THE EFFECTS OF OBSTETRIC MEDICATION ON NEWBORN BEHAVIOUR

Submitted by

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"To the woman He said, Many are the pangs,
many are the throes I will give thee to
endure. With pangs thou shalt give birth
to children..."

(Genesis 3, verse 16)

May this woman give birth happily!
May she give birth,
May she stay alive,
May she walk in health before thy divinity!
May she give birth happily and worship thee!

(Mesopotamian invocation to
Ishtar, the Sun God, cited
in Kitzinger, 1978)

ABSTRACT

In a study of the effects of obstetric medication on the neonate, 145 mothers and their offspring were studied from 36 weeks of pregnancy to six weeks after the birth. Fifty-one mothers requested intramuscular pethidine, 59 chose epidural bupivacaine and 35 decided not to have drugs. Data were collected during the antenatal period on health, psychological state, and expectations of the coming birth and baby. In the delivery room, observations were made of the infant and his parents, and selected assessments from the Brazelton Neonatal Behavioural Assessment Scale (BNBAS) were performed. The full BNBAS was carried out on days 1, 3, 7, 21, and 42. The Prechtl Neurological Examination (PNE) was done by a paediatrician on day 6. Records were kept by the mother over the first week of her infant's feeding and sleeping pattern, and for 24 hours after the 21 and 42 day visits. A series of questionnaires were also given to the mother during these first six weeks, covering the experience of labour, her mood, and perceptions of the baby.

A multiple regression analysis using "dummy variables" for pethidine and bupivacaine indicated that the mere presence or absence of pain-relief during labour generally had no effect on the neonatal measured used. However, when biochemical indices of drug metabolism in the infant (maternal dose, cord blood concentration in the infant, half-life, and pre- and post-delivery "exposure") were entered into the equation then maternal analgesia and anaesthesia were shown to have consistent and long-lasting effects on the infant. Higher cord levels of pethidine were associated with babies who were more prone to

respiratory difficulties, and drowsy and unresponsive immediately after delivery. In the following six weeks depressed attention and social responsiveness were found in connection with high drug levels, as were difficulties in state control at 3 and 6 weeks.

After greater exposure to bupivacaine in utero infants were more likely to be cyanotic and unresponsive to their surroundings in the delivery room. Visual skills and alertness decreased significantly with increases in the cord blood concentration of bupivacaine, particularly on the first day but also throughout the next six weeks. Adverse effects of bupivacaine levels were seen on motor organisation, state control and physiological response to stress. However, the changes involved were relatively subtle, and the failure to find "between-groups" differences suggests that many mothers who received either bupivacaine or pethidine had babies who performed as well, and sometimes better, than those who had not been given drugs.

Sleep and feed patterns and the neurological status of the infant were relatively unaffected by obstetric or medication variables. There were some modest associations between maternal psychological variables and neonatal and parental behaviour in the delivery room, but not over the next six weeks. Neither jaundice nor sex of the baby determined performance on the BNBAS. Discussion focuses on the interpretation of drug effects and the interdependence of psycho-social, obstetric and ecological variables in the management of childbirth.

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STATEMENT OF THE CANDIDATE'S CONTRIBUTION TO THE PROJECT

Although this study was a collaborative one the candidate was responsible for its design, the planning and co-ordination of data collection, coding and analysis, and a major share of the neonatal assessments.

A series of papers, partly based on earlier drafts of this dissertation, have already been published or presented at scientific symposia, co-authored with other members of the project team. A full list of papers in print appears in Appendix II.

For mothers-to-be, their partners, and their medical attendants, childbirth today has become a bewildering array of choices. Some of these involve the decision to make use of sophisticated technologies, for instance medical and surgical treatments for infertility, or fetoscopy and ultrasound screening to diagnose congenital anomalies. Other choices are more concerned with a search for the quintessence of birth itself, such as whether to deliver the baby into a quiet darkened room and warm bath, to allow siblings at the delivery, or to remain awake during a Caesarean section.

One of the most contentious aspects of labour and delivery practice is the use of pain relief. Before mothers choose from the many available options they want answers from their obstetrician or midwife - "How do the different drugs work?", "What side effects do they have?", "Do they interfere with natural labour?", "Will having drugs spoil the pleasure of the birth?", and most important of all, "Will the drugs harm our baby?". Medical staff find themselves not only having to answer such questions from an increasingly well-informed and thoughtful consumer population, but having to justify their practices in the light of current research.

Unfortunately, differing points of view often seem polarised into two opposing camps, those favouring "natural" childbirth versus doctors endorsing technology and "active management". However,

controversy, debate and fashion are not new in obstetrics; the table overleaf contains just a sample of divergent opinions about obstetric medication over the past 150 years. As background to the present study some of the developments in pain relief will be examined within a broader historical and anthropological context.

Childbirth has almost always been associated with rules, rituals, and kinds of "management". The framework of ideologies and beliefs which determines the conduct of pregnancy reflects a society's notions about the role of women and children, the level of understanding of the reproductive cycle, and its knowledge and practice of the healing arts. Although it could be argued that in the past birth would have been more integrated into the routines of family life, this is not to say that it was necessarily easy, natural, or painless. Popular sources probably overestimate the prevalence of societies in which women toiled in the fields well into their labour, squatted somewhere to effortlessly deliver the baby, and then returned to work within hours or days (Ford, 1945). As Simpson wrote when he introduced chloroform to obstetric practice:

> "the distress and pain which women often endure while they are struggling through a difficult labour are beyond description and seem to be more than human nature would be able to bear under any other circumstances" (Simpson, 1849).

Even "primitive" societies, with limited or inaccurate ideas of physiology and health care provide sanctions for and against activities and events thought to threaten mother, fetus, and infant. Attempts to manipulate the progress of labour are recorded in ancient history and in non-Western cultures today. Although Caesar himself was not born by Caesarean section, as long ago as 762 B.C. Roman law ordered that

Table INTRODUCTION 1. DIVERGENT OPINIONS OF OBSTETRIC MEDICATION

FOR	AGAINST
"I have no doubt whatever that some years hence the practice (ether and chloroform) will be general. Obstetricians may oppose it, but I believe our patients themselves will force the use of it upon the profession. I have never had the pleasure of watching over a series of better and more rapid recoveries; nor once witnessed any disagreeable result to follow in either mother or child; whilst I have now seen an immense amount of maternal pain and agony saved by its employment". (Simpson, 1848)	
	"The propriety of resorting to the use of chloroform and ether as means of obviating the pain and hazards of labor, is a question to be settled by an estimate of the safeness as well as necessity of it". (Meigs, 1849)
	"The ultimate fate of the present methods of obstetric analgesia may well hinge on the price the infant must pay for the mother's comfort". (Clifford and Irving, 1937)
"It seems clear that in our culture labor and delivery are for most women painful and that medications in one form or another will be necessary to relieve the pain, this being among the physician's first responsibilities. ...The proven untoward influences are relatively few. ...The medications used for analgesia and anesthesia, if they do not grossly alter the intrauterine environment, appear to be well tolerated by the fetus; and though there may be transient narcosis, there are probably few long-term untoward effects". (Bowes, 1970)	

FOR

"To criticise seriously the prescribing of a drug simply because infants exposed to it exhibit a slightly lower neuro-behavioural assessment score than do matched infants... would be irresponsible, and serve merely to play into the hands of therapeutic nihilists... Any distinction between drugs based solely upon the results of neuro-behavioural testing is an interesting and emotive exercise, which has proved useful for quoting to lay audiences in adovacy, or defence, of clinical management; it is probably of very little relevance to the subsequent development of the children concerned".

(Crawford, 1982)

AGAINST

"So far little has been said about pain in labour. It is my belief that the misunderstanding of this subject, and the use of analgesia as the first line of defence, is one of the saddest developments in obstetrics... pain thrives on fear, on lack of confidence and on loneliness, and must be fought with knowledge, confidence and encouragement".

(Dunn, 1976)

"There is no doubt in my mind that a significant proportion of the 4 million children and youths in the U.S. who are afflicted with significant mental and neurologic dysfunction are the victims of obstetric medication administered with the very best of intentions to the mother during labor and birth".

(Haire, 1981)

the operation be performed on women dying in the last few weeks of pregnancy in order to save the child; it became known as "lex caesarea" and the offspring as "caesones". Among the Jews there were laws to cover the rights of twins delivered by Caesarean section recorded in the Mischnejoth (before 140 B.C.), and by 400 A.D. the Talmud had exempted a woman from the usual days of purification if she had delivered abdominally (De Lee and Greenhill, 1943).

A culture's expectation of appropriate behaviour for the labouring woman is reflected in the efforts made to minimise any pain. Some societies, for instance, view labour as a "testing" time for the woman. Thompson (1967) reports that in a West African village a mother-to-be is expected to endure labour without making a sound; if she calls out she is told she is a coward and prolonging her labour. Belief about the source of pain may also determine the method of relief. Where pains are considered to be caused by the devil or evil spirits then it is quite appropriate to drive them out by spells, herbal concoctions, or physical actions. Among the Cuna Indians of Panama a shaman intervenes in difficult labours at the request of the midwife, to summon good spirits or call on the gods. Using "psychotherapy" techniques of a sort he may also weave a story around the mother's body in relation to the earth and all the forces of nature, giving her a focus for her painful ordeal and setting the journey of the baby into the context of particular cultural mythology. In other cultures the pain may be "given away" to someone else who "deserves" it more, such as an animal, a "good-for-nothing", or someone who lacks "moral fibre"(Kitzinger, 1978). The Egyptians recorded means for relieving the pain of birth, but these were probably unsuccessful or dangerous, and "worked" primarily as a result of faith in the healer himself (Moir, 1978).

In the past the power of midwives in affecting the outcome of fertility, pregnancy, and child survival often put them in the same position as witches. Assisting in the inquisition into witches in the 14th century, theologians argued that "no one does more harm to the Catholic faith than midwives" (Kramer and Sprenger, 1970). The Pope accused them of:

> "abandoning themselves to devils, incubi, succubi, and by their incanatations, spells, conjurations, and other accursed charms and crafts, enormities and horrid offences have slain infants yet in the mother's womb"

As late as 1591 the famous Scottish witch Eufame MacCalzean was burned alive after being found guilty of 28 charges of witchcraft, including using charms to cast the pains of labour onto a dog!

Even into the 19th century Christianity continued to re-inforce the notion that pain was divine punishment and a means of "achieving Grace through suffering". Most versions of the Bible have translated Genesis 3, verse 16 as inflicting a punishment on woman - she shall give birth "with pangs", "in sorrow", or "in pain". Oriental religions, too, expected a woman in labour to accept physical pain. However, this did not deter women and their attendants from procuring relief. From the middle ages onwards, the expansion of apothecaries made a number of potions and herbal mixtures widely available, including ergot and extracts from hemp, henbane, mandragora and poppy plants.

The age of "modern" pain relief began with Morton's use of ether for surgery in 1846, followed shortly after by chloroform and ether. As Professor of Midwifery at the University of Edinburgh, Simpson was the first to anaesthetise one of his patients in labour with ether. The following year he described the obstetric use of chloroform to a medical meeting in Edinburgh. However, there was great public opposition

to this breakthrough, particularly by the Scottish Calvinist clergy, who accused him of blasphemy, being "an instrument of the devil", and "violating the will of God". He eventually secured public favour after the successful administration of chloroform to Queen Victoria in 1853. A few drops of chloroform were dripped onto an open mask or handkerchief with each contraction; this early method of intermittent inhalational analgesia was soon fashionable and became known as "chloroform à la reine".

Nitrous oxide was first introduced to obstetrics in Russia in 1880, although it had already been used for dentistry by 1844 in America. Spinal anaesthesia was practiced in Germany in 1898. By 1901 two French doctors had independently administered caudal epidural anaesthesia as a single injection, although indwelling catheters for continuous epidurals were not in use until the 1940's. Considerable research into new drugs during and after World War II was carried out by an expanding pharmaceutical industry and resulted in a number of more effective, and safer, drugs being available to obstetricians and midwives. During the 1950's it was common for American women to be sedated during labour and delivery, with a number of drugs being used in a "cocktail mix". By the end of subject recruitment for the (U.S.) Collaborative Perinatal Study in 1965 the 39,000 deliveries had been carried out with 336 different premedication agents and 37 different anaesthetics (Broman, 1977).

It would be fair to say that in the early days of obstetric medication attending physicians were not overly concerned with the effect of drugs on the infant. Queen Victoria's physician made an observation that babies born to mothers who had chloroform do not

> "kick and scream in the violent way and grasp the bedclothes with the force during the first minute after birth, that is often observed under other circumstances" (Snow, 1853).

It has often been said, perhaps rather harshly, that because the mother, and not the infant, is the obstetrician's real patient then he is not worried by any minor problems that the infant may have. Brackbill (1979) suggests that -

> "... the obstetrician assumed (and still does?) that no matter how poor the infant's initial state, no matter how long the period before respiration began, no matter how blue his colour initially, no matter how unresponsive, if the infant ultimately appeared normal then he had suffered only transient difficulties".

It could also be argued that the popular view of the infant as a relatively unresponsive organism, whose world was an undifferentiated "blooming, buzzing confusion", made it unnecessary to look for subtle effects.

However, this is no longer the case. Our increasing knowledge about neonatal physiology and behaviour makes it appropriate to ask which areas of infant functioning may be compromised in the short and long-term by drugs given to his mother. And, as family size decreases, parents are intent on making their few birth experiences not just safe, but meaningful and rewarding. Research into attitudes and expectations about parenthood is important in illustrating how a woman's pregnancy cannot be viewed in isolation from other psychological and social factors in her life. Literature on these issues is discussed in Chapter 1 - THE STUDY OF NEONATAL BEHAVIOUR - along with the methodologies employed in investigating the effect of obstetric medication. Chapter II - OBSTETRIC MEDICATION AND THE NEONATE - outlines the facts

and principles of drug use, and provides a critical review of published studies of drug effects in the neonate. The remaining chapters present the aims, methodology, and results of this investigation of 145 mothers and infants whose labours were conducted under epidural anaesthesia with bupivacaine, with pethidine, or without drugs.

I. THE STUDY OF NEONATAL BEHAVIOUR

The newborn period has been of particular interest to investigators of early social relations. Two distinct approaches have now focussed on the postpartum period as an important source of the origins of particular styles of interaction between the two partners. On the one hand there are empirical studies suggesting that events such as separation of mother and baby can have deleterious effects (Klaus and Kennell, 1970) and that characteristics of the mother's handling (Sander, 1969) or the baby's temperament and behaviour (Osofsky and Danzger, 1974) partly determine subsequent interaction. In contrast, "microanalytic" studies of the behaviour between mothers and slightly older infants have revealed that the infant himself contributes a great deal to the "dialogue" with his mother (Stern, 1971; Trevarthen, 1975; Field, 1979), and that similar attention to an earlier period of development would be of value.

There has been a tendency, however, to ignore some of the complexities of the postpartum period by compartmentalising features into "independent" and "dependent" variables. It would be more accurate to view this period as being affected by a host of complex - and often inseparable - factors. This section will discuss some of what is known about the setting of birth in our culture today, the abilities and skills that mother and baby bring to the emergent social relationship, and some of the attendant methodological problems in studying infant behaviour and social interaction in the first week.

A. Newborn Capabilities

Recent work on social behaviour now recognises the greater role played by the infant (c.f. Schaffer, 1977a), and it is appropriate to begin with a description of the neonate's capabilities. Most of the myths that babies neither see nor hear in the first six weeks have been dispelled by systematic experiments on perception, although unfortunately mothers do continue to be given such outdated information in many maternity units. Empirical work has largely concentrated on perception and learning, but the experience of the neonate (and indeed of children up to the toddler stage) is strongly social in character, for most contact with the world of material objects and natural events is mediated by the actions of his caregivers.

The infant's readiness to participate in social interaction depends on at least two specific developments: his perceptual abilities in orienting and maintaining attention to social stimuli, and his capacity for sustaining an alert and responsive state. To a lesser degree his motoric control (holding his head in the midline, and sitting at an angle without flopping), and his neurological maturity (not startling or becoming tremulous in response to changes in light, noise, and temperature) also play a part. Mothers may well take account of the infant's individual characteristics - willingness to smile, "cuddliness", physical appearance, and propensity to be soothed by her voice - in initiating and sustaining interaction (Osofsky, 1976).

1. State

The infant's ability to modify his wakefulness and alertness to suit the circumstances contribute to his status as a partner, rather than just a recipient, in social interaction. The concept of behavioural

"state" has proved very valuable in infant research (Gregg, Haffner and Korner, 1976). Most of the work on state treats it as a descriptive evaluation defined by observable behaviour (Escalona, 1962; Brazelton, 1973), though reference to physiological measurements such as EEG has clarified some of the parameters (Prechtl, Akiyama, Zinkin and Grant, 1968; Stern, Parmelee, Akiyama, Schultz and Wenner, 1969). Six states are generally utilised in infancy work:

(1) deep sleep, where breathing is regular and movement absent;

(2) light sleep, with irregular breathing, occasional restlessness and rapid eye movements; (3) drowsy awakeness; (4) alert awakeness;

(5) a fussing, high activity state; and (6) crying. State used to be defined as a continuum ranging from deep sleep to high arousal, but this has since been replaced by the concept of states as specific modes of neural activity (Prechtl, 1982).

State must be taken into account in research for a number of reasons:

(i) The type and quality of response that the infant makes to stimuli is strongly related to the state which he is in at the time (Korner, 1969; Thoman, 1975). For example, it is easiest to obtain consistent orienting responses in an alert state (Prechtl, 1965; Brazelton, 1973), although successful attempts have been made to screen for hearing loss while the infant is in a sleep state (Bench and Weir, 1977).

(ii) Both internal and external events determine state. Important factors such as time since last feed, amount of sleep, noise, light, and temperature levels can be modified to bring an infant into an appropriate state for testing. If such variables are not controlled for in observational and experimental work spurious or misleading conclusions might be drawn (Beintema, 1968).

(iii) The infant shows a tendency to get into, and remain in a state that is appropriate for the situation. Stimulation will wake him, and usually he will become alert. If he is overwhelmed by stimulation he will fuss, and finally cry. But he is able, usually, to quiet himself again and return either to an alert state or to sleep. The exact pattern of the state changes will depend on the demands of the situation, on the baby's resources, and on the particular baby (Thoman et al, 1972).

The infant's ability to maintain his own state interacts with a responsiveness to the attempts of others to manipulate his state. The stimuli most likely to bring him in a controlled way from sleep to alertness are human stimuli, and he will quiet from a crying state more readily when efforts are made to comfort him (Korner and Grobstein, 1966).

Opinions differ on the extent to which the neonate's behaviour can be called intentional; we must recognise the problems of defining such an intangible and allusive aspect of human action. Nothing we have said here about control of state goes beyond the degree of sophistication of a simple homeostatic mechanism, but clearly the infant does become intentional in his actions as he develops. It may be that the most important contributor to this is the degree to which a mother will inevitably treat behaviour as deliberate and conscious. A mother devotes a great deal of time to shaping the infant's state toward her own goals. Thus she will attempt to wake him to ensure stronger suckling, or reduce his heightened state of activity and crying by soothing him to sleep. As Thoman (1975) puts it: "state acts as a prelude, a mediator, and an elicitor, as well as the context for any interaction that occurs between the infant and his mother".

2. Perceptual Abilities

Numerous studies have documented the infant's perceptual skills during the early weeks. It is well established, for example, that the infant can discriminate patterns of relatively fine detail, and tends to prefer areas of high contrast, or attend to movement (Fantz, Ordy and Udelf, 1962; Brennan, Ames and Moore, 1966). Extensive work

has been devoted to the topic of an innate preference for social stimuli, particularly "facedness" as reported by Fantz (1961). However, Hershenson (1965) and Wilcox (1969) both failed to confirm a preference for faces in infants under 16 weeks, and it has been suggested that any "preference" probably depends on simpler aspects such as contour density, contrast or symmetry (Haith, 1978; Maurer and Barrera, 1981).

Much work has also been done on auditory responses and discrimination in young infants. An auditory threshold for neonates has been established at about 40-60 dB above adult thresholds, with a greater sensitivity to low-frequency sounds (Weir, 1979). By the end of the neonatal period the infant has been shown to distinguish a strange from a familiar voice (Mills and Melhuish, 1974), and various speech sounds (Kuhl, 1978).

Perceptual and learning abilities relevant to social skills will be discussed throughout the following sections. More comprehensive reviews of perceptual behaviour in the neonatal period are contained in Bronson (1974), McGurk (1974) and Atkinson and Braddick (1982).

The infant's perceptual abilities at birth are likely to help the mother consider her infant as a real person. Klaus and Kennell (1970) noted that nearly three-quarters of the mothers in their sample "asked" the infant to open his eyes, and spent increasing periods of time adjusting the infant so that they were in an "en face" position. Like Robson and Moss (1970) they also mention that mothers often commented on feeling closer to the baby after he had looked at them. Observational and physiological (Theorell, Prechtl, Blair and Lind, 1973) data indicate that the infant spends more time awake in the first

few hours than he will later. Because the mother too is in a heightened state of expectation and arousal, the first 24 hours would seem to be an optimal period for social interaction (Hales, Lozoff, Sousa and Kenneck, 1977). One aim of the present study was to document more fully the infants' perceptual skills and organisation of behaviour during these first few hours.

B. Techniques For Investigating Early Behaviour

1. Infant Tests

It is only recently that neonatal observation has moved from single-variable studies of the infant's capacities towards a more global, multidimensional concept appropriate to the study of social behaviour (Yang et al, 1976). Even for the assessment of the effect of medical interventions on the neonate much reliance has been placed on the Apgar score (Apgar, 1953), which is an observation of 5 vital signs made at 1, 5, and sometimes 10 minutes. It is inadequate for reflecting subtle or sophisticated behaviours (Scanlon, 1973; 1974), or for interpreting delayed birth effects which are common even in the normal neonate (Brazelton, 1970; Escardo and DeCoriat, 1960). However, medical researchers have frequently concluded that various obstetric practices, including medication, had no effect on the neonate simply because the Apgar scores do not differentiate the experimental and control groups.

