 0.330

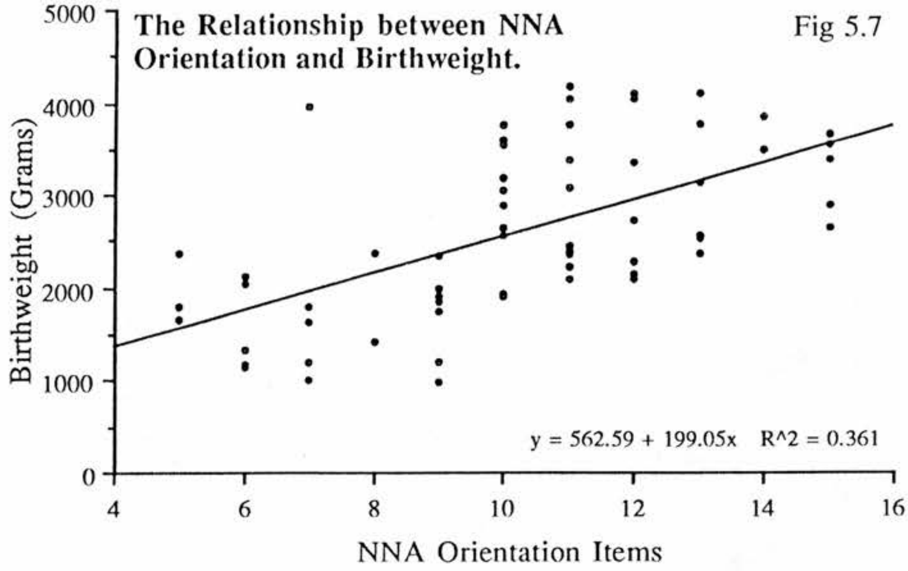

The Relationship of Hightactile NNA Responses to Birthweight.
Fig 5.2
Birthweight (Grams)
5000
4000
3000
2000
1000
0
10
20
30
Hightactile NNA Items
y = - 25.295 + 140.58x R^2 = 0.223

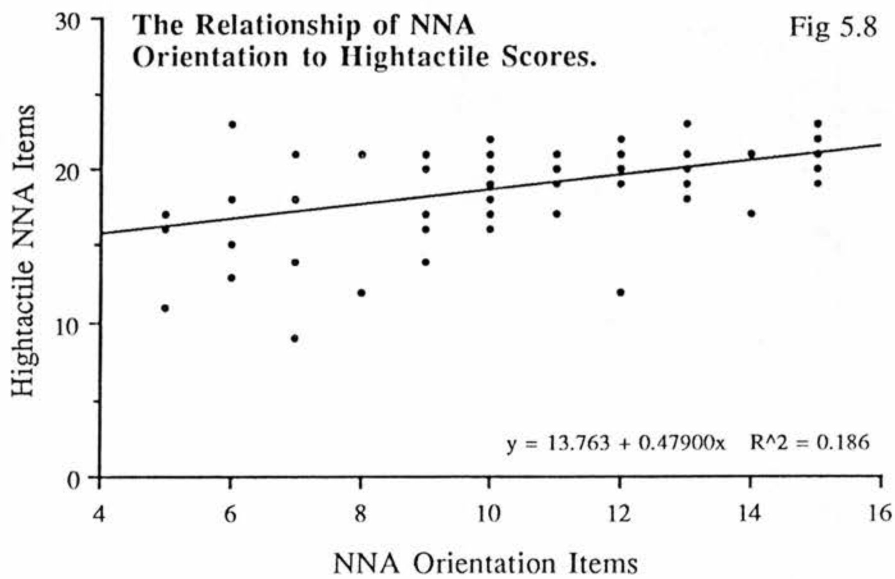

The Relationship of Hightactile NNA Responses to Gestational Age.
Fig 5.3
Gestational Age (Weeks)
50
40
30
20
10
20
30
Hightactile NNA Items
y = 26.063 + 0.55237x R^2 = 0.216

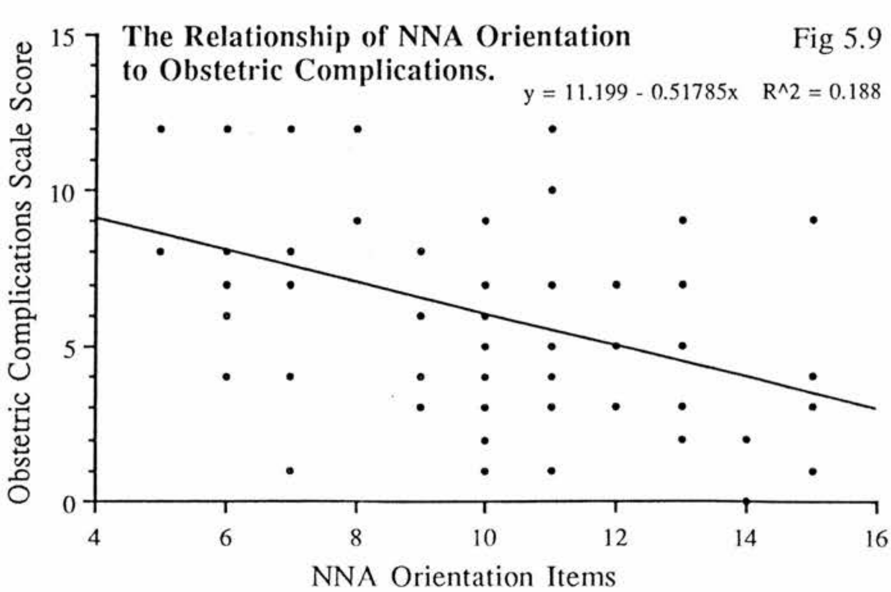

The Relationship of Gestational Age to Obstetric Complications
Fig 5.4
Obstetric Complications Scale Score
y = 24.474 - 0.51059x R^2 = 0.320
0
5
10
15
20
30
40
50
Gestational Age (Weeks)

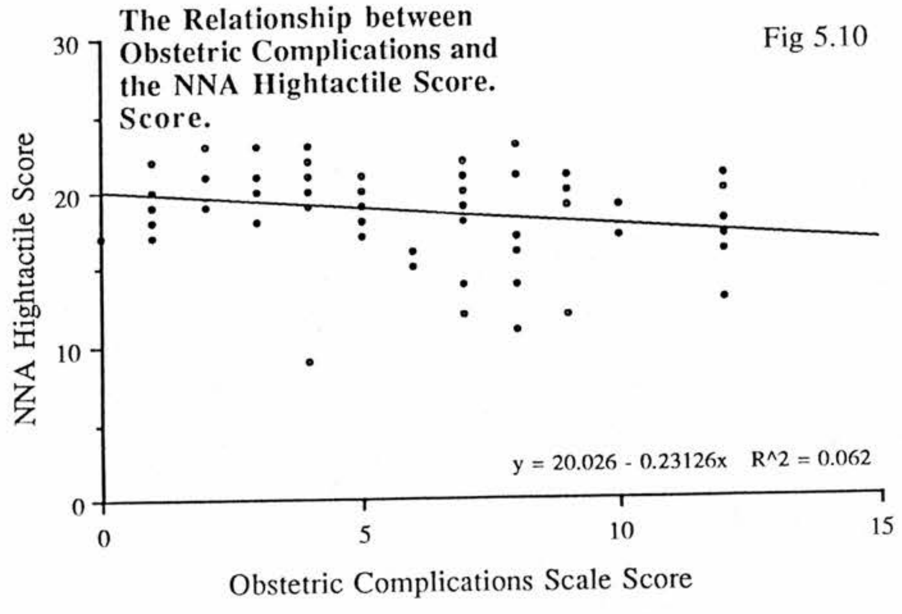

The Relationship of Gestational Age to Birthweight
Fig 5.5
Birthweight (Grams)
y = - 4703.8 + 200.76x R^2 = 0.643
0
1000
2000
3000
4000
5000
20
30
40
50
Gestational Age (Weeks)

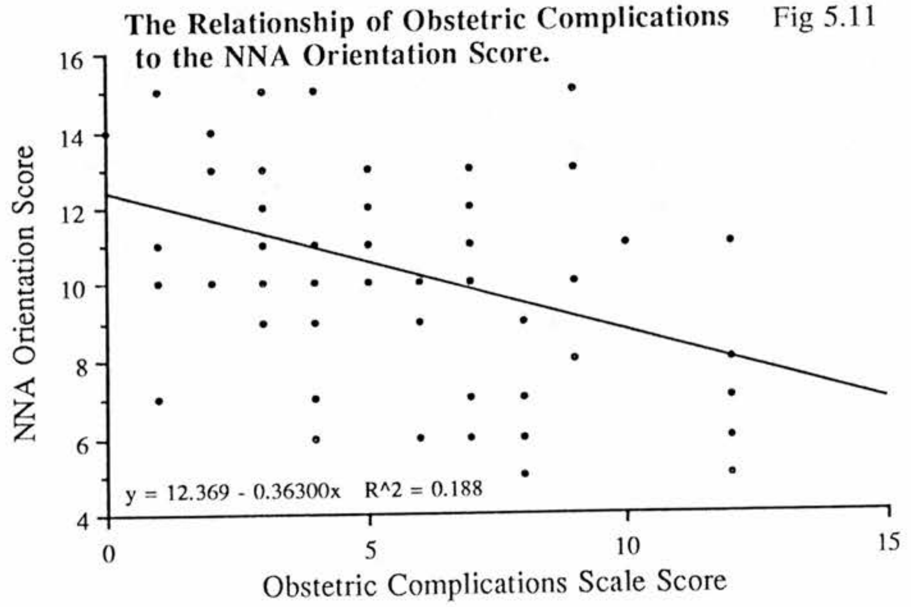

The Relationship of Gestational Age to the Overall NNA Score.
Fig 5.6
Overall NNA Examination Score
y = 17.106 + 1.5700x R^2 = 0.345
40
50
60
70
80
90
100
20
30
40
50
Gestational Age (Weeks)

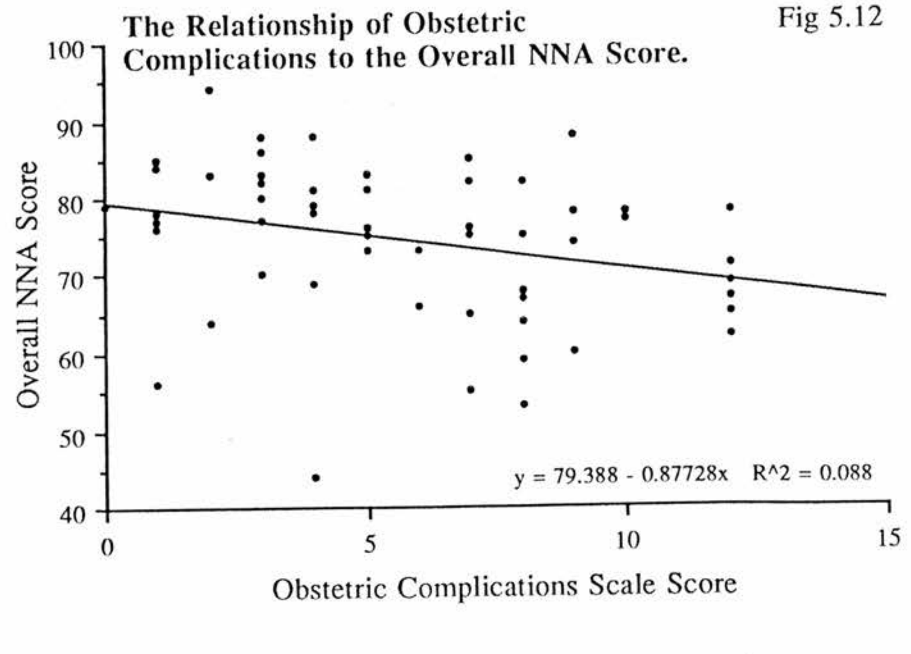

The Relationship between NNA Orientation and Birthweight.
Fig 5.7
Birthweight (Grams)
5000
4000
3000
2000
1000
0
y = 562.59 + 199.05x R^2 = 0.361
4
6
8
10
12
14
16
NNA Orientation Items

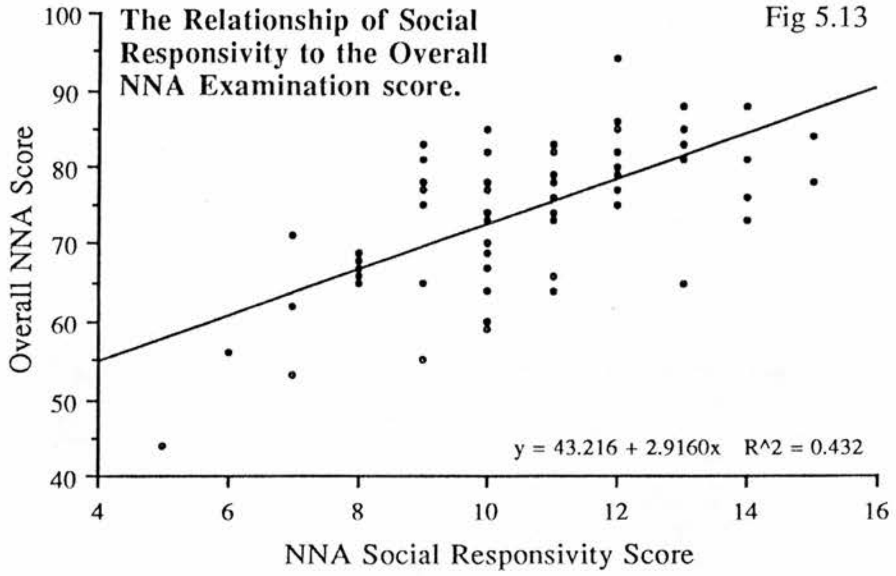

The Relationship of NNA Orientation to Hightactile Scores.
Fig 5.8
Hightactile NNA Items
30
20
10
0
y = 13.763 + 0.47900x R^2 = 0.186
4
6
8
10
12
14
16
NNA Orientation Items

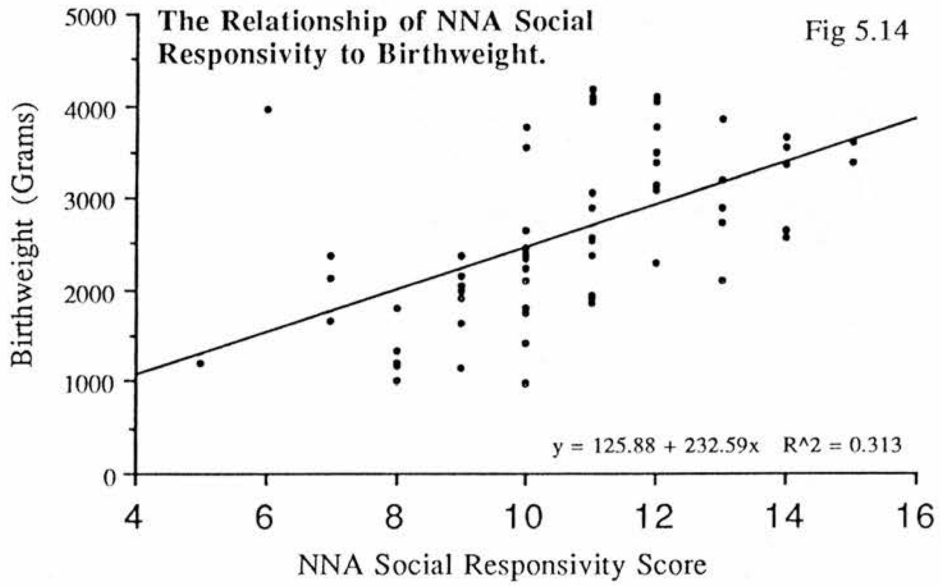

The Relationship of NNA Orientation to Obstetric Complications.
Fig 5.9
y = 11.199 - 0.51785x R^2 = 0.188
Obstetric Complications Scale Score
15
10
5
0
4
6
8
10
12
14
16
NNA Orientation Items

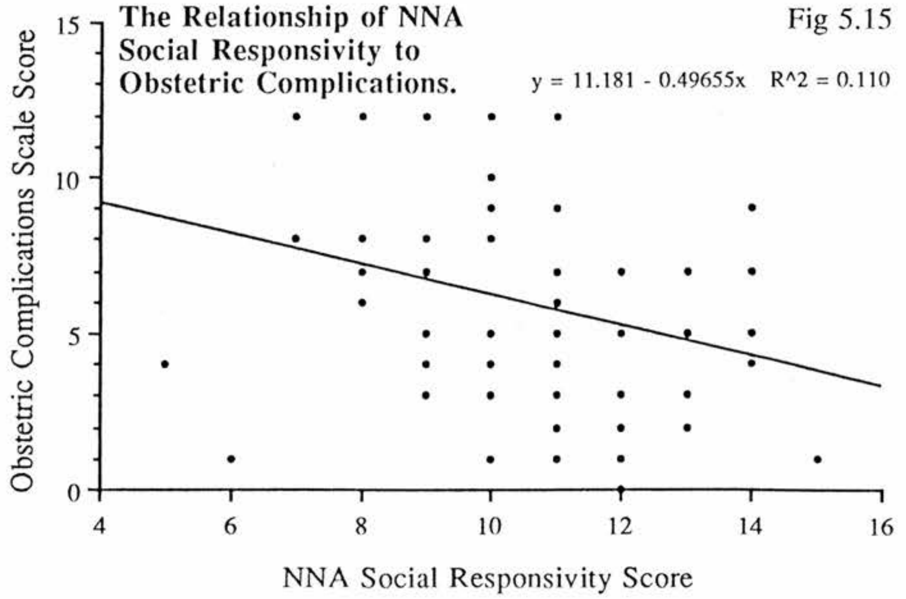

The Relationship between Obstetric Complications and the NNA Hightactile Score. Score.
Fig 5.10
NNA Hightactile Score
Obstetric Complications Scale Score
y = 20.026 - 0.23126x R^2 = 0.062
0
10
20
30
0
5
10
15

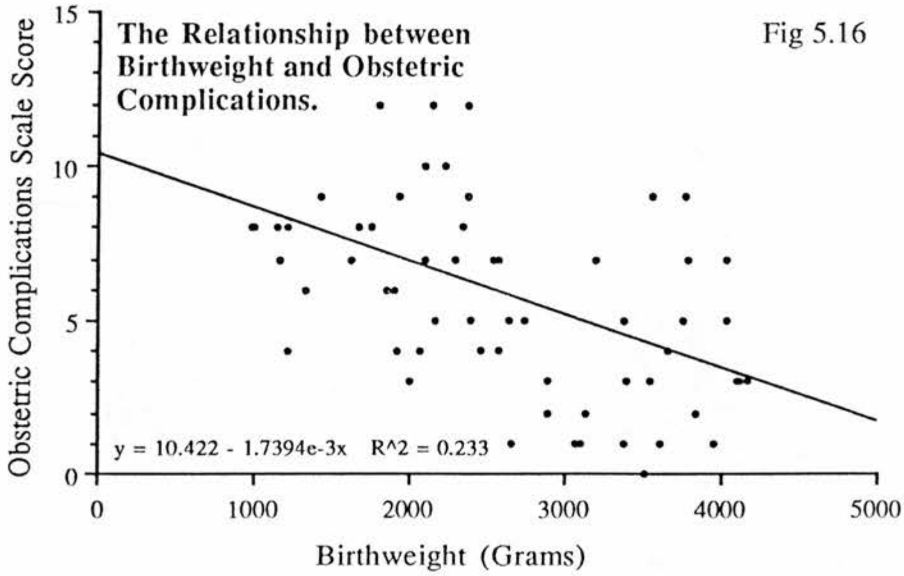

The Relationship of Obstetric Complications to the NNA Orientation Score.
Fig 5.11
NNA Orientation Score
Obstetric Complications Scale Score
y = 12.369 - 0.36300x R^2 = 0.188
4
6
8
10
12
14
16
0
5
10
15

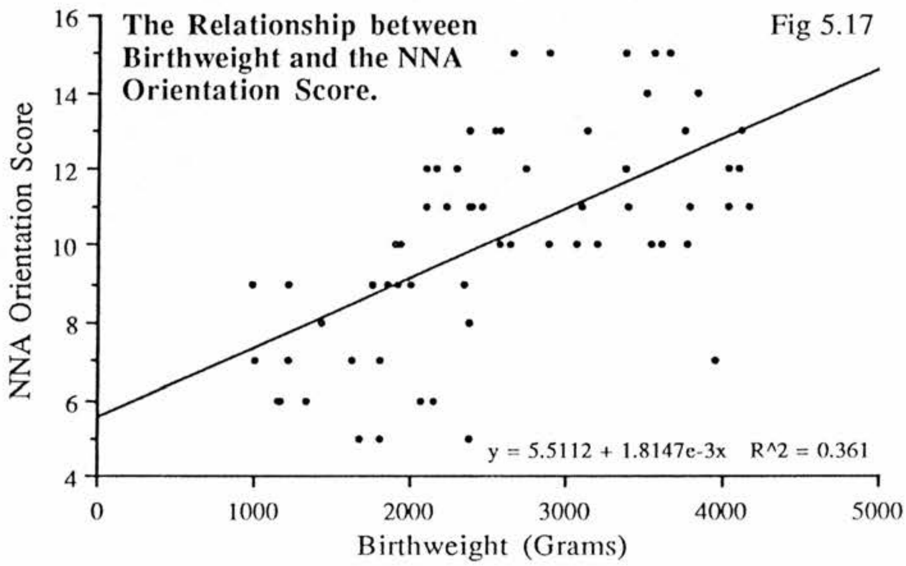

The Relationship of Obstetric Complications to the Overall NNA Score.
Fig 5.12
Overall NNA Score
Obstetric Complications Scale Score
y = 79.388 - 0.87728x R^2 = 0.088
40
50
60
70
80
90
100
0
5
10
15

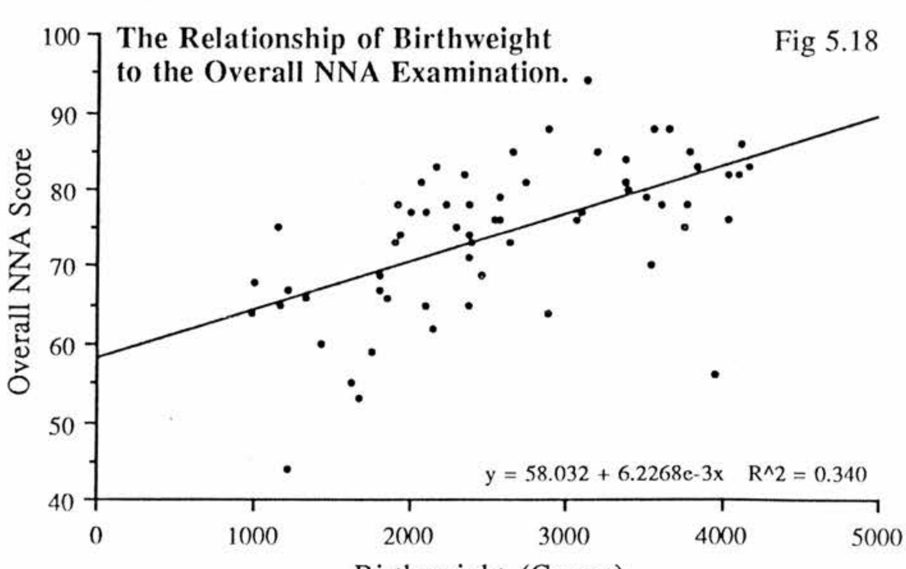

The Relationship of Social Responsivity to the Overall NNA Examination score.
Fig 5.13
Overall NNA Score
100
90
80
70
60
50
40
y = 43.216 + 2.9160x R^2 = 0.432
4
6
8
10
12
14
16
NNA Social Responsivity Score

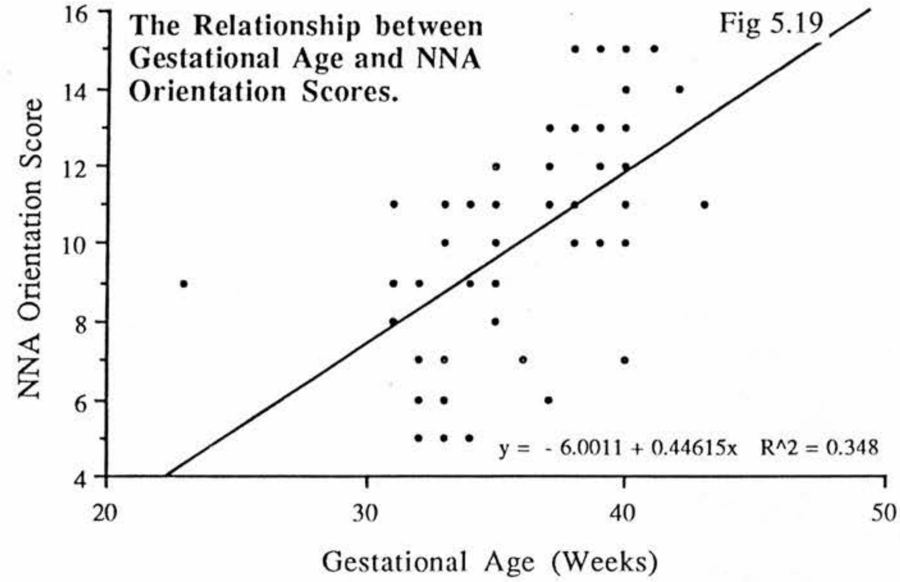

The Relationship of NNA Social Responsivity to Birthweight.
Fig 5.14
Birthweight (Grams)
5000
4000
3000
2000
1000
0
y = 125.88 + 232.59x R^2 = 0.313
4
6
8
10
12
14
16
NNA Social Responsivity Score

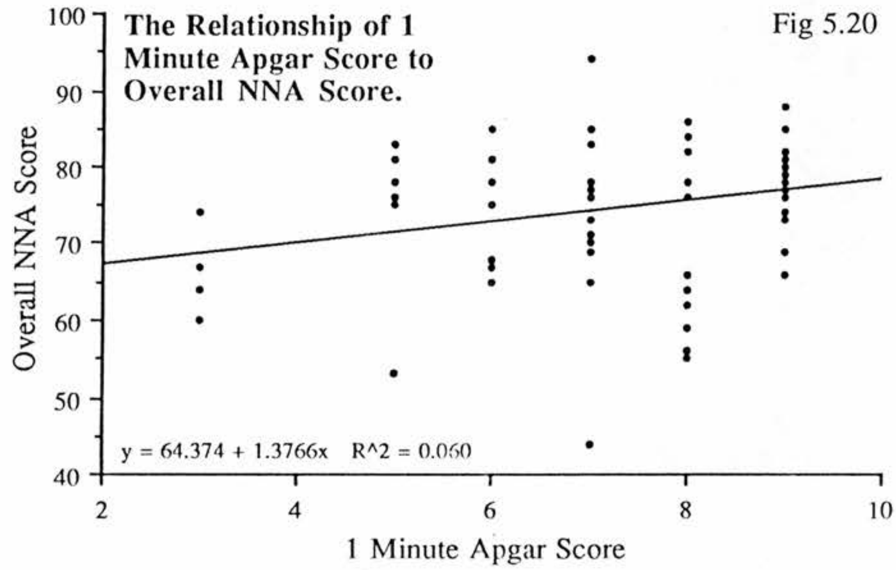

The Relationship of NNA Social Responsivity to Obstetric Complications.
Fig 5.15
y = 11.181 - 0.49655x R^2 = 0.110
Obstetric Complications Scale Score
15
10
5
0
4
6
8
10
12
14
16
NNA Social Responsivity Score

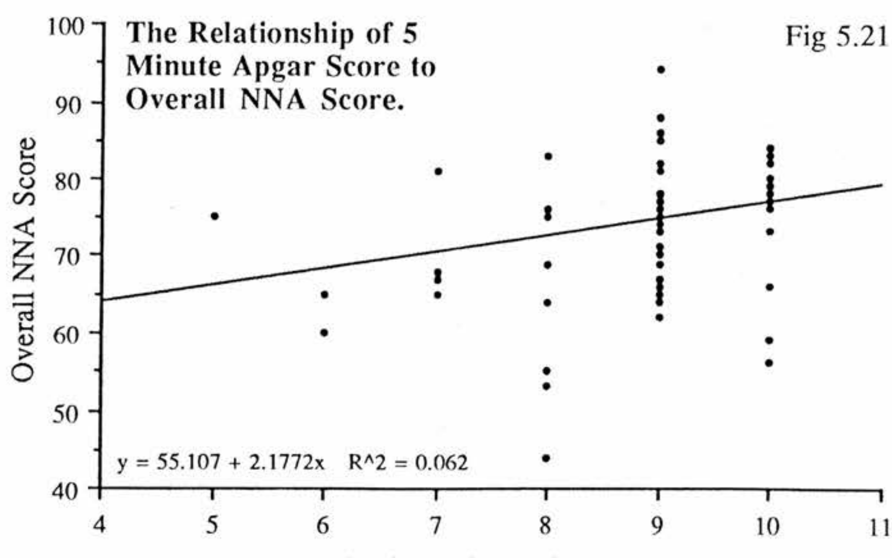

The Relationship between Birthweight and Obstetric Complications.
Fig 5.16
Obstetric Complications Scale Score
y = 10.422 - 1.7394e-3x R^2 = 0.233
Birthweight (Grams)
0
5
10
15
1000
2000
3000
4000
5000

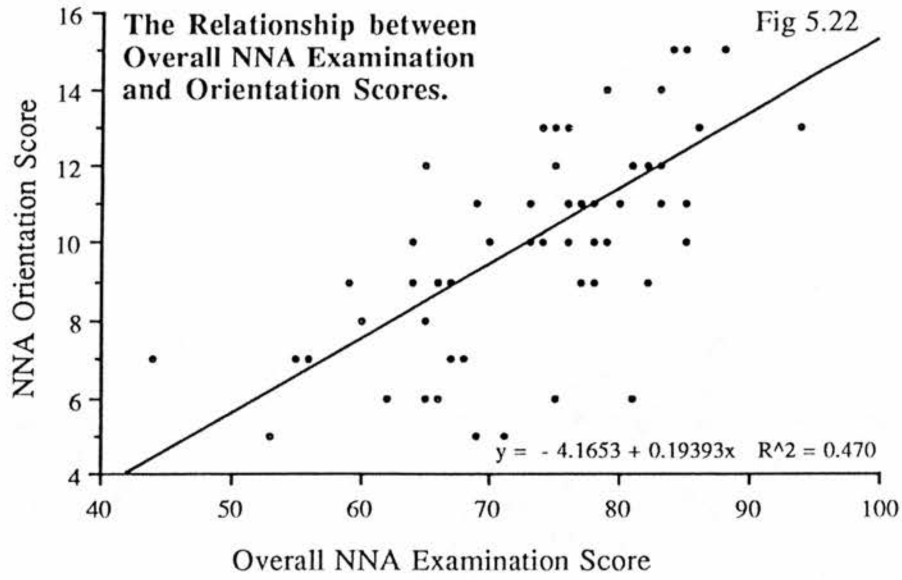

The Relationship between Birthweight and the NNA Orientation Score.
Fig 5.17
NNA Orientation Score
y = 5.5112 + 1.8147e-3x R^2 = 0.361
Birthweight (Grams)
4
6
8
10
12
14
16
0
1000
2000
3000
4000
5000


The Relationship of Birthweight to the Overall NNA Examination.
Fig 5.18
Overall NNA Score
y = 58.032 + 6.2268e-3x R^2 = 0.340
Birthweight (Grams)
40
50
60
70
80
90
100
0
1000
2000
3000
4000
5000

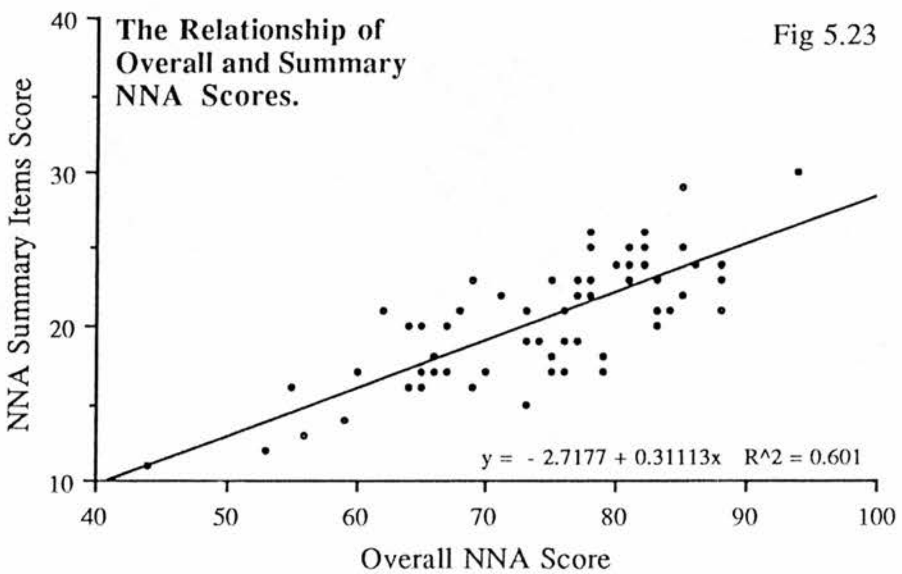

The Relationship between Gestational Age and NNA Orientation Scores.
Fig 5.19
NNA Orientation Score
Gestational Age (Weeks)
y = - 6.0011 + 0.44615x R^2 = 0.348