During the same period, however, developmental psychologists and paediatricians have developed a variety of "neurobehavioural" tests (Rosenblith, 1961; Scanlon et al, 1974; Brazelton, 1973). Brazelton's test (1973), is probably the most comprehensive and widely used of these.

It also offers an explicit focus on social behaviour, aiming to measure those characteristics of the infant which are most likely to promote appropriate caretaking and interaction from the mother. Special attention is paid, therefore, to visual and auditory responsiveness, and the infant's ability to control his state and respond in a systematic and appropriate manner to both stimuli and tester. Higher neurological functions are also assumed to be reflected in the test items which require the infant to habituate to, or "tune out" repeated presentations of an irrelevant stimulus. Motor tone, power, and activity are observed, as well as tremulousness and startles. Twenty reflexes drawn from the more comprehensive neurological examinations of Prechtl and his colleagues (Prechtl and Beintema, 1964) are also included, though these original authors have recently stated that such a selection is both inappropriate and inadequate (Prechtl, 1982).

Unlike tests for older infants (Bayley, 1969; Griffiths, 1954), the Brazelton assessment is designed to elicit and rate the best performance from an infant rather than his average, and is therefore also appropriate for the neonate whose orientation skills may only be evident for transient periods between a sleeping and a crying state. The test has been used to compare the normal, full term neonate with those who are of low-birthweight (Als et al, 1976), malnourished (Brazelton et al, 1977), or suffering the effects of maternal obstetric medication (Aleksandrowicz et al, 1974; Tronick, 1976). It has also proved sensitive to temperamental characteristics of non-Western populations: the Zinacanteco Indians (Brazelton et al, 1969); Chinese, Malay, and Tamil infants (Woodson and Woodson, 1977); Chinese-American

infants (Freedman, 1969); Navajo Indians (Chisholm, 1977); and Zambian infants (Tronick, Koslowski and Brazelton, 1973).

Despite its popularity this type of investigation is not flawless. As with other infant tests the Brazelton assessment assumes that the infant's behaviour is systematic and quantifiable, and can be classified into neat categories. Although quite easy to obtain high reliability between observers (Horowitz, Self, Paden, Culp, Laub, Boyd and Mann, 1971), it is a test in which each clinician seems to elicit behaviour in a slightly different manner; for instance, simply by holding the infant closer or talking in a softer voice the tester may inadvertantly encourage a better performance from a given infant. Scanlon (1974) indicates some of the problem inherent in behavioural observation of this sort as being: "observer subjectivity or bias, the quantification of measurement criteria, difficulties in controlling extraneous variables during testing, and inherent biases in population selection".

This last problem applies to any observations or experiments that depend on the infant's initial state conforming to set criteria; the selection of "alert" babies as subjects, for example, introduces a bias towards higher scores. Estimates of an infant's "appearance" and "cuddliness" as included in the Brazelton assessment are often subjective and difficult to justify to "scientific" clinicians. Some neurologists too are unhappy with the notion of "behavioural tests" altogether. Prechtl in particular, (1982) has made a number of scathing criticisms of the Brazelton assessment, including its "vagueness" of aim, the problem of "representativeness" of the test items, and the supposed enhanced prognostic value of behavioural over neurological assessments. Despite these problems the Brazelton Neonatal

Assessment remains at present one of the most useful tools in the investigation of neonatal behaviour.

2. Experimental Methods

Laboratory studies are commonly employed in the study of perceptual development and learning, and are now being utilised to assess aspects of social skills under controlled conditions. For instance, early studies of perception suggested that the eyes are salient features when neonates scan faces and face-like stimuli (Fantz, 1961; Ahrens, 1954). Carpenter (1974) utilised a preference technique to demonstrate that 2-week old infants preferred a mother's face to a stranger's, and that some infants even showed gaze aversion to the stranger's face. Three-week old infants can learn to suck significantly longer when the mother's voice is contingent than when a stranger's voice comes on (Mills and Melhuish, 1974). MacFarlane (1975) has demonstrated the development of olfactory discrimination and preference for mother over stranger. By presenting mother vs. stranger's breast pad on either side of the infant's cheek he found that at 2 days they turned equally to both, whereas by 5, and more clearly at 10 days, they turned towards the mother's. These early discriminative skills for the mother from other caregivers are considered to be an important base for later "attachment" behaviours (Schaffer and Emerson, 1964; Ainsworth, 1967; Blehar, Lieberman and Ainsworth, 1977).

Many conditioning experiments also have implications for social behaviour. For example, extensive research has documented the differences between non-nutritive and nutritive sucking patterns (Dubignon, Campbell, Curtis and Partington, 1969; Wolff, 1968), and specified the variables which reinforce particular aspects of sucking.

In experimental situations nutritive sucking rates can be altered by the amount of fluid delivered with each suck (Crook, 1976), the frequency with which the sucks are reinforced (Bosack, 1973), the characteristics of the nipple (Christensen, Dubignon and Campbell, 1976), the taste of the fluid (Crook and Lipsitt, 1976; Crook, 1977), and exteroceptive stimuli (Crook, Burke and Kittner, 1977).

Obvious comparisons can be drawn with components of the mother and infant feeding situation in the early weeks. Thus neonate's well-organised sucking behaviour can be modulated by the mother's selection of certain formulaes, bottles, and probably by the manner in which she "interrupts" the regular burst-pause pattern of his sucking, or reinforces his sucks by faster milk delivery. It is possible that subtle shifts in, say, the speed of administering milk, or teats which vary in hole-dimension from feed to feed, coupled with an infant whose sucking is rather irregular, may lead to disynchronies in interaction which present as feeding problems in the early weeks and months.

One must use caution, however, in generalising from the laboratory to the real life situation for a number of reasons. The experimental situation is usually highly artificial, with the infant restrained in a chair, attached to wires, electrodes, and feeding tubes, and in a silent, temperature-controlled room. White (1971) has suggested that a situation in which reinforcements are delivered at a constant rate is quite unlike the natural situation, where the relationship between the stimuli and responses is more erratic. Such an experimental situation may then not be representative of the way young infants really learn. Because of the rigorous demands on the infant inherent in experimental modification of behaviour there is some degree of selection and bias introduced. To be included in a learning experiment infants

usually must reach either a criterion number of sucks in the baseline minute, or a criterion amplitude, in order to activate equipment which delivers the reinforcement (Crook, 1976; Swoboda, 1976). Those infants whose sucking is strong and regular may well be developmentally more mature, or suffering less from the effects of birth trauma, thus yielding a less-than-representative group. Lewis and Johnson (1971) have commented that those babies who do not complete an experiment initially, but are subsequently retested do, in fact, perform differently, so that their elimination results in significant bias. In order to validate experimental findings it is necessary then to discover whether the mother, and other caregivers, predictably reinforce infant behaviour, and whether the infant regularly responds.

In early observational work Gunther (1955, 1961) described how aversive or avoidance conditioning takes place naturally when the infant's nostrils are occluded by the mother's breast while he is sucking so that he turns his head, swipes, and becomes agitated. Lipsitt (1970) suggests that some infants then develop a conditioned aversion to the mother which is a result of the simultaneous elicitation of strong approach and avoidance responses in the feeding situation. His research group has gone on to demonstrate that classical aversive conditioning can occur in the early weeks (Little, 1970). Kaye (1977) has investigated the social implications of the modification of feeding responses by observing the mother's stimulation of her infant when he pauses between sucking bursts; these findings are discussed in the later section on feeding. His study provides a useful corollary to the experimental investigations of Crook, Burke and Kittner (1977) into how auditory stimuli may disrupt nutritive sucking, and it has implications for strategies of encouraging sucking through external stimulation.

3. Indirect Assessment

Direct observation and infant testing have often been supplemented by "second-hand" data on the infant given by the mother. Because questionnaires can even be administered by post it becomes relatively easy to follow up subjects; some of these studies have yielded data on continuities in behaviour which may have otherwise been impractical to obtain. Richards and Bernal (1972), for example, asked mothers to keep diaries of the infants' daily cycle of feeding, sleeping, and crying. These records produced valuable information on feeding; breast fed babies tended to cry more after feeds, and their mothers responded quickly to their crying (Bernal, 1972). These diaries also made it clear that babies who were regular night wakers at 14 months had been more irritable and wakeful during the first 10 days of life, and continued to have consistently shorter sleep bouts in the intervening months (Bernal, 1973).

Carey has also investigated factors relating to night-waking (1974) and "difficult" behaviour (1972) in infancy by means of a maternal self administered questionnaire based on Thomas and associates' (Thomas, Chess, Birch, Hertzig and Korn, 1963; Thomas, Chess and Birch, 1969) interview about infant temperament. Sleep disturbance between 6-12 months showed a significant correlation with low sensory threshold (Carey, 1974), while difficult babies were more apt to have colic, as well as to have more lacerations requiring suture in the second year (Carey, 1972). In the Richards and Bernal cohort of Cambridge children lacerations and night waking also co-occurred, and accident proneness was primarily related to poor birth status (Barnes, 1975).

The Carey Infant Temperament Scale has more recently been modified for use in the neonatal period (Sostek and Thomas, 1977). In their small study of 18 infants "distractible" infants showed better social and motoric interaction and state control in a previously administered Brazelton Neonatal Assessment, and "intense" infants had better motoric interactive scores. Distractibility and intensity also predicted better Bayley test scores at 10 weeks.

Nonetheless instruments which rely on parental interpretation may be methodologically less sound than other forms of measurement. Bernal (1972) notes that diaries are "crude and can be unreliable" because mothers vary in the accuracy of their remembering and recording, or there may be a bias toward, say, multiparae being too busy to notice or record accurately. Carey discusses some of the methodological problems of his scale (1970), such as the discrepancies between the mother's impression of her infant's temperament and the actual behaviour which she describes. Many mothers minimized the difficulties of their infants, in the global rating, possibly because of a wish to make the infant seem more socially desirable. St. James Roberts and Wolke (1983) recently demonstrated that mothers' observations of their newborns' behaviours were selectively and systematically biased and suggest that ratings should really be considered as "social perceptions". Unlike Carey, however, they do not think that this bias can be avoided, since exacting training procedures are impractical with parents, and asking mothers to observe individual behaviours actually modifies what they do with their infant.

C. Studies Of The Mother And Infant

Having discussed the extent of the neonate's abilities, and some aspects of the way his behaviour is constrained, systematic, and modifiable, the following sections consider the study of the social relations of mother and child in the first week of life. There are two particular topics of interest for many researchers: the delivery room and the feeding situation. Both are of theoretical importance and provide for detailed investigation of some aspect of the baby, or the mother-child relationship. There has, however, been a tendency to forget, or at least play down, the cultural and social dimensions of what is seen. Thus it is pertinent first to review some aspects of pregnancy and the hospital setting that have become the norm for childbirth in our culture.

1. Coming To Terms With Pregnancy

There has been heated controversy over the past few years about the way in which the medical professions label childbirth as a form of illness (Kitzinger, 1975; Hart and Hart, 1976), and ignore the social and emotional context of this momentous period in a woman's life. It has been said that pregnancy begins not so much with intercourse and conception, but with the medical confirmation of conception (Macy, 1980). The responsibility for a pregnant woman's health and emotional well-being has generally been removed from her family and the midwife, to be taken over by the medical profession "operating" from large, busy, and, of necessity, impersonal antenatal clinics (Riley, 1977). However, despite increased education, specialisation and medical technology, there is still wide-spread ignorance among mothers-to-be about their own physiology and the body-changes of pregnancy and labour (Hubert, 1974).

There have been several studies of the reactions to pregnancy and the many disturbances that can be associated with this period. Breen (1975) distinguishes between approaches that regard pregnancy as a "hurdle", and those that consider it part of a woman's development. She considers that the former approach is "hardly conducive to an understanding of what a woman is experiencing at this time, what having a child means to her and how this will affect her future." In addition it tells us little about the outcome for the child, though plenty of work has attempted to do this. For example, as early as the 1940's behavioural characteristics of the infant have been linked to anxiety (Sontag, 1941; Turner, 1956; Ottinger and Simmons, 1964) and emotional stress (Abramson, Pater, Singh and Mbambo, 1969). Indeed, McDonald (1968), when reviewing the literature on the role of emotional factors in obstetric complications in general (including influences on the baby) concludes that anxiety is the major agent; "anxiety and extremes in its duration and intensity are postulated as necessary and sufficient conditions, respectively, for the development of psychogenic obstetric complications."

However, there are considerable difficulties in work of this sort, in trying to disentangle prenatal effects from other possible influences. McDonnald himself refers to the small samples, inadequate or absent controls, heterogeneous groups, retrospective data, and failures to state methods of sample selection, in the work he reviews. These points are re-emphasised by Copans (1974) who adds to this list the lack of "blind" testing, no control of covariables and the failure to distinguish between environmental and intrapersonal variables. In addition, these covariables (such as labour, medication, birthweight) themselves can be a result of prenatal or genetic effects.

Any study of the neonate that attempts to link his characteristics to the behaviour of emotions of his mother some months beforehand must also obviously take great pains to exclude any confounding effects due to her early handling and caring for the baby. Yet psychologists have paid scant attention to the potential "adaptability" of the newborn. The range for "time of observation" is often very wide, ignoring the possibility that one mother may have had much more opportunity to "influence" her baby, and some studies have made no attempt to control for feeding differences (i.e. breast versus bottle in Ourth and Brown, 1961). Even Copans' suggested solution to this problem seems to underestimate the reactivity of the newborn; he considers "making the necessary assumption that postnatal influences are at a minimum on day 3 since the pre-dominant environment is the hospital nursery". Admittedly mother-child contact has been very much less in America in the first days after delivery than in Britain (c.f. Barnet, Leiderman, Grobstein and Klaus, 1970), but even so it could be argued that the neonate will already have made many adjustments to his environment and the people caring for him (Sander, Stechler, Burns and Julia, 1970).

And, equally important, these caregivers will have made adjustments to him. There is a failure, when looking for prenatal effects, to recognise that the baby exerts a powerful influence on his mother too. Davids (1968) points out that the typical "before-and-after" design will not untangle this multiple cause and effect relationship. Psychologists have begun to put forward more complex models of this transaction - such as Sameroff's "mutual modification" (1975), but these models lend themselves poorly to operationalisation and testing. To examine the likelihood of behaviour disturbance after mild respiratory difficulties, and accepting that particular factors in the mother

(such as schizophrenia) might modify or exacerbate individual characteristics of the infant (excessive irritability) it would be necessary to observe a great number of mother-infant dyads to test adequately all combinations of mother and child characteristics.

Pregnancy is a period during which a woman prepares herself, adjusting both her emotions and her conception of her social role. Colman (1969) describes the woman's preparation as a plan, which covers her conduct for the coming events, including her relations with the attendant medical staff, her need for medication, her husband's involvement, and so on. For some women this "plan" is nurtured through the 6-7 months of antenatal care, and then shattered by the actual experience. It is especially likely to fail if she defines her success by conditions opposed to the usual obstetrical routine (Brook, 1976). Hart and Hart (1976) have documented the use of various techniques used by the medical personnel to establish a dominant position during the management of childbirth, and thus control the situation, particularly with "difficult" patients. On such an occasion the "crisis" of childbirth will include an element resulting from conflict with the hospital. There is probably a class difference in womens' reactions to hospital policies too; Woolett and her colleagues (1983) found that the working class patients in their sample viewed "medical interventions" during childbirth more positively than has been described previously. Mothers of all backgrounds, however, often comment how little time is devoted during their antenatal classes to the emotional preparation necessary for childbirth or to ways of coping with the many demands made during this period.

2. Birth And "First Meetings"

The most recent statistics for the U.K. (DHSS, 1974), indicate that 90% of all births take place in hospital. Thus in most cases the experience of a hospital delivery will stand at the beginning of the relationship of a woman with her child. It is important to know if any aspects of hospitalized birth can affect this relationship or the development of the child in the long term. The events of the delivery room have also attracted attention for other reasons - first because the delivery room provides us with the earliest opportunity for a detailed examination of the neonate's abilities, and second, because the mother's responses to her child at their first meeting, are presumed to be of much significance.

A hospital's policy on the use of such techniques as induction and acceleration of labour, forceps extraction, caesarean section, and analgesia may impose certain general characteristics on the infant population in that hospital. Some infants will show the effects of drowsiness or minimal depression resulting from maternal medication (Tronick et al, 1976), bruising caused by forceps delivery (Vuillamy, 1972), or slight prematurity associated with induction (Calder, Moar, Ounsted and Turnball, 1974). The stress may be compounded by the interrelations of these factors; primiparous women tend to have longer, more painful labours, and may more often receive an epidural anaesthesia and an instrumental delivery. Kitzinger (1975) suggests that induced labour tends to be more intense and painful, and thus also may result in epidural administration. Some paediatricians cite the use of forceps as a factor in the occurrence of neonatal jaundice (Friedman and Sachtleben, 1976), and some have implicated the use of induction agents such as oxytocin as well (Jeffares, 1977). The jaundiced infant suffers

from an increased demand upon the liver detoxification systems, and so is less well able to metabolise the drugs that cross the placenta during labour (Burt, 1971). These medical interventions may result in particular responses from the mother which are more attributable to the condition of the infant than to any "natural" behaviours.

Labour and delivery experiences may also be determined by sociological parameters. For example, decisions about the choice of pain-killing drugs will depend on such objective indications as parity, and cervical dilation, but also on the woman's preconceptions about the degree of pain to expect, her attitude about the extent to which pain "ought" to be endured, the support she receives from the nursing and medical staff, and the way that the latter interpret her signs of discomfort as indications for the use of analgesia (O'Driscoll, 1975).

The experiences of mother and of baby will vary from one situation to another because they involve those aspects of hospital policy that relate to ways of dealing with the labouring woman, the mother she becomes, and the baby.

The mother who delivers in hospital, for example, is less likely to handle her baby in the first hour than one who has a home confinement (Garrow and Smith, 1976). The baby may be given to the mother at times which suit the convenience of the medical attendants, but are not necessarily the most appropriate for the mother's comfort or for the baby's state of alertness.

3. Separation And Attachment

Having said that there are a complex of factors - social, psychological, and physiological - at work at the time of delivery, how are we to interpret studies of early maternal handling and the effects of separation? These studies are based on the concept of "attachment",

or "bonding", and this in turn owes much to the ethologists' observations of "imprinting". The findings are striking, but it is hard to take seriously the explanations that are given for the importance of early contact. Several authors have now discounted the notion that parturition brings about particular hormonal changes that constitute a critical or sensitive period for mothering (Wortis, 1971; Schaffer, 1977).

We still need to discover just what is important about early contact; is it physical contact per se, or the attitude changes that may accompany it? What is "early" - the first hour, the first eighteen hours (Hales et al, 1977), or the first week? Do the infant's characteristics play no part? The careful work of Robson and Moss (1970) goes some way toward extending our insights into the process of "attachment". Defining attachment as "the extent to which a mother feels that her infant occupies an essential position in her life", 54 primiparae were interviewed during the three months following the birth. The researchers noted a typical pattern of response by the mothers; at delivery they were preoccupied with finishing the task as quickly and painlessly as possible, and on first seeing their infant, interest was in appearance only. Description of the hospital stays were vague, the mothers experiencing feelings of unreality and estrangement related to their lack of experience with babies, and the extent to which care-taking activities were taken over by the nurses. The mothers coped with the "anonymity" of their infant by using such devices as finding family likeness and personalizing behaviours.

After 3 or 4 weeks of mastering caretaking tasks, and overcoming their fear of harming the child, mothers began to feel that the baby was able to recognise them as individuals - citing smiling, eye contact, visual following, ceasing to cry, and differential responses to adults as the clues to this. Only by the end of the third month was there strong attachment, shown in remorse at leaving their child and feelings of total involvement. In contrast, 34% felt that their first contact (i.e. at delivery) with the child had elicited no feelings at all. However, there were individual differences in response; "fast-attachers" usually had a high investment in the baby during pregnancy, while "late" or "no-attachers" either did not want the baby, or had a baby whose behaviour was deviant.

Robson and Moss feel that there is a strong difference between the mothers' emotional responses and the attachment shown in animal species; the latter is triggered by species-specific infant behaviours, and involves attendance to the infant's physical needs, while the onset of positive feelings in the human mothers seemed to reflect the "infant's capacity to exhibit behaviours that characterise adult forms of social communication". It must be pointed out that even though "attachment" seems to occur a matter of months after the birth for a fairly high proportion of women, failure to attend to her baby's physical needs is a rare occurrence.

Barnet et al. (1970), again on the basis of interview data, consider that separation - routinely after delivery, or that experienced by the mothers of premature babies - may produce differences in 3 areas: the sense of commitment or attachment to the infant, the development of confidence in mothering abilities, and the ability to establish an efficient caretaking routine. They point out that each of these will be affected in addition by such factors as parity, desire to have the

child, birthweight, and the infant's prognosis. The two cases of negative reactions to the baby in their study were associated with an initially poor prognosis for the very premature baby - cases, in effect, of "anticipatory mourning".

In a random allocation of mothers of premature babies to contact or no-contact groups, however, Leifer (Leifer, Leiderman, Barnett and Williams, 1972), failed to demonstrate any consistent caretaking differences between their groups. Seashore (Seashore, Leifer, Barnett and Leiderman, 1973), found that mothers separated from their premature infants held, caressed, and smiled less at the infants after discharge from hospital, but that by one year this difference had nearly disappeared. Separation seemed to lower the confidence of mothers who were separated if it was a first born infant, and there was a higher divorce rate in the twenty-two families where the mothers of prematures had not had contact. These findings implicate stress as creating problems within the family unit rather than just between mother and infant, and draw attention once more to the interplay of factors in the mother's previous experience, personality, family support, and her expectations and trust in the medical institution.

A more critical look at the whole bonding issue has been taken by a number of authors since these studies. Richards (1975) succinctly points out that "the idea of separation does not in itself constitute a psychological theory - it merely describes a particular state of affairs". He concludes in a later review that there may be short term effects of separation, but the long-term implications are inadequately researched and less convincing (Richards, 1978). In their selection of studies examining the outcome of children brought up in undesirable

circumstances Clarke and Clarke (1976) demonstrate that children's physical health, personality and intellect prove remarkably resilient to even the most adverse of early experiences. Single events have rarely proved responsible for the total determination of a parent-child relationship; the hallmark of human beings is their adaptability. In the most recent review of this field Sluckin and his colleagues (Sluckin, Herbert and Sluckin, 1983) remark that skin-to-skin contact may provide mutual comfort for parents and their infant but it "is not a sine qua non of happiness or of successful growth of mutual attachment".

4. Mother-Infant Behaviour During Feeding

Quite apart from any theoretical arguments about the importance of feeding for the psychological development of the infant, an observer on the postnatal ward will notice that often the feeding of her child provides a mother with almost her only meaningful contact with him. In addition it has the advantage for the psychologists that it is an often repeated activity, it usually involves mother and infant alone, and it is a goal-directed operation that has, nevertheless, an apparently well-defined and unambiguous goal. It has thus come in for more detailed analysis than any other maternal caretaking activity.

Brown (Brown et al, 1975) does give some indication of the behaviours which occur during a feed. In her bottle feeding sample of predominately black low-income mothers the "feeding" session actually turned out to consist of a series of brief feeding episodes which only lasted a total of 11 minutes out of the observed 30. They engaged in caretaking tasks about 10% of the time, while 21% of their time was spent in rubbing, kissing, rocking, and other affectionate behaviour.

The fact that the infants kept their eyes open for 43% of the time, and that the infants were more likely to have their eyes open when the mother was presenting the bottle emphasizes the potential for turning the feed into a social occasion. Although lightweight and heavyweight infants responded similarly to stimulation, mothers were more likely to stimulate the heavier baby by talking to him, and male infants were more likely to elicit affectionate behaviours. Brown suggests that in their particular population large male infants are most valued, whereas in Thoman's (Thoman et al, 1972) sample of breast feeding infants, mothers talked to and smiled at their female infants more often than the males.

In a more detailed examination of the sequences of talking and looking, Dunn and Richards (1977) demonstrated that these activities occurred when the baby was on the nipple, but when he was not sucking, and that the probability of looking away and not talking while he was actually sucking increased over the days. The feeds became more co-ordinated and "successful" over time as well, as measured by an increase in the time spent sucking, and a corresponding decrease in the number of times the nipple came out of the infant's mouth, and in the mother's attempts to stimulate sucking or change the infant's position. It was found that despite previous suggestions (Levy, 1958), the mother's "affectionate" behaviours were not closely related to each other or with their response to crying; rather, "affectionate" talking was significantly associated with the infant's sucking rate. The breast feeding infant was more likely to determine the pacing of his mother's behaviour than the bottle feeder, particularly in terminating sucking bouts and effecting his mother's talking and touching.

A variety of measures have been produced to facilitate these comparisons, e.g. looking at baby, time "en face", amount of affectionate contact, and so on, but we often end up in the paradoxical position of knowing that groups of mothers may differ in their behaviours toward their infants, while knowing mothing about why these differences appear, how they relate to the process of feeding, and whether they are likely to have any significance for the child's later development.

5. Methodological Problems Of "Interaction" Studies

However, on closer examination the purpose of this work has usually not been to tell us much about the process of feeding itself. Rather, the existence of a common activity has been used to provide a basis for comparisons of various groups. Research has documented differences between primiparae and multiparae (Thoman, 1972), breast and bottle-feeders (Dunn, 1975; Bell, 1968), high and low-maternal contact groups (De Chateau and Winberg, 1976), schizophrenic and non-psychopathic mothers (Schacter, Elmer, Ragins and Wimberly, 1977), and greater versus lesser quantities of analgesic medication (Brown, Bakeman, Snyder, Frederickson, Morgan and Helper, 1975; Parke, O'Leary and West, 1972). The study by Schacter, in fact, completely excluded coding of offering and accepting of food during the feed as they were interested only in "extra-nutritive" behaviour.

In several of their papers Dunn and Richards have drawn attention to other methodological problems inherent in the study of mother-infant interaction. Firstly, (Dunn and Richards, 1977), a finer analysis may be necessary to elucidate elements in the interaction; the use of time-sampling, for example in such a fast-paced situation, makes it

impossible to attend to subtle changes in the direction of gaze or postural adjustment. For this reason video-taping of the situation improves the available depth and breadth of focus and has been the choice in recent studies of face-to-face interaction in an "en face" play situation (Brazelton, Tronick, Adamson, Als and Wise, 1975), and during feeding (Kaye, 1977), as will be discussed shortly. Another problem in the interpretation of mother-infant studies is that neither maternal nor infant measures can be assumed to be independent of previous interactions between the two (Dunn, 1975). In saying, for example, that infant sucking rate was related to the mother's "affectionate" talking it would be erroneous to conclude that the sucking patterns represented congenital differences because sucking rate was equally affected by whether the infant was breast or bottle-fed. Their work has been invaluable in demonstrating the need to take related variables into account even when one is dealing with a fairly homogeneous obstetrically normal population. Again with regard to the measure of "affectionate" talking, this was related more consistently to suck rate in the early feeds which were influenced by labour and delivery events; the mother's smoothness of the feed and the incidence of difficulties in feeding were not useful predictors of later interactive behaviours.

More serious theoretical issues about methodology have been raised by Rosenthal (1973) who begins by stating that "Interaction has been one of the most evasive and misused concepts in the literature of Developmental Psychology". Most psychologists, she argues, have really been engaged in examining the impact that one member of the pair has on the other, i.e. the "uni-directional arrow" whereas interaction involves "the changing pattern of the mutual perceptions and behaviours of both

infant and caretaker vis-a-vis each other as a result of their respective previous mutual perceptions and behaviour vis-a-vis each other". The use of a variable such as "dyadic gazing" (Robson, Pederson, and Moss, 1969) or the charting of variables such as simultaneous smiling, looking, and talking (Lewis, 1972) goes some way toward elucidating frequency of interaction, types of behaviours, and the context in which interaction takes place. Rosenthal also cautions that even when an adequate design and observation framework has been developed there are problems in finding an adequate statistical model to deal with such an analysis. The usefulness of contingency tables with statements of conditional probabilities has been reported by Gewitz and Gewitz (1969) and Freedle and Lewis (1971): correlation co-efficients between aspects of the infant's behaviour and of the mother's behaviour are not a sufficient indication of interaction between the two partners.

6. A Microanalytic Model Of Feeding

Microanalytic studies provide clearer descriptions of the "meshing" of feeding behaviours that can really be termed interaction. Kaye's (1977) approach regards feeding as an example of the development of "dialogue", and he cites two distinct themes as giving impetus to his own theoretical position. The first of these is "turn-taking", which involves the use of fairly standardised signals by both partners, whether they be adults (Kendon, 1967; Duncan, 1972) or mother-infant dyads (Robson, 1967; Jaffe, Stern, and Peery, 1973), and the possibility that these "rules" for turn-taking might be learned in early infancy. The other concerns such early dialogue as a precursor to language proper, particularly as it contributes to what Bruner (1975) terms the "alternation-of-comments-upon-a-common-topic".

In a study of 30 newborn infants observed during a feed, Kaye concentrated attention on two superficially simple phenomena, the infant's sucking and pausing, and the mother's attempts to alter the tempo by jiggling the infant or the bottle. And yet the pattern of jiggling and sucking brings together aspects of a mother's need to find regularity in the interaction with her infant, as well as the increasing ability of the infant to accommodate his own actions to the demands of the situation. Thus, initially, mothers interpret the infant's pausing as "signs of flagging" and stimulate him by jiggling. The infant, however, responds instead to the end of jiggling by a resumption of sucking, so that the mothers change their response to "jiggle-stop", which leads at two weeks of age to a shorter duration of jiggling and pausing. She utilises his immaturity - with its guarantee of "salient regularity, rhythmicity, predictability ... she can predict the temporal structure of her infant's behaviour ... to build, through mutual differentiation of responses, a basic pattern of interaction which will <u>not</u> depend upon biological clocks, but upon mutual monitoring and feedback".

Kaye considers that later interactions will reiterate the phenomenon found in feeding during the newborn period: a first phase in which the mother accommodates to the infant's autonomous patterns of behaviour, then the next phase in which the actions form a "mutual contingency" or "game". He also suggests that the social interaction between mother and baby will show continuity and consistency across other tasks, events, and ages. For example, the mutual regulation between the partners should predict (to some extent), the mother's post-partum recovery and sense of role satisfaction, and smoothness

and self-regulation during a Brazelton Neonatal Assessment should predict the success of the mother's anticipation of her infant's sucking and pausing pattern.

There is some evidence that this may be the case. Osofsky (1976) found that the behaviour of both mother and infant was consistent between a feeding session and the mother's "stimulation" of her own infant using selected Brazelton items. In particular the mother's attentiveness to the infant, and the infant's predominant state, eye contact with the mother, and responsivity were consistent across situations. The finding that infant responsivity during a feed correlated strongly with maternal attentiveness and sensitivity to the infant gives credence to Kaye's predictions, even though Osofsky was not directly concerned with food intake and sucking regulation.

II OBSTETRIC MEDICATION AND THE NEONATE

A. Practice And Principals

1. The Way In Which Drugs Affect The Fetus And Neonate

It has been recognised since about 1900 that drugs given to the mother cross the placenta and enter the circulation. Further work indicated that equilibration between the maternal and fetal circulation can be very rapid (Ville, 1965; Mirkin, 1973). Substances cross the placenta by (Notarianni, 1979):

a) Simple diffusion - substances cross from regions of high to low concentration (i.e. oxygen and carbon dioxide);

b) Facilitated diffusion - in which a carrier substance within the placenta increases the rate of transfer, (glucose and other sugars) in the direction of the concentration gradient;

c) Active transport - across a membrane involving molecular transfer against a concentration gradient, and entailing metabolic energy (vitamins, amino acids, calcium);

d) Special processes - including a) pinocytosis in which small amounts of plasma are engulfed by microscopic invaginations of the cell membrane and transferred directly to the fetus, and b) breaks in the placental membrane (red blood cells).

Drugs probably cross the placenta by simple diffusion (Moya and Thorndike, 1962). When drugs are structurally similar to endogenous material normally transferred by facilitated diffusion and active transport they may also do so in the same manner.

Since maternal drugs present in the maternal circulation will reach the fetus the important questions might be how much medication reaches the fetus, how quickly it enters the fetal circulation, and how long it remains in the fetus.

Cutting the cord ends the unique arrangement by which the neonate's drug load was metabolised and eliminated by the mother. The neonate's ability to detoxify and excrete medication is hampered by a liver which is too deficient in the enzymes necessary to break the products down and a kidney which is inefficient at flushing waste from the body. Drugs also enter the central nervous system readily because of the incomplete blood-brain barrier and lodge in immature, still developing tissues. Table II.1. suggests some other factors which determine the pharmacokinetics of obstetric medications.

2.Clinical Use In Labour And Delivery

Tables II.2. and II.3. list the vast array of drugs available for obstetric use, although some are not commonly used in the U.K. (such as sedatives), a few have only very specialised uses nowadays (i.e. Librium in pre-eclampsia) and others have been replaced by more effective or less dangerous compounds (Pethilorfan). The clinical uses of each group of drugs follows, along with a brief description of some particular disadvantages or side-effects where appropriate.

a. Narcotic analgesics

These are often considered to be the most effective form of pain relief. Pethidine was one of the earliest (1939) synthetic narcotic analgesics. It acts primarily on the central nervous system, producing analgesia by acting on the cerebral cortex, and does not seem to alter other responses such as touch, smell, and sound (except for a possible decrease in visual perception). The principal effects are suppression of pain, mild drowsiness, respiratory depression, nausea and sometimes vomiting (Goodman and Gilman, 1970). It often works by altering the perception of pain - rather than necessarily decreasing it.

Table II.1. PHYSIOCHEMICAL FACTORS AND THE PHARMACOKINETICS OF OBSTETRIC-RELATED DRUGS

(a) the size of the pregnant or parturient woman

(b) the condition of the pregnant or parturient woman - whether she is anaemic or diabetic, is deficient in protein, has liver or kidney damage, inherited a metabolic disorder or enzyme deficiency, etc.

(c) the condition of the fetus - whether he is premature or has been under-nourished in utero, has inherited a metabolic disorder or enzyme deficiency, is subject to Rh incompatibility, etc.

(d) whether it is a single or multiple pregnancy

(e) the condition of the placenta - aging characteristics, pathology, size, perfusion rate and amount, etc.

(f) the time the drug is taken or administered relative to conception, fetal development, labour or birth

(g) the quantity of the drug ingested or administered and whether it is given in single or repeated doses

(h) the route of administration of the drug

(i) the absorption characteristics of the drug

(j) the distribution of the drug within the mother, placenta, amniotic fluid and fetus

(k) the rate of placental diffusion of the drug and the maternal-fetal ratio reached

(l) the rate and ability of metabolism and excretion of the drug by the mother

(m) the rate and ability of metabolism and excretion of the drug by the fetus and the rate at which the drug is returned to the mother

(n) the pH (acid-base balance) of the fetal-placental-maternal system

(o) the concentration of the drug or its metabolites left within the circulation and tissues of the infant when he is detached from his mother's circulatory system at birth

(p) the rate and ability of metabolism and excretion of the drug by the newborn infant as affected by environmental factors such as temperature, nursery procedures, drugs administered postnatally, etc.

(From Haire, 1981).

Table II.2. DRUGS COMMONLY FOUND IN THE OBSTETRIC LITERATURE: PREMEDICATION AGENTS

Narcotic Analgesics

morphine	
pethidine	(U.S. = Meperidine/Demerol)
alphaprodine	(Nisentil)

Narcotic Antagonists

nalorphine	(Nalline)
levallorphan	(Lorfan)
naloxone	(Narcan)

Combined analgesics plus antagonist: Pethilorfan (Pethidine + Lorfan)

Sedative - Hypnotics

Barbiturates:	amobarbitol	(Amytal)
	secobarbitol	(Seconal)
	pentobarbitol	(Nembutol)
	phenobarbitol	
Non-barbiturates:	diazepam	(Valium)
	scopolamine	(Hyoscine)
	chloral hydrate	

Tranquilisers

chlorpromazine	(Thorazine)
promazine	(Sparine)
promethazine	(Phenergan)
reserpine	
chlordiazepoxide	(Librium)
diazepam	(Valium)

(After Brackbill, 1979).

Table II.3. DRUGS COMMONLY FOUND IN THE OBSTETRIC LITERATURE: ANAESTHETICS: GENERAL ANAESTHETICS AND RELATED AGENTS

Inhalant

cyclopropane	
enflurance	(Ethrane)
halothane	(Fluothane)
methoxyflurane	(Penthrane)
nitrous oxide	
trichloroethylene	(Trilene)

Intravenous: Barbiturate:	thiopental	(Pentothal)
	methohexital	(Brevital)
Non-barbiturate:	ketamine	(Ketalar, Ketaject)

Local Anaesthetics

Procaine Analogues and Related Compounds

bupivacaine	(Marcain)
chloroprocaine	(Nesacaine)
etidocaine	(Duranest)
lignocaine	(Xylocaine)
mepivacaine	(Carbocaine)
prilocaine	(Citanest)
tetracaine	(Pontocaine)

(After Brackbill, 1979)

Some mothers in labour report that it changes their sense of time - making the contractions seem further apart than they really are. It is said to alleviate the fear, anxiety, and anticipation of pain, but this is not a universal conclusion. Indeed, some studies of women in labour suggest that for a substantial number of patients it is an unsatisfactory drug - with only 25% (Holdcroft and Morgan, 1974) to 60% (Beazley, Leaver, Morewood and Bircumshaw, 1967) reporting that it controlled the pain of contractions.

Nonetheless pethidine is one of the "popular" drugs for obstetric analgesia in Britain. It was reported to be used for 56% of births in 1958 and 68% in 1970 (Richards, 1976). The British Birth Survey (1973) showed that 46% of deliveries involved pethidine, and a further 23% pethilorfan. In the U.S. (as Meperidine) it was administered to 61% of the patients in the Collaborative Perinatal Study between 1958-1965 (Broman, 1977).

b. Sedatives

These drugs do not induce unconsciousness in normal doses, but instead produce calm, drowsiness or sleep. The main group, barbiturates, are injected orally, intramuscularly (i.e. sodium phenobarbitol) or intravenously (thiopental), depending on the time available to produce an effect and the duration required.

c. Tranquilisers

Tranquilisers produce a calming effect by reducing the intensity of emotional reactions. The two "major" (indicating profound effects) tranquilisers applied to obstetrics are chlorpromazine (or promethazine), which potentiates general anaesthetics or analgesics, and reserpine. Two "minor" tranquilisers - Librium and Valium - are used (primarily

in the U.S.) in the first stage to reduce anxiety. Valium also has a muscle relaxing effect and can be used to control convulsions.

d. General anaesthetics

General anaesthetics produce a state of unconsciousness by depressing CNS function. This can be done by sufficient concentrations, and length of application, of inhalation anaesthetics gases (nitrous oxide, ethylene, cyclopropane) or liquids (ether, halothane, trichloroethylene).

High doses of sedatives - particularly barbiturates such as thiopental - are also used for Caesarean section delivery. Thus, general anaesthetics are not pain-relievers as such.

In the U.K. trichloroethylene was quite commonly used in the past for periodic self-administration during 1st and 2nd stages of labour; a mix of 50% nitrous oxide and 50% oxygen is more usual now. In the U.S. methoxyflurane is the drug of choice for this situation.

General anaesthesia in the U.K. is almost exclusively used for Caesarean section (or third stage complications like retained placenta). However, in the American literature (albeit not recently) it is not unusual to see papers utilising general anaesthesia for vaginal deliveries. In his classic text Bonica (1967) indicated its use for anyone not "emotionally suited" to remain awake during delivery.

e. Local anaesthetics

Local anaesthetics provide pain relief by blocking the transmission of impulses through the peripheral nerves. The first of these was cocaine, which was already in use for this purpose in 1884. Now, however, synthetic derivatives are used since cocaine is a powerful stimulant on the CNS, and is addictive. The compounds most often

employed for obstetric anaesthesia - mepivacaine, lignocaine, prilocaine, bupivacaine - belong to the "amide" group. They act rapidly, last longer, and penetrate the tissues better than those in the "ester" group.

These drugs are used in obstetrics for: (Fig.II.1)

(i) Infiltration - injecting it directly into the tissue (i.e. the perineum for an episiotomy);

(ii) Conduction block - injecting it next to a nerve trunk, a "paracervical" anaesthetic, blocks uterine pains while a "pudendal" blocks the area during second stage of labour, particularly for forceps delivery;

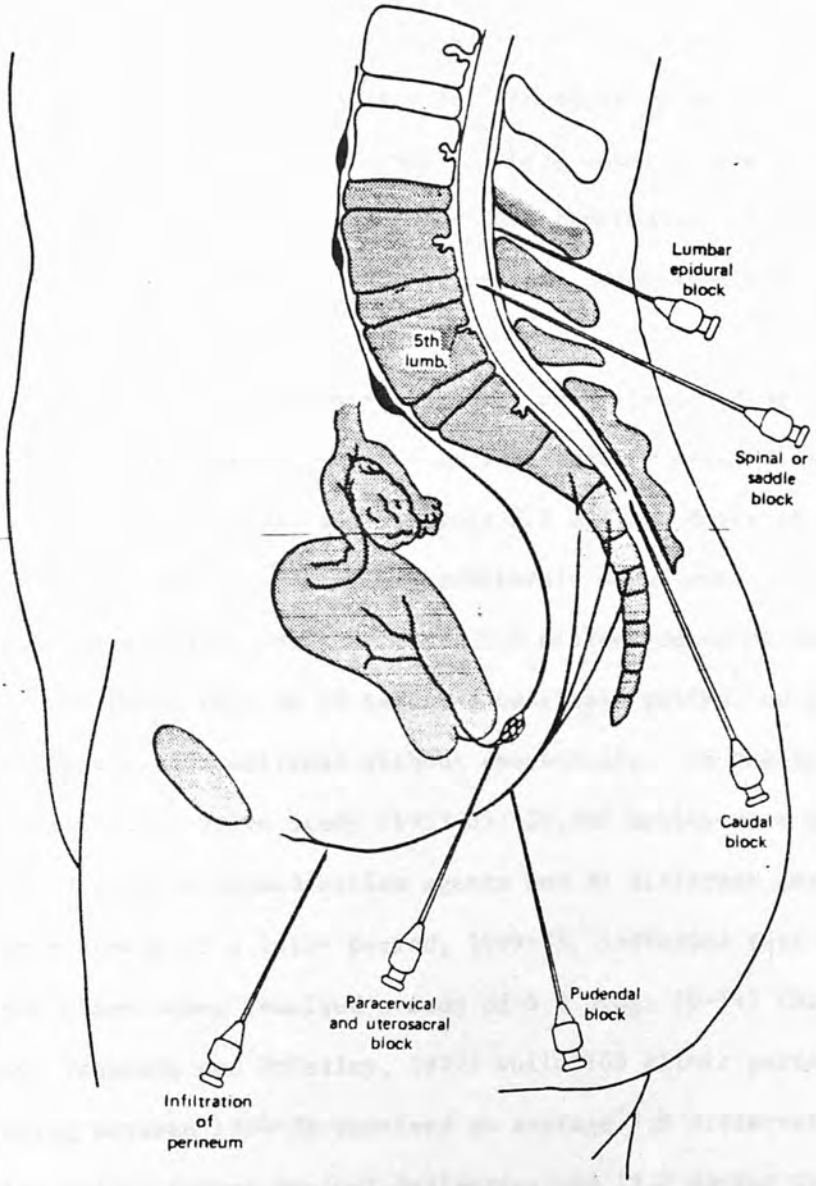
(iii) Massive block of spinal nerves, which can be either

(a) Spinal anaesthesia; the drug is injected into the subarachnoid space, in direct contact with the spinal cord. This results in transient sensory and motor paralysis of the whole lower half of the body. In the U.S. this is a common procedure, and the "saddle" block is also used.