The Relationship of 1 Minute Apgar Score to Overall NNA Score.
Fig 5.20
Overall NNA Score
1 Minute Apgar Score
y = 64.374 + 1.3766x R^2 = 0.060

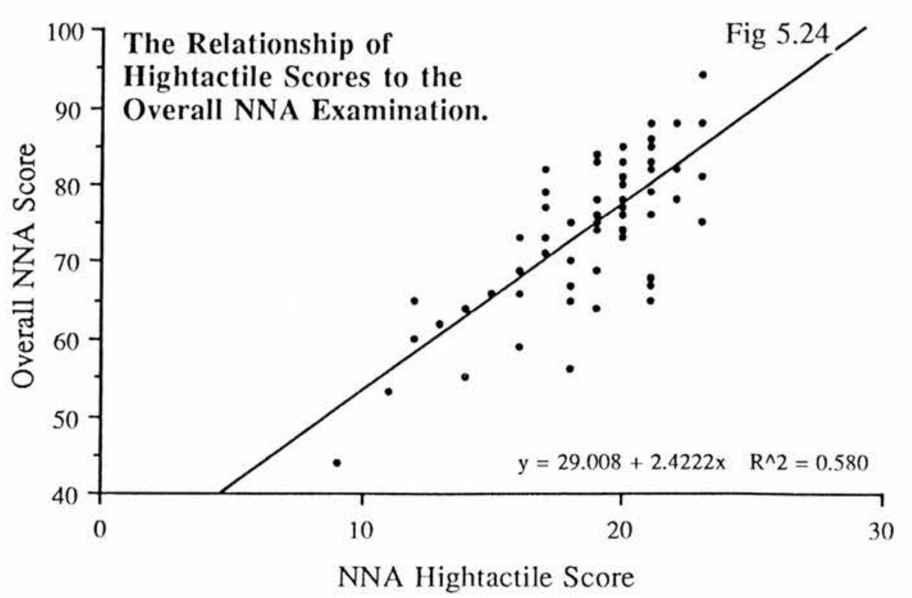

The Relationship of 5 Minute Apgar Score to Overall NNA Score.
Fig 5.21
Overall NNA Score
5 Minute Apgar Score
y = 55.107 + 2.1772x R^2 = 0.062



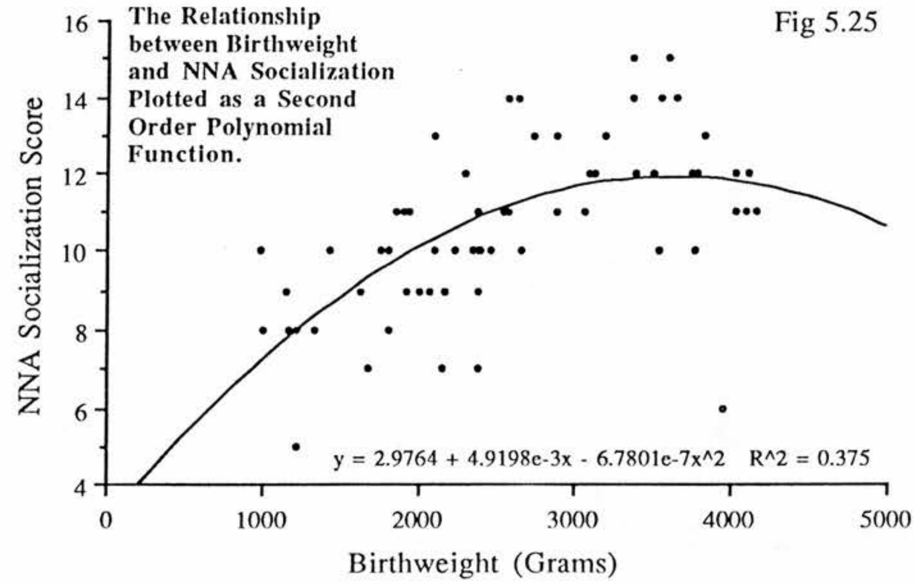
The Relationship between Overall NNA Examination and Orientation Scores.
Fig 5.22
NNA Orientation Score
Overall NNA Examination Score
y = - 4.1653 + 0.19393x R^2 = 0.470
16
14
12
10
8
6
4
40
50
60
70
80
90
100

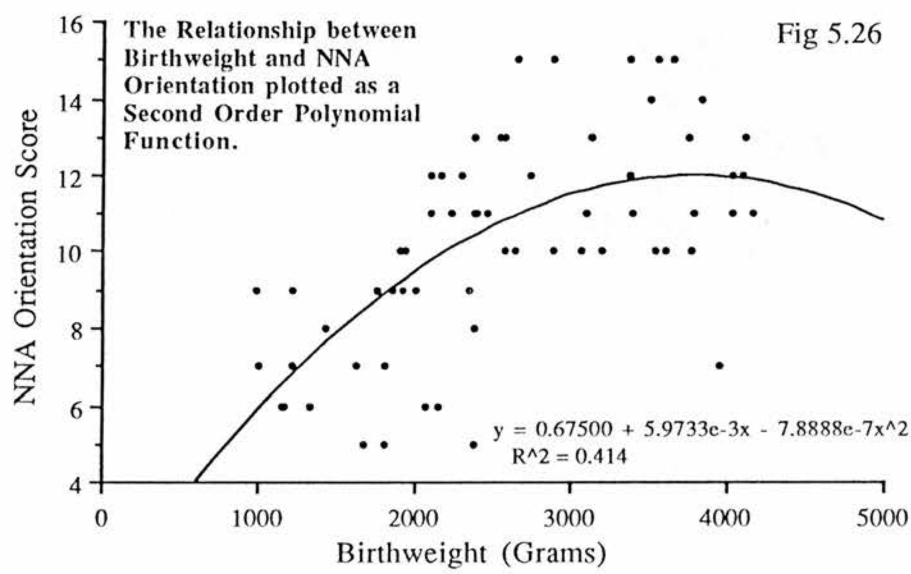


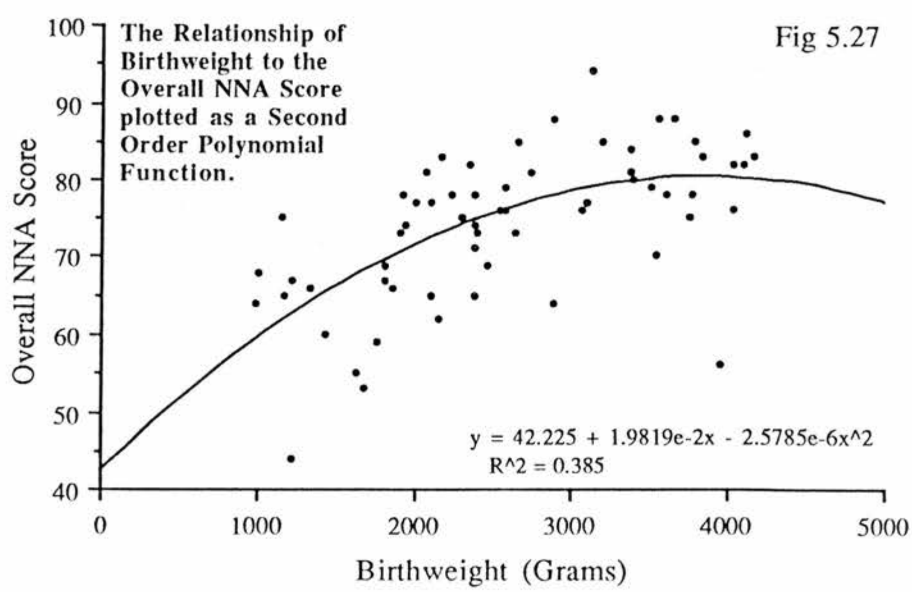
The Relationship of Overall and Summary NNA Scores.
Fig 5.23
NNA Summary Items Score
Overall NNA Score
y = - 2.7177 + 0.31113x R^2 = 0.601
40
30
20
10
40
50
60
70
80
90
100



The Relationship of Hightactile Scores to the Overall NNA Examination.
Fig 5.24
Overall NNA Score
NNA Hightactile Score
y = 29.008 + 2.4222x R^2 = 0.580
100
90
80
70
60
50
40
0
10
20
30


The Relationship between Birthweight and NNA Socialization Plotted as a Second Order Polynomial Function.
Fig 5.25
NNA Socialization Score
Birthweight (Grams)
y = 2.9764 + 4.9198e-3x - 6.7801e-7x^2 R^2 = 0.375


The Relationship between Birthweight and NNA Orientation plotted as a Second Order Polynomial Function.
Fig 5.26
NNA Orientation Score
Birthweight (Grams)
y = 0.67500 + 5.9733e-3x - 7.8888e-7x^2
R^2 = 0.414


The Relationship of Birthweight to the Overall NNA Score plotted as a Second Order Polynomial Function.
Fig 5.27
Overall NNA Score
Birthweight (Grams)
y = 42.225 + 1.9819e-2x - 2.5785e-6x^2
R^2 = 0.385

The above figures represent interrelationships between these data are displayed with a regression line of best fit computed using the formula Yi = aXi + b + error. These are computed assuming a linear relationship between variables with the exception of figures 5.25 - 5.27, which use a second order polynomial function.

In brief, the following relationships were found:

a) Social responsivity was statistically significantly related to a number of other factors. Significant positive correlations were found with:

	Total NNA examination score	*.775**
	Orientation	*.758**
	Hightactile Score	*.574**
	Summary Items	*.343**
	Obstetric Complications	*-.331**
	Birthweight	*.339**
and	*Gestational Age*	*.322**

(= sig. at $p<0.01$).*

b) Birthweight was found to correlate significantly with a range of factors:

	Gestational Age	*.802**
	Orientation	*.601**
	Total NNA Examination Score	*.583**
	Social Responsivity	*.559**
	Apgar (5 Minute)	*.534**
	Obstetric Complications	*-.482**
	Hightactile	*.472**
	Apgar (1 Minute)	*.393**
	Habituation	*.354**
and	*Summary Items*	*.339**

(= Sig. at $p<0.01$)*

d) A positive correlation was shown between NNA orientation scores and, social responses ($p<0.01$), birthweight ($p<0.01$), gestational age ($p<0.01$), and hightactile responses ($p<0.01$).

e) One and five minute Apgar Scores were shown to correlate positively with birthweight ($p<0.01$) and negatively with obstetric complications ($p<0.01$), five minute scores also correlating significantly with orientation ($p<0.01$). Apgar scores failed to predict functioning on other aspects of the

NNA.

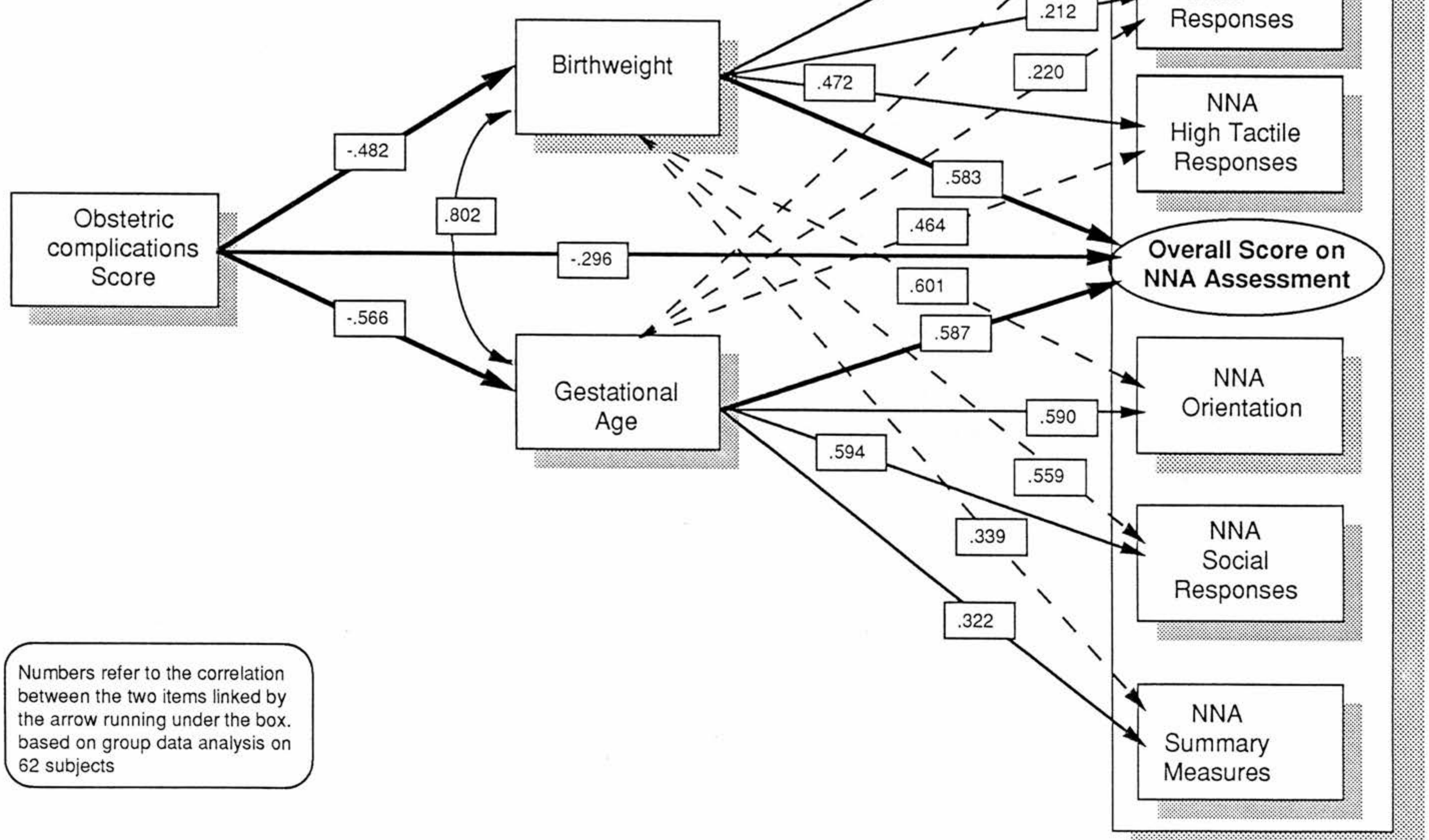
f) No significant relationship was found between maternal age and either birthweight (0.008, N.S.) or obstetric complications (0.24, N.S.).

The polynomial functions plotted against birthweight in figures 5.25 to 5.27 demonstrate a more significant fit with the data than is generated by a linear function plotted on the same dataset. This suggests that there is a bell shaped distribution to the data with a spread of birthweights over which optimal performance on the NNA might be expected.

A flow diagram (Fig 5.28) illustrates some of the principal correlations between predictive factors and neonatal examination scores.

Flow Diagram Of Relationships Between Certain Factors Important In The Development Of Early Interactive Competence.

Fig 5.28



Numbers refer to the correlation between the two items linked by the arrow running under the box. based on group data analysis on 62 subjects

Overall, the NNA would seem to be a sensitive indicator of the effects of birthweight and to a lesser extent of obstetric complications, with findings which are in line with those reported on the APIB (outlined on table 9.1, p159).

5.3.3.2) NNA Results - Premature vs. Fullterm Differences

The second stage in the data analysis was a comparison of the premature with the fullterm control infants, treating these as separate groups.

The mean, standard deviation, and standard error for the two groups on the sixteen core variables are displayed as table 5.2, overleaf, and presented in detail as Appendix V and VI.

To test whether the premature and fullterm groups differed significantly, for each variable, a 2-tailed single sample t-test was computed for the premature group data against the fullterm dataset. This was to test the hypothesis that the two groups do not differ significantly on the various factors assessed, and could be from the same population. The results are tabulated as Appendix VII.

Significant differences were seen between the premature and fullterm infants on most of the item packages and the overall NNA score. In order to check whether individual items might discriminate as well between these groups, posture and Moro (vestibular) response were analysed individually. These items failed to discriminate between the populations as did the lowtactile package score. No significant difference in maternal age was found between the two groups.

Premature and Fullterm Group Characteristics - Core Variables

Table 5.2

				Premature Group (N = 33)			Fullterm Group (N = 29)	
	Mean	S.D.	Std Error	Mean	S.D.	Std Error	t Value	Prob. (2 tail)
Maternal Age	27.727	6.045	1.052	27.138	4.47	0.83	0.56	0.5793
Obstetric Complications Score	7.545	2.916	0.508	4.034	2.639	0.49	6.917	0.0001
Birthweight (Grams)	1902.394	506.334	88.143	3389.69	541.202	100.499	-16.874	0.0001
Gestational Age (Weeks)	33.606	2.657	0.462	39.517	1.214	0.225	-12.781	0.0001
NNA Habituation	3.667	1.291	0.225	4.655	0.936	0.174	-4.398	0.0001
NNA Posture	2.606	0.496	0.086	2.586	0.501	0.093	0.232	0.8178
NNA Lowtactile Score	18.153	3.232	0.563	18.897	1.896	0.352	-1.325	0.1945
NNA Hightactile Score	17.333	3.425	0.596	20.172	1.583	0.294	-4.716	0.0001
NNA Vestibular (Moro)	1.848	0.619	0.108	1.828	0.539	0.100	0.19	0.8503
NNA Orientation	8.697	2.352	0.409	11.966	2.061	0.383	-7.985	0.0001
NNA Socialization Score	9.424	1.687	0.292	12.000	1.89	0.351	-8.82	0.0001
NNA Summary Variables	19.394	3.691	0.642	21.483	3.897	0.724	-3.252	0.0027
Overall NNA Score	69.455	8.885	1.547	79.621	7.65	1.421	-6.573	0.0001
Resuscitation Required (Y/N)	0.333	0.479	0.083	0.138	0.35	0.065	2.344	0.0255
Apgar (1 Minute)	6.606	1.784	0.311	7.759	1.455	0.27	-3.712	0.0008
Apgar (5 Minute)	8.394	1.248	0.217	9.207	0.726	0.135	-3.741	0.0007

5.4) *Chapter Summary and Conclusions:*

The development and validation of a neonatal examination technique has been described. The principal aims of the examination were that it should be practicable, easy to administer and sensitive to interactional and neurological factors. This was to be achieved as far as possible without the problems inherent in the earlier assessment tools reviewed in Chapter 3. These aims have been achieved.

It was hypothesised that the assessment would demonstrate linear trends across the total dataset and significant differences between premature and fullterm infant groups. The first hypothesis was supported with significant correlations of NNA total and package scores with both birthweight and gestational age. The second hypothesis was also supported - clear group differences emerged on all aspects with the exception of maternal age, the lowtactile package score and posture and Moro response as individual items.

It has been found that obstetric difficulties have a significant effect on neonatal scores and that this effect is additive to that of birthweight despite screening out of major obstetric complications in the normal manner, using the Obstetric Complications Scale. The extent of the negative relationship between this variable and orientation found (-0.434) warrants further investigation with a more broadly compromised population.

Most of the interrelationships examined demonstrated clear *linear correlations. This was not the best model for all aspects, however. The relationship of birthweight to the NNA, although showing a 0.583 correlation as a linear function conformed more closely to a polynomial function. Thus, there seemed to be an optimal range to either side of which performance on the scale declined rather than a steady increase in performance with increase in birthweight.*

CHAPTER 6:

MOTHER-INFANT INTERACTION RESEARCH: PSYCHOLOGICAL COMPLEXITY IN THE INFANT REQUIRING SPECIFIC MATERNAL SUPPORT.

The infant is now known to be a psychologically complex organism that is adapted, at least from term, to engage with adult caregivers in interactions of motives which will underpin its later cultural adaptation. Recent decades have witnessed the appearance of the fruits of a large corpus of research on mother-child interaction which support the view that such capabilities as the infant possesses for interpersonal contact are used and responded to by adult caregivers in elaborate patterns of interaction. Such findings may be interpreted as in line with the principle of minimal redundancy in evolving biological systems as formulated by Humphrey (1983). He proposed that any human processes, no matter how complex, such as consciousness, will have a degree of functional utility which, otherwise, would have caused them to be selected against as wasteful.

In the current context, interactive skills, which infants and caretakers can be observed to expend considerable energies upon, would be likely to be selected against if they did not confer enhanced survival. There is evidence that in utero exposure of the fetus to vocal patterns leads to postnatal preference for those patterns (DeCasper & Spence, 1986) This indicates that prenatal experiences and reactions can contribute to the development of early interactions. There are also a number of studies on the behavioural development of the fetus which show that there is a systematic unfolding of active and reactive *behaviours over the gestational span (eg: Edwards & Edwards, 1970). Prenatal effects, in utero, are beyond the scope of the present study, and will be given only passing reference here. However, they are important for our investigation for a variety of reasons - primarily because they show how prenatal exposure (whether sensory or teratogenic) can have effects on later development (see Hill, 1984), and also for the information that the study of prenatal responses can lend to our views of the purposes of postnatal motor and sensory development. Thirdly, they are of theoretical importance in considerations of the relative contributions of genetic and experiential factors to human behaviour.*

This chapter will review the evidence relating to the processes of, and postnatal capabilities for, early interaction. The review will examine the effects which espousal of certain theories and models can be on interpretation of findings.

Finally we shall turn attention to the research evidence on interrelationships between observed patterns of interaction and particular aspects of neonatal status in the infant born preterm.

6.1) THEORIES AND MODELS - THEIR DIFFERENT USE IN EMPIRICAL ANALYSIS

As a preliminary to discussion of levels of analysis and specific theoretical frameworks, we need to examine the impact of 'theories' and 'models'.

Nagel (1970), Carnap (1970), Braithwaite (1970), with most other philosophers of science, would agree on a definition of a theory as a partially interpreted calculus where both predicate and name terms are not fully articulated, and which is thus not empirically testable, although it may serve as a guide for exploration and discovery. Polanyi and others emphasise that the function of a theory is to enunciate and clarify the motivation for a line of scientific research. The logical completeness of a theory is inversely related to its importance as a motive for enquiry. A model, on the other hand, is a system which has undergone a second interpretation such that all of its predicate and name terms are mapped onto potential states of affairs which have, within the framework of the discipline involved, been agreed to exist in the real world. A model, then, as opposed to a theory, can be tested against empirical evidence.

This point is made clearly in the following quote:

> *"... theories may be underdetermined by data: that is, ...theories may be incompatible with each other and yet compatible with all possible data."*
>
> *Steven Lukes (1970)*

In essence, therefore, a theory can never be prescriptive; it can only provide the framework for one or more descriptive models; only a model or 'articulation' can be subjected to scientific scrutiny and finally endorsed or rejected, and a theory cannot be disproven by the refutation of a model which has been derived from it.

For example, the viewpoint voiced by David Will in defence of the respectability of Freudian theory (Will, 1983) stems from *this same argument. He draws on the work of philosophers of science such as Roy Bhaskar (Bhaskar, 1976) to defend the view that irrefutable theories do not necessarily negate the merit of specific models derived from them and that to this extent, Freudian approaches are theory driven and thus are defensible against the Popperian claims of irrefutability.*

A variety of different models have been devised for the description and analysis of caregiver-infant interaction. The emphases made in these different models are necessarily reflected in the type of data collected, the conclusions which are drawn, and the explanatory power, theoretically at least, which the model can be said to possess. As in any area, increasing the range of situations to which a model can be said to be appropriate has the direct corollary of a decrease in the degree of detailed proof which can be obtained. The point which needs to be made here is that empirical data can provide inductive support for the model under test, but neither proof nor disproof of the encompassing theory.

6.2) THE BASIC FRAMEWORK OF THEORIES FOR ANALYSIS OF NEONATAL INTERACTION WITH A CARETAKER.

A large number of theoretical stances can be adopted in looking at interactional data. The model which has been adopted in this research project makes the explicit assumption that it is important to look at differences in a variety of factors, such as the behavioural repertoire of the infant and perinatal stress factors as well as at patterns of interaction, in any study of *early developmental processes. An underlying theoretical framework which most closely approximates to the intersubjective one outlined below is assumed.*

In order to highlight the importance of theory for interpretation of data in this field, several general types of theory will be briefly discussed. The aim of this exercise is to highlight how acceptance or dismissal of a theory leads to differences in the type of research conducted, and to the conclusions that can be drawn. Each of the theories to be described has direct, implicit and explicit consequences for research.

6.3) THEORIES OF INFANT-CAREGIVER INTERACTION

Five major theoretical pers pectives have influenced the study of infant-caregiver interaction:

1) *Biological, Caregiver-Driven Theories: In a Watsonian behaviourist tradition, these approaches see the infant as passive and moulded or constructed by his/her caregiving environment.*

2) *Biological, Infant-Driven Theories: The converse of caregiver driven theories, these see the infant's repertoire as unfolding in a self-regulated programme irrespective of external forces, other than extreme environmental prejudice.*

3) *Symbiotic Environmental Theories: These derive from recent developments in the behaviourist tradition. They view the development of interaction as a complementary process arising from the mutual environmental support afforded each dyad member by the other. The behaviours of both infant and caregiver are viewed as constructed through a process of learning.*

4) Symbiotic Epigenetic Theories: These, largely from the Piagetian school, view the development of the interaction of the dyad as arising from an interplay of environmental and genetic factors but with developmental direction primarily vested in the infant.

5) Intersubjective Theories: In these, the development of infant-caregiver interaction is portrayed as a process which is strongly canalized by biological structure and innate prewiring of both the infant and mother. This, like 3) and 4) above, is an epigenetic model. Here, however, stress is put on the innately founded intersubjective or metacognitive aspects of the process above all others, while it is accepted that learning, by both infant and caretaker, play an important part in development.

6.3.1) Biological Caregiver-Driven Approaches to Interaction Analysis

Early investigators working in the behaviourist-empiricist tradition of metaphysical behaviourism, saw the infant as a tabula rasa and consequently they viewed the infant as highly malleable, created almost entirely by a history of outside pressures. Such a view led to an implicit assumption that no individual differences in infant behaviour or physiognomy would have effects in parent-infant interaction, as this was caregiver-driven. On such a model, the contribution which variations in infant characteristics would have is minimal.

To adopt such a viewpoint on early development is to automatically harness ones analysis to a search for intra-individual differences in maternal behaviour towards the infant or in other influences outside the neonate. These are conceived, therefore, to be the only possible predictive measures of variation in outcome. With such a research approach, no differen-

ces in the infant's contribution to developmental processes would be found even if such differences were present and important, as they would not be investigated.

One brief quote from Watson will suffice to illustrate the extreme version of this approach:

> *"All we have to start with in building a human being is a lively squirming bit of flesh, capable of making a few simple responses such as movements of the hands and arms and fingers and toes, crying and smiling, making certain sounds with its throat. Parents take this raw material and begin to fashion it in a way to suit themselves. This means that parents, whether they know it or not, start intensive training of the child at birth."*
>
> *Watson (1928)*

One can see the early work of researchers such as Klaus and Kennell as being in practice, although not theoretically, in this vein. In their work on the effects of increasing early mother-infant contact, the effects of increased contact were assessed as if the infant had little if any contribution apart from being there. In their most quoted study, for example (Klaus, Jerauld, Kreger, McAlpine, Steffa & Kennell, 1972), the mothers and babies were filmed together, and the films were coded on aspects of the mothers behaviour to the infant such as maternal "en face" behaviour, touching the infant, fondling the infant, stroking, kissing, bouncing and cuddling. The implicit assumption would seem to be that the infant is a constant factor, differences observed being attributed to the effects of contact on the mothers behaviour alone.

6.3.2) Biological, Infant-Driven Approaches:

An advocate of infant development as a totally preprogrammed sequence with little impact of the environment on its unfolding would view with scepticism the idea of looking for any differences in early interaction. Indeed, he would consider any such differences as being of little significance for development if they were found. If differences were found, they would be seen as either resulting from unimportant variations in parental behaviour, which would have no impact on developmental outcome, or, from differences in genotype that could not be altered in any event. Such a view would most closely resemble the current position of many sociobiologists who stress the role of genetic complement in the development of behaviour. Several psychologists have attempted to develop this position, Dan Freedman perhaps being the best known (see, for example Freedman, 1979). Recently, attempts have been made to apply this model to the explanation of abusive and neglectful behaviour by parents, which are described as resulting from infant characteristics that precipitate such adult responses (see Frodi, 1981; Gelles & Lancaster, 1987).

6.3.3) Symbiotic Environmental Approaches:

This approach is best exemplified by either family therapeutic models arising from General Systems Theory (von Bertalanffy, 1968), or the ideas of reciprocal determinism of behaviour put forward by Patterson (1982), and Bandura (1977).

Such approaches view interactional development as a recipro-

cally determined process, all interactants being affected by all others. The emphasis is, therefore, on a reflexive, environmentally driven developmental system with an implicit assumption that differences in phenotype, or physiognomy, will under normal conditions have little impact on outcome. An elaboration of this model can be found in Lewis's chapter in The Handbook of Infant Development (2nd Edn.) (1987).

6.3.4) Symbiotic Epigenetic Approaches:

This type of theory sees the development of interaction and of the behaviour of the infant as processes governed by the interaction between developing behavioural phenotype and the environmental factors which constrain and dictate its expression. Both a specific genotype and a particular spatiotemporal environment are assumed to be necessary prerequisites for any particular developmental process to take place.

The research which best characterises this approach is that of the Piagetian school (see Donaldson, 1978; Butterworth, 1981; Butterworth and Light, 1982). In his writings and research, Piaget emphasised the importance of an epigenetic model to his understanding of developmental processes.

This interactional model gives importance to constitution and environment in equal part, but it incorporates questionable contingent assumptions. In particular, it is assumed that development passes from simple reflex association towards functional integration of movement and action, and it assumes that behavioural accommodation drives developmental process.

*Both of the above assumptions have been challenged. The first on the basis of research which appears to demonstrate complex early integration of skills in areas such as smiling (Oster, 1979), facial imitation (Meltzoff & Moore, 1978), and reaching (von Hofsten, 1979), and work on 'amodal' perception in infancy (Aitken & Bower, 1983). The second axiom, that behaviour is driven by behavioural accommodation, is questioned on the basis of observations of the essentially normal sequence of development of infants who have experienced minimal (DeCarie, 1969) or distorted (*Butterworth & MacPherson*, 1987) opportunities for such accommodation.*

6.3.5) <u>Intersubjective Approaches:</u>

> *"You accept my verification of one thing. I yours of another. We trade on each other's truth."*
> *William James (1890)*

Implicit acceptance of the conscious and interpersonally grounded underpinnings of human action is, according to this approach, a prerequisite for social communication. It is the adoption of such a model which has motivated much 20th century philosophical analysis of the necessarily social basis of cognition. Wittgenstein's 'Private Language Argument', (Wittgenstein, 1953) argues that cognition is of necessity social, and therefore that to proceed from this point to argue in support of ideas such as solipsism (or, indeed, the temporal genesis of consciousness within the infant from a pre-conscious state) seems nonsensical. When we recall Peiper's (1963) *statement that "a consciousness similar to our own ...<u>does not exist</u> in the child before the end of the first year of life", the importance of this theoretical stance becomes apparent.*

One may of course call the supposition of some form of innate social awareness into question. Descartes took this idea to its extreme when he questioned our ability to know that other people were in any way qualitatively distinct from automata. Wittgenstein's argument would be that a social structure is necessary before the argument for its contingency could be posed, and therefore that such an argument is necessarity invalid. In the same vein as Wittgenstein's argument for the necessary presence of social structures, the intersubjective viewpoint on interaction is that such social abilities are necessarily present in both infant and caregiver.

In agreement with the Symbiotic-Epigenetic approach detailed above, intersubjective models of development (see Trevarthen, 1986) stress the importance of innate differences in biological structure as a crucial aspect of development. Stress is also laid, however, on the importance of specific social environmental affordances for the physical and interactive development of the infant.