(b) Lumbar epidural anaesthesia; similar amounts of drug are injected between the dura membrane and the bones of the spine into the "epidural" space. Local anaesthetic can also be injected into the (downward) extension of this space, and is known as "caudal" anaesthesia.

As long as the solution does not get injected high up into the epidural space sensory impulses from the uterus are blocked without interfering with motor activity. Its main side effect on the mother is hypotension, which is caused by relaxation of the smooth muscle of the arterioles and consequent vasodilation.

FIGURE II.1 SITES FOR ADMINISTRATION OF LOCAL ANAESTHETIC AGENTS IN OBSTETRICS



(Brackbill, 1979)

3. Obstetric Medication: Variations In Practice

The use of medication in labour varies widely between countries and changes as new, supposedly safer and more effective, drugs are introduced. In the United States, where women generally deliver in hospital under the care of a private "attending" physician, individual doctors favour particular "regimes". These usually involve what is known as the "drug cocktail" - in which a combination of drugs is given at different times to remove the pain associated with particular stages in labour.

Brackbill (1979) presents some data on perinatal drug use for the American obstetric services. In 1973 private practitioners prescribed for their hospital patients 3.7 million doses of narcotic analgesics, 1.3 million doses of barbiturate sedatives, 1.1 million doses of non-narcotic analgesics and 1.1 million doses of tranquilisers. In 1974 she found that in 18 teaching hospitals polled, only 5% of deliveries were accomplished without anaesthesia. In the large Perinatal Collaborative Study (1959-65) 39,000 babies were delivered with 336 different premedication agents and 37 different anaesthetics. A further survey of a later period, 1969-75, indicated that 241 middle to upper class women received a mean of 6.0 drugs (0-14) (Hill, Craig, Channey, Tennyson and McCulley, 1977) while 168 clinic patients delivering between 1974-76 received an average 7.0 different drug administrations during vaginal deliveries and 15.2 during Caesarean sections (Stewart, Cluff and Philp, 1977).

In the U.K. pain relief is usually a rather more straightforward affair, with fewer drug options and greater emphasis on administration of one type or another for normal labour. Available drugs can be classified into the following broad groups:

a) narcotic analgesics (usually pethidine; pethilorfan in the past)

b) inhalation anaesthetics (50% nitrous oxide and 50% oxygen; trichloroethylene in air; methoxyflurane)

c) regional anaesthesia using local anaesthetic (usually bupivacaine).

A small number of women manage labour pains through psycho-prophylaxis (breathing and relaxation techniques) but may desire (or require) brief "whiffs" of an inhalation anaesthetic in the second stage.

Table II.4. indicates analgesic and anaesthetic usage at St Mary's during the first year of our study. Pethidine and epidural anaesthesia were by far the most common; nitrous oxide seems to have become less popular than it was when epidurals were not available. This also indicates a change even since the early 1970's when the British Birth Survey (1973) showed that 46% of births involved the administration of pethidine and a further 23% included pethilorfan. Combinations of drugs are seldom used here, except for Caesarean section, although epidural anaesthesia is often started midway through labour if pethidine has proved ineffective or unacceptable. Recently, there has also been an increase in the use of epidural anaesthesia for Caesarean sections, thus avoiding the potential hazards of general anaesthesia as well as giving mothers the satisfaction of being awake and attentive during the moment of birth.

Consumer choice has also become a factor in determining clinical practice. In the U.K. the National Childbirth Trust has been influential in encouraging women to manage with minimal amounts of analgesia, and sometimes to stand up to obstetricians and midwives who insist on drugs for the patient's "own good". Periodic scare stories in the national media and parent-craft magazines about effects on the baby (i.e. "feeding problems") or mother (i.e. headaches or even paralysis after

Table II.4. PAIN RELIEF IN LABOUR AT ST MARY'S HOSPITAL, 1976

	No. deliveries	%
No analgesia	155	18.3
Pethidine	290	34.3
Epidural anaesthesia with bupivacaine	298	35.3
Other procedures (Nitrous oxide inhalation, pudendal block etc.)	26	3.1
General anaesthesia (for Caesarean section)	76	9.0
TOTAL	845	100

(Notarianni, 1979).

epidural anaesthesia) have also dissuaded many women from trying what is available. In contrast, there are probably a number of women who would like to have an epidural but whose local hospital does not have sufficient anaesthetic cover to provide a safe service. For example, when Queen Charlotte's Maternity Hospital (London) introduced an "epidural on demand" service, with round-the-clock anaesthetic registrar and consultant cover they found that the up-take of epidurals rose to 42% while pethidine decreased to 24% (Morgan, 1982).

Recently the drug companies themselves have made efforts to "sell" their product to the consumer. Some companies use their promotional material and medical representatives to stress to obstetricians and midwives the "acceptability" of their drug. Duncan, Flockhart and Company, makers of Marcain (trade-name for bupivacaine) now present their method of pain-relief directly to parents, with a cassette tape about labour, and a leaflet on Epidural Anaesthesia - "Painless Labour" Explained (Fig. II.2.).

B. Studies Of The Effects Of Drugs On Neonatal Behaviour

The following sections summarise the major contributions to the literature on the effects of drugs on neonatal behaviour. They are organised under headings pertaining to the type of behaviour studied, and, where possible, grouped according to the medication/s given to the maternal sample. Details have usually been presented about sample size, any unusual features about the statistical design, and an indication of the methods for handling the "apples and pears" problem of a variety of drugs being given in varying dosages and at different points in the labour. This should enable the reader to appreciate the

FIGURE II.2 PROMOTIONAL LEAFLET ON EPIDURAL ANAESTHESIA BY DUNCAN FLOCKHART AND COMPANY

The birth of your baby will be preceded by two stages of labour. The first stage involves the thinning out and opening up of the cervix to enable the baby's head to pass into the birth canal. The second stage is the progress of the baby along the birth canal and ends when your baby is born.

You may be aware, throughout the last few weeks of your pregnancy, that your womb (uterus) has been contracting, but your labour cannot be said to have begun until these contractions become uncomfortable – but not necessarily painful, and occur at regular intervals. The contractions will increase in strength and frequency during this first stage of labour, probably producing some backache at first, followed by pain in the lower abdomen, and finally the whole abdomen, by which time the contractions should be occurring about every 5 minutes. The frequency of contractions will continue to increase until the cervix is fully dilated and the baby's head begins to descend into the birth canal. The first stage of labour is then complete.

In the second stage of labour the nature of the discomfort changes, as the contractions of the uterus may be accompanied by a feeling of pressure by the baby's head on the 'back passage', and an uncontrollable desire to push the baby out – the so-called bearing down reflex.

The intensity of the discomfort felt during both these stages of labour varies from woman to woman and can be relieved in a number of ways. A combination of the following methods may be used:–

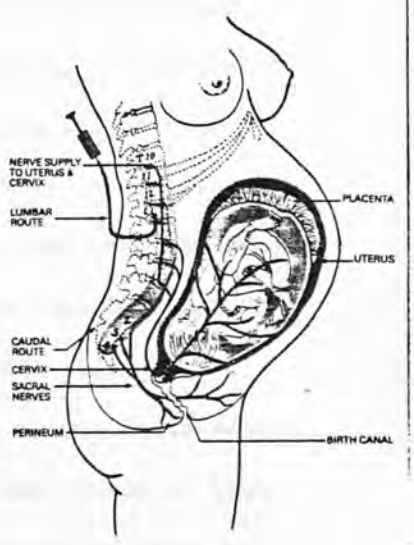
1. **Psychoprophylaxis** ("Natural Childbirth")
Relaxation and breathing exercises are taught during pregnancy and a small proportion of women require nothing else. The training always helps other methods of pain relief.

2. **"Pain-killing Drugs"**
Powerful pain-killing drugs produce adequate pain relief in the majority of women in labour, but unfortunately doses of these drugs, large enough to give complete relief are not always suitable owing to the undesirable sedative effect this would have on your baby at birth.

3. **Anaesthetic Inhalers** (e.g., gas and oxygen)
As well as using powerful pain-killing drugs, the discomfort in the second stage of labour can be relieved by breathing gas mixtures. Many women find these very helpful and soon learn how to use them to the best advantage.

4. **Epidural Block**
The epidural block is the most effective method of relieving pain during labour. It may be given via the lumbar or the caudal route (see diagram). The technique produces a complete relief from discomfort in the majority of women with little risk of harmful effects. Unlike the "pain-killing" drugs it will not sedate your baby and in consequence risk a delay in that first vital cry which heralds his independent existence.

Because the sensory nerves from your uterus and birth canal go to a confined area in your spinal cord (see diagram opposite) it is possible, by a specialised technique, to bathe these nerves with local anaesthetic. In order to do this, the anaesthetist places a very fine tube in the region of these nerves, through which a long-acting local anaesthetic can be injected at intervals throughout your labour. The positioning of this tube is carried out painlessly by an injection in your back, and when in position you are unaware of its presence. The quantity of local anaesthetic required to give complete pain relief in the first stage of labour may also produce some numbness over your lower abdomen and upper parts of the thighs, and occasionally some heaviness in the legs may be noticed. When the second stage of labour begins the local anaesthetic is injected into the tube whilst sitting up, and thus deadens sensation in the sacral nerves (see diagram). This will relieve the discomfort in the perineum and abolish the desire to "bear down" without diminishing the ability to do so when required. It will also make your legs fairly numb and difficult to move for about an hour. The object of this is to enable the obstetrician to deliver your baby slowly and painlessly even if forceps are used, and also to carry out any stitching without pain or the additional risk to both you and your baby of a general anaesthetic.



The epidural block can be started at any time during your labour, but to obtain maximum benefit from it, it is advantageous to have the epidural tube inserted before labour is fully established. In experienced hands the procedure carries minimal risk. It also has the added advantage that you will be able to enjoy the experience of childbirth, since you will be both comfortable and fully awake; and your baby, being unaffected by drugs, will have the best possible start in life. The effect of the epidural will wear off within an hour or so after birth, when the normal mild discomfort of continued uterine contractions will return and can then be relieved by taking an analgesic such as codeine or aspirin.

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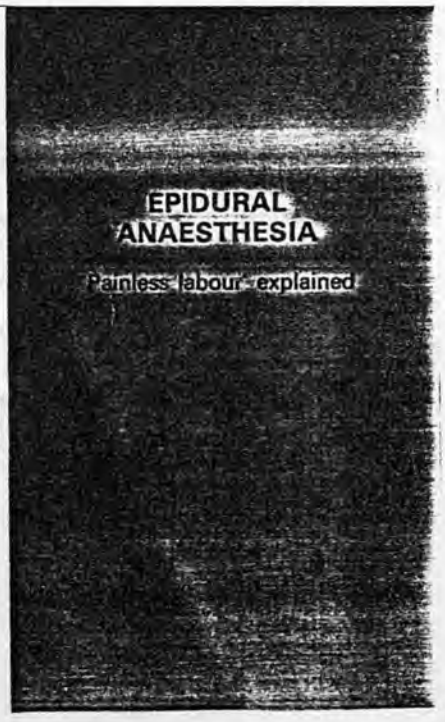

difficulties of judging what "drug effects" really refer to, and whether sample sizes justify the conclusions. Unless otherwise mentioned the samples consist of Caucasian mothers, and infants who are the products of low-risk pregnancies by vaginal deliveries.

1. Physiological Measures

Even into the 1970's obstetricians, anaesthetists, and more rarely, paediatricians have often used nothing more than the Apgar score (Apgar, 1953) to justify the "safety" of maternal medication for the neonate. This scale was designed as a simple quick tool to evaluate physiological adaptation to extrauterine life in the first 15 minutes (but is most commonly scored only at one and five minutes). It consists of five items - heart-rate, respiration, muscle tone, colour, and response to stimulation) on a three point scale (0,1,2). A score of 8-10 indicates good health; a low score in the first minute indicates an urgent need to resuscitate the baby, and scores of less than six at five minutes have been associated with poor neurological outcome in childhood.

However, because a total Apgar score masks individual physiological parameters, other measures of respiratory status are a more sensitive measure of depression. With advances in neonatal monitoring authors are now able to determine such ventilatory indices as acid base status at delivery (pH and base excess), continuous respiratory and cardiac rate, and transcutaneous oxygen, or alveolar carbon dioxide tension and carbon dioxide output. But the reader will note that the majority of studies reported in this section (particularly the older ones) still present an often undefined variable called "depression" as their outcome measure, and it is usually anaesthetists who are likely to utilise the more sophisticated indices.

a. Narcotics

Clifford and Irving (1937) carried out their investigations of opiates versus barbiturates several years before the introduction of pethidine. They were probably the first to demonstrate a direct relationship between the dose-delivery interval of analgesia and respiratory depression. For the opiates the peak effect was found 4-6 hours before delivery, after which 36% of the babies subsequently needed resuscitation. When Shumann (1944) reported that pethidine caused minimal or no respiratory depression it seemed to offer an obvious advantage over other drugs. However, by the 1950's, evidence had accumulated that pethidine too was a powerful depressant (Taylor, Fumetti, Essig, Goodman and Walker, 1955) and could be found in neonatal urine (Way, Gimble, McKelway, Ross, Sung and Ellsworth, 1949).

Apgar et al (1952) examined the transfer of pethidine during labour, although she only studied nine cases and some received another form of medication as well. She reported cord levels at delivery ranging from 130-760 ng/ml and fetal/maternal ratios of 1.06-4.50. Only 1 case of depressed respiration occurred, leading to the conclusion that doses sufficient for satisfactory pain relief do not cause neonatal depression, even when present in the fetal/neonatal circulation.

Bonica (1957) seems the first to specify a "peak depression" dose-delivery interval of 1-4 hours after administration of pethidine. Later, Schnider and Moya (1964) presented a more robust study with large numbers; 650 women received one dose of 50, 75 or 100 mg pethidine; 147 received secobarbital with pethidine; 350 had no pethidine. However, most patients were also anaesthetised (65% epidural, 15% saddle block, 12% pudendal or local). The incidence of low Apgar scores (0-6) was 5.7% without pethidine, 6.5% with the single dose and 11.6% when secobarbital was also administered. The time to spontaneous respiration was

13.6% in this "cocktail" group but only 4.8% without pethidine. Peak respiratory depression occurred 2 hours after a dose of 50mg and 3 hours where 75 or 100mg was used. Levy (1971) however, compared pethidine to pentazocine in a double blind study of 93 first born infants. The Apgar score indicated no difference in the incidence of depressed infants. Although there was no control group included, review of another 93 first born infants gave similar results. Zaru, Esposito and Zaru (1967) even advocated continuous intravenous infusion of pethidine (40mg per hour) since newborn depression was not significant.

Morrison and his colleagues (1973) looked at the mechanics of pethidine transfer in 65 women, sampling at 5, 15, 30, 60, 120 and 180 minutes after intravenous (not the more usual intramuscular) administration. Infants born within an hour of the pethidine evidenced no respiratory depression, but most of those born 3-6 hours later showed moderate or severe depression. In the group born 1-3 hours afterwards the degree of depression was consequent upon the maternal metabolic pattern. Mothers, who themselves metabolise pethidine very rapidly, may confer a greater disadvantage on their infants. The authors suggest that pethidine metabolites may also determine the degree of depression.

Since then pharmacologists have attempted to identify and quantify the metabolic products in both the mother and the fetus. Two which have been suggested to produce fetal depression are pethidine-N-oxide (Mitchard, Kendall and Chan, 1972) and 4'-hydroxypethidine (Lindberg, Bogentoft, Bondesson and Danielson, 1975). Few studies have examined neonatal metabolism, probably because of its technical difficulties (collection of blood/urine, need for sizeable samples, specificity of assay). Crawford and Rudofsky (1965) found that 8 of 10 infants excreted both norpethidine and pethidine after a maternal dose of 50mg; the

remaining two excreted only pethidine in 0-48 hr. urine. When two infants received a 1mg of intramuscular (IM) pethidine no metabolites were detected. This contrasts with O'Donaghue's (1971) identification of norpethidine and pethidinic acid in neonate urine samples after maternal dose or 1 mg IM injection. Hogg, Wiener, Rosen and Mapleson (1977) found an increasing ratio of norpethidine to pethidine in neonatal urine after maternal pethidine administration in labour.

The most recent work from Belfrage's Swedish group (Belfrage, Boreus, Hartvig, Drestedt and Raabe, 1981) also identified the norpethidine metabolite in increasing concentration up to 4 hours after administration to the mother (their last sampling point). However, they conclude that the depression seen at birth is less related to its main metabolite than to the total amount of pethidine transferred to the fetus.

b. Inhalation "Analgesia"

In the U.K.,nitrous oxide, trichloroethylene and methoxyflurane have been used in subanaesthetic concentrations to produce analgesia. Pain relief is rapid, but short-lasting, so usually they are reserved for the late 1st and 2nd stage of labour. Although their intermittent use should preclude depressant effects the situation is difficult to study because they are so often used in conjunction with hypnotic and/or sedating drugs, and thus may potentiate their effects. Moya and Thorndike (1962) concluded that nitrous oxide administered in normal doses (50% in 0_2) does not lead to significant respiratory depression, but may do so when 75% concentrations are used. Arthurs and Rosen (1979, 1981) advocated continuous use of 50% nitrous oxide in oxygen (through a nasal catheter) to supplement narcotic analgesics, since it enhanced pain relief and had "minimal" effects on the infant.

Trichloroethylene (Trilene), however, has a high blood partition co-efficient and high lipid solubility index, which results in slow induction and recovery. Cumulative effects can result in maternal drowsiness and a decrease in efficient uterine contractions, and, because it is rapidly transferred to the fetus, has been reported to produce marked sedation (Moya and Thorndike, 1963). Methoxyflurane (Penthrane) too, is slow in induction and recovery, and, like trichloroethylene, has a characteristic smell which is unacceptable to many patients. In the standard concentration (0.35% in air) the levels in fetal and maternal blood are low, but neonatal respiratory depression has been reported in direct proportion to the placentally transferred load (Clark, Cooper and Brown, 1970).

c. Local anaesthetics

1. Lignocaine

Lignocaine was used in a study of epidural anaesthesia (+/- oxytocin) on the fetal and neonatal status of 72 infants (Wingate, Wingate, Iffy, Freundlich and Gottsegen, 1974). The 100 patients in the control group had either no analgesia (21), chloral hydrate (26) or pethidine (53). Significant fetal heart rate decelerations (usually late decelerations) were seen in 55% of the epidural group - 40% of those with stable blood pressure and 71% of those who had become hypotensive.

Schifrin (1972) also looked at the effects of oxytocin stimulation and epidural anaesthesia (both lumbar and caudal blocks) using lignocaine. A quarter of the 360 fetuses showed late decelerations - 40% in the epidural + oxytocin group, compared to 17% in those whose mothers had neither oxytocin or epidural. Of the 25% of mothers given epidural, 72% of their infants developed late deceleration patterns. No differences in neonatal outcome between the groups were found.

2. Bupivacaine

Noble and his colleagues (Noble, Craft, Bootes, Edwards, Thomas, and Mills (1971)), compared 100 women given bupivacaine epidural block (0.5%; 8 ml doses) with 102 delivered with "conventional" analgesia (no drugs, entonox, pethidine, morphine). Although patients were randomly allocated to either group, 43 were discarded; they argue that this bias results in favour of conventional analgesia. There were no differences in fetal heart rate (FHR) or the occurrence of meconium staining (an indication of "fetal distress"), but the epidural group had higher Apgar scores. Noble's work was important in demonstrating that hypotension due to epidural block can easily be corrected by having the mother adopt a left lateral position, and thus prevent some of the fetal heart changes in the other studies, which may themselves compromise the infant.

Wiener, Hogg and Rosen (1976) included a number of respiratory indices in their well-controlled study of bupivacaine (11 infants) versus pethidine (18) and Naloxone (15) (a narcotic antagonist). For the first three assessments (30 minutes, 4, 8, and 12 hours) the bupivacaine group had lower mean alveolar carbon dioxide tension (but significant only at 30 minutes), while Naloxone had lower tension and higher excretion than the other two groups. They concluded that this indicates less marked depression in bupivacaine infants than those born to mothers after pethidine, but that both groups had more respiratory morbidity than those whose pethidine had been reversed by Naloxone.

3. Fetal toxicity

One report has documented the effects of local anaesthetics accidently injected into the fetus. Four infants who received mepivacaine during caudal anaesthesia became apnoeic, bradycardic, and began convulsing shortly after birth (Sinclair, 1965). These effects are like those reported in toxic doses in the adult: apnoea and vascular collapse from medullary depression, bradycardia due to myocardial effects and convulsions following cortical excitation. Rosefsky and Petersiel (1968) also cited two neonatal deaths following mepivacaine used in paracervical block. The first was stillborn following prolonged bradycardia after the anaesthetic, while the second had poor Apgar scores, subsequent convulsions, and died 2 days later. However, in that study there was no evidence of injection into the fetus.

d. Sedative-hypnotics/tranquilisers

Early reports of diazepam (Valium) promoted it to increase maternal comfort and reduce pethidine requirements (Bepko, Lowe and Waxman, 1965). However, Valium crosses the placenta very quickly, can accumulate in the fetus (Gamble, Moore and Lamki, 1977) and has a very long half-life (93.2 hours) (Mahon, Chaba and Umeda, 1976); its metabolite N-desmethyl diazepam is also a potent sedative and muscle relaxant (Randall, Scheckel and Banziger, 1965). It has been associated with fetal cardiac compromise, and neonatal hypotonia, respiratory depression and temperature instability (Owen, Irami and Blair, 1972; McCarthy, O'Connell and Robinson, 1973). The use of large doses of Valium in eclampsia can prolong this depression.

Lorazepam is a more recent benzodiazepine with a shorter half-life (12 hours); it is metabolised slowly to an inactive glucuronide which can still be detected at 1 week. Although neonatal cord maternal ratios are low (McBride, Dundee and Moore, 1979; Whitelaw, Cummings and McFadyen, 1981) it can produce respiratory depression at doses of 2.0mg (when followed by 100mg of pethidine).

Physiological measures have usually been relied on when evaluating the morbidity associated with drugs used for Caesarean sections. Kjellmer and colleagues (Kjellmer, Magno and Karlsson, 1974) took measures of respiratory status to compare barbiturates versus nitrous oxide to induce anaesthesia for abdominal deliveries. There were no differences between the groups in blood gas values, but the PaO_2 was significantly greater between 30 and 180 minutes, and the $PaCO_2$ in the first 10 minutes after delivery than in a vaginally delivered control group. The Apgar scores for the barbiturate group included only 5 out of 16 infants with a score of less than 8 at 1 minute, and no low scores at 5 minutes; the nitrous oxide group had 3 out of 10 with less than 8 at 1 minute and, again, no low scores after that. But the authors still remark that the nitrous oxide babies "gave a very vital impression ... needed less cutaneous stimulation to cry vigorously" than those in the barbiturate group.

e. Meptazinol - a new contender for labour pain relief?

In the past few years efforts have gone into developing and testing a new analgesic suitable for obstetric use, which would provide greater satisfactory pain-relief than pethidine without its accompanying depressive effects on the neonate. Meptazinol has been in use for several years as post-operative pain relief and has been tested for use in labour at several maternity units prior to its projected general market release (Meptid) in the U.K. in early 1983.

Meptazinol is a centrally-acting analgesic drug belonging to the hexahydroazepine series. Technically an opioid mixed agonist-antagonist, early investigations suggested that it has a low incidence of typical opiate properties such as respiratory depression.

Study of the offspring of 13 mothers indicated a low neonatal/maternal plasma concentration ratio of 0.57 and a half-life of 3.4 ± 1.5 hours. Six neonates sampled at 12 hours had an average concentration of less than 5% of the initial value, and all the samples from five neonates at 18 hours were below the detectable limit of 3 ng/ml. (Franklin, Frost, Robson and Jackson, 1981).

In a clinical trial by these same authors, 50 mothers received meptazinol and 50 pethidine in I.M. doses of 1.8 mg/kg body weight (6 in each group received 2 injections). Data were collected on Apgar score, and transcutaneous PO_2 monitoring and recordings of crying and movement were made in 43 of the infants from 30-60 minutes after birth. There were no significant differences in Apgar scores (about a quarter had a one minute score of 7 or less in both groups), or transcutaneous PO_2 (M = 11.2 kPa; P = 10.7 kPa). However, a range of $\geq$ 2.0 kPa was recorded in significantly more babies ($p < 0.05$) in the meptazinol group (67%) than in the pethidine group (27%), and significantly more crying and movement ($p < 0.05$) were recorded. The authors found no differences in the incidence of weight loss or neonatal jaundice, but significantly greater numbers of meptazinol infants ($p < 0.01$) were discharged by day 6 (65%) than those in the pethidine group (39%); the meaning of this advantage, however, is difficult to interpret. Nicholas (1983) plotted dose-delivery interval against Apgar score, initial apnoea and time to sustained respiration, and found slightly greater "sedation"; but no significance tests are reported.

Although "behavioural assessments" (unspecified measures of muscle tone, irritability, lethargy, feeding, jaundice and vomiting) were made, the authors state that so few abnormalities were reported as to make between group comparisons unnecessary.

The reported 3.4 hour half-life makes this drug very attractive. However, its maternal side effects are just as great, depressive effects do not really seem significantly reduced compared to pethidine, its projected cost is much higher and its long term behavioural effects have not yet been evaluated.

f. Limitations of immediate physiological assessment

Nonetheless, as Dubowitz baldly puts it, the information one gets from the Apgar score is "whether the infant is dead or alive; whether the infant is fully conscious or moribund; the state of the respiratory or cardiovascular systems and a crude idea of the state of function of the lower centres of the nervous system as reflected by the state of tone and reflex irritability" (1975). Assertions about "peak effect" and depression may simply confuse the issue. If a drug is administered within an hour of delivery and the newborn shows no effect it may not confirm that the drug has had no effect, but that the effect has yet to be seen. Brazelton's (1970) clinical observations are well-known regarding the number of neonates who are responsive in the delivery room but two to three hours later are relatively unresponsive, acrocyanotic with little motor activity and very slow heart and respiratory rates. To get a picture of the full range of neurological functioning and the higher order skills necessary for socially responsive interactions with the environment, more sophisticated assessments are necessary; and preferably, these measurements should

be made on several occasions. The next section will review some of the effects on behavioural functioning during the later neonatal period.

2. Behavioural Studies

a. Attention and habituation

A few studies have examined the effect of medication in relation to perceptual abilities. Turner and Macfarlane (1978) investigated the effect of pethidine on localisation of human speech sounds by 2-7 day old neonates. They claim that infants whose mothers received 100-150mg of pethidine could not make a significant discrimination between sounds coming from the left and right, spent less time with their heads turned to 20^{o}, 25^{o} and 30^{o}, and more time turning away from the sound source. However, the study is rather unconvincing as it relies on a total of 4 pethidine cases versus 4 babies whose mothers had a variety of drugs. In addition they may not be a representative sample since a further 6 infants were excluded because they were too fussy or drowsy.

Stechler (1964) studied visual attentiveness in 20 infants, between 2 and 4 days old, whose mothers received "medication" (including pethidine, alphaprodine, pentobarbitol, promethazine). Those infants exposed to drugs within 1½ hr. of delivery looked for significantly less time at the pattern. A more complex analysis involving "time-weighted" dosage scores confirmed this relationship for increased total looking time with longer dose-delivery interval.

The reverse of "attending" to stimuli is the ability to cease responding, or to "habituate". The "habituation paradigm" has been examined in relation to drugs for several parameters (i.e. motoric responses, heart rate) and in three modalities (auditory, visual and tactile). (In addition to the studies detailed below, habituation (decrement) to a torch light, rattle and bell are part of the BNBAS and are reported under Global Assessments section. Unfortunately, data is not usually presented for the individual items and the scores and procedures are not readily comparable to the more complex methodology here).

Twenty-three infants participated in tests of habituation to white noise and the Graham Behavioural Scale at 2 days, and a follow-up Bayley Scale at 1 month (Conway and Brackbill, 1970). To deal with the "mixed bag" analgesia and anaesthesia regimes in the mothers, a "potency score" was derived based on the type and amount of medication. At 2, 5, and 28 days slow habituation was associated with high drug potency scores. Brackbill continued this work (Brackbill, Kane, Manniello and Abramson, 1974a) on habituation with a study of 25 infants, in which she also administered an early form of the Brazelton N.B.A.S. Their mothers all received epidural anaesthesia (plus prilocaine) but the independent variable was the additional pethidine (50-150) given to 14 of the mothers (mean = 77mls). Infants of mothers who had not received pethidine habituated twice as fast as the others, and the correlation between the dose and habituation rate was highly significant. In the last of their studies (Brackbill et al, 1974b), they included another 19 infants whose mothers had been pre-medicated. Again "potency scores" allowed ranking of the infants. Habituation scores were correlated with drug

dosage and time of administration in the whole group, and in the "pre-medication" sub-sample habituation was also correlated with potency score.

Moreau and Birch (1974) extended Brackbill's situation to test habituation to auditory and somesthetic stimulation in 60 female infants - 29 of whom had been delivered after general anaesthesia. Most mothers in both groups had also received pethidine, and half had been given local anaesthesia too. Ipsilateral eye movements and cardiac acceleration responses were the dependent variables. Eye movement responses to white noise, and cardiac responses to the tactile stimulus habituated more rapidly, and remained consistently reduced, in the no-general-anaesthetic group. The authors therefore argue that habituation is dependent on the type of response examined and the particular modality that is stimulated, and that "general" conclusions about the relation between obstetric medication and habituation are unwarranted. This is supported by a study of older infants (50 at 4 months; 50 at 5 months) whose mothers had mixed pre-medication and anaesthetic (Friedman, Brackbill, Caron and Caron, 1978). Decrement of motor responding to a visual stimulus was only moderately associated with medication - and more so with analgesia in one age group.

b. Sleep, wakefulness and EEG status

Emde, Swedberg and Suzuki (1975) studied sleep-wake cycles in 20 infants over the first 10 hours; they refer to "mixed pre-medication" but the most common "ingredient" was pethidine 50-75 mg, then diazepam 5-10 mg. "Drugged" infants were awake for half as long in the first 2 hours (15.3 vs. 37.8 minutes) and in the following 8 hours (4.7 vs. 9.8 minutes). These infants also spent longer periods in "non-REM"

("quiet") sleep and the length of their rest-activity cycles were increased (45 vs. 32 minutes).

Polygraphic recordings of sleep cycles over a 2½ hour period were used in a study by Yang, Zweig, Douthitt and Federman (1976) to collect data on 85 first born neonates at a mean age of 58 hours. They measured 3 aspects of sleep: a) percentage of the period spent in a "quiet" versus "active" sleep, b) duration of the second sleep episode within that period, and c) autonomic variability as represented by the standard deviation of the heart rate/respiratory rate in each stage. Seventy-two mothers received a total of 240 separate analgesic administrations, while 13 had anaesthesia or a "block" or "local" infiltration, so the authors were not able to examine the type of medication. Instead, they analysed total dosage, time of effective administration of the first, and last, drug, and time of maximal effect. Drugs given earlier in labour were significantly correlated with a larger percentage of quiet sleep, and a longer duration of the second quiet sleep episode. They conclude this to be a reflection of homeostatic stability, since quiet sleep is considered to be a physiologically more stable state than active sleep, (Roffwarg, Muzio and Dement, 1966).

These results and interpretation seem quite contradictory, since Emde's group of drugged infants were reported as sleepier. However, Yang indicates that their maximal drug effect (168 minutes before delivery), and the last administration (107 minutes before delivery), took place considerably earlier than in other reports, supposedly allowing early metabolism and excretion of the medication. Without comparable information about Emde's subjects, one cannot exclude the contribution of dose-delivery time differences to the result.

A few studies have specifically investigated the effect of medication on EEG. Borgstedt and Rosen (1968) studied 41 infants whose mothers had received various drugs - pethidine (50-100 mg) was the most common. EEG recordings were done between 36 and 42 hours after delivery, and abnormalities defined as an increase in 15/sec to 25/sec low voltage waves. Babies were also categorised as "behaviourally impaired", or not, according to how "difficult to arouse" they were in a neurological examination at 36 hours. There was a significant relationship between medication and both "behavioural impairment" and EEG alterations; behavioural and EEG status tended to go hand-in-hand. By 48-72 hours difficulties in arousal had disappeared in all but 3 infants, but increases in low voltage fast activity persisted in 10 others. This study is unusual in including primarily black infants, although there is no reason to expect that there would be any differences in EEG according to ethnic origin.

Brower (1978) recorded EEG patterns at about 48 hours, in 45 infants of mothers given meperidine. By examining traces before and after different forms of stimulation (visual, auditory, tactile and olfactory), he found a significant difference between drug groups (including pethidine +/- diazepam versus only an anaesthetic) during peripheral auditory stimulation at 63 dbs. This auditory intensity effect seemed diminished in the presence of promethazine. The "promethazine" versus "pethidine" groups differed specifically in responses involving the occipital region.

This confirmed earlier suggestions of changed occipital activity made by Hughes and colleagues in the late 1940's. In the first study (Hughes, Ehemann and Brown, 1948) they performed EEG's on days 1, 2

and 3 in 20 neonates whose mothers received secobarbitol and noted "depressed" activity even though the infants appeared, and behaved, bright and alert. In the second study (Hughes, Hill, Green and Davis, 1950) they examined a larger number of infants delivered after differing doses of meperidine (100mg, 200mg, 300mg), vinbarbitol (5-8 grains, > 8 grains), and morphine (10mg, 15mg). Here too they noted depressed, primarily occipital, activity in the meperidine group (1 infant died after vinbarbitol although the cause and effect relationship is not clear).

However, other authors have concluded that there is no correlation between maternal medication and cortical suppression, or other altered EEG patterns, including Ellingson (1958), (meperidine, barbiturates, or combinations of these drugs), Liberson and Frazier (1962), ("anaesthesia and analgesia", barbiturates), and Rosen and Satran (1964).

c. Sucking and Feeding

There are numerous skills necessary for successful feeding - at the very least, the reflex actions needed to co-ordinate sucking, swallowing and breathing, and the energy necessary to maintain a fairly constant rate of sucking. Reduction in sucking strength, or erratic sucking, whether it be due to medication, prematurity, or perinatal factors, may make it more difficult for the mother to feed her infant. Few studies, however, have investigated more than one component of these skills, and have either concentrated on artificial procedures in a laboratory, or drawn conclusions from maternal reports of feeding or observation of the mother-infant dyad.

In a carefully controlled laboratory study of nutritive sucking (Kron, Stein and Goddard, 1966), secobarbitol was found to exert a profoundly depressive effect on rate, strength (pressure), and consumption of a 5% sucrose solution over the first 3 days. It is unfortunate that the authors were satisfied with such small sample groups (10/10), since this study is one of the few in the literature to randomly assign patients to a drug/no-drug condition.

This same sucking procedure was one aspect of behaviour measured in a comprehensive study from a team of Cardiff anaesthetists (Wiener, Hogg and Rosen, 1976). They found no differences in feeding performance (rate, pressure, consumption over 5 minutes), at 4, 8, 24 and 48 hours in infants whose mothers received pethidine (18) or bupivacaine epidural (11), except for increased frequency of sucks in the bupivacaine group at 12 hours. However, a further group of pethidine infants (15) who then received Naloxone (a narcotic antagonist) at birth were always better in every measure, except at 8 and 12 hours, and sucking pressure at 24 hours.

"Anaesthetics", with or without sedatives, have also been implicated in shorter laboratory nutritive sucking times, but sedation alone was related only to lowered food intake. (Dubignon, Campbell, Curtis and Partington, 1969). Despite the respectable sample size (210 infants), it is difficult to evaluate the findings in the absence of details of type, dosage, and timing of medication, especially since many of the laboratory measures were also influenced by other perinatal factors such as labour length, type of delivery, and non-optimal pregnancy factors. At least one other study (Yang, Zweig, Donthitt and Federman, 1976) has failed to find a relationship between medication and laboratory sucking measures, although it too dealt with a population (85 infants) receiving one or more of seven different drug regimes.

Using the less sophisticated procedure of counting sucks on a finger, poor sucking in the first 48 hours has been associated with general anaesthesia using either ketamine (mean dose 3.1 mg) or thiopental (mean dose 0.7 mg). when compared to chloroprocaine (470 mg) given extradurally. When pethidine was given in addition to either chloroprocaine epidural block, ketamine, thiopental, or lidocaine pudendal block, single dose of 50 did not affect behaviour, but doses of 75-100 depressed sucking and the rooting reflex up to 48 hours (Hodgkinson, Bhatt, Kim and Wang, 1976).

Other researchers have concentrated on the infant's behaviour when fed by his mother. "Pre-medication" (mainly scopolamine), has been associated with less effective breastfeeding in the first 4 days, thus requiring more maternal stimulation, and a 24 hour lag in weight gain (Brazelton, 1961). Although this study controlled for experience by using multiparae, it is possible that the differences were due to bias in reporting, or the effects of medication on the mother's handling skills, or even on her milk production. Richards and Bernal (1971) investigated sucking and feeding over the first ten days in infants whose mothers received pethilorfan. Data presented (on only part of the sample), indicated that the drugged infants had a reduced sucking rate and a longer latency to cry when the teat was removed. There was also a tendency toward shorter feeds with more interruptions, longer periods off the nipple, and more stimulation to suck given by the mother.

d. Global behavioural assessments

With the introduction of standardised scales for the assessment of neonatal neurology or behaviour many authors seized on the opportunity to examine multifactorial aspects of the infant's functioning. Currently the most popular instruments are the Scanlon Neurobehavioural Exam (1974) and the Brazelton Neonatal Behavioural Assessment Scales (BNBAS) (1973). The Prechtl Neurological Examination (1964) has been utilised in studies primarily concerned with more "primitive" reflexes and aspects of muscle tone than the other two. Nevertheless, there is considerable overlap between the scales - for instance the Brazelton includes many of Prechtl's reflexes, and each scale includes measures of state, tone, and responses to stimulation. They all enable the tester to form a global impression of the infant's strengths and weaknesses but were not designed to yield a numerical total score. In more recent versions some concessions have been made to the clinical utility of a total score. Prechtl's team has presented an abbreviated form of their test which gives an "Optimality" score (Prechtl, 1977).

Some of Brazelton's co-workers and followers have presented different ways of reducing this unwieldy number of scores, either by grouping the items into logically defined clusters (Als, Tronick, Adamson and Brazelton, 1976; Brown, Aylward and Bakeman, 1978) or by empirically determining a set of core items from factor analysis (Sameroff, 1978).

1. The Scanlon Neurobehavioural Exam

In the first use of his own scale, Scanlon and his colleagues (Scanlon, Brown, Weiss and Alper, 1974) compared 28 babies whose mothers had received lignocaine (9) or mepivacaine (19) with 13 in a

non-epidural group. The use of additional drugs in both the epidural group (11 had alphaprodine and/or secobarbitol) and the non-epidural group (7 received low spinal or local anaesthesia, of whom 4 also received alphaprodine and/or secobarbitol) makes the data somewhat difficult to interpret. They concluded that the epidural group demonstrated poorer performance in habituating to a pinprick, muscle strength and tone (particularly pull-to-sit and arm recoil), rooting (but not sucking) and the Moro reflex. There were no differences in overall alertness or a global summary score. There was a trend to more rapid recovery in the lignocaine versus the mepivacaine group. His characterisation of epidural babies as "floppy but alert" is an often repeated phrase in the literature.

In 1976 the same team studied bupivacaine (Scanlon, Ostheimer, Lurie, Brown, Weiss and Alper, 1976). Since its greater potency enables a lower dose to be given, this usually leads to a longer dose delivery interval and there were no differences between the behaviour of 20 bupivacaine-group babies and 20 controls. Bupivacaine was only detectable in one infant after delivery and Scanlon estimated that disappearance from the blood would be rapid as a result of uptake into the tissues (but see present study, Pharmacology, Section IV.B).

In addition to their physiologic and sucking measures, Wiener, Hogg and Rosen (1976) administered the Scanlon test at 30 minutes, and 4, 8, 12, 24 and 48 hours, a test of feeding at 4, 12, 24 and 48 hours, and measured respiratory status in the period after delivery. Of the 44 infants, 11 mothers had received bupivacaine epidurals, 18 had pethidine and 15 infants had been given Naloxone immediately after their birth with pethidine.

The bupivacaine group habituated faster than the pethidine group, except at 30 minutes and 24 hours, but there was no difference between the bupivacaine and naloxone group. There were also no differences between the pethidine and bupivacaine groups for general and elicited reflexes, but sometimes the bupivacaine group demonstrated fewer responses than the naloxone group. On the tone measures the naloxone babies scored much higher than the pethidine group, with the bupivacaine group significantly lower than either of the others. Tone was considered poor up to 48 hours. The authors conclude that the bupivacaine group had less depressed behaviour than the pethidine group, but that the naloxone treated group was the least affected. They do lead the reader to assume, therefore, that the naloxone infants are performing like unmedicated "controls", whereas in fact it might be that they are hyperstimulated.

Corke (1977) used the Scanlon examination at 4 hours to test a sample of 51 English infants whose mothers received either no analgesia (14), bupivacaine epidural block (15), or pethidine + promazine (22). He found that for the overall score, pinprick response and habituation, reflex behaviour, and rooting and sucking that the epidural group did best, followed by the no-drug and then the pethidine group. On the tone items (P-S, recoil, truncal and general tone) the no drugs group had the highest scores, followed by the epidural and then pethidine groups. He did not measure any detailed behavioural changes ascribable to dosage, but still concluded that bupivacaine is the best drug for management and is "likely to be of benefit".

Following on from other work using bupivacaine and mepivacaine for epidural anaesthesia, Merkow and his colleagues (Merkow, McGuinness, Erenberg and Kennedy, 1980) looked at any particular advantage of one over the other for pudendal blocks. It is important to use the smallest

effective amount of drug for pudendal block, and particularly paracervical block, because it is rapidly absorbed. Habituation to a pinprick was quicker in the mepivacaine group infants than in the bupivacaine and chloroprocaine-treated groups. By 24 hours this effect had disappeared. There were no differences between the three groups in muscle tone or alertness. However, there was a positive correlation between the 4 hour (neonatal) mepivacaine level and the dose-delivery interval, but not with either the delivery or 24 hour samples. Citing Scanlon's (Scanlon et al, 1974), findings of a significantly depressive effect of mepivacaine given earlier in labour (27 minutes versus 13 minutes), they conclude that a threshold might be reached whereby neurobehavioural effects could be demonstrated in the case of prolonged dose-delivery intervals.

Scanlon's scale was also used to evaluate bupivacaine given in the larger doses necessary for Caesarean section delivery (McGuinness, Merkow, Kennedy and Erenberg (1978). The 20 (elective) section patients were randomly assigned to either lumbar epidural anaesthesia with bupivacaine or spinal anaesthesia using tetracine. Despite a cord blood level of 0.17 (nearly twice as high as in the vaginal deliveries in the Scanlon series), there were no significant differences on the neurobehavioural measures between the two groups of infants. There was no correlation between the levels of bupivacaine and the test scores. The study would have been stronger with the inclusion of a control group of vaginal deliveries, particularly since the authors conclude that diminished muscle tone at 4 hours was related to the Caesarean section procedure itself.