The important difference in comparison with the viewpoints mentioned above is that intersubjective models place a central emphasis on the evidence for preverbal intersubjective structures (see Trevarthen, Murray & Hubley, 1981). The active recognition, by both mother and infant, of being engaged in emotionally regulated interaction with another person is seen as a fundamen-

tal process underpinning the acquisition of all subsequent affective, cognitive and linguistic abilities. A definition of the core concept of this perspective is as follows:

> *" Intersubjectivity, defined as communication between conscious and intending beings, requires coordination between evolving states of attention, changing emotions and cognitive adjustments, including such subtle varieties of mental adjustment as recognition, decision, doubt or rejection. It involves coordination of intentions by means of signals that convey the directions and intensities of actions before they are executed, when they are still purposes in the making that can only be detected through their autonomic, attentional and postural antecedents."*
>
> *Trevarthen (1986)*

Intersubjectivity is thus a necessary aspect to being a social person. For Trevarthen, this is part of the fundamental bedrock of human mental development:

> *"...for infants to share mental control with other persons they must have two attributes. First, they must manifest at least the rudiments of individual consciousness and intentionality. This attribute I call subjectivity. Then, to communicate, infants must also be able to couple their subjective control of themselves to subjectivity of others. That is to say, they must have intersubjectivity."*
>
> *Trevarthen (1979)*

In order for the dyad to function and develop, the infant and the caretaker must have the capacity to recognise the emotional and cognitive states of the partner. This is a process which Trevarthen (1986) refers to as 'alteroceptive' functioning.

Rommetveit, in his discussion of 'commonalities' necessary for communication expresses the situation thus:

"...Some basic shared knowledge of the world appears to be embedded as meaning potentials .... Such potentials, we shall claim, reflect at a very abstract level some minimal commonality with respect to experientially founded perspectives on and categorization of our pluralistic social world and may hence be conceived of as a common code of potentially shared cognitive-emotive perspectives on talked about states of affairs."

Rommetveit (1985)

These interpersonal/emotional psychological structures are viewed as fundamental and necessary for social development and cultural adaptation to take place. They are necessarily antecedent to the linguistic vehicles for communication.

The notion of intersubjectivity is similar in definition, to that of 'Metacognition' in the attributional psychology literature. By metacognition is meant the ability to recognise or at the least allow for the likely inter- and intrapersonal models of both self and one's co-interactant as they overlap with one's own, and, thereby be able to enter into a meaningful 'dialogue'.

"...my habitual sense of myself-for-others is as pervasive and unnoticed as my lived body and my mood, and it must envelop the person as I currently sense him there in space."

Wiltshire (1982)

To date, most of the research on metacognition has looked at verbally mediated processes (see Antaki & Lewis, 1986), however the importance of interpersonal perspective-taking cannot be underestimated in the case of the preverbal infant or child, and there is now a move within psychology toward addressing the affective aspects of metacognition as well as the verbal-

cognitive:

> *"...significant metacognitions, or rather self-other appreciations, become affairs of the heart rather than affairs of the head. (See Romanshyn's complementary analysis of mirror work as 'soul work', 1986)."*
>
> *Honess (1986)*

In the attributional literature, success in interaction is often called mirroring - a concept which has also been used extensively in the psychoanalytic literature in discussion of mother-child interaction (see: Pines, 1986; Winnicott, 1971).

> *"The child's image of the world is mirrored twice, once directly, and again as a representation of the representation of others. His image of himself is also mirrored twice, once with direct knowledge of his internal states and again by his representation of his behaviour in the eyes of others. Each image extends and modifies the other."*
>
> *Shields (1978)*

If we take Rommetveit's definition of intersubjectivity:

> *"A state of intersubjectivity with respect to some state of affairs S is attained at a given stage of dyadic interaction if and only if some aspect Ai of S at that stage is brought into focus by one participant and jointly attended by both of them.*
>
> *Rommetveit (1985)*

We can see strong parallels between the intersubjective and the metacognitive view. On Rommetveit's example, both interactants must possess similar or coextended models Ai of the state of affairs S for communication to take place.

If the infant is unable to recognise that another person is present, interaction, by definition, would not be able to take place. Conversely, the complexity of interactions that have been observed can be taken as support for the presence of such *interpersonal awareness.*

Some recent developments in this area have recognised the importance of recognition and articulation of both self and other by both partners in the adult-infant dyad, (eg: Bråten, 1987). In general, however, insufficient emphasis has been placed on the necessity for the infant to hold articulated intra- and interpersonal models of self and other for interaction to take place.

An intersubjective model of adult-infant interaction can be expressed diagrammatically as is shown overleaf in fig 6.1.

For either adult or infant to engage in interaction with the other, a common range of reciprocal expression structure must be established, wherein, to a significant extent, there is a matching of the inter- and intrasubjective representations possessed by each of the interactants - ie where A and A' and I' and I have a significant degree of correspondance. It must also be the case that for each interactant on their own internal models of self and other, there exists the possibility for dialogue - for A there must be the possibility of dialogue between A and I', and for I there must exist the possibility for dialogue between A' and I. There has been widespread lack of recognition of the necessarily reciprocal nature of this process. This has led many workers in the field of early intervention to neglect the importance of the infant's contribution to the process of developing mutually satisfying interchanges and consequently maternal stimulation interventions have been developed which may be actively rejected by the infant.

Successful Adult-Infant Primary Intersubjective Exchange

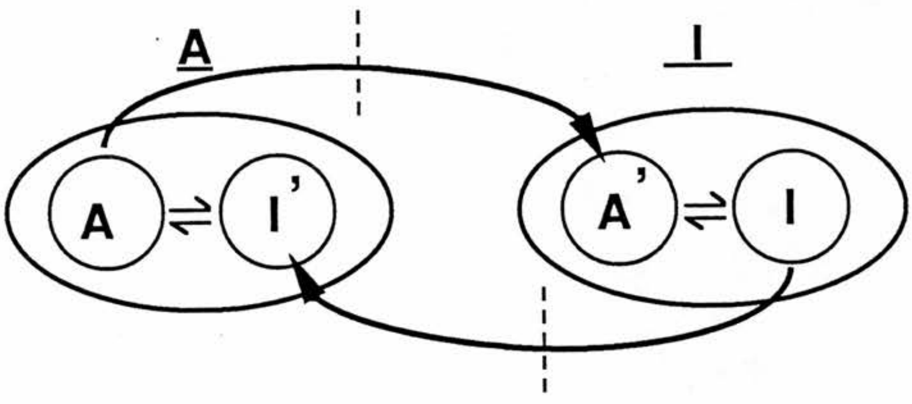


Fig 6.1

6.4) *MOTHER-INFANT INTERACTION RESEARCH FROM AN INTERSUBJECTIVE PERSPECTIVE*

From an intersubjective viewpoint, interactions between caregiver and infant are assumed to be observable aspects of a mutual metacognitive process between the participants. This does not, of course, rule out the possibility that an observer could attribute volition to another or to an object as in the early work on perceived movement (Sherif 1936), but it is assumed that for any ongoing interaction a mutually satisfying system of exchanges of expression needs to develop. Dysfunction in this process can thus be viewed as, in part at least, a mismatch of those metacognitive expectations and their emotional qualities.

Fig 6.2 outlines one possible framework for viewing early interaction. This is Goldberg's framework for interpreting parent-infant interaction and possible problems in it from prematurity (Goldberg, 1978). It is a one-sided, parent-focussed cognitive framework reliant on a parental strategy of matching actual to expected behaviour. Such an approach, on the above thesis, could not result in effective improvement in interaction.

Figure 6.3 presents a revision of the framework to allow for a dyadic metacognitive process of interaction. On this revision, both interactants gauge the level of congruence which their prediction has with the ongoing interaction. Where either or both partners find there is an affective or emotional mismatch, this could have one of two negative implications for the development of the dyad. It could result in either (a) increasing attempts to elicit consistency in the behaviour of the *partner, which, if originating from the adult could in the extreme case take the form of physical abuse as a means to elicit predictable behaviour in the infant, or, (b) decreasing attempts to ellicit consistent responses - the characteristic pattern seen in maternal and infant depression (see Emde, 1979). Such situations are simulated by artificially reducing the availability of either partner for interaction (see Trevarthen, Murray & Hubley, 1981). Although the terms 'judgement' and 'checking' are used in the diagram, it is not suggested here that this is a conscious cognitive process of matching up actual events to expectation, but rather that this is an intuitive affective process which relies on congruence of emotional stimulation with need.*

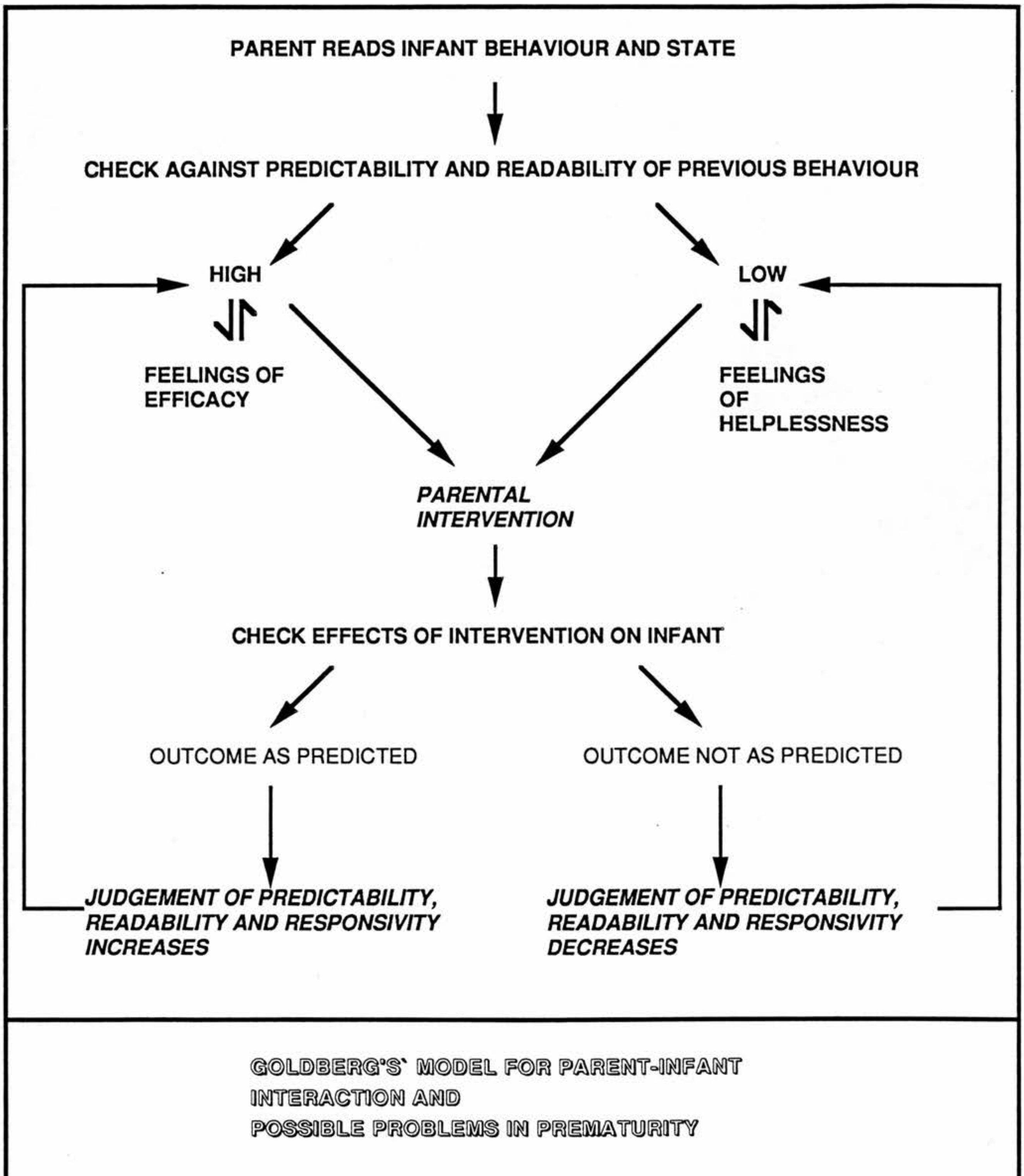

PARENT READS INFANT BEHAVIOUR AND STATE
CHECK AGAINST PREDICTABILITY AND READABILITY OF PREVIOUS BEHAVIOUR
HIGH
FEELINGS OF EFFICACY
LOW
FEELINGS OF HELPLESSNESS
PARENTAL INTERVENTION
CHECK EFFECTS OF INTERVENTION ON INFANT
OUTCOME AS PREDICTED
OUTCOME NOT AS PREDICTED
JUDGEMENT OF PREDICTABILITY, READABILITY AND RESPONSIVITY INCREASES
JUDGEMENT OF PREDICTABILITY, READABILITY AND RESPONSIVITY DECREASES
GOLDBERG'S` MODEL FOR PARENT-INFANT
INTERACTION AND
POSSIBLE PROBLEMS IN PREMATURITY

Fig 6.2

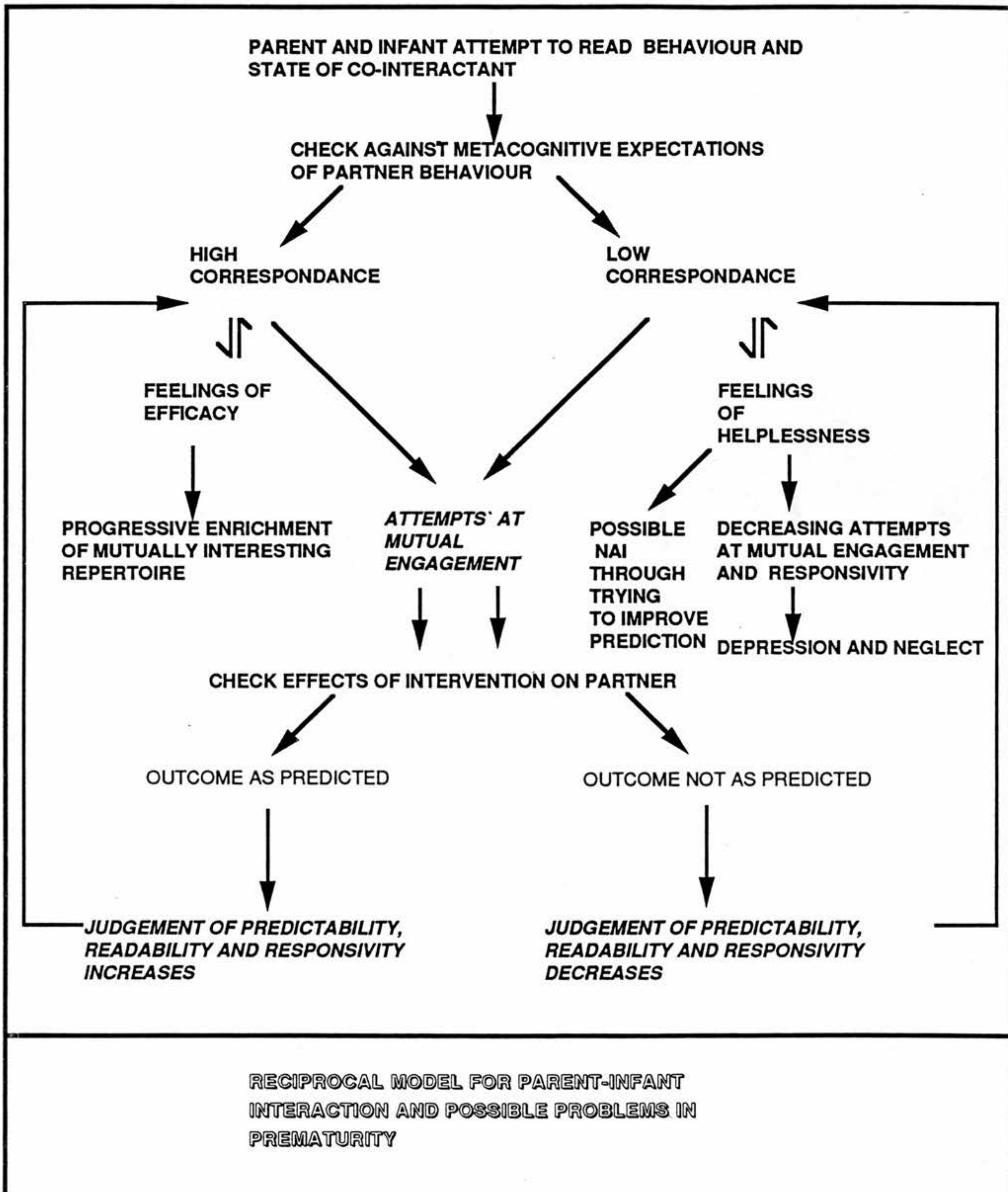

PARENT AND INFANT ATTEMPT TO READ BEHAVIOUR AND STATE OF CO-INTERACTANT
CHECK AGAINST METACOGNITIVE EXPECTATIONS OF PARTNER BEHAVIOUR
HIGH CORRESPONDANCE
LOW CORRESPONDANCE
FEELINGS OF EFFICACY
FEELINGS OF HELPLESSNESS
PROGRESSIVE ENRICHMENT OF MUTUALLY INTERESTING REPERTOIRE
ATTEMPTS AT MUTUAL ENGAGEMENT
POSSIBLE NAI THROUGH TRYING TO IMPROVE PREDICTION
DECREASING ATTEMPTS AT MUTUAL ENGAGEMENT AND RESPONSIVITY
DEPRESSION AND NEGLECT
CHECK EFFECTS OF INTERVENTION ON PARTNER
OUTCOME AS PREDICTED
OUTCOME NOT AS PREDICTED
JUDGEMENT OF PREDICTABILITY, READABILITY AND RESPONSIVITY INCREASES
JUDGEMENT OF PREDICTABILITY, READABILITY AND RESPONSIVITY DECREASES
RECIPROCAL MODEL FOR PARENT-INFANT INTERACTION AND POSSIBLE PROBLEMS IN PREMATURITY

Fig 6.3

6.5) Chapter Summary and Conclusions

This review of the evidence relating to the processes of, and postnatal capabilities for, early interaction has briefly examined the primary theoretical models used in the area of mother-infant interaction research and the constraints on subject matter which follow from adoption of certain of these models. The effects on both the description and the interpretation of research findings were discussed.

Particular attention has been given to the intersubjective model of parent-infant relationships. A model, drawing on this framework is presented in which reciprocal effects on interaction are produced by the intersubjective and intrasubjective awareness of both infant and parent. It is suggested on the basis of this model that changes in observed interaction might be effected by the generation of differences in the mother's awareness of the alteroceptive repertoire and expectations of the infant.

CHAPTER 7

ENHANCEMENT OF EARLY COMMUNICATION: THROUGH THE FACILITATION OF EARLY CONTACT, AND THROUGH FEEDBACK TO THE MOTHER OF INFORMATION ABOUT EARLY INFANT COMMUNICATIVE ABILITIES,

Many approaches have been taken to the enhancement of early communication between parents and young preterm infants. Most were based on implicit theories of preterm neurobehavioural development. Three distinct models can be detected:

1. *The premature infant as foetus - this model sees the preterm infant as the same in both developmental level and responsivity as the unborn foetus of the same gestational age.*

2. *The premature infant as normal fullterm neonate sees the premature neonate as no different from the fullterm in both developmental level and responsiveness to stimuli.*

3. *The model of the premature infant as different sees the developmental level, responsivity, and repertoire of the premature as essentially different from that of either the unborn foetus of comparable gestation or the fullterm infant.*

The effect of accepting any of the above models on the development of a facilitative technique for the premature dyad is most easily seen in the types of sensory experience which are made available to the neonate in each case:

7.1) The 'Premature as Foetus' View

In Masi's excellent review (1979) the 'premature as foetus' model is seen as the most commonly accepted one:

> *"Most researchers have assumed that the premature infant is an extrauterine fetus and have tried to mimic the womb environment by providing stimulation similar to that received in utero including various forms of tactile-kinesthetic or auditory stimulation."*

The focus of supplemental stimulation in such an approach is on providing an environment which mimics that of the foetus, ideally one of similar gestational age. This view has led to the use of reduced lighting levels (Als 1986), rhythmic rocking to increase vestibular stimulation (Korner, Ruppel & Rho 1982), and the use of heartbeat recordings and other intrauterine sounds (see Wolke 1987) in an attempt to provide an analog to the foetal environment. The results of such stimulation approaches have been promising, increased weight gain, decreased crying, reduction in apnoeic attacks and faster developmental progress all being reported (see the review by Masi 1979).

An implicit aspect of this viewpoint is that once the infant has attained a full term equivalent gestational age, these types of stimulation would no longer be appropriate. However, in a number of studies, it has been found that, the use of stimuli such as heartbeat tapes can have continuing beneficial effects with fullterm infants.

7.2) The Premature as a Normal Fullterm

If we accept the premature as a fullterm infant, the type of stimulation to which we would wish to expose the neonate is very different. Studies which have used this type of approach have provided a range of visual, auditory and tactile experiences more appropriate to the newborn such as bright shapes, faces, mobiles, recordings of mothers speech. Perhaps surprisingly, given the successful results of the 'infant as foetus' work, such *stimulation approaches have also been promising (see Masi 1979, Field 1980).*

The similar successes reported with both of these approaches leads to the conclusion that a broad range of stimulation approaches are beneficial to the developing premature infant, and that perhaps the routine state of affairs is not often adequate for the fostering of appropriate patterns of early development as judged on the gross outcome criteria used in many of the above mentioned studies.

7.3) The 'Premature as Developmentally Different'

The approach of treating the premature infant as both different from the fullterm infant and as less predictable in its responses and interests has had a less exhaustive research analysis than the foregoing models.

Dieter Wolke has introduced the term 'developmental neonatology' to cover the range of psychological interventions focussed on the Special Care Baby Unit:

> *" Environmental neonatology is concerned with the study of newborn special care facilities and their impact on the medical and developmental status of sick infants. The term was first introduced by Gottfried and Gaiter (1985).*
> *Developmental neonatology is a term which should be added to environmental neonatology to refer to the study of developmental changes and progress of the preterm or sick infant while still in the special care baby unit (Wolke 1986)."*
>
> *Wolke (1987)*

In his paper, Wolke states as a universal principle that there is no easy recipe to the care of the preterm and/or sick neonate other than that such infants should receive individuali-

sed developmental care. He states three core aspects of this viewpoint to be, 1) that sensitive observation of the infants strengths, weaknesses and responses to procedures need to be closely monitored, 2) an individual careplan should be drawn up for each infant to minimise stress and aid behavioural development, and 3) that the careplan should adapt to respond to changes in the capacities of the infant.

The best available work in this tradition comes from Josephine Brown and her group from the Grady Hospital in Atlanta, and from Tiffany Field and her colleagues at the Mailman Institute in Miami. Brown, LaRossa, Aylward, Davis, Rutherford & Bakeman (1980) performed an extensive investigation of the utility of nursery based interventions of various types with premature babies and their mothers.

Four groups of dyads were evaluated:

<u>Group 1)</u> a non-intervention control group, (N = 26)

<u>Group 2)</u> in which the infants themselves received individualised stimulation programs, carried out by nursing staff, designed to make them more active contributors to mother-infant interaction, (N = 13)

<u>Group 3)</u> in which the mothers received special training to help them to be more responsive to the cues from their infants, (N = 14)

<u>Group 4)</u> received the input given to groups 2 and 3 in combination. (N = 14).

All intervention infants were black, singleton, less than 37 weeks GA and 1000-1750g, with mothers of at least 18yrs and with no obvious neurological or physical handicap. Some of the *comparison group mothers were however below 18 yrs.*

Groups 2 and 4 had approximately 18 additional hours of stimulation over the 16 days before discharge. In group 3, the mother was shown how to carry out an appropriate programme of stimulation but it was not monitored.

Outcome in this complex study was assessed on eight criteria:

1) *The Brazelton Neonatal Behaviour Assessment Scale as an assessment of the effects of stimulation,*
2) *frequency of maternal hospital visiting prior to discharge,*
3) *observation of maternal and infant behaviour during feeding prior to discharge,*
4) *observation of maternal and infant behaviour during feeding at 3 months,*
5) *videotaped observation of maternal and infant behaviour during Bayley administration at 1 year,*
6) *quantity and quality of social, cognitive and emotional support on the HOME scale,*
7) *Bayley scales at 12 months,*
8) *Percentile weight scores at 12 months.*

Despite the theoretical justification for the interventions used, the intensity and complexity of the study, and the sophisticated nature of its statistical analysis, the authors were pessimistic about the outcome results. They reported:

> *"..failure to find either short-term or long-term effects of nursery based intervention with healthy prematurely-born babies and their mothers. We used a large number of outcome measures designed to evaluate various aspects of mother-infant interaction and infant development... We found only one short-lived group difference: While the mothers themselves were still in the hospital, those who received specific training visited their infants more often than did those who received no training."*

In questioning the reasons for the findings of the Brown et al it is important to consider the nature of the stimulation programme employed.

In essence, the programme was one of sensory exposure for periods of some 30 minutes, geared to the level of the infant, with tactile, vestibular, visual and auditory stimuli using both inanimate and social stimuli (see Brown 1976, Brown & Hepler 1976). Although the infant could be assumed to be responsive to the interventions, the sessions were carried out without account being taken of the infants momentary state. As we know from other research on preterm infant responsivity, (Als & Duffy 1982, DiVitto & Goldberg 1979, Field 1980) premature infants are often either hyper- or hyporesponsive to sensory stimuli and could in some cases have been actively rejecting of and distressed by such a program. Such preterm differences persist at least into later infant development (Field 1977). Brown et al also note the difficult in engaging the mothers in the stimulation program and in maintaining maternal interest after discharge.

The work of Susan Widmayer on a population similar in many respects to that used in the Brown et al study (Widmayer & Field 1981) found highly contrasting results with a far simpler and less demanding intervention strategy focussing on a simple intervention used from time of discharge.

Thirty healthy preterm (GA <37 weeks) black infants of low SES mothers were assigned to one of 3 groups.

1) *(N = 10) Observed and discussed Brazelton testing of their infant, and administered the MABI at discharge and at weekly*

intervals over the first month.

2) (N = 10) Administered the MABI at discharge and at weekly intervals over the first month.

3) (N = 10) Control Group.

Outcome was assessed at 1 month on the BNBAS, with both experimental groups showing significantly greater scores on the interactive items of the scale as compared to the controls. At 4 months, videotaped feeding and face-to-face play was rated as significantly more positive in the experimental groups as was motor-adaptive ability on the Denver Developmental Screening Test. At 12 months, scores on the Bayley scales found significantly better mental scale scores in both experimental groups and a trend towards better performance on the motor scale:

	Group 1	*Group 2*	*Group 3*
Mental	*127*	*122*	*97*
Motor	*118*	*108*	*96*

The principal difference between this study and that of Brown et al is in the facilitation of interaction through the demonstration of the skills and repertoire of the individual premature infant - an example of the importance of the core features of Wolke's model, discussed above. The striking difference in outcome would seem to support the necessity for individualised as opposed to generally applicable approaches to enhancement of interaction.

Such a viewpoint would seem to be supported by the general lack of success of the didactic anticipatory guidance approach, where parents are given preconceived views of what their child will and will not do. One recent study found no effects of an *intensive trial with 39 families given age-specific discussion of affective, cognitive and physical development of 'the infant' through the first 6 months, and his/her most likely problem behaviours when these were compared to controls (see Dworkin, Allen, Geertsma, Solkoske & Cullina 1987). In contrast, a recent study (Bristor, Helfer & Coy 1984) on a 'perinatal coaching' program for primiparous parents of fullterm infants found significant intervention effects from the use of an individually tailored intervention approach:*

> *" The Perinatal Coaching Program provides parents with knowledge about the behavioural capabilities of their newborn. Parents are informed and shown how to use these capabilities when interacting with the infant. While coaching includes a demonstration of many of the capabilities assessed by the Brazelton neonatal assessment scale, it goes further by providing a supportive one-to-one, demonstration feedback environment."*

The parents involved in this program played with, looked at and talked more to their infants on videorecording at 28 days postpartum.

7.4) Conclusions on the Enhancement of Early Communication with the Developmentally Different Premature Infant

On the basis of the material reviewed in this chapter, it would seem that the view of the premature as developmentally different from the fullterm newborn is the one which fits best with our current knowledge base.

Several aspects of intervention programmes with this population seem to be important for their success:

1) That the programme is, or can be seen by parents as, individually tailored for a particular infant.

2) That the programme acknowledges the responsiveness of the infant as an important aspect of the process leading to improved development, and therefore that 'doing things to' the infant is no substitute for 'doing things with' him/her.

3) That the programme directly involves the parent in the process, rather than assuming that the infant can be helped 'in vacuo' to become a better interactant.

Several aspects are also shown to be of lesser importance where the outcome variable of interest is the interaction of infant with his/her parents, and not specific aspects of infant functioning:

1) It seems that involvement in the programme does not necessarily have to begin whilst the child is in the SCBU or transitional nursery (Widmayer & Field 1981).

2) The focus need not be on 'stimulation', and in some cases this may indeed prove a counterproductive focus, given the rejection of overstimulation by many prematures.

There are many factors, then, which can be incorporated into or excluded from an intervention package to aid mothers in early communication with developmentally different infants.

CHAPTER 8

METHODS FOR THE COMPARATIVE ANALYSIS OF EARLY INTERACTIONS:

> *"He who does not doubt does not investigate, and he who does not investigate does not perceive, and he who does not perceive remains in blindness and error."*
>
> *Al-Ghazali (1058-1111)*
> *(Quoted in Rutter & Hersov 1985)*

Methods for the analysis of infant-caregiver interaction have received considerable attention over the decades since Stern's seminal (1971) article on parent-infant interaction. Various questions/queries have been posed about the nature of this process - in particular, the extent to which it is 'driven' by either interactant, and the methods used have reflected the views of the researchers involved.

Two questions need to be addressed with regard to the analysis of early interactions:

1. *Is the use of single case methodology or of group data analysis currently most appropriate in answering the questions in this area ?*
2. *What methods of data analysis and/or reduction are available ?*

8.1) Individual Vs. Group Analysis of Data:

The use of individual and group designs in psychology both have a long history. Several recent authors have written strongly in support of the single case approach both to 'academic' and to 'clinical' research (Carramazza 1984,1986, Kazdin 1982, Peck 1985). It seem to this author, however, that tacit presupposition *of population norms needs to be assumed as a starting point before meaningful single-case research can ever be usefully carried out. At least some yardstick for what is an appropriate or meaningful dimension of, or focus for, study needs to be used to guide even the staunchest single-case researcher. A primary factor is the extent to which both within individual and across subject differences in observed patterns preclude other than the use of metalevel theoretical prediction as a starting point.*

8.1.1) Group Research Approaches

Those who argue for group designs claim that data derived from single cases, although interesting, cannot provide definitive evidence for either the existence, or the generality of phenomena. Group researchers would see it as invalid to generalise from results with the individual case, or to predict the behaviour of others on this basis. Group designs are seen as necessary in justifying the application of a derived explanation to a range of subjects. Single case study descriptions are often dismissed on such grounds if they remain unreplicated.

To adopt this stance is essentially to argue for inductive reasoning as the basis of all scientific method - that any important finding requires an arbitrary but agreed level of replication before it can be accepted as being true. With the adoption of such a position, comes a move from the acceptance of absolute to probabilistic criteria for the truth or falsity of all theoretical claims. If, at an accepted level of probability, (let's say 0.05), a phenomenon can be demonstrated to occur, then *it gains scientific respectability, and, within such a framework, allows predictions and generalizations to be made.*

This inductive basis for science has been heavily criticised within philosophical circles. Several philosophers of science, most notably Sir Karl Popper, have argued that attempts to falsify are the basis for science, not attempts to replicate (Popper 1963).

There are several inherent problems in reliance on group research:

(a) implicit acceptance of probabilistic criteria for truth and neglect of cases which do not concurr with the model under test as irrelevant where the null hypothesis is rejected.

(b) a high probability of epiphenomenal and confounded criteria subject group selection, without an appropriate rationale for group selection.

(c) <u>if</u> a Popperian stance is adopted, there is the additional 'problem' that even if correct, a model can never be known to be so.

8.1.2.) <u>Single Case Research Approaches:</u>

Psychological researchers who argue for the importance and scientific respectability of single case methodology, however, propose a very difference model of what constitutes acceptable research evidence. At its most extreme, this view has rejected group research as unable to provide <u>any</u> answers:

> *"Within ultra-cognitive neuropsychology, it is held that group studies generally provide misleading or uninterpretable information as far as inference to normal function is concerned."*
>
> *Shallice (1988)*

Caramazza (1986), for example, argues that to average results across what may prove to be non-homologous populations is at best irrelevant and at worst misleading. A good example of this being Kertesz and Phipp's cluster analysis of the functional problems in an unselected group of aphasic infarct patients with a variety of lesion sites (Kertesz & Phipp's 1977). Their clustering on functional neurological criteria corresponded only slightly and insignificantly to a neurological classification, on lesion site. Thus one might argue in this case that, from the point of view of rehabilitation, neurological grouping of patients was unhelpful and inappropriate.