Independently, a Finnish group (Hollmen, Jonppila, Koivisto, Maatta, Pihlajaniemi, Puuka and Rantakyla, 1978), decided that the added stresses of abdominal delivery merited a separate study of epidural anaesthesia. They used epidural (lidocaine) and general anaesthesia in alternate patients (30) due for elective section for fetopelvic disproportion. Although the Prechtl and Beintema Neurological Examination (several times between 2 hours and 7 days) was used, the items reported mirror closely the Scanlon items in the McGuinness (1978) study. According to the neurological assessment 55% of infants in both groups were normal except for some weakness of integrated muscles. A significantly greater number of infants in the epidural group had weak sucking, rooting, and grasp reflexes. However, there was a strong correlation between weak reflexes, or abnormal neurology, and maternal hypotension (common in epidural patients).

Interestingly there were also 3 hypotonic drowsy infants in the general anaesthesia group - all three mothers had received clonidine as a treatment for hypertension - and these authors suggest that depressed motor performance in other studies using spinal anaesthesia may be due to associated hypotension; they do not really offer any evidence for this hypothesis.

2. The Brazelton Neonatal Behavioural Assessment Scales

Standley and his colleagues (Standley, Soule, Copans and Duchowny, 1974) tested 60 infants, on the 3rd day, whose mothers received local-regional anaesthetics and/or analgesics. A set of scores for analgesia reflected dosage and time of administration, while anaesthesia was scored "yes" or "no"; the BNBAS data was summed to yield an alertness,

irritability and motor maturity score. The unmedicated babies were most alert, least irritable, and most mature motorically. Anaesthesia seemed to exert a greater effect than analgesia, such that the no-anaesthesia group were less irritable and had higher motor maturity scores. When anaesthesia was controlled for them there were no behavioural differences attributable to the dose of analgesia - but this may reflect their somewhat arbitrary rating of equivalence of dosage between 3 quite differently acting drugs.

Aleksandrowicz and Aleksandrowicz (1974) attempted to deal with the problems of poly-pharmacy with complex statistical methods. Their sample consisted of 44 infants who were tested on days 1 to 5, 7, 10, 28 with the BNBAS. Each day's data was subjected to factor analysis and 4 days were discarded; for each factor a "marker item" was chosen to represent that factor. The drugs (number unspecified) were classified into 7 pharmacological groups, and each infant was given a set of 7 drug scores (based on drug/s given and dosage). A multiple regression analysis yielded the finding that a:

> "moderately substantial (about one-fifth to one-third) amount of the variance for the six of the seven Brazelton items, which appeared as marker variables on at least three of the four testing days, was predictable by a subset of the seven drug group scores on one of the four or three testing days".

The items showing the largest relationship to drugs were habituation, orientation-responsiveness, smiles, and cuddliness. Tranquilisers, barbiturates, scopolamine, and succinylcholine all came up frequently in these correlations - many behavioural effects were still evident at one month of age. (This paper was criticised later in the journal, and this correspondance is discussed in Section III.A.)

Keenly aware of the lack of "baseline" data on non-medicated mothers and infants, some American researchers have been driven to other approaches to data collection. Horowitz and her colleagues (Horowitz, Ashton, Culp, Gaddis, Levin and Reichmann, 1977) journeyed to Israel for a sample of 65 infants (31 receiving mixed drugs, 34 no medication) and to Uruguay for another 80 infants (29 mixed drugs, 51 no medication). These BNBAS scores were then compared to data collected by Aleksandrowicz for her previous study of 34 American infants. Their aim of replicating the Aleksandrowicz study of daily testing was thwarted by the Yom Kippur war in Israel and other problems in Uruguay, so they had data on days 1-4 and 28 in Israel, and on day 3 only in Uruguay. For the Israeli infants there were virtually no differences attributable to medication. The Uruguayian infants also showed no "meaningful" effects of medication (i.e. on a few items the significant difference only represented one scale score point, which is less than the "test error" for inter-observer reliability). A comparison of test scores for the three national cohorts indicated that the Kansas infants (all "drugged" infants) were less good at orientation, self-quieting and consolability, which they suggest may be due to the higher levels of medication used than even in the Uruguayian and Israeli "medication" groups.

Hodgkinson and his colleagues (Hodgkinson, Marx, Kim and Miclat, 1977) compared babies born after vaginal delivery under general anaesthesia with thiopental (52) or ketamine (45), versus those receiving chloroprocaine extradural (i.e. epidural) anaesthesia (177). They were examined with the Scanlon scale at 8 and 32 hours after delivery. The percentage of high scores for tone, rooting, sucking, Moro, placing, alertness, pinprick response and habituation, and overall

assessment(s) was greatest in the extradural group, followed by the Ketamine and then the thiopental group. In a guest discussion following the paper, Brown chided the authors for not including a control group, but points out they themselves did not find any significant differences between a chloroprocaine and a non-extradural group.

Brazelton and his colleagues (Tronick, Wise, Als, Adamson, Scanlon and Brazelton, 1976), investigated "carefully controlled amounts" of analgesic premedications and anaesthetics over the first 10 days of life. With the shorter Scanlon scale they found that the epidural group (14) had poorer motor organisation than the others ("minimum" drugs = 20; analgesics = 20) - particularly on truncal tone, arm recoil and pull-to-sit, but no lesser responsiveness. On days 1 through to 10 there were no striking or consistent effects of epidurals, locally administered anaesthetics or analgesic premedication for any of the BNBAS dimensions. They did demonstrate a marked improvement over the ten days for all dimensions except the decrement items, which were best on day 3. The authors emphasise that these findings cannot be generalised to deliveries involving higher drug dosage, since only minimal amounts seemed to cross the placenta in their subjects.

The most recent use of the BNBAS to examine epidural anaesthesia was unusual in its efforts to also measure the contribution of oxytocin to alterations in behaviour (Murray, Dolby, Nation and Thomas, 1981). This excellent study included measures of mother-infant interaction during feeding, baby diaries and maternal perceptions of the infant, and the maternal version of the BNBAS (Field, Dempsey, Hallock and Shuman, 1978) over the first month. On the first day infants in the two epidural groups did poorly on the motor, state control, and

physiological response clusters. In the oxytocin + epidural group depression on the motor scale was even greater (a tendency to being tense and hypertonic). However, the amount of bupivacaine received, or circulating, did not appear to be related to performance.

By discharge the differences were less obvious but the epidural infants were more labile in state control (confirmed by mother's diaries indicating frequent crying) while the epidural + oxytocin had a flat unresponsive state pattern (with corresponding sleepiness marked on the diaries). A high percentage of jaundiced infants in this group (20% for phototherapy), suggests one explanation for the drowsiness. The only apparent difference in the mother-infant interaction measures was greater eye contact in the unmedicated group. At one month of age there were few advantages to the unmedicated group. These mothers handled their infants more affectionately, and did not stimulate them to suck as often, but there were no BNBAS differences. However, mothers in the medicated group reported their infants as less adaptable, more intense and more "bothersome". Differences were "confirmed" by the mothers' ratings of the baby on the MABI, where the drug groups came out with poor interactive ability, state control and overall performance. Mothers in these two "drug" groups also fed the baby less frequently and were not as prompt in responding to the infant's cries. Although at 1 month the mothers' assessment of their infant conflicted with the examiner's 1 day later, their scores were highly correlated with the examiner's assessment at 1 day, implying that a mother's early impression of a disorganised baby may persist well beyond his actual depressed behaviours.

In one of the few English studies in the literature using the BNBAS, Hall (1977) examined 50 first born infants on day 5 as part of a prospective study of childhood disturbance in "at-risk" mother-infant pairs. It was probably a less medically optimal group than others, since there was a high incidence of smoking in pregnancy, low social class, mothers under 20, pre-eclamptic toxaemia, induction, and forceps deliveries. Since 84% of the mothers received pethidine, the authors were forced to derive a simple drug score based on multiples of 50 mg dosage. A multiple regression analysis, with other factors held constant, yielded behavioural effects of induction, birthweight, toxaemia and maternal height, but not pethidine.

C. Related Issues In The Study Of Obstetric Medication

1. Safety Considerations Of Drugs In Labour

The use of analgesia and anaesthesia for childbirth introduced special hazards because of the need to consider the effect on the fetus as well as the neonate. A series of papers in the 1940's drew attention to the fact that even then medications were being used without the necessary knowledge about their pharmacological properties and without sufficient care and attention to patient management (Shields and Taylor, 1957). Drugs were often administered in excessive doses - one grain of morphine in 1% of a series of 293 patients (Mengert, 1942; Montgomery, 1940); an injudicious mixing of many drugs - narcotics, hypnotic, uterine stimulant, gas etc. within a few hours (Galloway, Grier and Blessing, 1936). Administering obstetric anaesthesia did not even call for special training! (Waters and Harris, 1940).

Over the last two decades the absolute maternal mortality rate during childbirth has fallen dramatically, but the percentage of maternal deaths due to anaesthesia has actually increased. Most such deaths occur during general anaesthesia - because of difficult endotracheal intubations, inexperienced anaesthetists and failure to adequately prevent lung soiling by regurgitated gastric contents - but in the last report for 1973-75 (DHSS, 1979) two deaths associated with local anaesthesia were mentioned.

In America, Haire (1981) presented evidence to the Subcommittee on Investigation and Oversight of the House Committee on Science and Technology in Washington about the marketing and use of obstetric drugs. Her argument was that -

> "... a significant proportion of the 4 million children and youths in the U.S. who are afflicted with significant mental and neurologic dysfunction are the victims of obstetric medications administered with the very best of intentions to the mother during labour and birth."

This is, of course, an extreme view and one which is not entirely supported by her selective summary of the literature and her misrepresentation of some studies, including one of the papers published from the present author's research project.

Nonetheless, within this report she does make some important points about the way in which the U.S. Food and Drug Association implies that such medication has been proven safe for obstetric use. For instance, most package inserts state that "safe use in pregnant women other than in labour has not been established". In fact, the majority of those drugs have <u>not</u> been approved by the FDA for labour and delivery either but by default the wording seems to indicate that they have. <u>Only</u> when "obstetric" use is listed in the "Indications"

section does this indicate approval. It is worth noting her other criticisms of the FDA approval system (Haire, 1980):

a) Unpublished data are accepted as evidence of safety without public scrutiny of the research design;

b) A drug can be approved as safe if it is similar to one already on the market, even though that one was never properly investigated;

c) The FDA does not require systematic, long term follow-up of individuals nor is there any system of periodic review;

d) There is no adequate procedure for obtaining reports of adverse drug reactions;

e) Some of a drug's most serious adverse effects can be buried under "Allergic Reactions" rather than in more appropriate sections;

f) The FDA refuses to establish a multidisciplinary perinatal advisor drug committee to consider the effects on the child; at present the appropriate committee is made up of obstetricians.

Although the comparable U.K. body for licensing and marketing medications has not been subjected to the same degree of public pressure and professional criticisms, periodically there is disquiet here too about the delayed withdrawal of harmful drugs from the market, and the efficacy of procedures designed to prevent adverse consequences to patients. Such problems underline the need for careful evaluation of obstetric medications in the first place and an assimilation of this data by practicing obstetricians, as well as controls on the appropriate training and skills required for their safe administration.

2. Evaluations Of Psychoprophylaxis As An Alternative To Maternal Medication

Before the advent of modern pain-relieving medication, women in labour "managed" as a result of special postures, herbal remedies, manipulations by their birth attendants, and, probably unknowingly, alterations in their breathing patterns according to the stage of labour. In the 1940's,Grantly Dick Read (Read, 1944) put forward the view that part of the pain felt by "modern" women was due to emotional tension and incorrect breathing. He advocated understanding of the physiological process of labour and delivery coupled with the practice of specific techniques for muscle relaxation and breathing. Twenty-five years later Lamaze (1970) introduced his "psychoprophylactic" method of childbirth which involved awareness of, and concentration on, breathing patterns during each contraction to preclude the anxiety and tension associated with these. Both men believed that such preparations would reduce pain to a minimum and allow a "natural" birth without the use of medication.

Despite a very large following amongst women in countries around the world,few studies have carefully evaluated the efficacy of these methods. Early studies tended to emphasise the "exercise"/"no exercise" dimension and some failed to detect differences (Roberts, 1953; Peel, 1955; Burnett, 1956). More recently several papers presented at the Psychosomatic Conference in 1972 reported significantly less medication during labour in patients who had learned psychoprophylaxis (Enkin, 1972; Fischer, 1972; Hommel, 1972). Sharley (1970) carefully matched a large sample of 600 women on age and parity, and found that the "prepared" women used less medication, had shorter labours and fewer episiotomies, and their infants had higher Apgar scores. It is possible

though that the outcome measures were themselves highly intercorrelated. Zax and his colleagues (Zax, Sameroff and Farnum, 1975) found that women did not differ significantly in their anxiety during the subsequent birth process, but they did receive less medication and reported more positive feelings about the experience. Involving husbands in antenatal psychoprophylaxis enhanced these advantages in several similar studies (Henneborn and Logan, 1975; Huttel, Mitchell, Fischer and Meyer, 1972).

It is a quite important methodological point that many women still receive analgesia during labour because of the standardised drug regime in their particular hospital, thus invalidating an outcome measure such as "amount of medication received". Alternative dependent variables, perhaps such as "satisfaction with labour", or analogue pain scales, would make such studies more informative.

Other obstetricians (Marx, 1982) however, emphasise the limitations of psychoprophylaxis, particularly in a long and stressful labour. The breathing techniques themselves can lead to hyperventilation, which may produce decreased fetal oxygenation. Prolonged maternal pain and consequent anxiety can cause the increased release of stress hormones from the adrenal gland (epinephrine, norepinephrine and corisol). This too results in decreased fetal oxygen because of constricted blood vessels and impaired placental blood flow.

3. The Effect Of "Stress" On Physiological Parameters In Labour

Myers and his colleagues have spent many years investigating the effect of maternal anxiety on the offspring of rhesus monkeys. He argues that caged animals experience greater all-round stress because of their confinement and enforced contact with man than those

in free range tropical settings. In 1500 (dated) pregnancies they found higher mean birth weights in the free ranging environment and distinct differences between the placentas, as well as a low stillbirth rate. The high (15-17%) mortality in the caged animals accords with other reports of excessive stillbirths (70-100%) occurring in animals shipped from Asia to America. According to these reports, efforts to minimise psychological stress during capture and transport by more sensitive handling, abolition of gang caging, and the use of tranquillisers seems to have been as important as improved medical care in reducing fetal mortality (Myers and Myers, 1978)

Myers became interested in the direct effect of maternal psychological stress on fetal oxygenation after observing that their stillbirth frequency in the caged population increased 3-6 days after any handling (e.g. blood sampling, escape and recapture). There is a sizeable body of literature on stress and reproductive failure in lower order species like rats and mice. Excessive handling (Runner, 1959), bells and flashing lights (Gronroos, Kaupplia and Soiva, 1961) and "no-escape" conditioned avoidance situations (Hochman, 1961) are all associated with increased rates of fetal death and resorption. Also after "stressful" induction of anaesthesia in the mothers there were chemical indications of asphyxia in the first blood samples withdrawn from the fetus. Prospective investigation demonstrated that discrete episodes of stress (for example, induced by positioning of the monkeys, experimenter intrusion), produced matching periods of fetal bradycardia and hypotension. This reduction in maternal-fetal oxygen transfer was confirmed by sequential fetal sampling, which also pinpointed the course of the asphyxia. Asphyxia could always be reduced by re-anaesthetising the mothers with pentobarbital.

The effects of maternal stress on the human fetus are less fully documented although there are a number of reports at the anecdotal level, such as women miscarrying after road traffic accidents, falls etc. Sontag and his colleagues did some of the pioneering work demonstrating fetal reactivity to both soothing stimuli (music played to the mother) and stress (Sontag, Steele and Lewis, 1949). With the advent of fetal heart rate (FHR) monitoring, Copher and Huber (1967) were able to plot FHR variability after application of stress to the mother. In labour, various FHR changes have been noted in response to intrusive procedures on the mother, such as vaginal examination, or a group of doctors entering the room - referred to in America as the "white coat" phenomenon (Huddleston, Perlis, Macy, Myers and Flowers, 1977).

4. Alternative Explanations Of Drug Effects - Personality, Pregnancy And Outcome

Several authors have drawn attention to the possibility that maternal personality or social factors may contribute more to the variance in infant behaviour than the medication given. There have been many attempts to plot the relationship between personality characteristics, "life-events" and anxiety on pregnancy outcome. The large Perinatal Mortality Survey (Davids, DeVault and Talmadge, 1961) indicated that there was a higher incidence of stillbirth in women who had lost their fathers during childhood and those with illegitimate pregnancies. Excessive stress during the pregnancy has been implicated in obstetric complications (McDonald, 1965; 1968), infant problems or abnormalities (James, 1969; Gorsuch and Key, 1974). On the other hand, several authors have not found a positive relationship (Brown, 1964;

Burstein, Kinch and Stern, 1974). Low social class or status, poor housing or "inner city life", have also been statistically associated with difficult pregnancies (Barron and Vessey, 1966).

Yang, Zweig and Douthitt, (1976) examined attitudes, fears and reactions to the pregnancy and newborn infant in relation to the amount of drug requested and/or received. Women who required high doses of pain relief were different from those who received low doses or none at all. Another study measured women's anxiety during antenatal visits and found that high levels correlated well with the amount of medication later given during labour (Brown, Grodin and Manning, 1972). Davids and his colleagues have also suggested that anxious mothers have a more negative view of child-rearing and greater difficulties with their infants, and that some of their infants are likely to be developmentally delayed (Davids, Holden and Gray, 1963). Several studies have implicated anxiety as a factor in low birth weight (Gunter, 1963; Shaw, Wheeler and Morgan, 1970).

III THE "ANALGESIA STUDY": METHODS

A. Rationale For The Present Study

As has been seen, there is now a large literature implicating obstetric medication as a depressive agent on newborn behaviour, as well as a number of more recent contradictory reports suggesting that the use of newer agents (such as bupivacaine) and smaller doses avoids this hazard (Tronick et al., 1976; Scanlon et al., 1976). However, almost all of the existing behavioural studies are flawed in ways which make the interpretation of results difficult. Firstly, the studies have largely been carried out in American hospitals, where the use of medication is routine, and more importantly, where the practice of polypharmacy results in a very large number of drug regimes; thus rendering the evaluation of a specific compound or dose almost impossible. In general, sample sizes are small, which makes it doubly difficult to separate out effects of parity, social class, and obstetric factors.

A few authors have attempted to caution their readers about the poor methodology rife in this area of research. Kramer, Korner, and Thoman (1972) emphasize that without random assignment to drug groups, factors such as parity and length of labour will covary with drugs since they contribute to the rationale concerning drug administration. They cite one of their studies of 404 women (at Stanford University Hospital) in which the curve was U-shaped. Multips and women with short labours tended to have no drugs or to receive medication shortly before delivery, thus representing the two extremes of the extent to which the newborn has medication to eliminate.

Federman and Young (1976) raised issues pertinent to many studies in their letter criticizing Aleksandrowicz and Aleksandrowicz (1974). Firstly they made a number of criticisms of the data reduction technique:-

a) the sample size (44) fails to meet established criteria for a factor analysis of 27 variables, such that when a "shrinkage correction" was applied only 3 items (rather than 8) have one-fifth or more of their variance predicted by drug scores;

b) the mean of the "marker" items is questionable; and

c) meaningfulness of factors should be the main criteria for use.

They also make further points about interpretation of results:-

d) the two significant predictions do not occur above chance level;

e) the 3 "patterns" they report (an increasing trend, decreasing trend, peak in the middle) are in fact the only possible patterns;

f) many of the effects seem to facilitate function, not depress it.

It was therefore decided to carry out a study in a London teaching hospital where the following in-built controls would be possible:

1) The use of single analgesic agents (pethidine by intramuscular injection) or local anaesthetic (bupivacaine via an epidural route);

2) A sizeable sample not receiving medication;

3) Biochemical analyses of fetal and maternal blood samples to obtain the time course of excretion of the drug;

4) A prospective study with obstetric and psychological measures on each mother before the birth of her infant, and her perceptions of him in the first weeks after birth;

5) A variety of measures on each infant from the moment of birth until the second month, allowing consideration of the stability of behaviour;

6) The use of multivariate statistics to partial out the obstetric and personality factors which are likely to be associated with the use of a particular drug, or the time course and dosage of it;

7) Adequate sample sizes for the results to be meaningful.

B. Methods

1. Subject Recruitment

Healthy pregnant women were invited by the research midwife and senior obstetrician to participate in a study of medication given for pain relief during labour. A notice was hung in the Antenatal Clinic asking interested patients to contact the Sister, and if no contra-indications appeared in the notes, the study was explained to her and consent obtained. It was stressed to each patient that she need not make up her mind about pain-relief until she was actually in labour, and that it was common for expectant mothers to change their minds several times up until the day of delivery. Otherwise, patients whose notes indicated that they were suitable were approached by the research midwife and the study explained to them. Patients were recruited between the 30 and 35th week of pregnancy in order to rule out threatened abortion, persistent hypertension, breech position or other unfavourable lie, twins, and other conditions indicating non-optimal pregnancies.

Unfortunately, no attempt was made to keep track of the numbers who refused to participate, or dropped out for personal reasons after initial consent. This is because recruitment was done by a succession of midwives with other responsibilities in addition to the Analgesia Study; psychologists were not involved at this stage in order to preclude their knowledge of the obstetric history of each patient. It is known

that there were more refusals during the stage of collecting serial scalp samples on the fetus, particularly among multiparae who fully realized the additional discomfort this would entail during labour. It is our general impression that it was the more educated, middle class patients who volunteered, rather than waiting to be approached, and that primiparae were also more interested. It was easiest to recruit patients likely to want epidurals, which may reflect the higher proportion of epidurals given in the hospital, or may simply indicate that those who wanted an epidural were firmer in their choice, and felt that we were only interested in patients who had already decided on a method of pain relief. In order to insure a reasonable balance between the groups it was decided to stop actively recruiting primiparae toward the end of the study in order to concentrate our resources on multiparae who might be more likely to labour without medication.

2. Characteristics Of The Final Sample

Although we had initially aimed for a sample of 180, it became apparent that with the falling birthrate at the hospital it would be necessary to set a completion date of April 1977 if we were to realistically code and analyse all the data within the terms of the grant(s). By this time we had recruited 145 patients, and these formed the final sample. A further 18 patients had been excluded because they received both pethidine and epidural anaesthesia, and/or their labour resulted in operative delivery under general anaesthesia. All infants of sample mothers were tested, regardless of their own condition or subsequent paediatric problems. Thus the sample consisted of infants born to obstetrically normal mothers, rather than a group

of normal infants chosen after birth as in the majority of previous studies; however, in the event none of the infants did prove to have medical problems.

Characteristics of the mothers in the sample are presented in Tables III.1, III.2, and III.3. There were 35 patients who did not receive drugs, 51 who received pethidine by intramuscular injection, and 59 who were given bupivacaine via epidural anaesthesia. There were no differences between the three groups with respect to the following: social class, maternal age, maternal height, weight at booking and weight gained in pregnancy, gestational age at booking and delivery, incidence of smoking and antenatal complications, duration of the third stage, birthweight and sex of infant, weight of the placenta, or the presence of meconium stained liquor. As might be expected in a free choice situation, certain characteristics favoured delivery without medication. Pethidine or an epidural were received significantly more often by primiparae, and the length of first and second stage of labour were significantly greater in the two drug groups. The incidence of oxytocin-induced or augmented labours and forceps deliveries was also significantly greater in the drug groups. (These variables were also significantly interrelated with each other and with delivery outcome, which will be discussed later).

A copy of the computer form on which the obstetric information was coded appears in the Appendix. Some of the information obtained, however, was not considered important to the present analysis and was therefore omitted.

Table III.1 MATERNAL AND INFANT CHARACTERISTICS (Chi-square analyses)

FACTOR	No drug		Pethidine		Bupivacaine		Total	
	N	(%)	N	(%)	N	(%)		(%)
Parity[1]								
Primip	14	(40.0)	32	(62.7)	41	(69.5)	87	(60.0)
Multip	21	(60.0)	19	(37.3)	18	(30.5)	58	(40.0)
Social Class								
I/II	16	(45.7)	22	(43.1)	37	(62.7)	75	(51.7)
III	11	(31.4)	24	(47.1)	15	(25.4)	50	(34.5)
IV/V	5	(14.3)	4	(7.8)	7	(11.9)	16	(11.0)
Not known	3	(8.6)	1	(2.0)	0	(0.0)	4	(2.8)
Infant Sex								
Male	15	(42.9)	27	(52.9)	28	(47.5)	70	(48.3)
Female	20	(57.1)	24	(47.1)	31	(52.5)	75	(51.7)
N =	35		51		59		145	

[1] $X^2 = 8.21$, 2 d.f., $p < 0.02$

Table III.2 OBSTETRIC FACTORS IN PREGNANCY AND LABOUR (Chi-square analyses)

	No drug		Pethidine		Bupivacaine		Total	
	N	(%)	N	(%)	N	(%)	N	(%)
Smoking								
Smoker	8	(22.9)	16	(31.4)	17	(28.8)	41	(28.3)
Non-smoker	27	(77.1)	35	(68.6)	42	(71.2)	104	(71.7)
Antenatal Complications								
None	27	(77.1)	41	(80.4)	41	(69.5)	109	(75.2)
P.E.T.	3	(8.6)	3	(5.9)	8	(13.6)	14	(9.7)
U.T.I.	2	(5.7)	2	(3.9)	3	(5.1)	7	(4.8)
A.P.H.	0	(0.0)	2	(3.9)	1	(1.7)	3	(2.1)
Threatened Abortion	1	(2.9)	2	(3.9)	2	(3.4)	5	(3.4)
Anaemia	2	(5.7)	0	(0.0)	2	(3.4)	4	(2.1)
Other	0	(0.0)	1	(2.0)	2	(3.4)	3	(2.1)
Use of Oxytocin[1]								
None	35	(100.0)	40	(78.4)	26	(44.1)	101	(69.7)
To Augment Contractions	0	(0.0)	5	(9.8)	14	(23.7)	19	(13.1)
To Induce Labour	0	(0.0)	6	(11.8)	19	(32.2)	25	(17.2)
Amniotic Fluid								
Clear	34	(97.1)	48	(94.1)	54	(91.5)	136	(93.8)
Meconium	1	(2.9)	3	(5.9)	5	(8.5)	9	(6.2)
Forceps[2]								
None	33	(94.3)	46	(90.2)	32	(54.2)	111	(76.6)
Forceps	2	(5.7)	5	(9.8)	27	(45.8)	34	(23.4)
N =	35		51		59		145	

[1] $X^2 = 35.41$, d.f. $p < 0.001$

[2] $X^2 = 27.79$, d.f. $p < 0.001$

Table III.3 MATERNAL AND OBSTETRIC VARIABLES (interval data)

VARIABLES	No drug		Pethidine		Bupivacaine		Significance[1] of difference between groups		
	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.	
Maternal Age	26.9	3.6	27.3	5.4	28.2	4.3	27.4	4.4	N.S.
Maternal Height (cm)	162.2	5.9	161.2	5.4	160.8	6.2	161.4	5.8	N.S.
Booking Weight (kg)	57.1	5.7	58.3	6.5	59.9	8.8	58.5	7.0	N.S.
Weight Gain (kg)	12.3	9.8	11.1	4.2	10.1	3.9	11.2	6.0	N.S.
Gestation at Booking Dates	13.9	3.8	13.6	4.9	15.4	6.4	14.3	5.0	N.S.
Gestation at Booking by Fundal Height	15.2	5.6	14.1	4.6	15.7	6.7	15.0	5.6	N.S.
Gestation at Labour	40.2	1.0	40.0	1.1	40.3	0.9	40.2	1.0	N.S.
Oxytocin (max. m.u.)	0.0	0.0	11.1	4.7	9.9	8.2	10.5	6.5	N.S.[2]
Duration 1st Stage (min)	345.2	171.4	471.2	222.7	511.7	247.1	442.7	213.7	$p < .005$
Duration 2nd Stage (min)	25.9	18.2	37.5	31.9	67.1	42.3	43.5	30.7	$p < .001$
Duration 3rd Stage (min)	5.3	2.3	5.7	2.6	5.3	1.9	6.4	8.5	N.S.
Blood Loss (ml)	179.4	78.1	219.8	91.3	249.1	94.1	216.1	87.8	$p < .005$
Placental Weight (gm)	630.1	121.1	645.3	111.2	607.0	147.5	627.5	126.6	N.S.
Infant Weight	3.5	0.4	3.5	0.4	3.5	0.4	3.5	0.4	N.S.
N =	35		51		59		145		

1 from analysis of variance, unless indicated

2 from t-test between Pethidine and Bupivacaine groups

3. Sample vs. Population Characteristics

During the course of this study it was not feasible to ascertain the generalisability of data on these sample patients to the greater obstetric population. However, by examining computer records for the St. Mary's maternity patients over roughly the same time period, we could at least compare certain aspects of pregnancy in the two groups. The variables available (Table III.4) indicate that their physical characteristics, previous obstetric history and labour progress were similar.

4. Procedures

A chronological summary of the procedures involved in the study is presented in Table III.5. However, for convenience, these will be discussed according to the type of information which was collected, under the following headings: 1) Maternal Psychosocial and Health Questionnaires; 2) Obstetric History and Labour and Delivery Procedures;[1] 3) Behavioural Observation and Assessment of the Newborn; 4) Maternal Recording of Infant Sleeping and Feeding Patterns; 5) Paediatric Neurological Examination of the Infant; and 6) Data Processing and Analysis.

a) Maternal Psychosocial and Health Questionnaires

A variety of self-administered questionnaires were given to the mother to complete in the antenatal period, and some of these were repeated at later points in the post-partum weeks. When the study was planned initially (by M. Mills and myself) it was considered that

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[1] These procedures were designed and executed by persons other than the author, but are discussed in full because they are essential to complete understanding of the study.

Table III.4 SAMPLE VERSUS POPULATION CHARACTERISTICS AT ST. MARY'S HOSPITAL

			Sample 1976 - 1978		Hospital Population[1] 1976 - 1978	
			mean	S.D.	mean	S.D.
Maternal age			27.4	4.4	27.0	5.2
" height at booking (cms)			161.4	5.8	161.5	5.9
" weight at booking (kgs)			58.5	7.0	61.0	9.7
Gestation at booking by dates (weeks)			14.3	5.0	15.1	7.3
Gestation at onset of labour by dates (weeks)			40.2	1.0	40.1	1.5
Parity:	primiparous		60%		50%	
	multiparous		40%		50%	
Previous spontaneous abortions:						
	% having had	0	89%		84%	
		1	11%		13%	
		2+	1%		3%	
Previous terminations:		0	85%		86%	
		1	14%		12%	
		2+	1%		2%	
Course of labour:	spontaneous		71%		71%	
	induced		17%		15%	
	augmented		12%		14%	
Liquor staining:	none		94%		89%	
	meconium stained		6%		11%	
		N =	145		2040	

[1] Computer data was not gathered continuously through this period, so does not reflect the total number of patients delivered at St. Mary's.

Table III.5 SEQUENCE OF DATA COLLECTION ON SAMPLE MOTHERS AND INFANTS

ANTENATAL	Obstetric History of Mother Maternal Self-Administered Questionnaires
DELIVERY	Blood Samples : Mother Infant (Umbil. Vein, Artery) Time-Sampled Observation of Infant Selected Items of Brazelton Exam Non-Nutritive Sucking Mother Begins Sleep, Feed Charts of Infant
DAY 1	Brazelton Assessment Non-Nutritive Sucking Nutritive Sucking Maternal Questionnaires Neonatal Heel Pricks at Selected Times (2, 6, 12, 24, 36, 48 hours)
DAY 3	Brazelton Assessment Non-Nutritive Sucking
DAY 5	Prechtl Neurological Examination Maternal Questionnaires
DAY 7	Brazelton Assessment Non-Nutritive Sucking Nutritive Sucking Maternal Questionnaires Sleep and Feed Charts Collected
DAY 21	Brazelton Assessment Non-Nutritive Sucking 24-Hour Sleep Chart on Infant
DAY 42	Brazelton Assessment Non-Nutritive Sucking Maternal Questionnaires 24-Hour Sleep Chart on Infant

in-depth interviews would be the most appropriate means of securing information about the kinds of feelings, attitudes and expectations of the pregnancy and baby that determine a mother's behaviour toward her baby. Information of this sort is not usually obtained in studies of drug effects, and therefore it is often impossible to be certain that changes in infant behaviour are in fact due to maternal medication (or other obstetric variables), rather than by deliberate or unconscious shaping of such behaviour by the mother. For instance, a mother who believes that infants do nothing but sleep is likely to put him down again immediately after a feed, rather than provide the kind of visual and auditory stimulation from which he is likely to profit. Similarly, a mother who is extremely anxious about her pregnancy and her mothering capabilities may elicit different behaviours from her infant than one who is both experienced and confident. As the mother's caregiving opportunities and responsibilities increase over the first few days, one would expect differences between infants to also increase.

Clearly then, it becomes important to be able to measure in what respects mothers are different before they "opt into" a particular drug group, and to control such variables in the final analysis. If, as had been suggested and observed, it is the intelligent and well-educated middle class mother who prepares herself sufficiently to succeed in a "natural" childbirth without medication, then it is perhaps these characteristics in her which might determine her infant's superior performance. Such mothers are also likely to be more confident, less inhibited, more tolerant and less rigid - all of which could be manifest in a particular style of caregiving and stimulation. In contrast, and possibly quite unfairly, is the stereotyped working class mother who is not particularly

well-prepared for her labour, who accepts induction, episiotomy, and pethidine without question, and who bottle feeds her infant on a schedule and then immediately puts him down to sleep again.

However, in spite of a conviction that all of this information is of extreme relevance to the investigation of causal relationships between perinatal factors and later behaviour, it was obviously impractical to collect that much data in the present study. Firstly, in piloting an interview schedule on 20 mothers it became apparent that even very probing questions did not always yield the insightful answers we had anticipated; most mothers seemed to give similar answers to the same questions. Secondly, it was difficult to fit an extended interview into the routine antenatal appointment, and difficult to arrange for patients to make an extra trip just to be interviewed. However, most restricting was the fact that to test the infant "blind" to the obstetric history, would require separate interviewers for the mothers and these were simply not available to us.

Instead, it was decided to use a selection of self-administered questionnaires which would provide an inventory the mother's personality, response to her pregnancy, expectations of the labour and of her baby, and her mood during pregnancy. Because large numbers of subjects were anticipated, spread over a long period of time, certain of these questionnaires were to be utilised for the first 60 cases only, and their merits reassessed before further use. Because we were dependent on the research midwives to collate and distribute the questionnaires, there were also several points at which patients failed to complete everything as planned.

The following questionnaires were given to patients at the antenatal clinic appointment nearest to 36 weeks gestation:

1. Eysenck Personality Inventory (EPI)
2. Rutter Malaise Checklist (RMI)
3. Nowlis Mood Adjective Check List (NMACL)
4. "Your Baby" Questionnaire (YBQ)
5. "Your Labour" Questionnaire (YLQ)

1. The Eysenck Personality Inventory (EPI)

In order to probe aspects of personality before the birth, we used Form A of the Eysenck Personality Inventory (Eysenck and Eysenck, 1963), which contains 57 questions reflecting the subject's behaviour, feelings and actions. S. Eysenck (1961) used an earlier version of this assessment (postnatally though) to look at the relationship between personality and the tolerance of pain in labour, as well as any association between extraversion or neuroticism and the attitude to childbirth. Although length of labour and delivery complications did not distinguish the two groups, extraverts complained more about the pain, but neuroticism was unrelated to behaviour in labour or the attitude to it. Some of the findings may be rather dated; their unmarried mothers from Moral Welfare Institutions were said to be "really difficult" by the staff, and scored as highly extraverted and more neurotic. Also, at least one of their suggestions would certainly be incompatible with the increased choice and autonomy given to mothers in labour - "Knowing the degree of extraversion of their patients might then help nurses to drug extraverts more heavily than introverts". Nevertheless, the study indicated the utility of looking at personality indices in relation to situational behaviour; it could have made stronger points had the scale been administered in the antenatal period.

The current scale includes 24 "Extraversion" questions, 24 "Neuroticism" questions and 9 "Lie" questions. Typical examples of these would be "Do you often long for excitement?" (E), "Are you often troubled by feelings of guilt?" (N), and "Are all your habits good and desirable ones?" (L).

We deliberately reproduced the questionnaire on plain paper in order to avoid the words "Personality Inventory", as many patients were suspicious enough of psychologists probing into their feelings. Despite this deception many women found the instrument "intrusive" and "offensive", and compliance was poor compared to the other forms.

2. The Rutter Malaise Inventory (RMI)

First used in the Isle of Wight study, Rutter's Malaise Inventory consists of items referring to the emotions or aspects of physical state having an important psychological component (Rutter, Tizard, and Whitmore, 1970). It was largely based on the much longer Cornell Medical Index Health Questionnaire (CMI); fourteen items were taken directly from that inventory of 195 questions (Broadman, Erdman, Lorge, Gershenson, Wolff, and Broadbent, 1952). High scores on Rutter's Malaise Inventory have been shown to relate strongly to the existence of psychiatric disorder (Rutter, 1976). Wolkind (1974), using it retrospectively, found that it related well to reported past treatment for neurotic symptoms.

The scale was used again in the comprehensive study of psychological and social aspects of pregnancy in East End women having their first baby at the London Hospital between 1973 and 1974 (Wolkind and Zajicek, 1981). In their sample women were asked to describe their "health" prior to the pregnancy. Since we did not recruit patients until the

third trimester it was felt that such retrospective responses would be invalid, so our patients were instructed to answer each question as it referred to current "health". The items ranged from straightforward physical symptoms ("Do you often have backache?") to more probing questions about emotional state ("Do you often suddenly become anxious for no good reason?"). Responses consisted of "Yes" or "No" only, with a maximum score of 30. The complete scale appears in the Appendix.

3. The Nowlis Mood Adjective Check List (NMACL)

The Nowlis Mood Adjective Check List (NMACL) has been used and developed over 25 years, and its applications are discussed fully in Nowlis and Green (1965) and Nowlis (1966). His definition of mood is the "effect on a person of his own configurations of activity" - i.e. "level of activation". The questionnaire consists of a series of adjectives describing feelings or mood which the subject circles as appropriate:

(✓✓) definitely feel that way (=3)

(✓) slightly feel that way (=2)

(?) cannot decide (=1)

(no) do not feel that way (=0)

The raw scores are combined into 13 factors on a 0-3 point scale, as indicated above. The 13 mood dimensions are: Aggression, Concentration, Deactivation, Social Affection, Anxiety, Depression, Egotism, Pleasantness, Activation, Nonchalance, Scepticism, Startle, and Angst. An example of the questionnaire and the items making up each factor are in the Appendix.

4. The "Your Baby" Questionnaire (YBQ)

The "Your Baby" Questionnaire used here was adapted from Broussard's original (Broussard and Hartner, 1970). In their study mothers were first asked to rate their perception of the "Average Baby" and then to complete a similar form probing perceptions of their own 1-2 day or 1-month old infant. The total scores were examined to see whether each mother rated her own infant as better than, worse than, or the same as the "average" infant. Broussard then used these criteria to label babies as "low-risk" if their mothers rated them as better, or "high risk" if their mothers rated them the same or worse than the average baby. She argues that such labels have predictive validity for psychiatric problems at 4½ years (Broussard and Hartner, 1970) and at 10/11 years (Broussard and Hartner, 1975).

However, for our purposes the "double" presentation of the questionnaire seemed unwieldy and unnecessary, and so we opted to use the "Your Baby" portion only, once antenatally and twice postnatally. This consists of six questions about typical neonatal behaviour - crying, vomiting, feeding, elimination, sleeping and predictability of routines. A "none" (0) to "great deal" (4) scale was used, with higher scores reflecting more problematic behaviour. An example of each form - (A) pregnancy, (B) 1 week post-partum, and (C) 6 weeks post-partum - can be found in the Appendix.

5. The "Your Labour" Questionnaire (YLQ)

In order to match the "before" and "after" perceptions of the unknown baby with similar feelings about the unknown birth, a questionnaire was designed by M. Packer to cover nine aspects of labour and delivery commonly mentioned in the textbooks and by mothers-to-be.

These questions included feelings of relief at finally going into labour, expectations of coping ability, labour length, pain and the need for drugs, excitment of both mother and father at seeing the baby, and expectations about relations with labour ward staff in terms of help given and degree of embarrassment felt by the mother. The scoring system employed was rather like that of the "Your Baby" questionnaire, with "0" representing good scores and "4" indicating great difficulties (either expected or experienced).

The scale was administered first as an "Expected Labour" Questionnaire in the package at 36 weeks of pregnancy and then again as an "Experience of Labour" at 24 hours after the birth. This second sampling point was chosen in order to give the mother an opportunity to rest and recover from the labour without, hopefully, allowing too great a time lapse to distort her perceptions. Our reluctance to postpone its administration until later in the first week has recently been substantiated by another group of researchers studying childbirth (Woolett, Lyon and White, 1983). They noted that when interviewed in labour women's principal preoccupations were with the impending delivery and pain, but even by two days later that comments had changed to focus less on the labour than on postnatal problems. At this later time their perceptions had also become more negative and critical. A sample of both our questionnaires appears in the Appendix.

b) Obstetric History and Procedures for Labour and Delivery

At the onset of labour a standard procedure was followed by the Obstetric Registrar, or whoever carried out the delivery. Continuous fetal heart rate monitoring was undertaken, and uterine contractions were measured with either an external tocograph, or with an intrauterine catheter in the induced and augmented labours according to the method

of Steer (1974). Continuous monitoring is standard in this obstetric unit, and thus imposed no special limitations on patients in the Analgesia Study. An intramuscular injection of pethidine, 100 or 150 mg. combined with 10 mg. of metaclopromide was administered at the patient's request and repeated as required. Metaclopromide is purely an anti-emetic, and was selected in order to avoid the synergistic effects of the "potentiators" (such as sparine) which are more commonly combined with pethidine. In the case of epidural anaesthesia, an epidural catheter was placed 3 cm cranially from the tip of the Touhy needle, and was injected at room temperature at a constant rate over 10 minutes with the patient in the lateral position. The anaesthetic solution consisted of a 10-14 ml. volume of 0.375 per cent bupivacaine without adrenaline, and all patients also had an intravenous infusion of 5 per cent dextrose in water.

At delivery, blood samples were collected from a maternal forearm vein and the neonatal umbilical vein and artery, and neonatal heel prick samples were collected at 2, 6, 12, 36, and 48 hours after delivery. Samples were measured by gas liquid chromography and mass spectrometry and a fuller discussion of the methods of the drug assay are available in papers by Caldwell and his colleagues (1976, 1978a, 1978b).

Apart from the procedures regarding administration of pain relief, all other routines were similar to those of regular patients. For instance, where induction or augmentation of labour was indicated because of antenatal signs (rising blood pressure, etc.) this was done according to the attending clinician's judgment in each individual case. No criteria were specified for the immediate post-delivery care of the infant, although staff were aware that we were observing the infant and mother. Resuscitation of an infant was determined by his clinical

condition at the discretion of attendant medical staff. The Apgar Score was recorded at 1 and 5 minutes by the obstetrician or midwife who carried out the delivery.