8.1.3) Small Group Designs for Unmapped Areas

A compromise between the benefits of the single case and the group position seems the most useful as a basis for advancing research and knowledge on the extent and the malleability of effects of prematurity on mother-infant interaction.

The points made by the single case methodologists are valid criticisms of group research, and the criticisms of wholly single-case methods appear equally valid. The optimal strategy for any research will depend on the extent of present knowledge, and whether research seeks to 'flesh out' and ratify an established theory, to critically test such a theory, or to explore an area which has received only limited attention.

The subject matter of this thesis lies somewhere between that of the theoretically sophisticated and knowledgeable single-case neuropsychologist and the group study inductivist. A number *of competing models, outlined in Chapters 6 and 7 provide differing possible explanations for what can be observed in normal circumstances in the premature parent-infant dyad. One aim in the thesis has been to engineer a change in one particular aspect - the mothers' perception of and behaviour towards her infant and observe the effects of this intervention and to compare the effects of this change with what might be normally found. This approach, using small numbers, allows predictions made on the basis of competing developmental explanations to be put to the test.*

8.2) Methods of Data Reduction and Analysis:

A variety of methods have been employed in the analysis of early interaction (see:Browne 1986). The discussion in Chapters 6 and 7 of the importance of theoretical models relates most obviously to the choice of methods employed in the analysis of raw data. It is possible that prescriptive models which limit the range of potential interactions will constrain the possible conclusions which can be drawn. Interpretation of results, once obtained, can also be affected by theoretical stance (see Bloor 1976), through selective attention, selective methods of analysis and selective emphasis, though the extent to which this might be the case is more limited.

In developmental research focussed on early interaction, the following methodologies, and approaches to data reduction and analysis have been most commonly employed:

1) Detailed Ethological Description
(for example, Darwin 1877, Trevarthen 1978(b);

2) Turntaking Analysis
(for example, Stern 1974(b));

3) Transactional Analysis
(for example Sameroff & Chandler 1975);

4) State Transition Analysis
(for example, Stern 1971);

5) Lagged State Transition Analysis
(for example, Brown & Bakeman 1978, Sackett 1979);

8.2.1) Detailed Ethological Description

Detailed ethological description is, in many respects, a prerequisite for any of the other analytic methods. It is important that any analysis is based on an observational coding scheme of sufficient detail, focussed on aspects of the process likley to be pertinent to the investigation in question. A reliable, but invalid or tangential system of observation would provide little information after analysis. The selection of an adequate coding system is as much an empirical as a theoretical question, for it is not possible to predict the patterns of behaviour which might be observed. Such descriptive recording might take the following form:

MOTHER'S BEHAVIOUR					INFANT'S BEHAVIOUR		
CODE	VOC.	MOV'TS	GAZE	TIME	VOC.	MOV'TS	GAZE
Indicates focus	"That's right!"	Touch r.leg with 1. hand	I's face	0.00	Quiet	Takes toy from M.	M's Face

et seq.

8.2.2) Turntaking Analysis

Turntaking analysis is probably the earliest and best known of the statistical methods for investigating interaction. The model assumes that either partner, but not both, can be acting at any point in time and the sequence of behaviours can be analysed to look for patterns or consistencies. An example will be given here to illustrate:

MOTHER:	*"Aren't you my cutie ?"*	*(1.42 Sec.)*
PAUSE		*(0.6 Sec.)*
IMAGINED RESPONSE FROM INFANT: "YES."		*(0.43 Sec.)*
PAUSE		*(0.6 Sec.)*
MOTHER	*"You sure are."*	

(from: Stern 1977)

This approach allows one to look for patterns in the number, duration and complexity of turntaking bouts within an interaction. It's principal limitation as a method is the assumption that the process of dyadic interaction does not allow both partners to be acting simultaneously, and cannot therefore cope easily with the description of situations where the 'listener' expresses varying degrees of interest or disinterest in his/her partner.

8.2.3) Transactional Analysis

This approach is essentially a refinement of turntaking analysis which allows for the possibility of intra- and inter-subject effects over time, such that the behaviour of a subject can affect his/her own subsequent actions and those of their partner. It also allows for the possibility that both partners *might act at the same time, and thus escapes the principal criticism of simple turntaking models.*

8.2.4) State Transition Analysis

State transition analysis is a refinement of the above models which treats the dyad rather than its individual constituents as a coherent system which, at any point in time is in any one of a specified range of states. Analysis of the sequence of states through which the dyad is seen to move allows one to compute state transition probabilities - the liklihood that, being in any one of that range of possible states, the dyad will continue in that state or change to any of the others.

This type of approach provides a descriptive model of the dyad as a system which behaves within certain predictable parameters, and to test assumptions concerning the degree to which a particular dyad correspond to a predicted pattern of transitions.

8.2.5) Lagged State Transition Analysis

A refinement on the previous technique, developed by Sackett (Sackett 1979), Bakeman (Brown & Bakeman 1978) and others allows the researcher to look for interrelationships between time or event sequences which are not directly adjacent - for example, there may be a delay in an infants replies to parental overtures which would be picked up on looking at, say, the relationship between every third time segment which might be lost by looking for only direct consequences in the following segment. In the *following sequence, the adult behaviour O at times 1 and 6 is followed by the infant behaviour R at times 3 and 8 respectively.*

Time	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*
Adult	*O*	*N*			*P*	*O*		
Infant			*R*	*B*				*R*

A lagged time sequence analysis would detect this relationship which would be undetected on simpler turntaking analyses. This approach thus allows the researcher to investigate more complex patterning of interaction than the other techniques dealt with above.

8.3) Sampling

An important practical question in performing the above types of analysis is that of sampling intervals. If a continuous recording is being taken using film or videotape, with subsequent analysis, and if the analysis is further aided by use of an electronic timer, and the possibility of slow motion replay, the question becomes one of optimality rather than of practicality. Roger Bakeman (1979,1983) has carried out extensive studies on the relative utility of different time sampling intervals in the analysis of mother-infant interaction as a tool for use in the evaluation of an intervention program for families of premature infants. His conclusion was that a 5 second coding interval was as helpful statistically in differentiating groups as any shorter time intervals coded on the same interaction transcript data.

A further point may be whether to employ time sampling or event sampling. In the former, the sequence is broken down into time intervals which could be as short as 100th of a second, while the latter divides up the sequence according to the sequence of events as they occur, irrespective of the temporal aspect. Time sampling is thus easier to quantify, however the data generated is less accurate with respect to the proportion and actual sequencing of time spent in specific states.

8.4) Instrumentation:

Until recently, the assessment of interaction was reliant on 'in vivo' techniques, with little hope of establishing reliability or of demonstrating effects to the skeptical. The idea that workers such as Darwin had reliably observed infant functioning was easily questioned. The development of three areas of interaction research methodology have led to changes in this state of affairs:

1) *The introduction, first of filmed recording of interaction, and, more recently of videotaping, has given the facility for detailed analysis and coding of behaviour sequences with the added bonus of ease of establishing inter-rater reliabilities. The ability to superimpose an electronic timer on screen allows accurate timing of events, and makes inter-rater reliability easy to establish. The ability to playback in slow motion also aids analysis.*

2) *The development of automated coding devices such as the 'Datamyte', and more recently of direct computer coding allows for quick and reliable transcription of interactional data.*

3) *The development of standardised procedures for assessment has led to an increase in replicability of research methods.*

8.5) Interaction Analysis Methods to be used in the Current Research

The current research project made a preliminary investigation and comparison of the patterns of interaction which could be observed in three groups of mother-infant dyads.

A combination of two methods of analysis was decided upon. First, a detailed transcription of the recorded sequences was carried out. This was done in order to facilitate analysis of the patterns of protoconversation observed, and allow analysis of the mothers speech. Maternal speech has been shown to be sensitively attuned to the availability of the infant for interaction in artificially perturbed situations (Murray & Trevarthen 1986). It was hoped that maternal speech differences might be observable between the various types of dyad recorded. The second method of analysis was simple dyadic state coding using a 5 second epoch time sequence analysis to facilitate inter-rater reliability assessment. The aim of this coding was to investigate whether gross differences could be seen, thus a simple state coding was felt to be adequate for the purposes of the research.

8.6) Chapter Summary and Conclusions

The relative usefulness of large group, small group and single case research have been reviewed. It was suggested that the choice of approach was dependent on the knowledge base in any area and the aim of the research. The current thesis is in a relatively underresearched area, and is thus most suited to small-N exploratory theory testing.

A variety of methods of analysing interaction sequences was presented, and the benefits and drawbacks of using each briefly put. For the thesis analyses, the combination of ethological description with a simple dyadic state analysis was felt to be the most likely to yield useful information, and the approach adopted was briefly described.

CHAPTER 9:

ENHANCEMENT OF EARLY COMMUNICATION IN DYADS WITH THE BIOLOGICAL PERTURBATION OF PREMATURITY.

A core component of this thesis has been the development and preliminary evaluation of a parents manual aimed at enhancing early interactions between mothers and their premature infants. It is apparent from much of the work carried out to date that, when matched against those of fullterm infants of the same gestational age, the observed patterns of interaction seen in the premature parent-infant dyad differ considerably (see: Field 1978, DiVitto & Goldberg 1978, Brown & Bakeman 1980).

The aims in devising a manual of activities to be practiced by the mother with her premature infant are threefold. First, to increase maternal knowledge of infant affect, behavioural responsiveness and preferences. Second, to improve maternal confidence and skill in handling and stimulating her infant. Lastly, to reduce observed differences when compared to fullterm dyads and "normalize" the interaction of the preterm mother-infant dyad.

The clinical importance of such an intervention, were it to prove successful would be considerable. At the extreme end of the continuum of interactional dysfunction it would provide a means to combat the increased risk of early abuse and neglect for which the premature infant is at significantly higher risk (Frodi 1981; Hunter, Kilstrom, Kraybill & Loda 1978; Klein & Stern 1971; Lynch, Roberts & Gordon 1976; Murphy, Jenkins, Newcombe & Sibert 1981).

It can be argued that actual physical or emotional abuse or neglect are the endpoint of what Sameroff and Chandler (1975) have termed the "continuum of caretaking casualty" rather than unique problems seen in only a small group of pathological parents. Any practicable method of shifting the continuum away from the dysfunctional toward the adaptive end of this spectrum would be of obvious value, as it would lead to a reduction in cases reaching the threshold for actual abuse. A parentally administered, manual-based programme, as a simple, low-cost intervention technique could provide such a practicable method for reducing the risks and the numbers of caretaking casualties.

The separation/bonding failure models remain prevalent in the clinical literature concerning the problems of the premature dyad (see Klaus & Kennell 1982), despite frequent criticism questioning its validity (see: Chess 1983; Lamb 1982; Sluckin, Herbert & Sluckin 1983). A brief justification of the continuum position as contrasted with the bonding failure model seems necessary in support of the approach advocated here.

The bonding failure model argues that the central problem for the preterm dyad results from limitations on early contact imposed by separation during critical/sensitive periods in the early postpartum. This contact is viewed as necessary for the development of an affectionate early relationship between mother and infant. This view receives support from the improvements seen in interactions of normal mother-infant dyads allowed 'extra' contact (Klaus, Jerauld, Kreger, McAlpine, Steffa & Kennell 1972;

O'Connor, Sherrod, Sandler & Vietze 1978; O'Connor, Altemeier, Sherrod, Sandler & Vietze 1979). The main point of contention is whether the effects of early contact are significantly greater than those produced by other commonly confounded factors. Concluding their review on this issue, Sluckin, Herbert and Sluckin (1983) weigh up the evidence thus:

> "Although there are studies which seem to indicate differences in maternal behaviour contingent on extra contact following birth, they are modest in magnitude and constitute a small fraction of a mother's repertoire of behaviours. There is also an absence of any clear-cut link between some of the maternal behaviours being observed (despite the faith put in their pertinence in the literature) and the bonding construct."

> "What the research does tell us is that there is a host of other factors in addition to early contact which have a bearing on mother child relationships."

In a previous study, (Aitken 1980), it was shown that the behavioural repertoire of the infant was at least as important as whether separation took place in its effects on early patterns of interaction in the premature, with significantly different patterns of interaction being observed in premature mother-infant dyads where separation had not taken place.

9.1) Evidence for Actual and Perceived Differences in the Premature Infant

There is clear evidence for behavioural differences in the premature infant when compared to fullterm control, only one study to date, that of Paludetto and colleagues claiming to find no differences in behaviour by fullterm equivalent (Paludetto, Mansi, Rinaldi, DeLuca, Corchia, De-Curtis & Andolfi 1982). The majority of studies report premature infants as behaving differently (see Ferrari, Grosoli, Fontana & Cavazzuti 1983; Sell, Luick, Poisson & Hill 1980; Als Duffy & McAnulty 1988). Results of these studies are briefly outlined in table 9.1.

There is some limited cross sectional information on the "rhythms, repertoires and responsivity" (Field 1978) of the premature and of other high-risk groups.

In a seminal study by Field (1977), 12 separated premature, 12 healthy term and 12 nonseparated postterm infants were filmed with their mothers at 3.5 months post-EDD who were instructed to interact with their infants in three specific ways -

1) "An attention getting situation in which the mother was requested to pretend her husband was taking a movie of their infant and she in turn was trying to keep her infant looking at her face.",

2) "A spontaneous face-to-face situation in which the mother was asked to pretend she was at home at her kitchen table playing with her infant."

3) "An imitation situation during which the mother was asked to imitate all of her infant's behaviours as they occurred."

The results from these manipulations were interesting, with a significant trend for imitation to be most interesting as gauged by infant gaze, followed by spontaneous play, with attention-getting proving least successful. Maternal response to infant gaze aversion was also interesting, with greatest persistence shown by parents of preterm infants. Both high-risk groups differed significantly in the level of success in engaging their infants in the first two conditions, with all groups proving equally successful in engaging their infants by imitation.

Behavioural Differences in the Premature on Standardised Assessment

AUTHORS		SCALE	FINDINGS
Paludetto et al.	**(1982)**	**BNBAS**	Reported no behavioural differences at term between premature and fullterm infants.
Ferrari et al.	**(1983)**	**BNBAS**	Reported reduced orientation, motor, state and autonomic functions.
Sell et al.	**(1980)**	**APIB**	Reported reduced orientation, motor, state and autonomic functions.
Als et al.	**(1988)**	**APIB**	Reported reduced motor, state, autonomic attentional and self-regulatory functions.

Fig 9.1

In a later study, Field (1979), has looked at game playing at 4 months post-EDD in preterm, term and postterm infants. She has shown significant differences in the amount of game playing in a free-play laboratory situation between both preterm (27%) and term (39%)($p<0.005$) and between postterm (28%) and term (39%)($p<0.01$). The types of game most typically played by their sample (20 in each group) were consistent across the sample, with "tell-me-a-story", "pat-a-cake" and "I'm gonna get you" proving most popular across all groups. She concluded that "..the mothers of 'atypical' infants are not very playful."

Various aspects of the appearance, behaviour and vocalization of the premature infant are more physiologically arousing and are perceived as more aversive by adults than the same features in a fullterm infant (Frodi, Lamb, Leavitt, Donovan, Neff & Sherry 1978, Frodi 1981). These findings may in part be a function of objective differences between the two groups. Langlois and Stephan have written extensively on the role of actual physical attractiveness in the development of social relationships (Langlois & Stephan 1981) and *note that infants rated as attractive are held, made eye contact with and kissed more often than infants who are rated as less attractive. In a recent study using photograph ratings of a variety of infants, they found that attractive infants were also rated as likely to be 'smart-likeable', good, and unproblematic:*

> *"Strong and consistent expectations for behaviour of attractive and unattractive individuals thus appears to be elicited soon after birth.."*
>
> *Stephan & Langlois (1984)*

Nevertheless, another important aspect which requires consideration is the effect of attribution per se. This seems to be a powerful factor in respect of our connotation of premature characteristics. Miller and Ottinger (1986) performed an interesting study on this area. Ratings were made by 256 medical undergraduates of videotapes of the behaviour of two fullterm and two preterm infants either appropriately or incorrectly labelled as fullterm or preterm. No effect of labelling on scoring of operationally defined Brazelton items was shown, however there was a pronounced effect of labelling on a variety of global ratings. The labelled preterms were reliably rated as being more difficult to care for, less healthy, smaller, and less attentive (0.001), less enjoyable to interact with, less cute and less sociable (0.05).

Corter and his colleagues (Corter, Trehub, Boukydis, Ford, Celhoffer & Minde 1978) conducted two studies on nurse rating of the attractiveness of premature infants. In the first study, they established that both experienced (N=20) and inexperienced (N=20) nurses could reliably rate the relative physical attractiveness of five randomly selected premature infants, and that there was significant agreement both within and across the two groups of nurses. The second study compared absolute ratings of attractiveness between nurses who had cared for a particular premature infant (N=20) and ratings of the same infant by a matched nurse who had not cared for that infant. Here it was found that "Having cared for a particular infant increased the nurses' ratings of its attractiveness."

It seems that expectations concerning infant behaviour are related to both actual physical characteristics such as 'attractiveness' and to our expectations which are related to our connotations of labels (such as 'premature', 'fragile', 'cute', 'all right'...). However, the importance of attribution has yet to be fully investigated as it relates to parental responses to the premature infant.

9.2) Evidence for Differences in the Expectations of the Parents of the 'Different' Child

Unrealistic expectations and attributions (Azar, Robinson, Hekimian & Twentyman 1984), difficulties in detecting general and specific emotional cues (Kropp & Haynes 1987) and poor social problem solving (Azar, Robinson, Hekimian & Twentyman 1984, Scott, Baer Christoff & Kelly 1984) are commonly cited in the literature on child and infant abuse. It seems that parents who experience difficulties in coping with their infants and children are prone to particular types of cognitive distortion, and to have a reduced repertoire of skills for dealing with problem situations. This may be, in part and in some cases, a reflection of difficulties a parent might experience in establishing an appropriate metacognitive model of the responsiveness of an 'atypical' infant or child.

Some support for this view in the case of the neonatal infant can be taken from a study by Osofsky and Danzger (1974). These workers investigated the interrelationship between neonatal behaviour as assessed on the Brazelton NBAS and mother-infant *interaction during a bottle feed between 2 and 4 days of age in a normal sample of 51 non-white lower SES mother-infant dyads. They reported consistencies in state and behavioural measures across the two situations, and*

> *"..consistent and interactive relationships between patterns of maternal stimulation and infant behaviour in corresponding areas."*

The extent to which this process is amenable to change through changing both the behaviour and expectations of the parent of the premature infant is the focus of current intervention.

9.3) <u>Development of the "Things to Do with My Baby" Book</u>

In compiling a book of early activities for mothers to practice, several types of available material were consulted for ideas on general format and, to some extent, content. In particular, the following were found to be useful sources:

A) The 'Portage Project' material (Shearer & Shearer 1974) developed as a structured stimulation programme for developmentally delayed children aged 0-6 years in Oregon, using parents as the primary therapists.

B) 'Small Wonder' (American Guidance Services, 1979). A set of teaching materials, loosely based on the Portage model of giving structured and developmentally sequenced tasks over the 0-30 month age range, for the parents to teach their child.

C) The Miami Infant Stimulation Programme (Mailman Centre, Miami, Unpublished, 1977). This material was also developed along Portage lines, specifically for parents of premature infants 0-9 months of age.

D) The Sensory Stimulation programmes developed at the Grady Memorial Hospital in Atlanta by Josephine Brown and her colleagues ("Better Beginnings for Premature Infants and their Mothers", Preliminary Unpublished Manual, Brown, David & Larossa, 1978).

E) 'L'eveil du tout-petit', published in English as 'Exercises for Your Baby' (Lévy 1972), a series of exercises, mainly to encourage motor skill development, or 'alertness through movement' in the infant from 0-15 months of age.

Several aspects of the above materials were referred to in the structuring and presentation of this intervention manual. A fundamental departure from the philosophy of the above materials, however, is in the explicit rejection of a 'skill accretion' model of development as an appropriate framework for intervention with the premature. This model is inherent in all of the above materials, which in the main are based on developmental research from the psychometric, epidemiological tradition of Gesell, Bayley and others. Although such a model may be broadly valid in work with older normal populations where we have good data on the typical stages or ages at which specific skills are gained, even here, individual variability is high. Differences between infants *in both the rate and pattern of development can make problematic any strict adherence to a program based on continuing assumptions about the most likely next step in development for any given infant. In an abnormal population such as premature parent-infant dyads, individual variability will, if anything, increase. Moreover, the sequence of development of many aspects that have been investigated are not as one might expect to extrapolate from the average findings with the fullterm : The premature infant is, in the early months at least, 'developmentally different'.*

Of considerable importance is the finding that parents of the premature infant, left to their own methods, attempt to engage their infants' interest by being highly stimulating and intrusive (Field 1977). This finding, coupled to the well established fact that such stimulation is actively rejected by the premature infant argues strongly against an approach which advocates regular stimulation irrespective of infant attempts at internal and interpersonal regulation. The position is neatly stated by Heidi Als:

> *"The brain of the preterm infant, rather than as has been postulated in the past, too immature to register and process sensory information, appears overly sensitive and at the mercy of sensory information, unable to buffer its intake because of the lacking inhibitory controls..."*
>
> *Als (1986)*

9.3.1) The Structure of the "Things to Do with My Baby Book"

The example items from the manual are included as an appendix to this thesis, specifics of the individual items will therefore not be given detailed consideration here. This section *will concentrate on the basic structure of and rationale for the materials and activities chosen.*

An assumption made plain in the parent material is that the infant will <u>not</u> succeed with a number of the suggested activities when they are first attempted and that for some items at least, success may be possible at certain times but not at others. It is suggested that the process must be one of developing a knowledge of the individual preferences and capacities of the infant, and that, because of individual infant differences, this is an idiosyncratic process. There is no one best pattern of results to which the mothers should try to help their infant attain.

The introduction to the manual is as follows:

> ***"All babies are people, right from the word go. Like any other people, young babies have different characters, and you need to get to know their likes and dislikes. The idea behind this booklet is to give me an idea of the sorts of things you and your baby enjoy doing together through his or her first nine months. As your baby develops you will probably find that some things become more fun for both of you as your baby becomes more interested in certain types of activity while other things will become less interesting as your baby starts to work out how the world operates."***

For the exercises themselves, activity sheets are used. These consist of a brief verbal description of the activity to be attempted, space to record when the suggested activity has been carried out, and an accompanying photograph to illustrate the task.

The sequence of activities used is as follows:

0-2 Weeks	*1.*	*Rocking and singing lullaby*
	2.	*Watching and Copying I*
	3.	*Spongeing and Stroking*
2-4 Weeks	*4.*	*Following and Searching I*
	5.	*Baby Copying You I*
	6.	*Mobile I*
4-6 Weeks	*7.*	*Relaxing the Body I*
	8.	*Exercising Arms and Legs*
	9.	*Watching and Copying II*
6-8 Weeks	*10.*	*Grasping*
	11.	*Sitting and Chatting I*
	12.	*Mobile II*
8-10 Weeks	*13.*	*Wrist and Ankle Bells*
	14.	*Baby Copying You II*
	15.	*Singing and Dancing*
10-12 Weeks	*16.*	*Splashing in Warm Water*
	17.	*Turning Over and Turning Back*
	18.	*Watching and Copying III*
12-14 Weeks	*19.*	*Mirror Games I*
	20.	*Sitting and Chatting II*
	21.	*Meeting Someone New I*
14-16 Weeks	*22.*	*Peek-a-Boo I*
	23.	*Following and Searching II*
	24.	*Clapping Game I*
16-18 Weeks	*25.*	*Round and Round the Garden*
	26.	*Baby Copying You III*
	27.	*Wrist and Ankles II*
18-20 Weeks	*28.*	*Lifting Head and Back*
	29.	*Sitting and Chatting III*
	30.	*Listening to a Song*
20-22 Weeks	*31.*	*Following and Searching III*
	32.	*Relaxing the Body II*
	33.	*Textures I*
22-24 Weeks	*34.*	*Mirror Games II*
	35.	*Clapping Game II*
	36.	*Bathtime*

24-26 Weeks	*37.*	*Watching and Copying IV*
	38.	*Meeting Someone New II*
	39.	*Taking Things I*
26-28 Weeks	*40.*	*Sitting and Chatting IV*
	41.	*Textures II*
	42.	*Turntaking Game*
28-30 Weeks	*43.*	*Walking on Hands*
	44.	*Picking Things Up*
	45.	*Baby Copying You IV*
30-32 Weeks	*46.*	*Banging Toys*
	47.	*Taking Things II*
	48.	*Meeting Someone New II*
32-34 Weeks	*49.*	*Sitting and Chatting V*
	50.	*Knocking Down Blocks*
	51.	*Making Music*
34-36 Weeks	*52.*	*Chatting About Pictures*
	53.	*Playing Ball*
	54.	*Watching and Copying V*

Three exercises are suggested, which are to be tried daily over each fortnight and a set of materials has been constructed which can be used by mothers over the first nine months, giving a total of 54 activity sheets. In the current study, the effects of this programme were evaluated as it affected observed patterns of interaction at 7 weeks post full-term equivalent.

The sequence of exercises used was designed to provide mothers with the opportunity to experiment with different methods of relating and responding to their infants, based on developmental research findings on the types of activities likely to be responded to and participated in most readily by neonates and small infants. These break down into a number of discrete types of activity involving directly social activities such as turntaking and copying, activities with a secondary social component such as bathing, simple contingency activities using materials such as linked mobiles, and simple motor tasks such as grasping.

As mentioned above, there is wide variability in the early processes of development. No systematic longitudinal information is yet available on the development of affective responsivity in the premature, or of the extent to which this is modified by the degree of prematurity, length of separation, degree of medical distress or of other complicating factors such as maternal medical status.

Activities are thus suggested on the basis of likely types of activities which might interest the infant rather than knowledge that the activities will prove successful in this respect, with this assumption being made explicit to the mothers taking part.

Example items from the manual are shown as appendix XIV.

The final component of the manual given to mothers was a short list of books which might be useful to parents interested in the development of fullterm and preterm infants (Goldberg & DiVitto 1983; Harvey (Ed.) 1979; Kitchen, Ryan, Rickards & Lissenden, 1984; Rivers Redshaw & Rosenblatt, 1985) and a list of self-help organizations and their contact names and addresses.

9.3.2) *Theoretical Rationale for the Intervention*

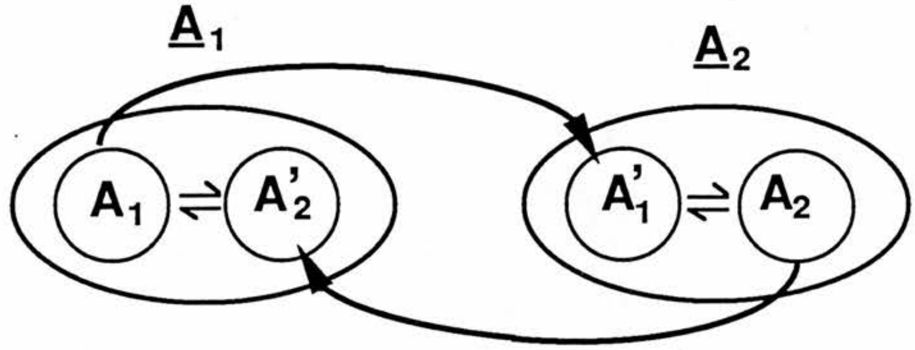
The basis for the intervention approach which was developed comes from the intersubjective model of interaction which was described in chapter 6. The aim of intervention is outlined in fig 9.2, and is to effect a change in the mothers internal model of her infant (P') through allowing her to develop a repertoire of behaviours which are more likely to prove of interest to the infant. This change being brought about through the use of a manual of activities, M P, used not as a directive process but as a means of allowing the mother to discover more about her infants interests and responses.*

A change in the mother's actions towards and mutual interests with her infant would be hoped to produce a concomitant change in the model of maternal behaviour (M') held by the infant, and in the infants actions and interests. This change can be seen as an increased concordance across the models M and P.

Fig 9.2

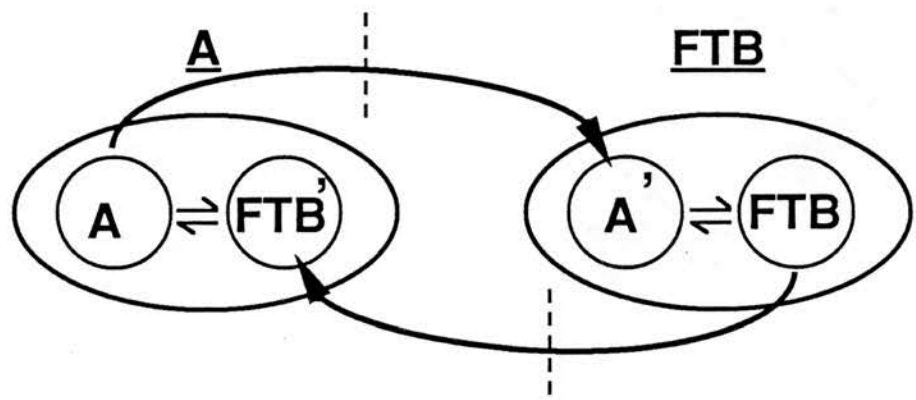
(a)

Adult-Adult Intersubjective Exchange



Successful Adult-Fullterm Infant Primary Intersubjective Exchange

(b)



(c)

Adult-Low Birthweight Infant Attempts Blocked by Lack of Intersubjective Congruence

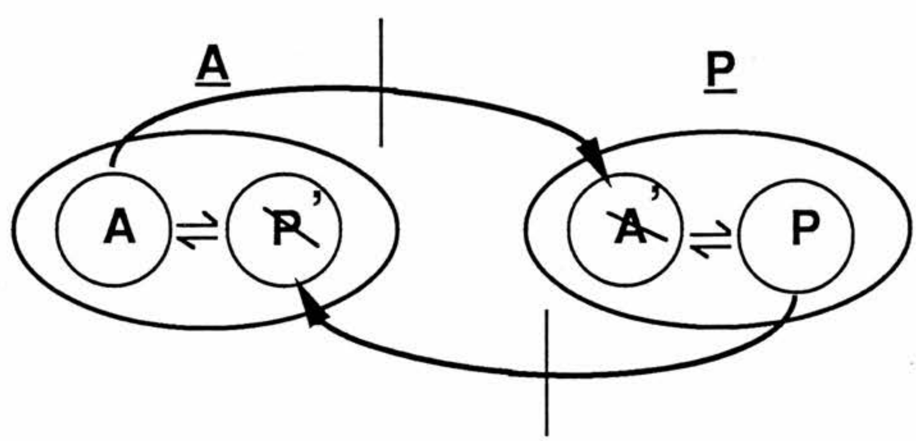
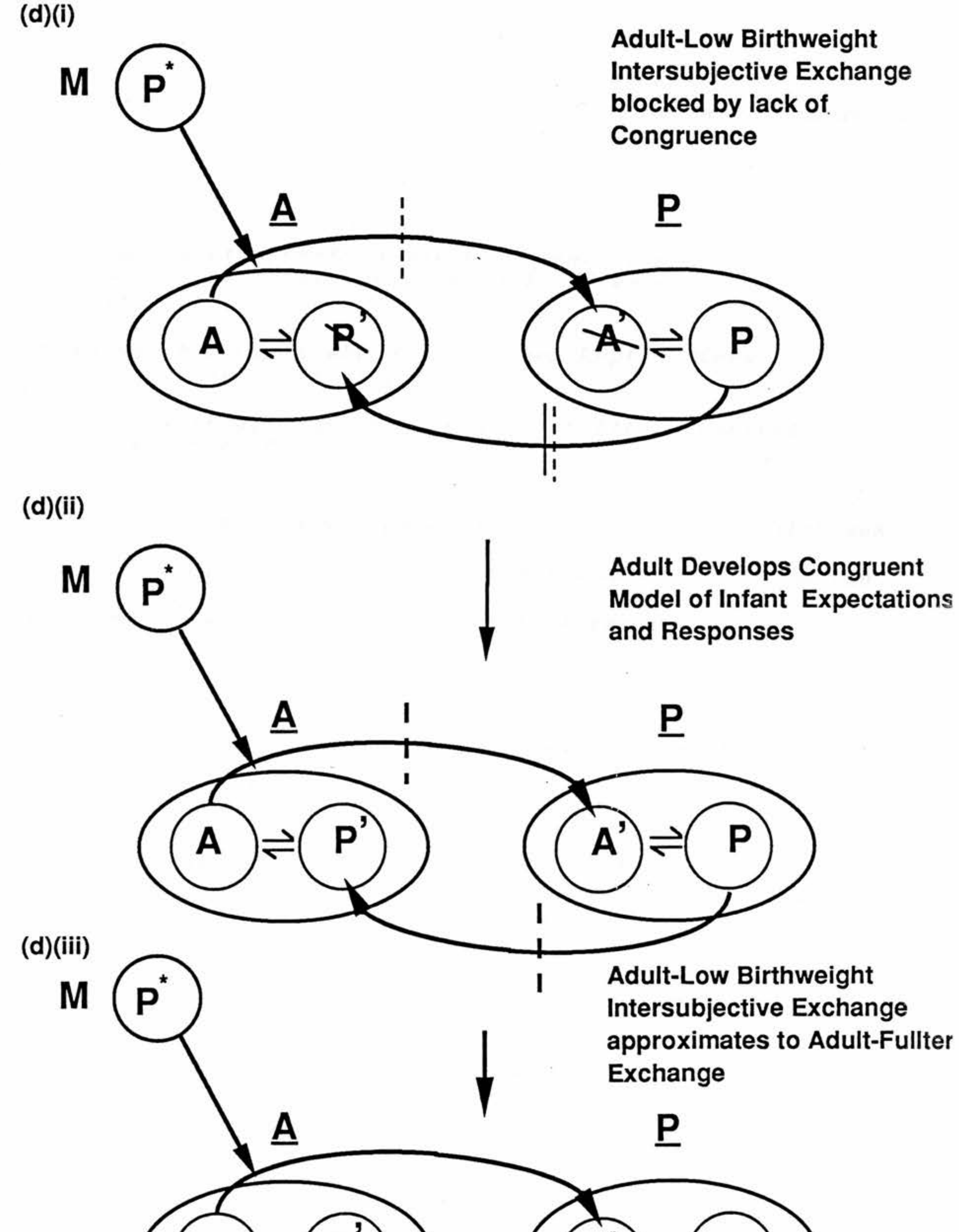


Fig 9.2 (Cont.)



(d)(i)
Adult-Low Birthweight Intersubjective Exchange blocked by lack of Congruence
M
P*
A
P
A
P'
A'
P
(d)(ii)
Adult Develops Congruent Model of Infant Expectations and Responses
M
P*
A
P
A
P'
A'
P
(d)(iii)
Adult-Low Birthweight Intersubjective Exchange approximates to Adult-Fullter Exchange
M
P*
A
P
A
P'
A'
P

9.4) An Evaluation of the Intervention Manual

The Intervention Manual was evaluated by detailed comparison of the patterns of observed interaction in three groups of infants:

1) Ten pairs of premature mother infant dyads who received the intervention manual and were instructed in its use,

2) Ten matched dyads where the mother kept a diary record of her infant's development,

3) Normal interactions in a group of fullterm control infants (N = 10).

Data also is included separately on a final dyad which was originally part of the control cohort but was dropped from the analysis when it was found that the infant was taking frequent petit mal seizures.

All interaction sequences were filmed at seven weeks post estimated date of delivery.

The dyads were all filmed either in the Psychology Department, University of Edinburgh, or in the Video suite at the Department of Clinical Psychology, Royal Hospital for Sick Children, Edinburgh.

9.4.1) Method:

All of the dyads studied in this part of the thesis had been included in the earlier NNA assessment study, and had been approached at that point for inclusion in the interaction study. Consent had thus been given by the mother for this additional *work at the time of the original recruitment. The consent form and information sheet are reproduced as Appendix II.*

It was important that the dyads included in this part of the study were randomly allocated. This was to ensure that there would be no element of experimenter bias which might influence the mothers behaviour. It was originally hoped that this could be carried out by the clinical staff at the maternity hospital, however this proved logistically impossible. In order to achieve random allocation, all of the proformas for both the intervention exercises and the diary records were constructed to be identical in size and shape (17 stapled pages of A4 with a plastic cover). A professional, not involved in the study, independently randomised the booklets and diaries, placed each in a brown letter-coded envelope, and sealed the envelopes. Once sealed, they could not be distinguished by the investigator. A group allocation key was filled out which was kept sealed until the data collection and scoring were completed.

It was explained to each mother that the aim of the research was to investigate the types of activity which their infant found most interesting and engaging over the early months of life. All mothers were informed that they were taking part in a research project to investigate early development and interaction in premature infants. They were told that there were different types of booklet being used in the study and that it was important that the experimenter was kept naieve to the type of booklet that they had been given until after the data collection *was complete at seven weeks post-EDD.*

Specific Information Given to the Diary Group:

With the diary group, the booklet explained that we have little information on the types of thing which are found most interesting by the developing premature. It would be helpful, therefore, if they could note down the activities which their infants seemed to find most interesting and enjoyable, and any other information which they felt might be of interest.

Specific Information Given to the Intervention Group:

In their booklet, the intervention mothers were also told that this was an experimental study, and that as we have little knowledge of the interests of the premature many of the tasks would be useful in getting to know their infant, but might at times be of little interest to to their baby. It was stressed that this was a process of mutual learning and not an attempt to get them to do the 'right' things with their infants.

An appointment was made for all of the dyads to attend at seven weeks post-EDD to be videotaped.

When they attended at seven weeks, the mother was asked to indicate when she felt her infant would be likely to be most responsive and recording was carried out only when the mother was confident that her infant would be bright and alert. Several hours were allowed in each case to ensure that there was a high probability of filming the infant in as responsive a state as *possible.*

No specific instructions were given to the mothers, other than that they should play with their infants as they would do normally in any enjoyable, non-caretaking situation (i.e. at any time other than when feeding, changing or bathing).

Once the mother and baby were settled, a five minute sequence of interaction was videotaped in each case, with a timebase on screen to facilitate coding, and all sequences were recorded on either U-Matic or studio quality VHS video equipment to ensure a high quality of image and soundtrack for subsequent analysis.

9.4.2) Videotape Analysis

Two forms of analysis were carried out on the videotaped records:

a) Dyadic State Analysis

This was a time series rather than event series analysis, with the possibility that successive epochs could be coded as being in the same dyadic state. Each 5 minute video sequence was divided into 5 second epochs. Each epoch was coded for the predominant dyadic state occurring over that 5 second period. A simple four state coding system was used which had been developed for and successfully employed in an earlier observational study (Aitken 1980) on perinatal interaction in premature dyads.

In deciding on the length of sequence, it was accepted (in *line with Bakeman & Gottman 1986) that sequences of interaction require to be of a minimum length such that NP (1 - P) >/= 9 (where N is the number of observations and P is the random probability of occurrence of any code) in order to generate meaningful data. In a 4 state coding system such as this, the number of datapoints is satisfied by any sequence of 48 or above (48 * 0.25 (1 - 0.25) = 9), thus the 60 event sequence used here is adequate for statistical analysis.*

As the aim of the study was to look at differences between the groups in the structure of the overall interaction, a simple percentage count of the number of epochs spent predominantly in each of the four dyadic states was computed. This, together with the mean number of epochs in each state and its standard deviation is presented as table 9.1. The raw data is given in Appendix XII. A simple (T to T + 1) state transition probability analysis was also carried out.

The four dyadic states were operationally defined on the basis of the presence or absence of interactive behaviours shown by both partners, using criteria as follows:

A) <u>Mother Interacting</u>: Maternal gaze at the infant, together with active stimulation (which could take the form of talking to, making noises, non-caretaking touch such as stroking, elliciting responses such as rooting or grasping from the infant, kissing, or vestibular stimulation).

B) <u>Mother Not Interacting</u>: Maternal gaze may or may not be towards the infant, but is otherwise not engaged in any interactive behaviour unless this is of a routine caretaking nature (such as adjusting clothing or wiping mouth).

C) Infant Interacting: The infant is gazing towards the mothers face in a manner appropriate for en face should the mother reciprocate. Soliciting behaviours with or without eye gaze such as non-distress vocalization and active hand and arm movements are also scored.

D) Infant Not Interacting: The infant is not gazing towards the mother and is not otherwise attempting to engage in interaction.

It was not felt that more sophisticated coding or analysis techniques such as lagged transition analysis were necessary to address these issues, nor that such analyses would provide clearer answers to the hypotheses under test.

b) Verbatim Transcription of Vocalization and Movement

For this analysis, detailed written analyses were made of each sequence, noting occurrences of maternal imitation, repetition, questioning, physical contact, infant vocalization, expressive movements, eye contact and any other salient features of the process. The number of maternal utterances towards the infant was recorded, as was the total number of syllables used by mother throughout and the mean number of syllables per utterance. An excerpt from a transcript of each of the three groups and from the epileptic mother-infant dyad is provided below (Tables 9.2, 9.3, 9.4, 9.5).

Table 9.1

Proportion of Epochs Coded as Specific Dyadic States

	Control Group Dyads (N = 10)	Intervention Group Dyads (N =10)	Diary Group Dyads (N = 10)	Epileptic Infant Dyad (N = 1)
Both (Both mother and infant in mutual engagement)	71.00 42.6 (SD 6.535)	78.75 47.2 (SD 4.662)	8.30 6.6 (SD 1.955)	0.00
Mother Alone (Mother attempting to engage infant with no response over most of the epoch)	27.66 16.6 (SD 5.816)	20.83 12.5 (SD 4.625)	89.00 53.4 (SD 1.955)	76.60 45
Infant Alone (Infant atempting to engage mother with no response over most of the epoch)	0.00	0.42 0.3 (SD 0.483)	0.00	0.00 0
Neither (Neither mother nor infant engages in significant attempts to interact with partner)	1.33 0.8 (SD 1.317)	0.00	0.00	23.40 15

Data tabulated above comes from state analysis of 5 minute videorecordings of all infants at 7 weeks post EDD, analysed in 5 second time epochs. Figures shown are the percentage of time in each state, the mean number of epochs in each state and the standard deviation. (Raw data is given as Appendix XII).

Table 9.2

Sample from Interaction Transcript: Control Infant, 7 Weeks Postpartum

SECS	CODE		VERBATIM TRANSCRIPT
0 - 5	B	1.	**oooh! that was a big... Gees a smile 'gain Gees a smile 'gain**
		2.	touches chin touches cheek touches cheek
		3.	
		4.	ALERT, SCANNING MOTHERS FACE RAISES HANDS,MILD DISTRESS
6 - 10	B	1.	**oh. What you doing ? What you doing? It's a smile! oh!**
		2.	touches chest touches lip
		3.	
		4.	GAZE AVERT (UP RIGHT) EYE CONTACT SMILE...................... GAZE DOWN
11 - 15	B	1.	**oh. there's a smile ! there now.**
		2.	tickles cheeks & mouth
		3.	
		4.	SMILE.........
16 - 20	B	1.	**What you laughing at ? What you laughing at ? What you laughing at ? You going take..**
		2.	no physical contact..
		3.	
		4.	QUIET, WATCHING MOTHER...
21 - 25	M	1.	**..mum a walk ? You going to take mum a walk ? Aaaah ! Smiles.**
		2.	(mimicking yawn)
		3.	*YAWNS......................*
		4.	GAZE AVERT (UP RIGHT)

NUMBER KEY

1. **maternal speech**
2. maternal behaviour
3. *INFANT VOCALISATIONS*
4. INFANT BEHAVIOUR

DYADIC BEHAVIOUR CODE

B Both mother and infant engaged .
M Mother attempting to engage infant, no response over most of this time.
I Infant attempting to engage mother, no maternal response over most of this time.
N Neither infant nor mother engaged in attempts to engage the other .

Table 9.3

Sample from Interaction Transcript: Intervention Infant, 7 Weeks Post Estimated Date of Delivery

0	-	5	M	1.	**Hm.** **What's wrong then ?** **Att!**
				2.	
				3.	*Eeeeh.*
				4.	MOVING ARMS AND LEGS, SLIGHT GRIMACING...STILLS AND ALERTS
6	-	10	M	1.	**Is that Julie ?** **Thats Julie.** **Thats Julie**
				2.	intent gaze throughout..
				3.	
				4.	LOOKING AROUND SLOWLY..
11	-	15	B	1.	**Do you see Julie in the mirror ?** **What's that ?** **That's mummys nose !**
				2.	Moves head towards Julie's arm (nose touches hand).
				3.	
				4.	CONCENTRATION AND DIRECTED ARM MOVEMENTS TOWARDS MOTHERS FACE
16	-	20	B	1.	**That's mummys nose !** **Mhm.**
				2.	
				3.	
				4.	STILL AND ALERT ....
21	-	25	B	1.	**That's mummy's nose.** **Chicka - chicka - chicka - chew !** **Chicka - chicka - chew !**
				2.	
				3.	
				4.	STILL AND ALERT..
26	-	30	B	1.	**There we are.** **There we are.**
				2.	
				3.	*Aah.*
				4.	STILL AND ALERT ....
31	-	35	B	1.	**Do you want to go bouncing ?** **Do you want to go bouncing ?**
				2.	
				3.	
				4.	STILL......................................BECOMES MORE ANIMATED, MOVING ARMS AND TRUNK..

Table 9.4

Sample from Interaction Transcript: Diary Infant, 7 Weeks Post Estimated Date of Delivery

0	-	5	M	1.	**Come on.** **Are you going to tell me a story ?**
				2.	Posture appropriate for En Face.......
				3.	
				4.	ALERT - SCANS MOTHERS FACE
6	-	10	M	1.	**Tell me a story.** **Come on.**
				2.	Posture appropriate for En Face.......
				3.	*Click*
				4.	SOME GENERAL MOTOR ACTIVITY, NOT DIRECTED TOWARDS MOTHER
11	-	15	M	1.	**As much as he can do to keep his eyes open.** **Come on.**
				2.	Mother moves from attempts to maintain En Face in commenting.
				3.	
				4.	
16	-	20	M	1.	**Where are you ?** **This isn't the room you usually have, no it's not.**
				2.	Posture appropriate for En Face.......
				3.	
				4.	GAZES AROUND ROOM, TO RIGHT.
21	-	25	M	1.	**Stop staring at the camera !** **(Giggle)** **Stop it !** **Yes.**
				2.	Posture appropriate for En Face.......
				3.	
				4.	BABY TILTS HEAD BACK, BRINGS HANDS UP AND OPEN
26	-	30	M	1.	**Not going to pay me any attention at all (spoken as statement not question).**
				2.	Posture appropriate for En Face.......
				3.	
				4.	UNFOCUSSED - NOT ENGAGED BY MOTHER
31	-	35	M	1.	**Are we cruel to waken you up ?** **Are we ?**
				2.	Posture appropriate for En Face....... Reaches out to rub trunk.......
				3.	
				4.	UNFOCUSSED

Sample from Interaction Transcript: Fullterm Epileptic Infant at 7 Weeks Post-EDD.

Table 9.5

0	-	5	M	1.	**Tell me a story then.**
				2.	Touches feet lightly........................
				3.	*Uh Uh* *Uh*
				4.	HEAD UP, VISUAL SEARCHING TO RIGHT
6	-	10	N	1.	**Come on, tell a story.**
				2.	Wiggles baby's left foot briefly.
				3.	*Slightly laboured breathing, no communicative vocalizations.*
				4.	QUIET, UNFOCUSSED........................
11	-	15	N	1.	**Oh dear !**
				2.	Takes both feet by toes.
				3.	*Uh. Yawn +++*
				4.	QUIET, UNFOCUSSED........................
16	-	20	N	1.	**What do you see ? Hmm?**
				2.	Sits quietly, arms on lap, watching baby........................
				3.	*Aaah.*
				4.	CYCLING ARM AND LEG MOVEMENTS.
21	-	25	M	1.	**What you saying ?**
				2.	Sits quietly, arms on lap, watching baby........................
				3.	*Quiet*........................
				4.	UNFOCUSSED........................
26	-	30	M	1.	**NO SPEECH**
				2.	Sits quietly, arms on lap, watching baby........................
				3.	*Quiet*........................
				4.	NO MOVEMENT........................
31	-	35	N	1.	**Hi !**
				2.	Sits quietly, arms on lap, watching baby........................
				3.	*Quiet*........................
				4.	NO MOVEMENT........................

9.4.3) Inter-Rater Reliability

For the dyadic state analysis, inter rater reliability was carried out for a sample videotape from each of the three groups.

The results of this analysis are as follows:

Coded epochs	*= 180*	
Percentage agreement:	*= 92.7%*	
Cohen's Kappa	*= 0.864*	*(K >.75 is generally regarded as highly significant)*

9.4.4) Group Comparability

The premature subject data to be analysed was based on cases which were randomly allocated to the intervention package and diary groups. It was thus important to ascertain whether there were any significant group differences on characteristics such as birthweight or gestational age between these groups and whether both differed in similar degree from the fullterm control group. Individual subject raw data for birthweight, gestational age, maternal age, NNA examination total score and NNA orientation package score, together with the grouped data characteristics are given in Appendix VIII. The groups were compared using single sample group t-Tests, tabulated as Appendix X -XII which established that there was no significant difference between the intervention and diary groups on these variables, but that there was a significant difference between both groups and fullterm controls on all variables except for maternal age.

9.4.5) Results

The results of the videotaped analysis of the three groups is discussed and tabulated below.

9.4.5.1) Interaction Analysis:

The group data from this analysis for time spent in dyadic states is displayed as table 9.1 above. It is also presented graphically below as fig 9.3. The raw data, and basic group data analysis is tabulated in Appendix XII and XIII.

Significant group differences are demonstrated in amount of time spent in each dyadic state between the diary group and both intervention and fullterm control groups:

Control Vs. Premature Diary	:	$t = 9.457$ **	(df 16.897)
Intervention Vs. Diary	:	$t = 5.81$ **	(df 46.754)

(Unpooled variance t-test, ** sig. at 0.0005)

The difference between the intervention premature and fullterm control dyads does not reach statistical significance ($t = 0.073$ (df 12.799) NS).

The N to N + 1 transition data is presented as table 9.6 below, and as a series of state transition flow diagrams, fig 9.4(a), 9.4(b), 9.4(c) and 9.4(d). The transition diagrams show the mean number of epochs in each possible state together with the transition probabilities as a proportion of the total transition matrix.

State Transitions Calculated from Dyadic State Analyses within Groups

Table9.6

	Control Group Dyads (N = 10)	Intervention Group Dyads (N =10)	Diary Group Dyads (N = 10)	Epileptic Infant Dyad (N = 1)
M.AI. > M.AI.	0.672 ; 0.243	0.500 ; 0.088	0.924 ; 0.842	0.864 ; 0.644
M.AI. > Both	0.266 ; 0.058	0.417 ; 0.119	0.076 ; 0.069	0.000 ; 0.000
M.AI. > Neither	0.062 ; 0.014	0.000 ; 0.000	0.000 ; 0.000	0.136 ; 0.102
M.AI. > I.AI.	0.000 ; 0.000	0.083 ; 0.005	0.000 ; 0.000	0.000 ; 0.000
Both > Both	0.919 ; 0.617	0.870 ; 0.718	0.231 ; 0.020	0.000 ; 0.000
Both > Neither	0.000 ; 0.000	0.000 ; 0.000	0.000 ; 0.000	0.000 ; 0.000
Both > I.AI.	0.000 ; 0.000	0.000 ; 0.000	0.000 ; 0.000	0.000 ; 0.000
Both > M.AI	0.081 ; 0.054	0.130 ; 0.070	0.769 ; 0.068	0.000 ; 0.000
Neither > Neither	0.000 ; 0.000	0.000 ; 0.000	0.000 ; 0.000	0.600 ; 0.152
Neither > I.AI	0.000 ; 0.000	0.000 ; 0.000	0.000 ; 0.000	0.000 ; 0.000
Neither > M.AI.	1.000 ; 0.014	0.000 ; 0.000	0.000 ; 0.000	0.400 ; 0.102
Neither > Both	0.000 ; 0.000	0.000 ; 0.000	0.000 ; 0.000	0.000 ; 0.000
I.AI. > I.AI.	0.000 ; 0.000	0.000 ; 0.000	0.000 ; 0.000	0.000 ; 0.000
I.AI. > M.AI.	0.000 ; 0.000	0.000 ; 0.000	0.000 ; 0.000	0.000 ; 0.000
I.AI. > Both	0.000 ; 0.000	1.000 ; 0.005	0.000 ; 0.000	0.000 ; 0.000
I.AI. > Neither	0.000 ; 0.000	0.000 ; 0.000	0.000 ; 0.000	0.000 ; 0.000

In all cases, two figures are quoted - the first is the probability of change from the particular dyadic state, while the second is the probability of that change as a component of the total (N = 59 per subject) number of coded epochs.

Fig 9.3 Group Comparisons of Time Coded as being in Each Dyadic State.

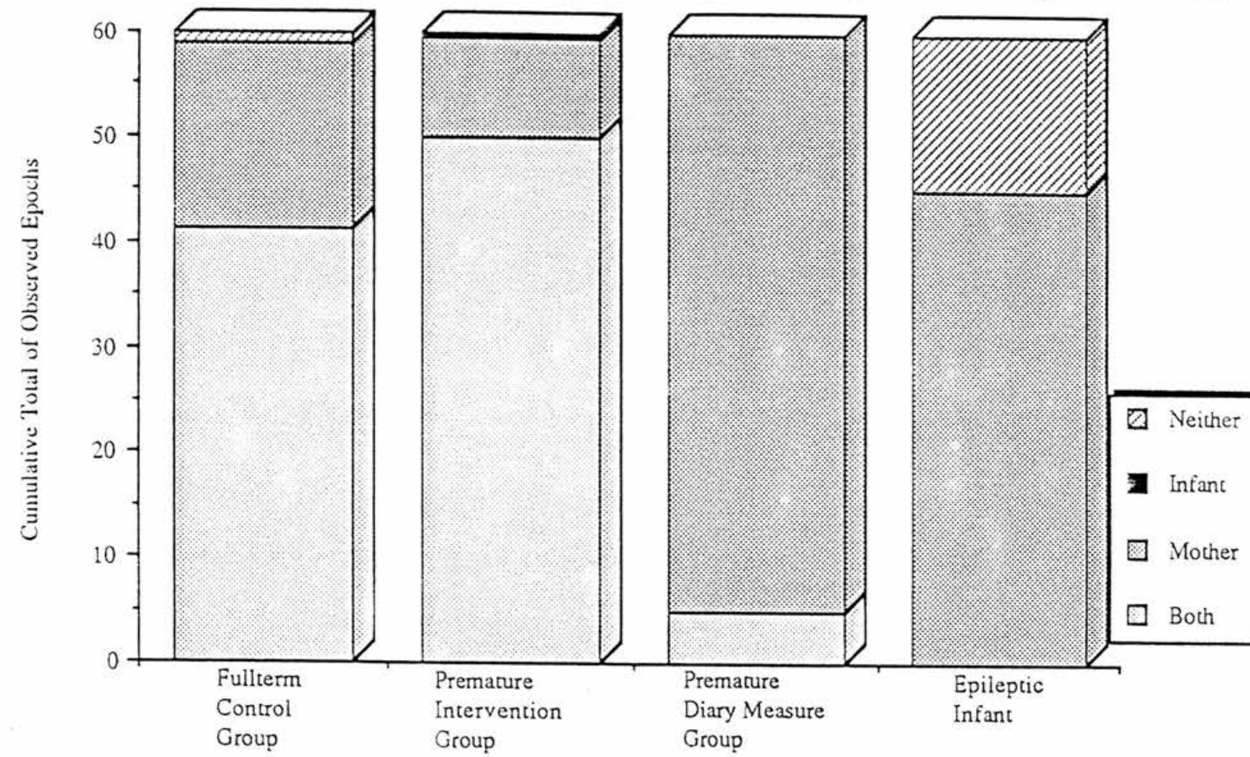


Fig 9.4 (a)

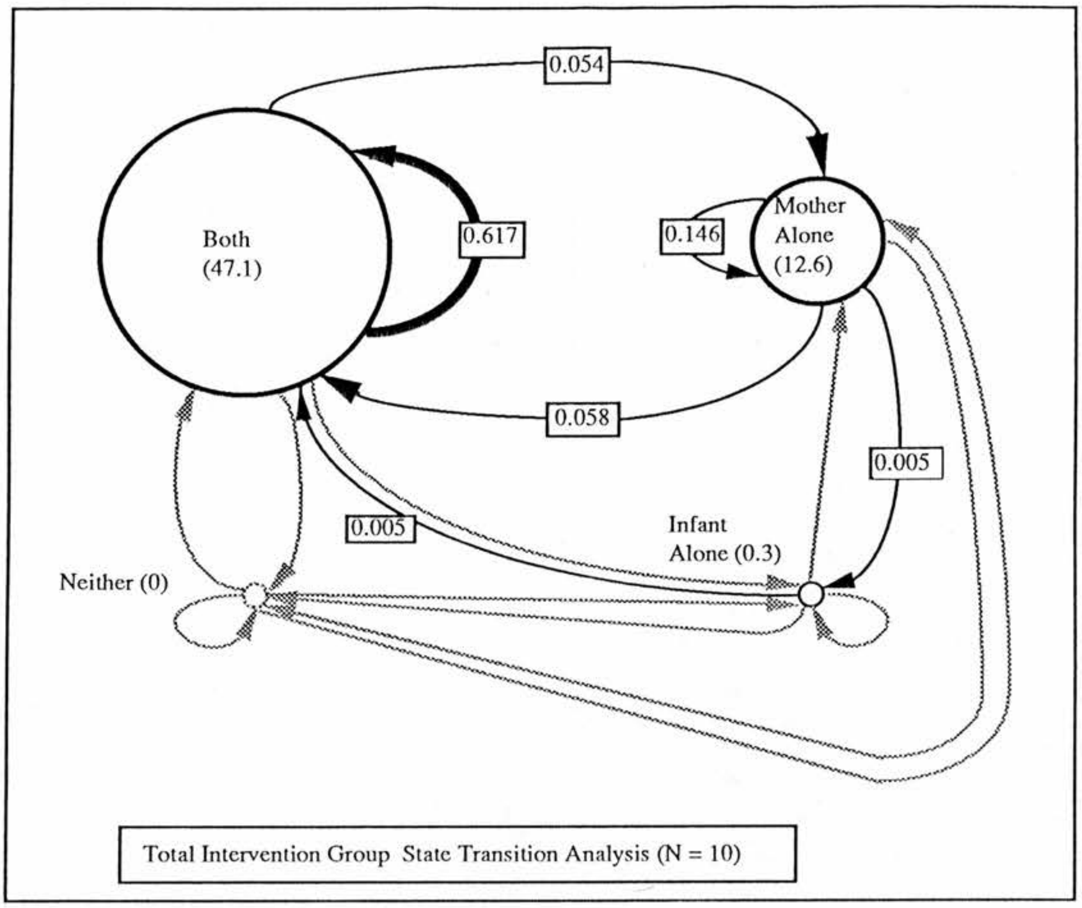


Fig 9.4 (b)

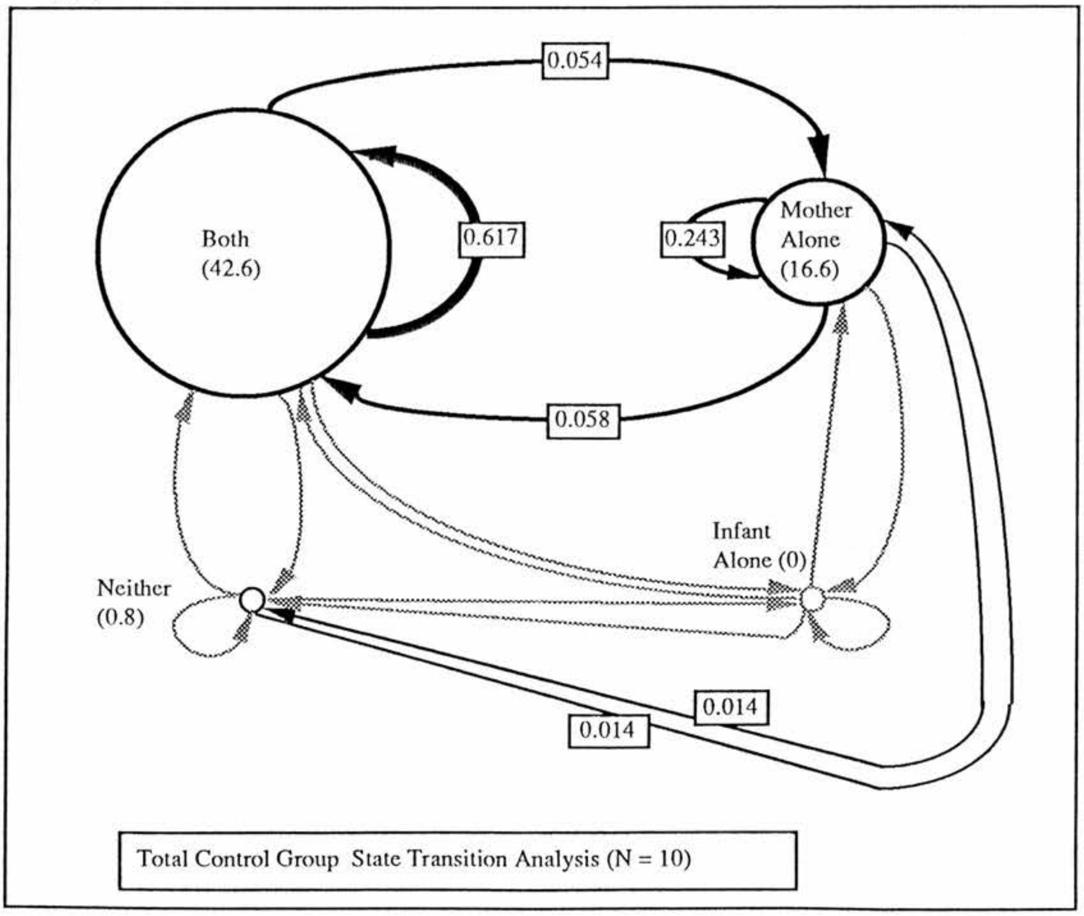
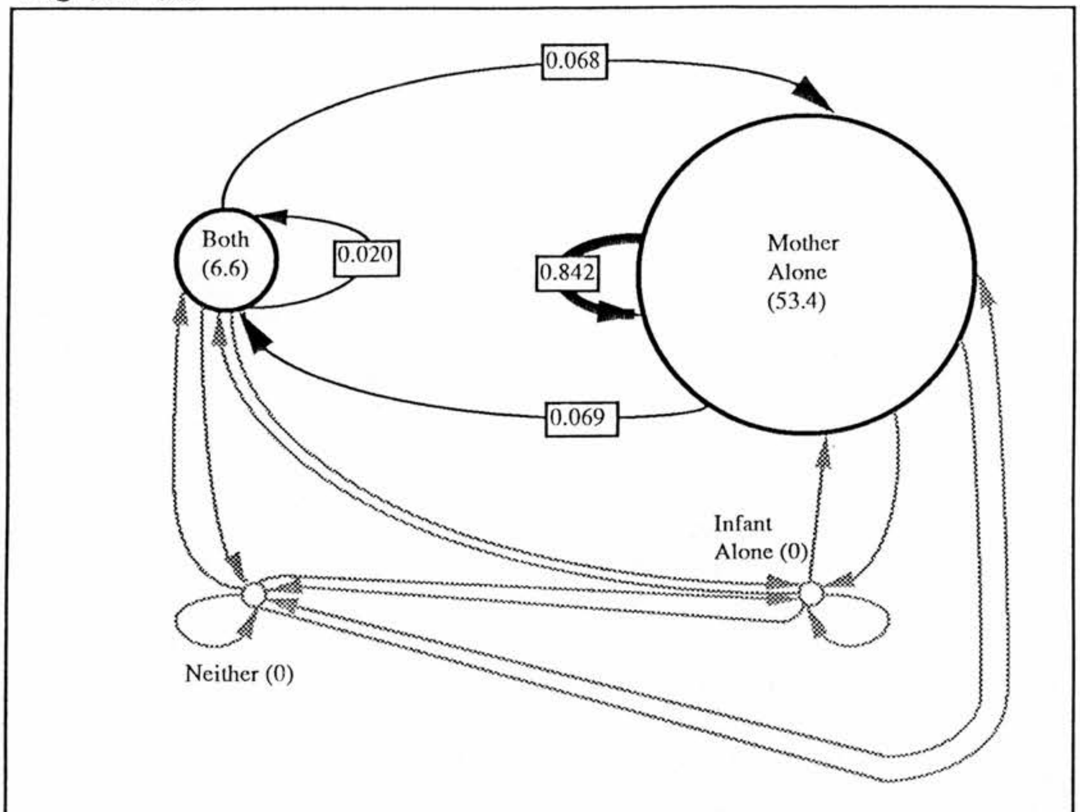
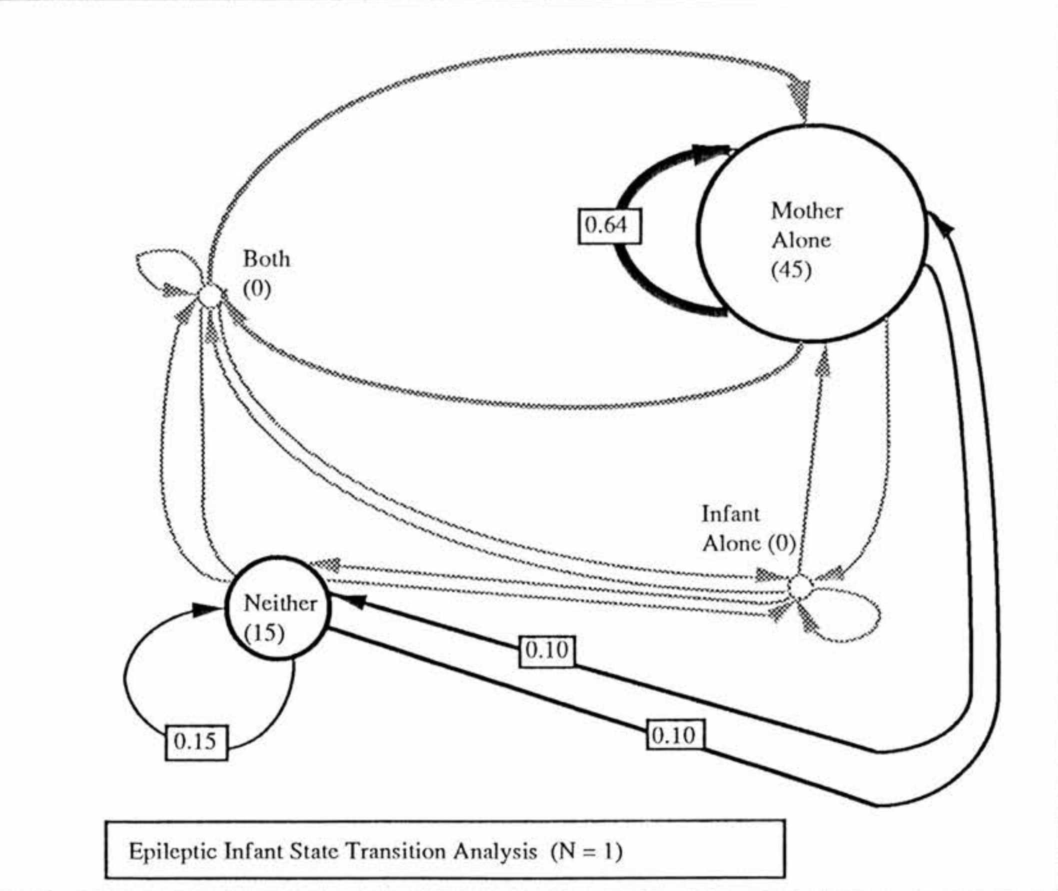


Fig 9.4 (c)



Total Diary Group State Transition Analysis (N = 10)

Fig 9.4 (d)



Epileptic Infant State Transition Analysis (N = 1)

Analysis of the transition data reveals a similar pattern to that seen with time spent in dyadic state. Collapsing the matrix of possible transitions into successes (M.Al > Both + I.Al. > Both + Both > Both) versus other transitions yields the following:

Control Vs. Premature Diary	:	$t = 5.728$ **	(df 8.9995)
Intervention Vs. Diary	:	$t = 2.8429$ *	(df 79.994)

(Unpooled variance t-test, * sig. at 0.005, ** sig. at 0.0005)

Comparison of intervention premature and fullterm controls again fails to reach statistical significance (t = 0.59455 (df 8.9987) NS).

9.4.5.2) Analysis of Vocalization:

Analysis of maternal vocalizations to the infant are presented below as tables 9.7 and 9.8. A number of measures of maternal speech differentiate between the groups. In particular, the average length of utterance is shorter in the fullterm and intervention groups.

There is no significant difference between intervention and control mothers in the proportion of questions asked of the infant (t = 0.5234 (df 9.71) NS), or the proportion of repetitions (t = 0.519 (df 22.899) NS)*. The diary group, in contrast, differ considerably from the other groups on both measures, with long periods of time during which the mother attempts to engage her infant with little success, and with a different structure to the speech used - fewer repetitions of either content or tonal pattern and fewer questions.*

* Unpooled variance t-test results

The epileptic mother infant dyad shows a marked contrast to the pattern seen in any of the study groups. Of particular interest is the amount of time spent by this dyad where neither the mother nor the infant attempt to engage the other. This is a possibility which was not observed in any of the study group dyads. The pattern of maternal speech was also different in being more brief than normal, where the diary prematures were more verbose. It is possible that this mother has begun to realise that the pertubation to communication which she is experiencing is due to an organic perturbation in her infant.

Table 9.7

Distribution of Certain Specific Types of Utterance Across the Groups Studied:

	CONTROL GROUP FULLTERM (N = 10)	INTERVENTION GROUP PREMATURE (N = 10)	DIARY GROUP PREMATURES (N =10)	EPILEPTIC INFANT DYAD (N = 1)
Interrogatives + Requests (eg: "What you doing ?"/ "Give me a cuddle.")	**35.8** (SD 12.4)	**38.0** (SD 19.8)	**27.8** (SD 8.4)	**22.0**
Complete Repetitions (eg: "What a face, what a face !")	**35.6** (SD 10.2)	**38.0** (SD 20.5)	**11.0** (SD 5.7)	**10.0**
Negative Statements about Infant (eg: "Whose a cross little thing !")	**1.0** (SD 1.4)	**1.5** (SD 1.9)	**6.7** (SD 1.7)	**6.0**
Negative Statements about Self (eg: "I'm sorry I shouldn't laugh at you." "Are we cruel to waken you up ?")	**0.2** (SD 0.4)	**0.0** (SD 0.0)	**2.0** (SD 0.8)	**0.0**

(Numbers refer to the average rate of occurrence of the specified forms of speech within a 5 minute videotaped sequence of interaction.)

Table 9.8

Distribution of Certain Specific Types of Utterance Across the Groups Studied (Cont.)

	Control Group Dyads (N = 10)	Intervention Group Dyads (N =10)	Diary Group Dyads (N = 10)	Epileptic Infant Dyad (N = 1)
Average length of maternal utterance. (In syllables, for maternal speech)	3.689 (SD .314)	3.278 (SD .339)	4.644 (SD .276)	2.254
Total Number of Maternal Utterances.	135.0 (SD 29.2)	122.8 (SD 25.4)	107.0 (SD 11.2)	63.0
Total Number of Maternal Syllables	494.2 (SD 85.0)	407.8 (SD 115.3)	495.0 (SD 26.6)	208
Maternal copying of Infant Vocalization. (eg: "Aaah!", "Achooh!")	2.2 (SD 3.0)	3.5 (SD 1.9)	2.0 (SD 0.8)	0.0
Maternal copying of Infant Behaviour. (eg.: blowing bubbles, tongueing)	1.3 (SD 1.5)	1.8 (SD 1.2)	1.0 (SD 0.8)	0.0

9.6) Chapter Summary and Conclusions

A review of behavioural differences in the premature infant and in adult responses to both actual and implied prematurity is presented. The interactive nature of the process of early development and of these components is discussed.

It is suggested that one factor likely to have led to decreasing parental attempts to engage with the infant in many previous intervention programmes has been lack of predictable success. This is a problem to which didactic approaches seem to have been particularly prone.

In the present research, the distress which such failure of expectations might bring was reduced, through providing a different range of maternal expectations of the outcome of intervention to those which were aimed at in most earlier work. Intervention was not focussed on achievement of specific developmental outcomes but rather on developing understanding of infant competencies and on positive patterns of early interaction. It was hoped that this emphasis would help to increase motivation and persistence on the part of the mother in the face of reduced predictability and levels of response from the infant.

The results suggest that this approach can be effective in restructuring the pattern of early interaction observed in premature mother-infant dyads. By seven weeks of age there is no significant group difference on either patterns of *interaction or maternal speech between intervention prematures and fullterm controls. Both groups are significantly different on these measures from the diary prematures. This was true for amount of time in each dyadic state, state transition probabilities, and for aspects of maternal speech such as number of interrogatives and number of questions asked. The length of utterance used by the intervention and fullterm control mothers was similar, and in both cases shorter than that used by the diary premature group. The only aspect of maternal language which was not found to differentiate in this way was the total number of syllables used by mother which differentiated the intervention prematures from the other two groups.*

The development and evaluation of a successful intervention approach to enhancing the early patterns of interaction in the premature infant has been described. The approach is based on the understanding and application of the intersubjective aspects of early development.

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CHAPTER 10
SUMMARY AND CONCLUSIONS

This thesis has had two principal aims:

1) *The development of a clinically practicable assessment measure which is sensitive to perinatal pertubations such as prematurity and obstetric complications and which could be used as the basis of a neonatal screening programme.*

and,

2) *the development and evaluation of an intervention approach based on an intersubjective model of early development.*

These aims have been framed within a review of the developmental and clinical literatures, highlighting the problems with contemporary theoretical and clinical approaches. There are apparent shortcomings to the available procedures in both of these areas. There is no readily available assessment procedure which is applicable to prematures and which focusses on the intersubjective nature of infant responses. The available measures, such as the APIB (Als, Lester, Tronick & Brazelton 1982), while useful, focus largely on aspects such as autonomic stability, motor and sensory capacities. As regards intervention approaches, none, to date, have used a similar intersubjective framework, and there are few reported successes. It is suggested that an interactional basis is a necessary component to effective help for such dyads.

10.1) The Development and Validation of a Neonatal Assessment

The Neonatal Neurobehavioural Assessment that was developed has been administered to a total sample of 62 fullterm newborns *and premature infants at estimated date of delivery. The findings from this cohort demonstrate the following relationships to neonatal status and responsivity:*

1) *that the scale is sensitive to the effects of birthweight and gestational age;*

2) *that it is influenced by the effects of obstetric complications;*

3) *that it is able to clearly differentiate between preterm and fullterm infants;*

and,

4) *that it is provides a sensitive indicator of the above variables in a manner which is not feasible with other currently available instruments.*

These findings are highly promising and warrant a more widespread validation of their clinical utility.

A number of further investigations would be useful in this respect, in particular:

1) *An independent assessment of the effects of obstetric complications and birthweight, looking at obstetrically compromised fullterm normal weight infants, and at obstetrically sound preterms;*

2) *A longitudinal study over the first 30 days postpartum. This would include postmature infants as the relationship of gestational age to optimality on the NNA was not found to be linear, with optimal performance only likely around fullterm;*

3) *Comparative evaluation against other, commonly employed, measures, in particular the Assessment of Preterm Infant Behaviour, Brazelton Neonatal Behaviour Assessment Scale - Revised, and the Neurologic and Adaptive Capacity Scoring System;*

4) *A within-subject longitudinal assessment to establish the stability of neonatal responsivity on the scale.*

10.2) *The Development and Evaluation of an Intersubjective Intervention Approach*

An intervention approach was developed which was based on an intersubjective model of early social development (Trevarthen 1985) focussed on the dyad to encourage mothers to develop mutually rewarding interactions with their infants. This was seen contrasted to the more commonly adopted 'Synactive' (Als 1986) or infant-focussed approaches which assume a knowledge of normal patterns of early premature development. It was suggested that a simple 'testing-out' approach to familiarising the mother with her own infants capacities would be of greatest likely benefit.

The package which was developed (see Chapter 9) was evaluated, comparing interactive outcome at seven weeks post EDD in ten infants against a matched group of ten control prematures where a diary record of development was kept, and a fullterm control group of ten infants at matched conceptional age. The results of this assessment clearly demonstrate the benefits of using such a simple cost-effective intervention strategy with such premature dyads.

The data collected demonstrated that the intervention led to the following:

1) *An alteration in the patterns of early interaction with an increase in the amount of time mother and baby spent in mutual engagement as compared to the premature controls;*
2) *An increase in the number and type of maternal utterances, such as questioning and imitation which correspond to the typical 'motherese' seen in the fullterm control dyads;*

3) An increase in the amount of maternal imitation of infant vocalization and facial movements over diary controls;

4) A decrease in the number of negative maternal statements about the infant over diary controls.

5) An increase in the amount of repetition observed, and a shortening of the average length of utterance used by the mothers during interactions over diary controls.

Overall, the intervention has been shown to increase the amount of 'normal' mother-infant interaction in premature mother-infant dyads. Typically, without the use of such an intervention, these dyads have been shown to be significantly deficient in their patterns of interaction and discourse (Aitken 1980; Beckwith & Cohen 1978; Brown, LaRossa, Aylward, Davis, Rutherford & Bakeman 1980; Field 1979).

The case of an infant, initially selected for the main study, who was shown to be suffering from epilepsy is also included as an example of a more pronounced perturbation with demonstrable disruptive effects.

10.3) Implications for a Further Programme of Research

Further validation of this intervention would be useful, in particular, the following aspects warrant further research:

1) Replication of the findings with a more tightly matched sample would be useful. Due to the randomised nature of the subject allocation procedure used, in the current study, subjects could not be closely matched, and although not significantly different did show variation on several criteria;

2) Replication of the findings with obstetrically sound prematures, obstetrically compromised fullterm infants and postmature infants to check whether the effects are specific to prematurity or are more general *in their applicability to the compromised infant.*

3) *Replication of the interactional component of the study using event rather than time sequence analysis. It is possible that a different form of interactional analysis might have given different results (if, for example, episodes of joint engagement proved to average less than half the coded epoch time in any one group this would be lost in the coding system employed as predominant state is coded.*

10.3) Conclusions

This thesis provides evidence that minor differences in gestational age, birthweight and obstetric complications have significant effects on the infant's overall neurobehavioural status and social responsivity.

It has been shown that, without intervention, there is disruption to early communication between mother and infant resulting from the 'biological perturbation' of prematurity.

Clear evidence is provided that the effects of such perturbations can be accommodated to by the mother with the aid of an intervention package which assists in developing her understanding of and relationship with her infant. It is also clear that there is a difference in the responsiveness of the intervention infants such that they spend significantly more time in mutual engagement than do the diary control infants, and, although different in some respects, largely resemble the patterns of early interaction observed in the fullterm controls.

The utility of an intersubjective, symbiotic framework in delineation of an intervention with biologically perturbed dyads *was tested. The feasability of such an approach has been clearly demonstrated.*

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APPENDIX I:

THE NEONATAL NEUROBEHAVIOURAL ASSESSMENT SCALE (NNA) MANUAL - ADMINISTRATION AND SCORING.

I wish to thank Lilly Dubowitz, Penny Palmer and Anna Morante of the Hammersmith Hospital, London, for their help and instruction in Neonatal Assessment, and on whose neonatal neurological assessment procedure (Dubowitz, Dubowitz, Palmer & Verghote 1980; Dubowitz & Dubowitz 1981) parts of the following scale are heavily based. I should also like to thank Heidi Als and Kevin Nugent of Boston Childrens Hospital, U.S.A. for observation of and reliability training on the Assessment of Preterm Infant Behaviour (APIB),(Als, Lester, Tronick & Brazelton 1982), and the Brazelton Neonatal Behaviour Assessment Scale (BNBAS) (Brazelton 1973, 1984), concepts from both of which instruments have been incorporated in the present scale.

NEONATAL NEUROBEHAVIOURAL ASSESSMENT (NNA) ADMINISTRATION MANUAL

This manual is intended as an outline of the method of administration for the neonatal assessment used in this research study. This examination is not a standardised assessment as such but rather a hybrid development from several existing methods of neonatal behavioural and neurological assessment. For fuller details of the assessments from which the current method has been developed, the reader is referred to the following papers and articles: Als, Lester, Tronick & Brazelton 1982; Brazelton 1973, 1984; Brown 1978; Dailey, Baysinger, Levinson & Shnider 1982; Prechtl 1977,1982; St.Clair 1978; Sullivan & Horowitz 1978. The intention in compiling this assessment has been to provide a technique which addresses both the behavioural and the neurological aspects of early infant assessment in a simply administered form, using items which themselves are af proven reliability and integrity as measures of early infant functioning.

TIMING OF THE EXAMINATION:

In ideal situations, the examination should be carried out midway between feeds (approximately 1.5 to 2 hours after the last feed if the infant is being fed 3 hourly), with the infant beginning the examination in state I, I/II, II or III (if his/her eyes are closed). If the infant is already in State III with eyes open or in a higher state, the habituation items if the scale are omitted and the examination begins with the assessment of posture. A timing difficulty is posed by the infant who is being fed nasogastrically on a more regular basis. In such cases, the *examination should be conducted when the infant is judged by the primary care staff to be in a light sleep state, and when the examination itself will cause the minimum of disruption to the routine of the unit.*

In the current study, all infants were assessed within 80 hours of full-term equivalent gestational age, for ease of comparison of results. In everyday clinical use, however, there is no particular reason to adhere to this criterion strictly, and it may be that serial assessments of stability of response will prove to be a valuable prognostic indicator (see Tynan 1986).

<u>ASSESSMENTS OF INFANTS IN INCUBATORS:</u>

With the premature, growth retarded or otherwise compromised special care infant, decisions on the appropriateness and feasability of assessment should always be made in consultation with the medical staff involved in the care of that infant. Factors such as difficulty in maintaining body temperature, hyperirritability, propensity to apnoeic attacks and physical distress consequent on handling may easily mitigate against a full neurobehavioural assessment.

An otherwise healthy infant who is in an incubator or being nursed under radiant heat can usually be fully assessed if he/she can be removed for short periods of time, or if the infant is free to move within the confines of the incubator or below the lamp. Medical limitations on the range of movement of the infant will lead to situations where only a limited examination can be carried *out, and where less of the examination material can be used.*

It is important that anyone planning to conduct neonatal assessments observe many such assessments being conducted by an experienced paediatric psychologist or clinician prior to attempting to work themselves, and that they have their competence in assessment confirmed by such a person prior to attempting to work independently.

EQUIPMENT:

To administer the NNA, the following four pieces of equipment are necessary:

- *i) An assessment proforma;*
- *ii) A pencil torch;*
- *iii) A simple, red, plexiglass rattle (essentially the same as used in the BNBAS (see:Brazelton 1984, p39);*
- *iv) A bright red ball, approximately 3 cm. in diameter (the author uses a red 'superball').*

STATE CODING:

The NNA employs the nine state coding system favoured by Als and her colleagues, which was developed for the APIB (Als, Lester, Tronick & Brazelton 1982), and which is a refinement on the more commonly used Prechtl five state coding system. The principal reason for using this, more elaborate, coding system is that the high-risk infant is more state labile than the normal fullterm, as many of the items on the examination are heavily state dependent. It is recognised that some authorities are not in full agreement with the reliability of differentiation which can be *achieved with more than a five state coding system (Prechtl 1982), however, the current author is convinced by the literature supporting both the six state system used in the BNBAS (see bibliography in Brazelton 1984), and for the thirteen state system employed in the APIB (Als, Lester, Tronick & Brazelton 1982). As state coding is normally used to ensure that the infant is in the most appropriate condition for assessment procedures to be conducted, rather than as a feature of the examination on which precise information is collected, the crucial factor is the ability of the assessor to discriminate between states in which the infant can and cannot be subjected to particular manoeuvres.*

<u>The thirteen states used in this assessment are defined as follows (see Als, Lester, Tronick & Brazelton 1983 if further details are required):</u>

1) (Ia) <u>DEEP SLEEP 1:</u> Breathing is regular, the facial musculature is relaxed, no eye movements are apparent and there are no spontaneous body movements.(Corresponds to BNBAS State I and to Prechtl State I).

2) (Ib) <u>DEEP SLEEP 2:</u> This involves rapid fluctuation between deep sleep as above, and brief isolated periods of behaviour as would be seen in light sleep - isolated startles, jerks and tremors.

3) (IIa) <u>LIGHT SLEEP 1:</u> Rapid eye movements apparent under closed lids, low activity level, some whimpering noises,irregular breathing.

4) (IIb) <u>LIGHT SLEEP 2:</u> Rapid eye movements apparent under closed lids, mild sucking and mouthing movements, some sighs and smiles, less agitated than in IIa.

5) (IIIa) <u>DROWSY 1:</u> Eyes open/closed, eyelid fluttering, diffuse movement, fussing.

6) (IIIb) <u>DROWSY 2:</u> As for Drowsy 1 but with less pronounced fussing behaviour - fewer facial grimaces, less vocalization...

(Neither state IIIa or IIIb appear in Prechtl's 5 state coding)

7) (IVa) <u>ALERT:</u> Awake and quiet, minimal motor activity. The infant appears somewhat distanced and not interested in activities around him/her. Eyes open intermittently.

8) (IVb) <u>HYPERALERT:</u> Awake and quiet, minimal level of motor activity, may appear to be fixed on visual stimuli and unable to break off or modulate fixation. Eyes wide open.

9) (IVc) <u>BRIGHT:</u> Awake and quiet, minimal level of motor activity, appears alert and to process information with internal modulation of level of interest.

10) (Va) <u>ACTIVE 1:</u> Diffuse fussing activity, eyes may be open or closed, infant is clearly aroused, some major motor movements, distressed facial expression.

11) (Vb) <u>ACTIVE 2:</u> Diffuse fussing activity, marked motor activity, distressed facial expression.

12) (VIa) <u>CRYING 1:</u> Crying as evidenced by crying face and grimacing, vocal cry may be slight, strained or absent.

13) (VIb) <u>CRYING 2:</u> Rhythmic, intense crying which is robust, vigourous and of normal volume.

For all items in the examination, state at time of administration should be monitored. State lability itself can be a useful measure of infant integrity, however, the primary function of close monitoring of state through the examination is to ensure that the infant is being tested in the optimal condition to obtain clear responses on any of the items administered.

All items are scored on a five point scale (although for some items there are several equivalent responses for any one point on the scale). The manual goes through the items in their normal sequence of administration, however, the sequence of items needs to be varied to accommodate the behavioural responses of the infant (pacifying, for example, necessitates prior distress on the part of the infant, and the point at which this can be assessed will vary with the irritability of the subject). The *order of items should be adhered to where possible as this should enable the infant to progress through the range of states, with self-consolability and consolability being assessed in the later stages of the examination, most commonly during the reflex section of the exam.*

SUMMARY GROUPING OF ITEMS:

In evaluating the results of this assessment, items are grouped under six summary headings: 1) Habituation to distal stimuli; 2) Responses to low tactile physical stimulation; 3) Responses to high tactile physical stimulation; 4) Orientation; 5) Social Responsivity, and 6) Summary Behavioural Items. An overall score on the examination is also calculated.

These clusters of items, with the exception of social responsivity, are broadly similar to those used by Lester in statistical analysis of the BNBAS (see Brazelton 1984 (Ch.5); Lester 1979a, 1979b), and in a previous unpublished study were shown to be amenable to similar statistical analysis (Aitken 1980).

NEONATAL NEUROBEHAVIOURAL ASSESSMENT:

DETAILS OF ITEM ADMINISTRATION

(A) HABITUATION ITEMS:

Item 1: *Habituation to Light* *Assess in States*

This item is assessed using the pencil torch. Up to ten short flashes of approximately one second are directed at one eye with a pause of at least five seconds, and always until the infant has quieted, between stimuli. Habituation is taken as two consecutive stimuli when no response has been ellicited from the subject. Response to the stimuli is judged on the basis of increase in respiration, reactive body and limb movements and eyeblink.

Scoring Criteria:

A) *No response to any of the ten stimuli;*

B) *either:*
i) Response to only the first stimulus;
ii) A progressive increase in response to each successive stimulus;
or,
iii) Fluctuating response to stimuli.

C) *either:*
i) Shutdown of physical responses after 2-5 stimuli, but with persisting blink responses;
or,
ii) Total shutdown of responses after 2-5 stimuli.

D) either:

i) Shutdown of physical responses after 6-10 stimuli, but with persisting blink responses;

or,

ii) Total shutdown of responses after 6-10 stimuli.

E) either:

i) An equal respons e to all of the 10 stimuli;

or,

ii) The infant comes to a fully alert state.

Item 2: *Habituation to Rattle* *Assess in States*

This item is assessed using the red plexiglass rattle. Up to ten brief shakes of the rattle, each of approximately one second duration are administered, with a five second pause between each stimulus. Habituation is judged according to the same criteria as are used for item 1, above: two successive stimuli eliciting no response.

Scoring Criteria:

A) No response to any stimulus;

B) Slight movement or blink to the first stimulus followed by habituation;

C) Startle or other movement or obvious respiratory responses seen to 2-5 stimuli followed by habituation.

D) Startle or other movement or obvious respiratory responses seen to 6-10 stimuli followed by habituation.

E) either:

i) An equal re sponse to all stimuli;

ii) The infant comes to a fully alert state;,

or

iii)Startles and other gross responses are seen throughout the examination.

(B) MOVEMENT AND TONE ITEMS:

Item 3: *Posture* *Assess in all States*

The infant is gently uncovered if swaddled, trying to disturb it as little as possible, and the predominant posture is noted. The posture which most closely approximates to that observed should be ringed on the scoring sheet and any notable differences (eg. limb flexion asymmetries) should be noted by modifying the diagram accordingly.

Scoring:

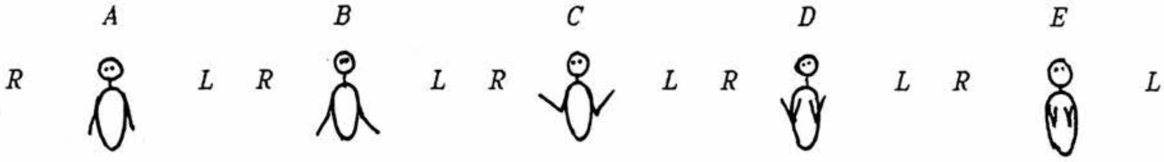
(Opisthotonic)

Having scored posture, the infant should be undressed in preparation for the rest of the movement and tone items.

Item 4: *Arm Recoil* *Assess in all States*

With the infant in the supine, grip both hands and extend the arms parallel to the torso. Release the hands briskly. If no response is ellicited, repeat the procedure after fully flexing the arms for 2-3 seconds. Any asymmetry of response observed should be recorded by circling R and L separately in the appropriate category for each arm.

Scoring:



A) *No arm flexion seen after 5 seconds.*

B) *Partial flexion at the elbow to 100° within 4-5 seconds.*

C) *Partial flexion at the elbow to 100° within 2-3 seconds.*

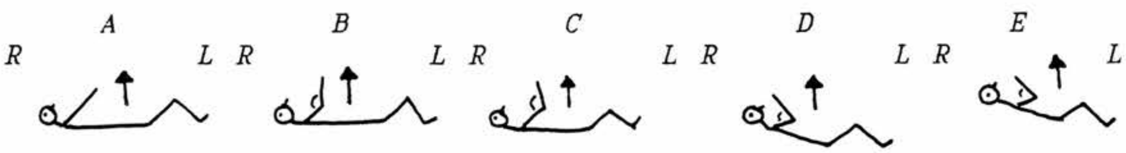
D) *Sudden jerky flexion at the elbow immediately after release to 60°.*

E) *Difficult to extend arms which snap back on release.*

Item 5: *Arm Traction* _ *Assess in all States*

With the infant in the supine and the head in the midline, lightly grip the wrist of one arm and slowly extend the arm vertically. Pay particular note to the angle at the elbow and the degree of resistance as the shoulder lifts clear. Repeat this manoevre with the other arm. Any asymmetry seen should be scored as for Item 4 above.

Scoring:



A) *Arm remains fully extended.*

B) *Weak flexion is maintained only momentarily.*

C) Arm flexed at elbow to 140° and maintained for at least 5 seconds.

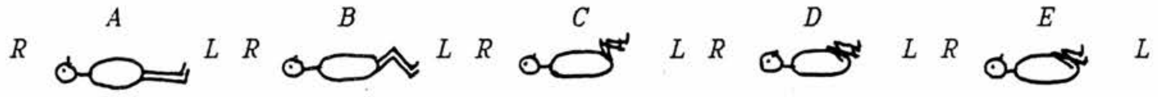
D) Arm flexed at elbow to 100° and maintained as shoulder lifts clear.

E) Arm flexed at elbow to over 100° and maintained as shoulder lifts clear.

Item 6: Leg Recoil Assess in all States

With the infant in the supine, lightly grip both ankles and flex the legs fully for 5 seconds. Extend the legs as far as possible by light traction on the ankles, maintain the extension for 2 seconds then release. Asymmetry is again scored as for Item 4.

Scoring:



A) No flexion within 5 seconds.

B) Incomplete flexion within 5 seconds.

C) Complete flexion within 5 seconds.

D) Instantaneous complete flexion.

E) Legs cannot be fully extended and snap back on release.

Item 7: Leg Traction Assess in all States

With the infant in the supine, lightly grip one ankle and extend the leg vertically until the buttocks are raised off the examination area by approximately 6 cm. Note any resistance, and score the angle maintained at the knee. Repeat the procedure with the other leg. Note any asymmetry as for Item 4.

Scoring:

A B C D E

R L R L R L R L R L

A) No flexion.

B) Partial flexion which is not maintained.

C) Flexion of 140°-160° established and maintained at the knee.

D) Flexion of 100°-140° established and maintained at the knee.

E) Strong resistance to extension, flexion of <100 maintained.

Item 8: *Popliteal Angle* *Assess in all States*

With the infant in the supine, approximate the thigh to the abdomen and extend the lower leg as far as possible towards the head by light pressure behind the ankle with the index finger. Assess each leg separately, noting the angle between the thigh and calf. An assymmetry should be noted as for item 4 above.

Scoring:

A B C D E

R L R L R L R L R L

160° 130° 110° 90° 70°

A) Calf can be extended to 160° angle with thigh.

B) Calf can be extended to 130° angle with thigh.

C) Calf can be extended to 110° angle with thigh.

D) Calf can be extended to 90° angle with thigh.

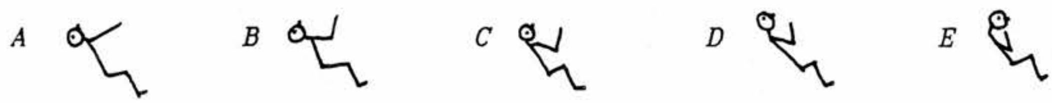
E) Calf can be extended to 70° angle with thigh.

All of the above figures are approximate, and scoring should be to the closest scoring to the actual angle observed.

Item 9: *Head Lag* *Assess in all States*

With the infant in the supine, lightly grasp both wrists and pull the infant into a sitting position by light traction. Be careful to keep the arms apart to minimise extraneous support for the head. Note the degree of flexion maintined at the elbow as well as the degree of head lag.

Scoring:



A) No flexion maintained at elbow, head control minimal, unable to raise head when clear of support.

B) Some slight flexion maintained at elbow, some degree of head control, but head position not in plane with spinal axis.

C) Good flexion maintained at elbow, reasonable head control, but still not in spinal plane.

D) Good flexion at elbow, head maintained in plane with spinal axis.

E) Strong flexion at elbow (<100°), head maintained forward of spinal axis.

Item 10: *Ventral Suspension* *Assess in all States*

Lift the infant in the supine, using one hand under the infants stomach and hold briefly in ventral suspension. Note the relation of the trunk to the head position, the degree of curvature in the back, and the degree of flexion maintained in the limbs.

<u>Scoring:</u>

A B C D E

A) No flexion in limbs, body limp with head lower than hips.

B) Slight arm and leg flexion, head held parallel to surface, back bowed.

C) Good flexion of arms and legs with distal elements (forearms, calves, and head) converging on a point symmetrically below the infant, neck flexed back out of parallel with spinal axis.

D) Good flexion in arms and legs, distal elements diverging from midpoint, head flexed but parallel to surface.

E) Good flexion in arms and legs, back straight, head held back with eyes looking forwards, hips parallel with shoulders.

<u>Item 11:</u> <u>Head Control (Posterior Neck Muscles)</u>

<u>Assess in all States</u>

Hold the infant lightly by the shoulders, supporting the head, and raise him/her to a sitting position. Allow the head to fall forwards whilst observing the trunk. Observe for up to 30 seconds.

<u>Scoring:</u>

A B C D E

A) No attempt made to raise head.

B) Head raised with vigourous jerk after several seconds.

C) Unsuccessful attempt to raise head gradually.

D) Head raised smoothly to upright position within 30 seconds.

E) Head remains upright and cannot be flexed forwards with reasonable pressure.

Item 12: *Head Control (Anterior Neck Muscles)*
Assess in all States

After completion of item 11, allow the infants head to fall slightly backwards whilst giving full support to the trunk with both hands. Observe for up to 30 seconds, until the infant had achieved a scoreable performance. Scoring criteria are as for item 11.

Scoring:

Item 13: *Head Raise in Prone* *Assess in all States*

(This item is to be assessed concurrently with item 14 unless restricted by motor difficulties or physical restrictions)

Place the infant in the prone position and place the head in the midline. Observe the behaviour of the infant for 15 seconds without intervention.

Scoring:

A) No response to manoevre observed.

B) Infant rolls head to one side.

C) Infant makes weak attempt to raise head and rolls same to one side.

D) Infant lifts head, nose and chin clear of surface.

E) Strong maintained head lift clear of surface.

Item 14: *Arm Release in Prone* *Assess in all States*

With the infant in the prone position, extend the arms in parallel to the trunk with the palms facing upwards.

Scoring:

A) No effort to raise the arms towards the head.

B) Some effort to raise the arms accompanied by generalised body wriggling.

C) Some flexion effort resulting in arm movement, but with neither wrist brought to nipple level.

D) One or both wrists brought to nipple level without use of excessive body movements.

E) Strong body movements with both wrists brought to head level ("pressups").

(C) SUMMARY MOVEMENT ITEMS:

Item 15: *Body Movements During Examination*
Observed in all States

This item is a summary record of overall spontaneous movement throughout the examination. If no spontaneous movements are observed, score movement which is ellicited by cutaneous stimulation.

Scoring:

A) Absent or slight spontaneous movement observed.

B) either
i) slow and infrequent movements,
or
ii) random and incoordinated movements.

C) Smooth and alternating moveme nts of the arms and legs which are of medium speed and intensity.

D) Smooth movements of the arms and legs which alternate with some jerky or athetoid ones.

E) either
i) predominantly jerky movements,
or
ii) predominantly athetoid movements.

Item 16: *Abnormal Movements or Posture*
Observed in all States

This is a summary item recording observed abnormal movements or postures through the course of the examination.

Scoring

A) No abnormal movements observed through the course of examination,.

B) either
i) Hands predominantly clenched but opened intermittently,
or
ii) Hands remain closed during Moro manoevre.

C) either

i) some mouthing movements,

or

ii) an intermittently adducted thumb.

D) Continuous mouthing movement through the examination.

E) either

i) A continuously adducted thumb,

or

ii) Hands remain clenched throughout.

Item 17: *Tremors* *Observed in all States*

This is a summary item recording any observed tremors through the course of the examination.

Scoring:

A) No tremors observed.

B) Tremors observed only in states Va,Vb,VIa,VIb.

C) Tremors only observed during sleep or after Moro or spontaneous startles.

D) Some tremors observed in states IVa,IVb,IVc.

E) Tremulousness observed in all states.

Item 18: *Startles* *Observed in all States*

This is a summary item recording all startles observed through the examination.

Scoring:

A) No startles observed.

B) Startles only observed in response to sudden noise, movement or to the Moro.

C) Occasional non-provoked startles seen.

D) 2-5 spontaneous startles noted during the examination.

E) More than 5 spontaneous startles observed during the examination.

(D) REFLEX ITEMS:

Item 19: *Palmar Grasp* *Assess in all States*

With the infants head positioned in the midline and the infant in the supine, lightly place your index finger into the hand from the ulnar side and press the palmar surface. Care should be taken that the dorsal side of the hand remains unstimulated dur ing this manoevre. This item should be administered for both hands and any asymmetry of response noted.

Scoring:

A) Palmar grasp absent (not ellicited).

B) either
i) asymmetry of response,
or
ii) short, weak flexion.

C) Medium intensity sustained flexion for several seconds which spreads to the forearm.

D) Strong flexion with contraction spreading to the forearm.

E) Very strong flexion in hand and forearm such that the infant can readily be lifted off the examination couch with flexion maintained.

Item 20: *Rooting* *Assess in all States*

Position the infant in the supine position with head in the midline. With one finger, lightly touch the corner of the mouth and make a downward and slightly lateral movement across the lower cheek. Repeat this manoevre three times.

Scoring:

A) No rooting response (defined as mouthing with head turning towards the stimulus).

B) either

or
ii) mouth opening with no head turning to the stimulated side.

C) Mouth opening with partial head turning in the direction of stimulation.

D) Mouth opening with full head turning and location of the stimulus.

E) Mouth opening with jerky, inaccurate head turning to the stimulus.

<u>Item 21:</u> *<u>Sucking</u>* *<u>Assess in all States</u>*

With the infant in the supine, and the head positioned in the midline, gently introduce an index finger (pad upturned towards the palate) to the infant's mouth. The power and form of the infant's sucking movements should be assessed after approximately five seconds.

<u>Scoring:</u>

A) No attempts at sucking are made by the infant.

B) either
i) the infant establishes a weak but regular sucking pattern,
or
ii) a weak and irregular sucking pattern is established.

C) Commencement of sucking is delayed, taking several seconds, however is strong and regular once established.

D) The infant establishes a strong, regular suck with a continuous train of at least five sucking movements, and clearly felt 'stripping' on the inserted digit (changing pressure moving from the front to the back of the mouth).

E) either
i) the infant clenches around the finger, but sucks when stimulated,
or
ii) clenches tightly with no sucking ellicited by digital stimulation.

Item 22: *Walking and Stepping* *Assess in all States*

Hold the infant upright with the neck supported, using one hand under each armpit.

For walking: with the infant's feet touching a firm horizontal surface, gradually move the infant forwards at a slight incline (ensure that the surface is an even one with no blankets or other obstructions).

For Stepping: holding the infant lightly but firmly under the arms, lift him gently such that the upper surface of one extended foot brushes the side lip of the cot as the infant is moved upwards. As for earlier items, any limb asymmetry should be noted.

Scoring:

A) Absence of both walking and stepping responses.

B) Either walking or stepping is weakly present but not both.

C) Some effort is made at walking but this is not continuous with both legs. Weak stepping is ellicited.

D) At least two steps are made with each leg. A clear stepping response is also ellicited bilaterally.

E) either
i) 'Stork' posture with no stepping ellicited and the legs held above the surface, jointly with strong brisk bilateral stepping response,
or,
ii) 'Automatic' walking and a strong brisk bilateral stepping response.

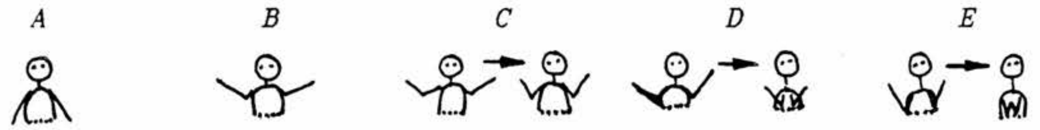
Item 23: *Moro Response* *Assess in all States*

There are two alternative methods of administering this item the second of which should be used where handling of the infant *should be minimised.*

Method 1: *With the infant's head supported in one hand, and the infant supported in the supine by the experimenter's other hand and his body at a 45° angle, the infant should be cradled briefly until relaxed. The head should then be allowed to fall back quickly through an angle of approximately 10°.*

Method 2: *Place the infant lying inclined in the supine on the experimenter's hands, unrestrained by blankets or other coverings, and at a slight angle to the horizontal (say 15°). the infant should be held until relaxed, then in a similar fashion to method 1, the whole of the infant's body should be allowed to drop quickly for 4-5 cm. with the head maintained in the same position relative to the trunk. Note any limb asymmetry.*

Scoring:



A) No Moro response ellicited: no arm movements seen in response to this manoevre.

B) Full abduction at the shoulder and extension of the arm.

C) Full abduction but only partial or delayed adduction.

D) Partial abduction at the shoulder and extension of the arms followed by smooth adduction movements.

E) either
i) very jerky Moro movements are ellicited,
ii) No or slight abduction is ellicited, but with clear adduction being seen,
or
iii) Marked adduction with no abduction.

Item 24: *Defensive Reaction* *Assess in all States*

With the infant in the supine, and head in the midline, place a hand or cloth over the top half of the infant's face leaving the nostrils clear. Continue this manoevre for approximastely 15 seconds and note the infants response.

Scoring:

A) No response ellicited, infant appears unconcerned.

B) either
i) general quieting with slowing of respiration and cessation of body movements,
or
ii) an increase in non-specific activity.

C) Neck stretching, undirected arm swipes and possible rooting to hand or cloth.

D) Swipin g movements with arm directed, in some cases at least, towards the interfering object.

E) Swipes with arms, and associated gross body movements.

(E) NEUROBEHAVIOURAL ITEMS

Item 25: *Eye Appearances* *Assess in all Waking States*

This item is a summary record of eye control observed during the examination, with particular reference to the orientation items administered in this section.

Scoring:

A) *either*
 i) *Sunset sign (where the aspect of the babies' eyes resembles a setting sun),*
 or
 ii) *Nerve Palsy.*

B) *Transient nystagmus, Strabismus, some roving eye movements.*

C) *Infant does not open eyes throughout the examination period.*

D) *Normal conjugate eye movements seen during the examination.*

E) *either*
 i) *persistent nystagmus;*
 ii) *frequent roving eye movements;*
 or
 iii) *frequent rapid blinking.*

....

ORIENTATION ITEMS

....

Item 26: *Auditory Orientation to Rattle* *Assess in States IIIa,b, IVa,b,c*

Where possible, the infant should be rested on the examiners knee, facing towards him. The same rattle should be used as was employed for auditory habituation (Item 2). With the infant's head positioned in the midline, supported by one hand, and the infant held at an angle of approximately 45°, the rattle should be shaken close to the ear for approximately 5 seconds. Care should be taken to make the noise made as consistent as possible from trial to trial. Repeat this twice for each ear. Note any asymmetry.

Scoring:

A) either
i) no orientation or other reaction is observed;
or,
ii) there is an auditory startle but no orientation is observed.

B) The infant brightens and stills. There may be head turning with eyes shut towards the stimulus.

C) The infant alerts and moves. There may be head turning towards the stimulus.

D) The infant alerts. There are obvious head turns towards the stimulus which persist, and searching with the eyes.

E) There is turning and alerting to stimuli on both sides, with prolonged searching. This may be accompanied by initial startle to stimuli.

Item 27: *Visual Orientation to Ball* *Assess in States IVa,b,c,*

The positioning of the infant is as for item 26. The stimulus ball should be held approximately 15-20 cm away from the infant's face, and initially presented in the midline. Once the infant has fixated on the ball, it should be moved slowly to one side and then the other up to 75° from the midline of the infants vision. Any tracking movements of head and/or eyes should be noted. If the infant succeeds with simple tracking, the experimenter should then proceed to investigate vertical tracking both upward and downward over a vertical angle of approximately 40° , and tracking in a slowly executed circle of approximately 20 cm. diameter traced in front of him.

Scoring:

A) The infant is unable to either focus on or to follow the stimulus.

B) The infant will focus on the stimulus and will follow jerkily for up to 30°. Once lost, he is unable to locate the stimulus again spontaneously.

C) The infant will follow for 30°-60° horizontally. He may lose the stimulus briefly but is able to relocate it without experimenter assistance. Brief vertical following glances are ellicited in response to vertical displacement of the stimulus.

D) The infant follows the stimulus well to more than 60° horizontally. There is some degree of vertical tracking with obvious frowning by the infant. Circular trajectory following cannot be ellicited.

E) The infant exhibits sustained and intense fixation on the stimulus. He is able to follow vertically, horizontally and in a circle with sustained effort.

Item 28: *Auditory Orientation to the Human Voice*

Assess in States IIIa,b,c,IVa,b,c

The infant should be positioned such that the examiner can speak close to his ear. This can be achieved either by holding the swaddled infant in both hands close to the examiners face or by placing the infant on a flat surface with his head in the midline such that the examiner can position him/herself close to the infant's head on each side. The examiner should speak softly to the infant and attempt to get him to orient towards the voice. This item should be repeated twice on each side. If the mother is present at the examination, it is useful to repeat the item getting her to speak to the infant.

Scoring:

A) either,
i) No reaction to the stimulus is seen;
or,
ii) there is an auditory startle but no true orientation to the stimulus.

B) *The infant is seen to brighten and still. There may be turning towards the stimulus with the eyes shut.*

C) *The infant alerts and moves about. There may be orientation towards the stimulus.*

D) *The infant alerts with consistent head turning towards the stimulus,though this may be inconsistent and with eye orientation to the source.*

E) *The infant conistently turns towards the stimulus, to both sides, this being accompanied by occasional startle.*

Item 29: *Visual Orientation to the Human Face*

Assess in States IVa,b,c.

The positioning and orientation of the infant is as for item 26. Without speaking, the experimenter should position his face approximately 15-20 cm from the infant as for the ball in item 27 , and, oncethe infant has fixated on this, move his or her face through a similar horizontal arc as for the ball. This manoevre should be repeated in the opposite direction, and, if the infant succeeds in this, by both vertical and circular tracking as for the ball.

Scoring:

A) *There is no attempt to fixate or follow the stimulus.*

B) *The infant will focus on the stimulus and may follow for up to 30° jerkily. He appears unable to locate the stimulus again spontaneously.*

C) *The infant will follow for 30°-60° horizontally. He may lose the stimulus but is able to relocate it spontaneously. Brief vertical glances can be ellicited but circular tracking is not seen.*

D) *The infant follows with head and eyes horizontally, and to some sustained extent vertically with frowning.*

E) *The infant exhibits sustained fixation to all stimulus manoevres. He is able to follow vertically, horizontally and in a circular path.*

Item 30: *Orientation to the Human Face and Voice*
Assess in States IVa,b,c.

The positioning of the infant is as for the preceding two items. The administration of the item is as for item 29 with the addition that the experimenter speaks softly to the infant as in item 28 whilst carrying out the various facial displacements.

Scoring:

A) Infant neither fixates on nor follows the stimulus.

B) Brightening and orienting towards the stimulus are seen. The infant may track, jerkily for up to 30° but has difficulty in relocating the stimulus once contact is lost.

C) The infant brightens, alerts and tracks the stimulus through 30°-60° horizontally. Brief vertical tracking may also be ellicited.

D) The infant brightens, alert s with prolonged head turns to horizontal tracking of the stimulus and with some upward tracking with frowning.

E) The infant will brighten, alert and track clearly to both sides, vertically, and in a circle.

(F) SUMMARY BEHAVIOURAL RATINGS

Item 31: *Alertness* *Assess on Behaviour Throughtout the Examination*

This item is a summary record of the level of alertness shown by the infant through the course of the examination.

Scoring:

A) The infant is inattentive, rarely or never responding to direct stimuli.

B) When alert and responsive, the infant remains in that *state for brief periods. There is variable response to the orientation items.*

C) *When alert, the infants responses are moderately sustained. The infant may use stimuli to bring himself to an alert state.*

D) *The infant exhibits sustained periods of alertness during the examination. Orientation is readily ellicited and reliable to visual, though often erratic to auditory, stimuli*

E) *The infant is continuously in an alert state and seems not to tire in his responsiveness to either auditory or visual stimulation.*

Item 32: *Peaks of Excitement* *Assess on Behaviour throughout the Examination*

This is a record of the highest state of arousal achieved by the infant through the course of the examination.

Scoring:

A) *The infant remains in a low state of arousal throughout the examination and never goes above State III.*

B) *The infant reaches a State IV or State V briefly, but through the majority of the examination is in a lower state.*

C) *The infant can reach State VI after stimulation, but will subside spontaneously to lower states without assistance.*

D) *The infant reaches State VI with or without stimulation, and is not able to quiet without assistance.*

E) *The infant reaches State VI with or without stimulation, and does not quiet either with or without assistance.*

Item 33: *Irritability* *Assess in States 3, 4.I,4.II,4.III, and 5.*

This item provides a summary score for the infant's responses to aversive procedures. In particular, uncovering, undressing, ventral suspension, Moro, pull-to-sit and walking & stepping items.

Scoring:

A) *No irritable crying is observed to any stimuli throughout the examination.*

B) *Crying is observed to 1-2 stimuli.*

C) *Crying is observed to 3-4 stimuli.*

D) *Crying is observed to 5-6 stimuli.*

E) *The infant cries to all aversive stimuli.*

Item 34: *Consolability* *Assess throughout Examination as Appropriate*

This summary item documents the extent to which the infant can be quieted on reaching a distressed state, and the amount of physical help which it requires in order to do so.

Scoring:

A) *State never goes above III throughout the examination, therefore consolability not assessed.*

B) *Consoling not required as infant, though becoming distressed at times, quiets spontaneously within a few seconds.*

C) *Consolation achieved by talking with hand on infant's stomach or swaddling.*

D) *Consolation achieved by infant being picked up and held, possibly with finger in mouth.*

E) *Infant not consoled by any of the above manoevres.*

Item 35: *Self-Consolability* *Assess throughout Examination as Appropriate*

This summary item documents the extent to which the infant is able to self-calm once distressed.

Scoring:

A) *State never goes above III throughout the examination, therefore self-consolation not observed.*

B) Infant self-quiets quickly by hand-to-mouth or other sucking activity, possibly with turning to increase ventral contact.

C) Self-quiets poorly, but can manage with assistance such as help to establish hand-to-mouth contact.

D) Needs to be settled by an adult, cannot self-quiet with limited assistance.

E) Cannot self-quiet nor be quieted by adult.

Item 36:	*Crying*	*Assess throughout Examination as Appropriate*
Item 37:	*Cuddliness*	*Assess during Examination when Consoling is found Necessary*
Item 38:	*Smiling*	*Observe throughout Examination*

No specific scoring scheme is employed for this item. Score only the presence or absence of smiling through the examination period.

Comments:

Note any particular features of the examination not covered explicitly by the examination.

APPENDIX II

Premature Baby Interaction Study

Information Sheet

The behaviour and early development of the healthy premature infant is something which we have only recently been able to study. Improvements in medical care over the past twenty years have led to a steady improvement in outcome for such babies. In order to give parents the best help and advice in how to relate to their premature infants, we are carrying out a project to investigate the early abilities of such babies and their early interactions with their mothers.

There are three parts to this research project:

1) To study the capabilities of the prematurely born infant when he/she reaches the expected date of delivery, using a standardised assessment of vision, hearing, motor ability, and responsiveness, the Neonatal Neurobehavioural Examination.

2) You will be given a diary to record what your baby is doing from day to day, which may also have some suggestions of things to try out - part of the aim is to see whether suggestions make any difference to what you notice your baby doing and do with him/her.

3) When your baby is seven weeks on from the estimated date of delivery, you and your baby will be videotaped chatting to each other for a brief period (of about five minutes) to look at the pattern of interaction and in detail at your babies responses.

This research is being carried out by Mr. **Ken. Aitken**, a Senior Clinical Psychologist at the Royal Hospital for Sick Children. If you have any queries or wish to discuss any aspects of the project with him, he can be contacted through the Department of Clinical Psychology, RHSC, on 031 - 668 2251 (Extn.27).

Premature Baby Interaction Study

Consent Form

I, ______________________ have had the nature of this study explained to me. I agree to my baby and myself taking part in this study which is being carried out by Mr.Aitken from the Royal Hospital for Sick Children. I understand that I am under no obligation to take part and that my descision to do so will not affect any aspect of the medical care of my baby or myself.

....

Signed: ______________________ *Date:* ________

Witnessed: ______________________ *Date:* ________

APPENDIX III

OBSTETRIC COMPLICATIONS SCALE (OCS)

OCS Scoring Sheet

Infants Name ______________________ Study Subject Number ________

Hospital Number ______________________ Sex

Birth Date

Mothers Name

Item	Optimal	Non-Optimal
1. Gestational Age	>37Wks	<37Wks
2. Birthweight	>2500g	<2500g
3. Marital Status	Married	Other
4. Maternal Age	18-30	Other
5. Previous Abortions	2/less	>2
6. Previous Premature Births	No	Yes
7. Previous Srtillbirths	No	Yes
8. Prolonged Unwanted Sterility	No	Yes
9. Time since last pregnancy	>12M.	<12M.
10. Parity	1-6	0/>6
11. Pelvis	No Disprop.	Disproportion
12. Rh.Incompatability/other haematological problem	No	Yes
13. Bleeding during pregnancy	No	Yes
14. Infections/other acute problems during pregnancy	No	Yes
15. Drugs given to mother during pregnancy	No	Yes
16. Maternal Chronic Diseases	No	Yes
17. Chronic Drug Abuse	No	Yes

18. Blood pressure during pregnancy	<140/90	>140/90
19. Albuminuria	No	Yes
20 Hyperemesis	No	Yes
21. Haemoglobin Level at end of Pregnancy	>10	10/<
22. Twins/Multiple Birth	No	Yes
23. Membranes Ruptured Prior to Delivery	0-12Hrs	>12Hrs
24. Delivery	Spont.	Other
25. Forceps	None/Low Elective	Other
26. Duration, First Stage	3-20Hrs	<3/>20Hrs
27. Duration, Second Stage	10-120Min.	<10/>120Min.
28. Induced Labour	No	Yes
29. Drugs During Labour and Delivery	No	Yes
30. Amniotic Fluid	Clear	Other
31. Fetal Presentation - Delivery	Vertex	Other
32. Fetal Heart Rate During Labour	100-160/Min.	<100/>160/Min.
33. Nuchal or knotted cord	No	Yes
34. Cord Prolapse	No	Yes
35. Plascental Infarction	No	Yes
36. Placenta Praevia/Abruptio	No	Yes
37. Onset of Stable Respiration within 6 minutes	Yes	No
38. Resuscitation Required	No	Yes
39. Prenatal Care During First Half of Pregnancy	Yes	No
40. Apgar Score - One Minute	7-10	0-6
41. Apgar Score - Five Minutes	7-10	0-6

(a) *Total (Raw Score):*_______________
(b) *No. of Items Recorded:*__________
(c) *% Raw Score (a/b):*_______________

	MATAGE	OCS	BWT	HABIT	POSTURE	LOWTACT	HIGHTACT	VESTIB	NNORIENT	SUMMARY
1	19	8	1750	2	2	15	16	1	9	14
2	22	5	2400	5	2	18	20	2	11	15
3	15	9	1420	6	2	13	12	2	8	17
4	32	8	1214	2	3	18	21	2	9	17
5	32	7	1170	4	2	18	18	2	6	20
6	26	8	1000	2	2	17	21	2	7	21
7	27	8	980	4	3	13	14	1	9	20
8	24	12	2140	4	2	15	13	1	6	21
9	29	12	2370	3	3	19	17	2	5	22
10	36	10	2100	6	3	19	17	2	11	19
11	24	4	1210	3	3	14	9	1	7	11
12	27	7	1630	2	3	16	14	2	7	16
13	24	8	1680	3	3	17	11	2	5	12
14	27	6	1900	2	3	24	16	2	10	21
15	24	6	1330	3	3	21	15	1	6	17
16	32	8	1150	2	2	21	23	3	6	23
17	31	10	2235	5	2	20	19	1	11	23
18	29	12	1800	3	3	22	16	2	5	23
19	28	8	2350	6	2	22	17	2	9	24
20	22	4	2455	5	3	18	19	2	11	16
21	27	3	2000	4	2	21	20	2	9	23
22	25	9	1930	3	3	19	19	1	10	19
23	37	6	1850	4	3	14	16	2	9	18
24	36	12	2370	4	2	17	20	2	11	26
25	27	5	2170	3	3	26	19	1	12	23
26	36	12	2370	3	3	17	21	2	8	16
27	20	4	1915	4	3	22	20	3	9	23
28	25	12	1800	4	3	13	18	2	7	20
29	20	4	2060	6	2	21	23	3	6	25
30	38	7	2540	3	3	17	20	1	13	19
31	38	7	2290	4	3	18	19	2	12	17
32	35	7	2100	5	2	15	12	2	12	17
33	21	1	3100	2	3	19	17	3	11	22
34	29	7	2580	5	2	19	19	1	13	17
35	28	5	4040	4	2	19	21	1	11	21
36	33	9	3770	4	2	19	20	2	10	25
37	33	7	3780	4	3	20	21	2	11	29
38	25	3	2890	4	3	20	23	2	15	21
39	29	9	2375	5	2	17	20	1	13	19
40	25	7	3200	5	3	22	21	2	10	22
41	35	2	3137	6	3	22	23	3	13	30
42	31	5	2730	4	3	21	20	2	12	24
43	24	1	2650	5	2	17	20	2	15	25
44	24	5	2640	4	3	18	17	2	10	19
45	31	7	4040	4	3	20	22	2	12	26
46	32	2	2890	6	2	19	19	2	10	16
47	27	3	4100	5	3	19	21	3	12	25
48	26	3	3540	4	3	16	18	2	10	17
49	28	0	3500	6	3	21	17	2	14	17
50	20	4	2580	6	3	19	21	2	10	18
51	31	5	3760	4	2	18	18	2	13	18
52	30	1	3060	5	2	18	20	2	10	19
53	29	3	3400	4	2	17	20	2	11	24
54	23	1	3610	4	2	16	22	2	10	22
55	21	9	3560	6	3	19	21	2	15	24
56	22	1	3950	2	3	16	18	1	7	13
57	27	4	3650	5	2	19	22	2	15	23
58	18	5	3370	5	3	16	20	2	12	23
59	19	3	4109	5	3	18	21	2	13	24
60	26	1	3380	4	3	21	19	1	15	21
61	29	2	3840	4	3	19	21	1	14	21
62	32	3	4170	6	2	23	20	1	11	20

APPENDIX IV

	OVERALLNNA	GA	SOCIAL ITEMS	Resusc.Req.	Apgar 1	Apgar 5
1	59	23	10	0	8	10
2	73	31	10	1	7	9
3	60	31	10	0	3	6
4	67	31	8	1	6	9
5	65	32	8	0	7	6
6	68	32	8	1	6	7
7	64	32	10	1	3	8
8	62	32	7	1	8	9
9	71	32	7	1	7	9
10	77	33	10	0	7	10
11	44	33	5	0	7	8
12	55	33	9	0	8	8
13	53	33	7	1	5	8
14	73	33	11	0	9	10
15	66	33	8	0	8	9
16	75	33	9	0	6	5
17	78	34	10	0	8	9
18	69	34	8	0	9	8
19	82	34	10	1	9	9
20	69	34	10	0	7	9
21	77	35	9	0	7	9
22	74	35	11	0	9	9
23	66	35	11	0	9	10
24	78	35	11	0	6	9
25	83	35	9	0	5	8
26	65	35	9	0	6	9
27	78	35	9	1	5	9
28	67	36	10	1	3	7
29	81	37	9	0	5	7
30	76	37	11	0	5	9
31	75	37	12	0	5	8
32	65	37	13	1	6	7
33	77	37	12	0	9	10
34	76	38	14	0	7	8
35	76	38	11	0	9	10
36	78	38	10	0	7	9
37	85	38	12	0	7	9
38	88	38	13	0	9	9
39	74	38	10	1	3	9
40	85	38	13	0	6	9
41	94	39	12	0	7	9
42	81	39	13	0	6	7
43	85	39	10	0	9	9
44	73	39	14	0	9	9
45	82	39	12	0	9	10
46	64	39	11	0	8	9
47	82	40	11	1	8	9
48	70	40	10	1	7	9
49	79	40	12	0	9	10
50	79	40	11	0	9	10
51	75	40	12	1	5	9
52	76	40	11	0	8	10
53	80	40	12	0	9	10
54	78	40	15	0	9	10
55	88	40	14	0	9	9
56	56	40	6	0	8	10
57	88	40	14	0	9	9
58	81	40	14	0	9	9
59	86	40	12	0	8	9
60	84	41	15	0	8	10
61	83	42	13	0	7	8
62	83	43	11	0	7	10

Fullterm Dataset

X_1: MATAGE

Mean:	Std. Dev.:	Std. Error:	Variance:	Coef. Var.:	Count:
27.138	4.47	.83	19.98	16.471	29
Minimum:	**Maximum:**	**Range:**	**Sum:**	**Sum Squared:**	**# Missing:**
18	35	17	787	21917	0

X_2: OCS

Mean:	Std. Dev.:	Std. Error:	Variance:	Coef. Var.:	Count:
4.034	2.639	.49	6.963	65.405	29
Minimum:	**Maximum:**	**Range:**	**Sum:**	**Sum Squared:**	**# Missing:**
0	9	9	117	667	0

X_3: BWT

Mean:	Std. Dev.:	Std. Error:	Variance:	Coef. Var.:	Count:
3389.69	541.202	100.499	292899.722	15.966	29
Minimum:	**Maximum:**	**Range:**	**Sum:**	**Sum Squared:**	**# Missing:**
2375	4170	1795	98301	341411075	0

X_4: HABIT

Mean:	Std. Dev.:	Std. Error:	Variance:	Coef. Var.:	Count:
4.655	.936	.174	.877	20.115	29
Minimum:	**Maximum:**	**Range:**	**Sum:**	**Sum Squared:**	**# Missing:**
2	6	4	135	653	0

X_5: POSTURE

Mean:	Std. Dev.:	Std. Error:	Variance:	Coef. Var.:	Count:
2.586	.501	.093	.251	19.381	29
Minimum:	**Maximum:**	**Range:**	**Sum:**	**Sum Squared:**	**# Missing:**
2	3	1	75	201	0

X_6: LOWTACT

Mean:	Std. Dev.:	Std. Error:	Variance:	Coef. Var.:	Count:
18.897	1.896	.352	3.596	10.035	29
Minimum:	**Maximum:**	**Range:**	**Sum:**	**Sum Squared:**	**# Missing:**
16	23	7	548	10456	0

X_7: HIGHTACT

Mean:	Std. Dev.:	Std. Error:	Variance:	Coef. Var.:	Count:
20.172	1.583	.294	2.505	7.846	29
Minimum:	**Maximum:**	**Range:**	**Sum:**	**Sum Squared:**	**# Missing:**
17	23	6	585	11871	0

X_8: VESTIB

Mean:	Std. Dev.:	Std. Error:	Variance:	Coef. Var.:	Count:
1.828	.539	.1	.291	29.499	29
Minimum:	**Maximum:**	**Range:**	**Sum:**	**Sum Squared:**	**# Missing:**
1	3	2	53	105	0

X_9: NNORIENT

Mean:	Std. Dev.:	Std. Error:	Variance:	Coef. Var.:	Count:
11.966	2.061	.383	4.249	17.227	29
Minimum:	**Maximum:**	**Range:**	**Sum:**	**Sum Squared:**	**# Missing:**
7	15	8	347	4271	0

X_{10}: SUMMARY

Mean:	Std. Dev.:	Std. Error:	Variance:	Coef. Var.:	Count:
21.483	3.897	.724	15.187	18.14	29
Minimum:	**Maximum:**	**Range:**	**Sum:**	**Sum Squared:**	**# Missing:**
13	30	17	623	13809	0

X_{11}: OVERALLNNA

Mean:	Std. Dev.:	Std. Error:	Variance:	Coef. Var.:	Count:
79.621	7.65	1.421	58.53	9.609	29
Minimum:	**Maximum:**	**Range:**	**Sum:**	**Sum Squared:**	**# Missing:**
56	94	38	2309	185483	0

X_{12}: GA

Mean:	Std. Dev.:	Std. Error:	Variance:	Coef. Var.:	Count:
39.517	1.214	.225	1.473	3.071	29
Minimum:	**Maximum:**	**Range:**	**Sum:**	**Sum Squared:**	**# Missing:**
38	43	5	1146	45328	0

X_{13}: SOCIAL ITEMS

Mean:	Std. Dev.:	Std. Error:	Variance:	Coef. Var.:	Count:
12	1.89	.351	3.571	15.749	29
Minimum:	**Maximum:**	**Range:**	**Sum:**	**Sum Squared:**	**# Missing:**
6	15	9	348	4276	0

X_{14}: Resusc.Req.

Mean:	Std. Dev.:	Std. Error:	Variance:	Coef. Var.:	Count:
.138	.351	.065	.123	254.425	29
Minimum:	**Maximum:**	**Range:**	**Sum:**	**Sum Squared:**	**# Missing:**
0	1	1	4	4	0

X_{15}: Apgar 1

Mean:	Std. Dev.:	Std. Error:	Variance:	Coef. Var.:	Count:
7.759	1.455	.27	2.118	18.759	29
Minimum:	**Maximum:**	**Range:**	**Sum:**	**Sum Squared:**	**# Missing:**
3	9	6	225	1805	0

Fullterm Dataset

X_{16}: Apgar 5

Mean:	Std. Dev.:	Std. Error:	Variance:	Coef. Var.:	Count:
9.207	.726	.135	.527	7.886	29
Minimum:	**Maximum:**	**Range:**	**Sum:**	**Sum Squared:**	**# Missing:**
7	10	3	267	2473	0

X_1: MATAGE

Mean:	Std. Dev.:	Std. Error:	Variance:	Coef. Var.:	Count:
27.727	6.043	1.052	36.517	21.794	33
Minimum:	**Maximum:**	**Range:**	**Sum:**	**Sum Squared:**	**# Missing:**
15	38	23	915	26539	0

X_2: OCS

Mean:	Std. Dev.:	Std. Error:	Variance:	Coef. Var.:	Count:
7.545	2.916	.508	8.506	38.652	33
Minimum:	**Maximum:**	**Range:**	**Sum:**	**Sum Squared:**	**# Missing:**
1	12	11	249	2151	0

X_3: BWT

Mean:	Std. Dev.:	Std. Error:	Variance:	Coef. Var.:	Count:
1902.394	506.344	88.143	256383.809	26.616	33
Minimum:	**Maximum:**	**Range:**	**Sum:**	**Sum Squared:**	**# Missing:**
980	3100	2120	62779	127634671	0

X_4: HABIT

Mean:	Std. Dev.:	Std. Error:	Variance:	Coef. Var.:	Count:
3.667	1.291	.225	1.667	35.209	33
Minimum:	**Maximum:**	**Range:**	**Sum:**	**Sum Squared:**	**# Missing:**
2	6	4	121	497	0

X_5: POSTURE

Mean:	Std. Dev.:	Std. Error:	Variance:	Coef. Var.:	Count:
2.606	.496	.086	.246	19.04	33
Minimum:	**Maximum:**	**Range:**	**Sum:**	**Sum Squared:**	**# Missing:**
2	3	1	86	232	0

X_6: LOWTACT

Mean:	Std. Dev.:	Std. Error:	Variance:	Coef. Var.:	Count:
18.152	3.232	.563	10.445	17.805	33
Minimum:	**Maximum:**	**Range:**	**Sum:**	**Sum Squared:**	**# Missing:**
13	26	13	599	11207	0

X_7: HIGHTACT

Mean:	Std. Dev.:	Std. Error:	Variance:	Coef. Var.:	Count:
17.333	3.425	.596	11.729	19.758	33
Minimum:	**Maximum:**	**Range:**	**Sum:**	**Sum Squared:**	**# Missing:**
9	23	14	572	10290	0

X_8: VESTIB

Mean:	Std. Dev.:	Std. Error:	Variance:	Coef. Var.:	Count:
1.848	.619	.108	.383	33.461	33
Minimum:	**Maximum:**	**Range:**	**Sum:**	**Sum Squared:**	**# Missing:**
1	3	2	61	125	0

X_9: NNORIENT

Mean:	Std. Dev.:	Std. Error:	Variance:	Coef. Var.:	Count:
8.697	2.352	.409	5.53	27.04	33
Minimum:	**Maximum:**	**Range:**	**Sum:**	**Sum Squared:**	**# Missing:**
5	13	8	287	2673	0

X_{10}: SUMMARY

Mean:	Std. Dev.:	Std. Error:	Variance:	Coef. Var.:	Count:
19.394	3.691	.642	13.621	19.03	33
Minimum:	**Maximum:**	**Range:**	**Sum:**	**Sum Squared:**	**# Missing:**
11	26	15	640	12848	0

X_{11}: OVERALLNNA

Mean:	Std. Dev.:	Std. Error:	Variance:	Coef. Var.:	Count:
69.455	8.885	1.547	78.943	12.793	33
Minimum:	**Maximum:**	**Range:**	**Sum:**	**Sum Squared:**	**# Missing:**
44	83	39	2292	161716	0

X_{12}: GA

Mean:	Std. Dev.:	Std. Error:	Variance:	Coef. Var.:	Count:
33.606	2.657	.462	7.059	7.906	33
Minimum:	**Maximum:**	**Range:**	**Sum:**	**Sum Squared:**	**# Missing:**
23	37	14	1109	37495	0

X_{13}: SOCIAL ITEMS

Mean:	Std. Dev.:	Std. Error:	Variance:	Coef. Var.:	Count:
9.424	1.678	.292	2.814	17.801	33
Minimum:	**Maximum:**	**Range:**	**Sum:**	**Sum Squared:**	**# Missing:**
5	13	8	311	3021	0

X_{14}: Resusc.Req.

Mean:	Std. Dev.:	Std. Error:	Variance:	Coef. Var.:	Count:
.333	.479	.083	.229	143.614	33
Minimum:	**Maximum:**	**Range:**	**Sum:**	**Sum Squared:**	**# Missing:**
0	1	1	11	11	0

X_{15}: Apgar 1

Mean:	Std. Dev.:	Std. Error:	Variance:	Coef. Var.:	Count:
6.606	1.784	.311	3.184	27.01	33
Minimum:	**Maximum:**	**Range:**	**Sum:**	**Sum Squared:**	**# Missing:**
3	9	6	218	1542	0

X_{16}: Apgar 5

Mean:	Std. Dev.:	Std. Error:	Variance:	Coef. Var.:	Count:
8.394	1.248	.217	1.559	14.874	33

Minimum:	Maximum:	Range:	Sum:	Sum Squared:	# Missing:
5	10	5	277	2375	0

Two Tailed t-Test of Premature Data against Control Sample

One Sample t-Test X_1: MATAGE

DF:	Sample Mean:	Pop. Mean:	t Value:	Prob. (2-tail):
32	27.727	27.138	.56	.5793

One Sample t-Test X_2: OCS

DF:	Sample Mean:	Pop. Mean:	t Value:	Prob. (2-tail):
32	7.545	4.034	6.917	.0001

One Sample t-Test X_3: BWT

DF:	Sample Mean:	Pop. Mean:	t Value:	Prob. (2-tail):
32	1902.394	3389.69	-16.874	.0001

One Sample t-Test X_4: HABIT

DF:	Sample Mean:	Pop. Mean:	t Value:	Prob. (2-tail):
32	3.667	4.655	-4.398	.0001

One Sample t-Test X_5: POSTURE

DF:	Sample Mean:	Pop. Mean:	t Value:	Prob. (2-tail):
32	2.606	2.586	.232	.8178

One Sample t-Test X_6: LOWTACT

DF:	Sample Mean:	Pop. Mean:	t Value:	Prob. (2-tail):
32	18.152	18.897	-1.325	.1945

One Sample t-Test X_7: HIGHTACT

DF:	Sample Mean:	Pop. Mean:	t Value:	Prob. (2-tail):
32	17.333	20.172	-4.761	.0001

Two Tailed t-Test of Premature Data against Control Sample

One Sample t-Test X_8: VESTIB

DF:	Sample Mean:	Pop. Mean:	t Value:	Prob. (2-tail):
32	1.848	1.828	.19	.4251

One Sample t-Test X_9: NNORIENT

DF:	Sample Mean:	Pop. Mean:	t Value:	Prob. (2-tail):
32	8.697	11.966	-7.985	.0001

One Sample t-Test X_{10}: SUMMARY

DF:	Sample Mean:	Pop. Mean:	t Value:	Prob. (2-tail):
32	19.394	21.483	-3.252	.0027

One Sample t-Test X_{11}: OVERALLNNA

DF:	Sample Mean:	Pop. Mean:	t Value:	Prob. (2-tail):
32	69.455	79.621	-6.573	.0001

One Sample t-Test X_{12}: GA

DF:	Sample Mean:	Pop. Mean:	t Value:	Prob. (2-tail):
32	33.606	39.517	-12.781	.0001

One Sample t-Test X_{13}: SOCIAL ITEMS

DF:	Sample Mean:	Pop. Mean:	t Value:	Prob. (2-tail):
32	9.424	12	-8.82	.0001

One Sample t-Test X_{14}: Resusc.Req.

DF:	Sample Mean:	Pop. Mean:	t Value:	Prob. (2-tail):
32	.333	.138	2.344	.0255

Two Tailed t-Test of Premature Data against Control Sample

One Sample t-Test X_{15}: Apgar 1

DF:	Sample Mean:	Pop. Mean:	t Value:	Prob. (2-tail):
32	6.606	7.759	-3.712	.0008

One Sample t-Test X_{16}: Apgar 5

DF:	Sample Mean:	Pop. Mean:	t Value:	Prob. (2-tail):
32	8.394	9.207	-3.741	.0007

	Control BWt	Control GA	Control Mat.Age	Control NNATot.	Control Soc.
1	4040	39	31	82	12
2	3700	38	33	78	10
3	3560	40	21	88	14
4	4040	38	28	76	11
5	4109	40	19	86	12
6	3610	40	23	78	15
7	3950	40	22	56	6
8	3370	40	18	81	14
9	2640	39	24	73	14
10	3200	38	25	85	13

	Interv.BWt.	Interv.GA	Interv.Mat.Age	Interv.NNA	Interv.Soc.
1	1214	31	32	67	8
2	1210	31	24	44	5
3	1630	33	27	55	9
4	2235	33	31	78	10
5	1800	34	29	69	8
6	2170	34	27	83	9
7	2370	35	36	65	9
8	1915	35	20	78	9
9	3100	35	21	77	12
10	1420	37	15	60	10

	Diary BWt.	Diary GA	Diary Mat.Age	Diary NNA	Diary Soc.
1	1170	32	32	65	8
2	1000	32	26	68	8
3	1900	33	27	73	11
4	1150	34	32	75	9
5	2455	34	22	69	10
6	2000	35	27	77	9
7	2370	35	36	78	11
8	2060	37	20	81	9
9	2540	37	38	76	11
10	2290	37	38	75	12

APPENDIX VIII

Control Group Characteristics - Interaction Analysis

X_1: Control BWt

Mean:	Std. Dev.:	Std. Error:	Variance:	Coef. Var.:	Count:
3629.9	462.894	146.38	214271.211	12.752	10
Minimum:	**Maximum:**	**Range:**	**Sum:**	**Sum Squared:**	**# Missing:**
2640	4109	1469	36299	133690181	0

X_2: Control GA

Mean:	Std. Dev.:	Std. Error:	Variance:	Coef. Var.:	Count:
39.2	.919	.291	.844	2.344	10
Minimum:	**Maximum:**	**Range:**	**Sum:**	**Sum Squared:**	**# Missing:**
38	40	2	392	15374	0

X_3: Control Mat.Age

Mean:	Std. Dev.:	Std. Error:	Variance:	Coef. Var.:	Count:
24.4	4.949	1.565	24.489	20.281	10
Minimum:	**Maximum:**	**Range:**	**Sum:**	**Sum Squared:**	**# Missing:**
18	33	15	244	6174	0

X_4: Control NNATot.

Mean:	Std. Dev.:	Std. Error:	Variance:	Coef. Var.:	Count:
78.3	9.129	2.887	83.344	11.659	10
Minimum:	**Maximum:**	**Range:**	**Sum:**	**Sum Squared:**	**# Missing:**
56	88	32	783	62059	0

X_5: Control Soc.

Mean:	Std. Dev.:	Std. Error:	Variance:	Coef. Var.:	Count:
12.1	2.644	.836	6.989	21.848	10
Minimum:	**Maximum:**	**Range:**	**Sum:**	**Sum Squared:**	**# Missing:**
6	15	9	121	1527	0

Intervention Group Characteristics

X_1: Interv.BWt.

Mean:	Std. Dev.:	Std. Error:	Variance:	Coef. Var.:	Count:
1906.4	587.446	185.767	345092.933	30.814	10
Minimum:	**Maximum:**	**Range:**	**Sum:**	**Sum Squared:**	**# Missing:**
1210	3100	1890	19064	39449446	0

X_2: Interv.GA

Mean:	Std. Dev.:	Std. Error:	Variance:	Coef. Var.:	Count:
33.8	1.874	.593	3.511	5.544	10
Minimum:	**Maximum:**	**Range:**	**Sum:**	**Sum Squared:**	**# Missing:**
31	37	6	338	11456	0

X_3: Interv.Mat.Age

Mean:	Std. Dev.:	Std. Error:	Variance:	Coef. Var.:	Count:
26.2	6.303	1.993	39.733	24.059	10
Minimum:	**Maximum:**	**Range:**	**Sum:**	**Sum Squared:**	**# Missing:**
15	36	21	262	7222	0

X_4: Interv.NNA

Mean:	Std. Dev.:	Std. Error:	Variance:	Coef. Var.:	Count:
67.6	12.131	3.836	147.156	17.945	10
Minimum:	**Maximum:**	**Range:**	**Sum:**	**Sum Squared:**	**# Missing:**
44	83	39	676	47022	0

X_5: Interv.Soc.

Mean:	Std. Dev.:	Std. Error:	Variance:	Coef. Var.:	Count:
8.9	1.792	.567	3.211	20.134	10
Minimum:	**Maximum:**	**Range:**	**Sum:**	**Sum Squared:**	**# Missing:**
5	12	7	89	821	0

Diary Group Characteristics

X_1: Diary BWt.

Mean:	Std. Dev.:	Std. Error:	Variance:	Coef. Var.:	Count:
1893.5	580.345	183.521	336800.278	30.649	10
Minimum:	**Maximum:**	**Range:**	**Sum:**	**Sum Squared:**	**# Missing:**
1000	2540	1540	18935	38884625	0

X_2: Diary GA

Mean:	Std. Dev.:	Std. Error:	Variance:	Coef. Var.:	Count:
34.6	1.955	.618	3.822	5.65	10
Minimum:	**Maximum:**	**Range:**	**Sum:**	**Sum Squared:**	**# Missing:**
32	37	5	346	12006	0

X_3: Diary Mat.Age

Mean:	Std. Dev.:	Std. Error:	Variance:	Coef. Var.:	Count:
29.8	6.408	2.026	41.067	21.504	10
Minimum:	**Maximum:**	**Range:**	**Sum:**	**Sum Squared:**	**# Missing:**
20	38	18	298	9250	0

X_4: Diary NNA

Mean:	Std. Dev.:	Std. Error:	Variance:	Coef. Var.:	Count:
73.7	4.968	1.571	24.678	6.74	10
Minimum:	**Maximum:**	**Range:**	**Sum:**	**Sum Squared:**	**# Missing:**
65	81	16	737	54539	0

X_5: Diary Soc.

Mean:	Std. Dev.:	Std. Error:	Variance:	Coef. Var.:	Count:
9.8	1.398	.442	1.956	14.27	10
Minimum:	**Maximum:**	**Range:**	**Sum:**	**Sum Squared:**	**# Missing:**
8	12	4	98	978	0

t-Test of Intervention Group against Diary Group

One Sample t-Test X_1: Interv.BWt.

DF:	Sample Mean:	Pop. Mean:	t Value:	Prob. (1-tail):
9	1906.4	1893.5	.069	.4731

One Sample t-Test X_2: Interv.GA

DF:	Sample Mean:	Pop. Mean:	t Value:	Prob. (1-tail):
9	33.8	34.6	-1.35	.105

One Sample t-Test X_3: Interv.Mat.Age

DF:	Sample Mean:	Pop. Mean:	t Value:	Prob. (1-tail):
9	26.2	29.8	-1.806	.0522

One Sample t-Test X_4: Interv.NNA

DF:	Sample Mean:	Pop. Mean:	t Value:	Prob. (1-tail):
9	67.6	73.7	-1.59	.0732

One Sample t-Test X_5: Interv.Soc.

DF:	Sample Mean:	Pop. Mean:	t Value:	Prob. (1-tail):
9	8.9	9.8	-1.588	.0733

t-Test of Intervention Group Characteristics against Control Cohort

APPENDIX X

One Sample t-Test X_1: Interv.BWt.

DF:	Sample Mean:	Pop. Mean:	t Value:	Prob. (1-tail):
9	1906.4	3629.9	-9.278	.0001

One Sample t-Test X_2: Interv.GA

DF:	Sample Mean:	Pop. Mean:	t Value:	Prob. (1-tail):
9	33.8	39.2	-9.113	.0001

One Sample t-Test X_3: Interv.Mat.Age

DF:	Sample Mean:	Pop. Mean:	t Value:	Prob. (1-tail):
9	26.2	24.4	.903	.195

One Sample t-Test X_4: Interv.NNA

DF:	Sample Mean:	Pop. Mean:	t Value:	Prob. (1-tail):
9	67.6	78.3	-2.789	.0105

One Sample t-Test X_5: Interv.Soc.

DF:	Sample Mean:	Pop. Mean:	t Value:	Prob. (1-tail):
9	8.9	12.2	-5.824	.0002

t-Test of Diary Group Characteristics against Control Cohort

APPENDIX XI

One Sample t-Test X_1: Diary BWt.

DF:	Sample Mean:	Pop. Mean:	t Value:	Prob. (1-tail):
9	1893.5	3629.9	-9.462	.0001

One Sample t-Test X_2: Diary GA

DF:	Sample Mean:	Pop. Mean:	t Value:	Prob. (1-tail):
9	34.6	39.2	-7.44	.0001

One Sample t-Test X_3: Diary Mat.Age

DF:	Sample Mean:	Pop. Mean:	t Value:	Prob. (1-tail):
9	29.8	24.4	2.665	.0129

One Sample t-Test X_4: Diary NNA

DF:	Sample Mean:	Pop. Mean:	t Value:	Prob. (1-tail):
9	73.7	78.3	-2.928	.0084

One Sample t-Test X_5: Diary Soc.

DF:	Sample Mean:	Pop. Mean:	t Value:	Prob. (1-tail):
9	9.8	12.1	-5.201	.0003

Interaction Sequence Raw Data

APPENDIX XII

a) Control Group (N = 10)

	Both	I.Al.	M.Al.	Neither
1.	38	0	22	0
2.	34	0	26	0
3.	47	0	13	0
4.	50	0	10	0
5.	49	0	10	1
6.	44	0	14	2
7.	46	0	14	0
8.	36	0	23	1
9.	47	0	13	0
10.	39	0	21	0

b) Package Group (N = 10)

	Both	I.Al.	M.Al.	Neither
1.	47	1	12	0
2.	53	0	7	0
3.	51	0	9	0
4.	39	0	21	0
5.	41	0	19	0
6.	48	1	11	0
7.	52	0	8	0
8.	44	1	15	0
9.	50	0	10	0
10.	47	0	13	0

APPENDIX XII

c) Diary Group (N = 10)

	Both	I.Al.	M.Al.	Neither
1.	5	0	55	0
2.	8	0	52	0
3.	4	0	56	0
4.	10	0	50	0
5.	6	0	54	0
6.	7	0	53	0
7.	5	0	55	0
8.	9	0	51	0
9.	7	0	53	0
10.	5	0	55	0

d) Epileptic Infant (N = 1)

	Both	I.Al.	M.Al.	Neither
1.	0	0	45	15

Package Group Interaction Matrix Statistics

X_1: Package Both

Mean:	Std. Dev.:	Std. Error:	Variance:	Coef. Var.:	Count:
47.2	4.662	1.474	21.733	9.877	10
Minimum:	**Maximum:**	**Range:**	**Sum:**	**Sum Squared:**	**# Missing:**
39	53	14	472	22474	1

X_2: Package Infant

Mean:	Std. Dev.:	Std. Error:	Variance:	Coef. Var.:	Count:
.3	.483	.153	.233	161.015	10
Minimum:	**Maximum:**	**Range:**	**Sum:**	**Sum Squared:**	**# Missing:**
0	1	1	3	3	1

X_3: Package Mother

Mean:	Std. Dev.:	Std. Error:	Variance:	Coef. Var.:	Count:
12.5	4.625	1.462	21.389	36.998	10
Minimum:	**Maximum:**	**Range:**	**Sum:**	**Sum Squared:**	**# Missing:**
7	21	14	125	1755	1

X_4: Package Neither

Mean:	Std. Dev.:	Std. Error:	Variance:	Coef. Var.:	Count:
0	0	0	0	•	10
Minimum:	**Maximum:**	**Range:**	**Sum:**	**Sum Squared:**	**# Missing:**
0	0	0	0	0	1

Diary Group Interaction Matrix Statistics

X_1: Diary Both

Mean:	Std. Dev.:	Std. Error:	Variance:	Coef. Var.:	Count:
6.6	1.955	.618	3.822	29.622	10
Minimum:	**Maximum:**	**Range:**	**Sum:**	**Sum Squared:**	**# Missing:**
4	10	6	66	470	1

X_2: Diary Infant

Mean:	Std. Dev.:	Std. Error:	Variance:	Coef. Var.:	Count:
0	0	0	0	•	10
Minimum:	**Maximum:**	**Range:**	**Sum:**	**Sum Squared:**	**# Missing:**
0	0	0	0	0	1

X_3: Diary Mother

Mean:	Std. Dev.:	Std. Error:	Variance:	Coef. Var.:	Count:
53.4	1.955	.618	3.822	3.661	10
Minimum:	**Maximum:**	**Range:**	**Sum:**	**Sum Squared:**	**# Missing:**
50	56	6	534	28550	1

X_4: Diary Neither

Mean:	Std. Dev.:	Std. Error:	Variance:	Coef. Var.:	Count:
0	0	0	0	•	10
Minimum:	**Maximum:**	**Range:**	**Sum:**	**Sum Squared:**	**# Missing:**
0	0	0	0	0	1

Control Group Interaction Matrix Statistics

X_1: Both

Mean:	Std. Dev.:	Std. Error:	Variance:	Coef. Var.:	Count:
42.6	6.535	2.067	42.711	15.341	10
Minimum:	**Maximum:**	**Range:**	**Sum:**	**Sum Squared:**	**# Missing:**
30	50	20	426	18532	0

X_2: Infant Alone

Mean:	Std. Dev.:	Std. Error:	Variance:	Coef. Var.:	Count:
0	0	0	0	•	10
Minimum:	**Maximum:**	**Range:**	**Sum:**	**Sum Squared:**	**# Missing:**
0	0	0	0	0	0

X_3: Mother Alone

Mean:	Std. Dev.:	Std. Error:	Variance:	Coef. Var.:	Count:
16.6	5.816	1.839	33.822	35.034	10
Minimum:	**Maximum:**	**Range:**	**Sum:**	**Sum Squared:**	**# Missing:**
10	26	16	166	3060	0

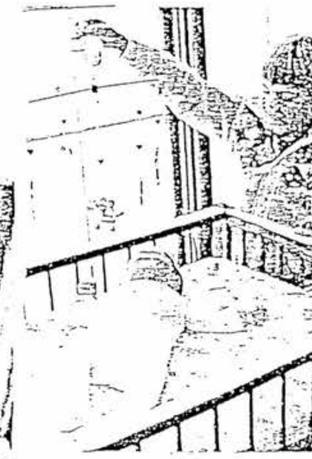
X_4: Neither

Mean:	Std. Dev.:	Std. Error:	Variance:	Coef. Var.:	Count:
.8	1.317	.416	1.733	164.57	10
Minimum:	**Maximum:**	**Range:**	**Sum:**	**Sum Squared:**	**# Missing:**
0	4	4	8	22	0

'My Baby Development Book'.

Baby: ______________________

Birthday: ________________



ABOUT THE RESEARCH:

You will have had an information sheet from the staff at the Simpson explaining the idea behind this research project.Each fortnight, while you are in the research study, you will be asked to try out three activities (making 12 in all) with your baby. Many of the things will be activities you will probably be trying out anyway, but we will be asking you to keep a note of each time you try them, and how your baby responded.

The activities we would like you to try are listed on the other side of the page. In thre booklet, there is a page on each activity, with space to record each time you tried it, and how your baby responded.

EXERCISE PROGRAM

0 - 2 Weeks

- i) Rocking and Singing Lullaby
- ii) Watching and Copying I
- iii) Spongeing and Stroking

2 - 4 Weeks

- iv) Following and Searching
- v) Baby Copying You
- vi) Mobile I

4 - 6 Weeks

- vii) Relaxing the Body
- viii) Exercising Arms and Legs
- ix) Watching and Copying II

6 - 8 Weeks

- x) Grasping and Holding
- xi) Sitting and Chatting
- xii) Mobile II

Rocking and Singing a Lullaby

Your baby is already familiar with your voice and heartbeat which he/she has heard from before birth. This is a chance for your baby to get used to soothing movements and sounds which will feel different now that he/she is no longer supported in water in your body or away from you.

Activity:

When your baby is awake and interested in what is going on, hold him/her gently against your body, or on your lap if you prefer, and sway or rock with them. Rock in time to a slow tune which you could hum or sing, or, if you aren't very musical, you could move in time to a record, tape or musical box. Check to see whether your baby enjoys being rocked and make sure that you move slowly and gently. Babies enjoy familiar rhythms and should quickly come to like this activity.

Tick off below each time you try this out:

✓	✓	✓	✓	✓	✓	✓	✓						

Try to write down the way your baby responded to the exercise in the space below:

Sally enjoys this exercise & it can calm her if she is upset

Watching and Copying

(0 - 2 WEEKS)

Sometimes babies are fascinated by things which follow their movements or sounds. This activity will help you to recognise when your baby is interested.

Activity:

Sit with your baby when he/she is bright and alert, watching for movements, changes of expression and listening for sounds. As far as you can, try to copy the movements, faces and noises you notice. At this age, some babies will find imitation interesting, others will not. This is a "getting to know you " game, which all infants find fun at some times.

A tip in getting your baby to stay brighter and interested for longer periods is to try to keep her in a fairly upright position on your lap or in a baby chair , rather than having him/her inclined in your arms or lying down.

Tick off below each time you try this out:

Try to write down the way your baby responded to the exercise in the space below:

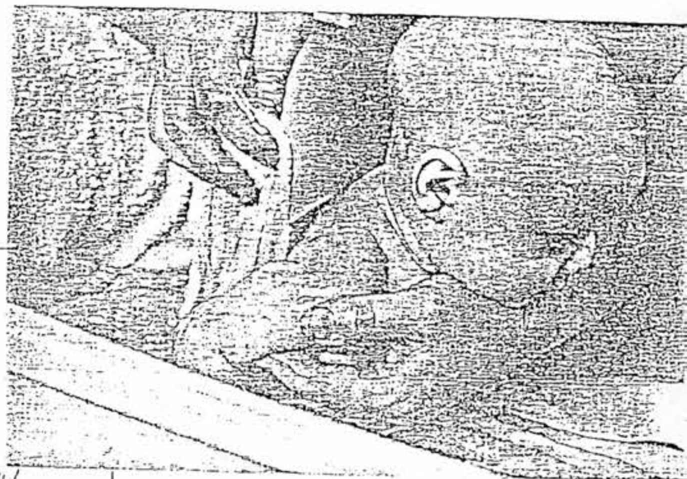
At first was not very interested would rather look at pictures, lights etc but at about 5-6 wks (0-1wk) she would look at you especially if s.thing up and try hard to smile at you although not really copying!
If you copy something she does she will occasionally look startled as if 'how can she do that as well'

oung babies enjoy being in warm water. Some doctors even believe in putting babies into water as soon as they are born as they are used to he feeling of support they get from the fluid that surrounds them before this.

This activity is to help you to play gently with your baby while bathing them.

Activity:

Sit your baby up in the bath/basin, supported by your hand as shown in the picture, and very gently stroke and massage his/her body arms nd legs. Notice whether your baby is tense in any part of the body and whether they seem to relax as you stroke and soothe them. Do this or as little or as long a time as you both seem to be enjoying yourselves.



Tick off below each time you try this out:

Try to write down the way your baby responded to the exercise in the space below:

At first was quite nervous of this have a photograph from Special care where you can see her grasping onto the basin! After about 1-2 wks of having her home she started to like this and will often lay her head against your arm as you are doing it. She also will suck on my arm although she has already been fed. loves her hair being washed and her head being massaged!

(2 - 4 WEEKS)

Following and Searching

Babies of this sort of age can usually follow objects which interest them with their eyes. They can't often find things once they have disappeared from view, and usually act as if the thing they have been following has vanished without trace without getting upset or earching.

Activity:

Take a small toy or brightly coloured object (a bright red is a good colour for gaining attention) and see whether your basby can follow it with his/her eyes. Notice how far the object is followed. Does your baby turn to follow the object ? Can he/she track it in circles and up and own ? Try this outr ofr a few minutes at a time, or until baby loses interest.

Tick off below each time you try this out:

Try to write down the way your baby responded to the exercise in the space below:

Not interested at all! - behaves as though it were not there at all! Would still rather stare at something in the distance.

Week up to 21st June - more interested in faces now but still not really interested in this. Will follow an object for a short while if held by a consultant médecin etc. after I have told them she isn't interested!!

Exercising the Arms and the Legs

This exercise is a way of improving the strength and coordination which your baby has in his/her limbs. All young babies go through an early stage of having strong grasps and leg movements. Your baby will probably already have gone through this stage by now.

Activities:

Arms: Try to get your baby to grasp hold of your fingers or thumbs with both hands, then lift up your hands so your baby has to tense his/her arms and pull. Note the amount of tension. Does your baby seem to enjoy this or not ?
Practice each day for a couple of minutes.
Legs: With your baby lying on his/her back, hold the legs gently near to the ankle and move them in and out - together at first, then a cycling motion one after the other. Keep this up for a short time. Note how relaxed your baby is, and how he/she responds to this.

Tick off below each time you try this out:

/	/	/	/	/	/	/							

Try to write down the way your baby responded to the exercise in the space below:

Arms - Sally enjoys this - most of the time. She grips tightly.
Legs - Only manage for a short time - she likes kicking & therefore tenses up.

(6 - 8 WEEKS)

Sitting and Chatting

Most parents notica a change in how 'chatty' their babies are at around this time or slightly later. This activity concentrates on somethin you will probably be spending time doing anyway, as your baby is becoming more interested in the important people around him/her.

Activities:
Prop your baby up on your lap or on a baby seat, but fairly close to you (within a couple of feet of your face is best).All you are asked t do is to chat to your baby in whatever way seems most natural to you - this could be copying, tickling, telling stories or whatever else you feel comfortable with and your baby seems to enjoy most. Continue this for about 5 minutes.

Tick off below each time you try this out:

/	/	/	/	/	/	/	/						

Try to write down the way your baby responded to the exercise in the space below:

Responds well - smiles & chats back.

There are many books on the market which are useful and informative about the development of both normally sized and small babies. Below is a list of four books which we think are quite good (and not too complicated if you don't know medical terms).

1. Born Too Soon: Preterm Birth and Early Development

by Susan Goldberg and Barbara DiVitto.
Published by W.H.Freemanand Company. ISBN 0-7187-1446-9. Paperback. (1983).

This is a good book which covers development over the first three years of life. It looks at many of the studies which have been carried out to look at the development of babies born prematurely. It is the most 'Scientific' of the books listed here.

2. A New Life: Pregnancy, Birth and Your Child's First Year

edited by David Harvey.
Published by Marshall Cavendish. ISBN 0-85685-566-9. Paperback. (1979).

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A very well illustrated guide to pregnancy and early development with masses of clear colour photographs and drawings covering most of the things you might want to know about early development, feeding, changing, common complaints.......

3. Premature Babies: A Guide for Parents

by W.H.Kitchen, M.M.Ryan, A.L.Rickards and J.V.Lissenden
Published by Thorsons Publishers Limited. ISBN 0-7225-0888-3. Paperback. (1984).

A short, very easily read book on premature infants and the sorts of questions most parents have in the early weeks and months: Breast feeding, contact with baby, why is she so small ? ,what will she be like when I get her home ?............

4. Born Too Early: Special Care for Your Preterm Baby

by Margaret Redshaw, Rodney Rivers and Deborah Rosenblatt.
Published by Oxford University Press. ISBN 0-19-261427-4. Paperback. (1985).

This is a well illustrated and written account of the early development of several premature infants, concentrating mainly on their time in hospital, with short sections on their early weeks at home and later followup.

SUPPORT GROUPS

There are many groups and organizations which provide help and information for parents of premature infants. Below are the details of how to contact two of the main ones:

I. NIPPERS. (National Information for Parents of Prematures: Education, Resources and Support). This can be contacted c/o the Perinatal Research Unit, St. Mary's Hospital, Praed Street, London, WC2.

II. Scottish Premature Baby Support Group (SPBSG) Contact: Mary Inglis, 5 Boghead Road, Lenzie, Glasgow Tel.: 041-777 6580

TABLE

Intervention Activity Sequence -

		Activity Type
0-2 Weeks	1. Rocking and Singing Lullaby	B
	2. Watching and Copying I	A
	3. Spongeing asnd Stroking	B
3-4 Weeks	4. Following and Searching I	C
	5. Baby Copying You I	A
	6. Mobile I	C
5-6 Weeks	7. Relaxing the Body I	B
	8. Exercising Arms and Legs	D
	9. Watching and Copying II	A
7-8 Weeks	10. Grasping	C +D
	11. Sitting and Chatting I	A
	12. Mobile II	C

Activity Key:

A : Direct Social Activities focussing on the development of affective reciprocity.

B : Care and stimulation activities with a secondary social component .

C : Simple contingency activities which focus the parent on infant perceptual abilities and directed awareness.

D : Tasks which focus parent awareness on infant motor skills.