A copy of the coding form used for the transcription of the obstetric history appears in the Appendix. The research midwife completed this form as soon as possible after delivery of a study patient.

c) Behavioural Observation and Assessment of the Infant

An attempt was made to select a variety of types of assessments in order to do justice to the infant's many capabilities, even in these first weeks of life. As mentioned earlier, it was felt that previous studies had often limited the search for drug effects to a single dimension (such as sucking, or mother-infant interaction), and had not begun the observations early enough, nor continued past the first month. In order to allow direct comparison of our data with other researchers we selected the Brazelton Neonatal Behavioural Assessment Scale (BNBAS) (Brazelton, 1973) as our main research tool, supplemented by a direct and naturalistic observation of the infant immediately after delivery. Polygraphic records of both non-nutritive and nutritive sucking were made at regular intervals,[2] and diaries were kept by the mother which chronicled her infant's feeding and sleeping behaviour. An independent neurological examination of the infant (the Prechtl Neurological Examination) was carried out by a paediatrician in the first week. Justification and explanation of these assessment techniques appears under each individual heading.

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2 The data on sucking do not form part of this dissertation.

Initially we had hoped to observe mother-infant interaction throughout the study, particularly as the data by Richards and Bernal (1971, 1974) on pethilorfan were so interesting. However, as the initiative for the study had originated with the Obstetrics Department,we acquiesced to their preference for more frequent and detailed investigation of specific infant responses. With our limited resources and staff (only 2 psychologists at the outset) it would have been difficult to fit such observations in. We also decided in conjunction with the statistician that analysis would have needed to be even more complex than forseen, and the results would require more cautious interpretation, because any given infant behaviour might be dependent on the mother's own style of interaction. During the course of the Analgesia Study a sub-sample of the subjects did participate in an observation of feeding styles carried out by M. Packer which confirmed our fears about the complications of transcription and analysis. In providing a complete account of newborn behaviour as affected by medication, and in countering the statements by other authors, however, we fully realise that such observations would have been invaluable.

1. Observations Of The Infant In The Delivery Room

The psychologist "on call" entered the delivery room only at the crowning of the head, in order to preclude knowledge of the maternal medication. As soon as the infant was delivered she/he commenced recording on pre-coded sheets, moving the pencil into a new time period every 15 seconds when signalled by a bleeper connected to an earpiece. The categories covered the infant's spontaneous behaviours ("state",

movements, visual following, crying, and physiological responses), procedures affecting the infant (resuscitation, examination, weighing, etc.), and the mother's (and father's) interaction with her infant (holding, talking, suckling, etc.). This period of "naturalistic" observation lasted 20 minutes.

After this a more structured assessment of the infant's ability was made by using selected items from the Brazelton Neonatal Behavioural Assessment Scale (to be discussed in the next section). The items chosen for this assessment were those which 1) could be elicited in the noise and chaos of the delivery room, and 2) were not distressing to those who might be watching the infant. This last point is particularly important for several reasons. Firstly, we feel quite strongly that these first few moments belong to the parents and their new infant, and that any non-essential routines must be seen to fit in with the parents' needs and desires. Although some mildly aversive procedures (such as pulling the infant to sit) are an essential part of the BNBAS, they were not considered appropriate in the delivery room where parents might rightly feel that their baby had had enough trauma during delivery itself. Secondly, if we were to earn the mother's trust in our ability to handle her infant it was important to show her the positive aspects of his behaviour. We therefore tested the 5 orientation responses, alertness, and general tone. In addition, some of the behaviours observed in the first twenty minutes were convertible to standardised 9-point scores as in the BNBAS (tremor, startles, hand-to-mouth, lability of state).

After these observations the infant was briefly removed to the laboratory upstairs in order to record a non-nutritive sucking record on the polygraph. It was explained to the mother that our equipment

was not portable, and that we would only be about 5 minutes; the father was encouraged to accompany us, and in most cases did so.

2. The Brazelton Neonatal Behavioural Assessment Scale (BNBAS)

The Brazelton Neonatal Behavioural Assessment Scale (BNBAS) was developed by T.B. Brazelton, a paediatrician, in the late 1960's, and finally published in 1973. It is largely based on previous infant assessments, such as those of Graham and Rosenblith (Rosenblith, 1961), but adds important new concepts based on research into the infant's ability to regulate "states" of waking and sleeping and to shut out disturbing stimuli by habituating to them. Designed as a clinical instrument to identify milder dysfunctions of the central nervous system, it also serves to identify individual differences between neonates, and define the repertoire of responses which are likely to influence his caregivers' interactions with him (Brazelton, 1973).

Als, Tronick, Lester and Brazelton (1977) consider that there are 5 characteristics which distinguish the BNBAS from its rivals. Firstly, it is based on a conception of the neonate as a highly complex and competent organism, able to control interfering motor and autonomic responses, to attend to more important external events, to habituate to, or defend himself against, negative stimuli, and to elicit stimulation from his environment. The examiner sets up appropriate interactive situations which test these capabilities. Secondly, the examination is based on optimal behaviour and requires a tester who is flexible and patient enough to provide ample opportunity to enable the infant's best performance to be scored.

Thirdly, the examination follows the infant through the spectrum of states of consciousness, rather than only testing behaviour when he is alert and attentive. Fourthly, it utilises these states in order

to understand his capacity for organising his behaviour to best take advantage of presenting stimuli, e.g. by calming himself down from a crying state. By provoking the infant to change state (by mildly stressful stimuli such as pulling him into a sitting position) the examiner tests his tolerance to handling and control of autonomic responses. Lastly, the assessment does not provide a "quotient" of behaviour, liable to influence caregiver expectations and label the infant from his earliest days: Rather it provides a cluster of items which reflect the underlying organisation of the infant.

There are 26 behavioural items, which can be grouped into four dimensions: 1) Attention and Social Responsiveness, i.e. the infant's capacity to attend to and process simple and complex environmental events; 2) Muscle Tone and Motor Organisation, which assesses the neonate's ability to maintain good tone, to control muscle behaviour, and to perform integrated motor activities, such as removing an occluding cloth, or bring his hands to his mouth to suck; 3) Control of States of Consciousness, i.e. his ability to maintain an appropriate state of sleep or wakefulness to meet environmental demands, and to alter these as necessary; and 4) Physiological Responses to Stress, which measures the infant's capacity to control autonomic responses, such as startles or tremulousness, in order to attend to stimuli.

Each item is scored on a 9-point scale; most items represent best performance. In this study 4 items were discarded (motor maturity, lability of colour, cuddliness, pinprick) because they proved to be too subjective during pilot testing, or adequate inter-observer reliability could not be obtained or maintained. The list of items finally included, can be seen in Table III.6; definitions are in the Appendix.

Table III.6 BRAZELTON NEONATAL ASSESSMENT SCALE AS USED IN PRESENT STUDY

I. CAPACITY FOR ATTENTION AND SOCIAL RESPONSIVENESS

Visual Orientation to Inanimate Object (Ball, Pattern, etc.)
Auditory Orientation to Inanimate Object (Rattle)
Visual Orientation to Animate Object (Face)
Auditory Orientation to Animate Object (Voice)
Orientation to Animate Visual and Auditory Stimulus (Face + Voice)
Alertness
Consolability

II. MUSCLE TONE AND MOTOR ORGANISATION

Muscle Tone
Activity Level
Hand-to-Mouth
Defensive Movement
Pull-to-Sit

III. CAPACITY FOR CONTROLLING STATE OF CONSCIOUSNESS

Response Decrement to:
- Repeated Light Stimuli
- Repeated Rattle Stimuli
- Repeated Bell Stimuli

Rapidity of Build-Up to a Crying State
Peak of Excitement
Irritability
Self-Quieting
Lability of States

IV. PHYSIOLOGICAL RESPONSIVENESS TO STRESS

Startles
Tremor

For the remaining items inter-observer reliability was established between the four testers at above 85% before the study began. Reliability was periodically checked between different pairs of testers according to the criteria set down in his manual. For each of the items this represents the ratio of agreements to agreements plus disagreements - a disagreement defined as a discrepancy of more than 1 point on the 9-point scale. The average interscorer reliability was 92%, and it never fell below 87%. The author had originally been trained by an approved "Brazelton examiner" and reliability had been checked prior to the beginning of the present study. These figures are comparable to those reported by other teams of investigators (Horowitz and Brazelton, 1973).

The full BNBAS also includes 20 reflex items which are designed to assess the infant's neurological intactness. We decided to omit these for reasons of time, and also because an independent neurological assessment was to be carried out on day 6 by the paediatric staff. Since Brazelton's reflex items are in fact drawn from the Prechtle Neurological Examination (PNE), it seemed more appropriate to administer the full examination.

The BNBAS is administered mid-way between feeds when the infant is in a sleep state. As infants in our unit are demand fed, it is not as easy to predict "mid-way" as in the American samples which were generally fed on four-hourly schedules. Thus we generally tested 1½ hours after the previous feed, and recorded the "time since last feed" on the scoring sheet. The BNBAS was administered on days 1, 3, 7, 21, and 42; selected items were tested in the delivery room in the first hour after birth. The range of testing times, both for age of infant, and in relation to time of feed, will be discussed in the Results section.

3. The Prechtl Neurological Examination (PNE)

The Prechtl Neurological Examination (PNE) (1964) is a systematic assessment of the functional sub-systems of the central nervous system, with an emphasis on simple and complex motor functions. His original format was not easily scorable except on a qualitative basis, so this author re-wrote it on an item by item basis to enable computer processing on a continuum from "optimal" (0) to varying degrees of "non-optimal" (1-3). A total score could be tallied for all of the items in each of 12 categories. A summary section provided several scores for important dichotomies that were not immediately retrievable from the individual totals (i.e. Hypotonia vs. Hypertonia) as well as some additional items that did not fit into available categories (i.e. Ease of Maintaining Optimal States). The scoring system proved to be similar to the optimality codes that appeared later in the second edition of his manual (Prechtl, 1977).

4. Sleep and Feed Diaries

We designed a "Sleep Chart" to be filled in by mothers and nursing staff based on that used in Richards and Bernal's study. The form consisted of a horizontal sheet of paper ruled into 10-minute sections, beginning at 12.00 a.m. The observer at delivery explained each chart to the mother before she was transferred to the postnatal ward and filled in the initial data as an example. A key on the chart reminded her of the various categories: sleeping, feed time, awakened by adult, and spontaneously wakes.

At 3 and 6 weeks the mothers were asked to keep a 24-hour record only beginning at 6.00 a.m. the following morning. On this chart 15-minute intervals were used, and some of the symbols and codes were slightly different: sleeping, awake, feeding, crying and woken up deliberately. Mothers were offered the opportunity to add other codes too; the most often marked activities were "playtime" and "outing", but these were not used in the analysis. No formal reliability checks were made, but records were periodically inspected. Like Richards and Bernal, we too found that mothers were interested and conscientious in keeping the diaries, although some specific sample and interpretation problems are mentioned in the results chapter VII, Sleeping and Feeding Patterns in the First Six Weeks.

The first week's record was transferred to a specially designed coding form for computer processing; this form can be seen in the Appendix. The data at 3 and 6 weeks were transcribed onto standard computer pads for punching so example sheets are not available. Details of the actual items selected for analysis are discussed in detail in Chapter VII, Section A.

d) Statistical Analysis

The major method of analysis of the data in this study was multiple regression. This method was chosen over others because it permitted us to examine the specific influence of drugs (and their dose-related facets) while controlling for the effects of other obstetric variables. As mentioned earlier, we are concerned that many of the findings of previous studies are invalid because they are confusing the consequences of drug with those of conditions which actually determine the need for

greater amounts of medication, such as length of labour, parity, and so on. Multiple regression allows the separation of these two aspects of the equation.

Two sets of analyses were carried out. In the first set the data were treated as if they were "between groups" by assigning variables to pethidine or bupivacaine or the non drug group. In the second set, each of the two drug groups was analysed separately using specific dose-related measures, yielding a "within-groups" design. In each type of analysis the obstetric variables were also entered into the equation, and are reported in the text as a separate section "obstetric variables".

Categorical variables such as drug group and method of delivery, which cannot be entered into the equation directly, were each represented by a set of "dummy variables". These are created by setting up a new variable for each class of a categorical variable, and assigning scores of 1 or 0 to these dummy variables for all cases, depending upon their presence or absence in each of the categories. One category is always excluded because it is represented by zeroes on all other categories, and thus becomes a reference category by which the effects of the other dummies may be judged and interpreted. For example, two dummy variables were created to represent the three drug groups. A baby whose mother had received pethidine was given a score of 1 on the first variable and 0 on the second, a baby in the bupivacaine group was assigned scores of 0 on the first and 1 on the second variable, while a baby whose mother had received no drugs was given scores of 0 on both of the variables.

The multiple regression technique permits the evaluation of the importance of any particular independent variable to be examined by "decomposing" the variance in the dependent variable explained by the

entire equation into components attributable to each independent variable included. The particular method adopted here treats each variable as if it were added to the equation last. The increase in explained variance due to its addition is then compared with the residual (unexplained) variance. The resulting significance test is effectively a test of whether the regression coefficient is significantly greater (or less than) zero, but this has the advantage of being made with the confounding influence of the other independent variables controlled.

On the first step then, only the dummy variables representing the drug groups were included as independent variables, while on the second step maternal, labour and delivery variables were inserted into the equation. By comparing the results of the first and second analyses, it could be seen whether apparently significant differences in behaviour between the drug groups were in fact due to differences in labour and delivery variables, or, alternatively whether significant differences between the drug groups were being masked by the confounding effects of these other variables. This method of analysis was used for the "between-groups" computation, entering the dummy variable for drug, and for the "within-group" analysis, entering the four dose-related variables, and then entering those same variables after all the obstetric measures had been entered. All "significant effects of drugs" reported in the text and tables refer to probabilities < 0.05 after obstetric variables are accounted for. Thus we are not concerned with the effect of drugs in conjunction with, say, the length of labour, or parity, because it would not be possible to say whether or how the three measures were causally related. In contrast, if, say, neonatal cord level of pethidine is related to reduced alertness after

obstetric variables are accounted for, it means that even though the baby may have absorbed more pethidine because his mother's induced labour lasted longer, the contribution of "cord level of pethidine" was still a major one after syntocinon and length of labour were removed from the equation.

1. Variables In The Main Analysis

The variables used in the multiple regression analyses are listed in Table III.7, and those entered as dummy variables are starred.

In the analysis carried out within-groups, four separate measures were used instead of the dummy variable "drug" in the between-groups design. This was done on the advice of the pharmacologists[3] involved in the study, since no single index of drug measurement fully takes into consideration blood concentration, rate of elimination, and total exposure. Parameters used for within-group analyses of both bupivacaine and pethidine were:

i) Total maternal dose during labour

ii) Umbilical artery concentration of the drug, which is taken as being equivalent to the neonatal blood concentration at birth

iii) Neonatal blood elimination half-life ($t\frac{1}{2}$) which indicates how quickly the neonate is disposing of the drug, although by itself it gives no measure of drug concentration

iv) Total perinatal exposure, that is, the area under the time curve both in utero and after birth. This measure was calculated separately for the pethidine and bupivacaine groups as follows:

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3 I am extremely grateful for the calculations supplied by J. Caldwell and L. Notarianni, in addition, of course to their biochemical analyses of the compounds.

Table III.7 VARIABLES USED IN THE MAIN MULTIPLE REGRESSION ANALYSES

* Drug group
Parity
Social Class
Mean Blood Pressure (during average of 17 pregnancies and labour)
Oxytocin (maximum rate of administration)
Length 1st stage labour
Length 2nd stage labour
* Type of delivery (i.e. forceps)
* Method of resuscitation
Apgar Score, 1 minute
Apgar Score, 5 minutes.

* "Dummy" variables

a) A regression line was fitted to the cord blood levels of all infants in the pethidine group plotted against the times between first maternal dose and delivery. For each infant, exposure up to delivery was then measured by the area under this line up to his or her elapsed time of exposure at delivery. Exposure after delivery was measured by the area under the elimination curve given by e^{a-kt}, where e^{a} is the umbilical cord blood level, t is the half-life of pethidine in the individual infant, and $kt = 0.69315\ (-\log_e \frac{1}{2})$. The pre-delivery exposure measure was used as the independent drug variable for the analysis of the delivery time-sampling and assessments at delivery. For the analyses of the Brazelton assessments on days 1-42, and other post-delivery measures, the pre- and post-delivery measures were added together before insertion into the regression equation.

b) In the case of bupivacaine, it is believed that the concentration of the drug in the fetus rises and falls according to a gentle curve after each administration of the drug. Therefore, the infant's pre-delivery exposure to the drug was simply measured by the umbilical cord blood concentration multiplied by the time from first administration to delivery. Post-delivery exposure was calculated as for pethidine above.

2. Other Analyses

In addition to the multiple regression techniques, other analyses were used where appropriate. These include correlations (Pearson's r, and Spearman's rank), ANOVA, and t-tests. The type of analysis is referred to in the text, with specific comment as to which correlation technique was selected, and if not obvious, the reason behind this.

The criterion for the null hypothesis was set at $p < 0.05$, although the reader is often reminded where a large number of analyses performed may caution against the significance of only a few relationships at this 0.05 level.

The computer programme usually reported the p values as "less than" 0.05, 0.01, and so on, but for the sake of exactitude the remaining values are referred to in the text by their true value.

IV TRANSITION TO A NEW WORLD: THE FIRST HOUR

A. Descriptive Measures Of The Delivery Room Observations And Assessment

Data on the newborn immediately after delivery consisted of both naturalistic observation for the first 20 minutes after birth, and selected items from the Brazelton assessment performed as soon as practical and convenient for the mother, infant, and medical staff. As such early observations are unusual in the literature, some space will be devoted to descriptive aspects, which will be followed by the effects of medication, obstetric factors, and psychosocial effects.

1. Respiratory Measures And Medical Procedures

A summary of the respiratory measures and procedures is presented in Table IV.1. A third of all infants appeared cyanotic (blue) during the first 20 minutes, although this would have referred to "blue extremities" only in some cases. Cyanosis was recorded on average for five intervals. Medical assistance in initiating or maintaining respiration was less common. Three-quarters of the group had only routine mucous extraction by suction, a practice designed to avoid aspiration syndrome, and often carried out before the trunk has been fully delivered. Since we only began our observations when the baby was "delivered", it is not possible to know whether the other 25% of the sample received mucous extraction before observations began, did not receive it at all, or experienced more intensive respiratory intervention immediately. 21% of the sample did have their breathing aided by some form of oxygen delivery, either by face mask or intermittent positive pressure ventilation (IPPV). The average length of oxygen administration was 3.6 intervals, about 45 seconds.

Table IV.1 RESPIRATORY MEASURES AND MEDICAL PROCEDURES RECORDED DURING THE FIRST 20 MINUTES

	Intervals[a]		Group distribution (%) in real time				
	Mean	S.D.	0	≤15 sec	≤1 min	≥5 min	≥10 min
Latency Cry	6.1	20.1	61	72	85	7	6
Cyanotic	5.0	13.6	66	70	76	6	2
Mucous Extraction	4.6	7.2	23	25	69	3	1
Assisted Breathing	3.6	10.3	79	80	87	7	4
Last Oxygen	5.8	15.2	79	79	81	13	5
Swaddled	57.4	20.5	4	4	4	96	83
Attended by Medical Staff	18.0	15.7	4	7	16	36	11
Aversive Procedures	14.7	13.9	5	9	23	25	4

[a] Interval = 15 seconds

? use of SD in data not normally distributed

Only 4% of the sample received oxygen for more than 10 minutes. Usually supplementary oxygen was required in the initial 1½ minutes, and only 5% of the sample required oxygen after the first five minutes.

Most infants were swaddled (wrapped up tightly in blankets) during this early period, on average 14 out of the 20 minutes. Some of the non-swaddling time was undoubtedly taken up by weighing, measuring, etc., which occupied about 3.5 minutes. Therefore, the amount of time left over for intimate skin-to-skin contact between mother and infant during these earliest minutes was minimal.

2. Control Of States Of Sleep And Wakefulness

The first 20 minutes were characterised by frequent state changes with only brief periods of alertness. The typical infant gave a short "birth cry" and then settled into a quiet, semi-alert state, interspersed with an occasional alert episode of less than a minute. Only half of the infants cried for more than 3 minutes, although many of them fussed (State 3/6 or 5) a great deal Table IV.2. Conversely, few of them slept; more than three-quarters never went into State 1 or 2, and those who did so tended to have had minor respiratory problems. More than one-third of the infants never reached a spontaneous alert state, and fewer than 20% stayed alert for more than 10 minutes.

At delivery the infants were far more labile than they would be 24 hours later during a full neonatal assessment occupying the same space of time. Again, the "typical" infant shifted into a new state about every 90 seconds. More than half changed state more than 10 times, and 4% changed more than 30 times. Some of this lability was undoubtedly due to the propensity for medical staff to intervene in these early minutes with caretaking tasks - weighing, measuring, and

Table IV.2 STATE CONTROL MEASURES RECORDED IN THE FIRST 20 MINUTES

	Intervals[a]		Group distribution (%) in real time				
	Mean	S.D.	0	≤15 sec	≤1 min	≤3 min	≥10 min
State 1-2[b]	6.0	15.4	74	76	80	87	4
State 3[c]	25.5	22.3	9	11	16	33	20
State 4[d]	18.3	21.2	38	39	44	51	18
State 3/6[e]	13.2	13.5	20	23	33	57	6
State 5[f]	1.6	4.42	78	83	90	95	0
State 6[g]	14.2	13.5	13	16	32	52	8

			0-2	≤10	≥20	≥30	
Number State Changes	11.9	9.6	10	56	17	4	
			Calm	Occasionally Cries			Always Cries
			(1)	(2-3)			(4)
Rating of Reaction to Aversive Stimuli[h]	3.0	1.0	10	48			42

[a] Interval = 15 seconds

[b] State 1-2= Sleep states 1 (deep), 2 (light)

[c] State 2 = Drowsy awake state

[d] State 4 = Awake and alert

[e] State 3/6 = Drowsy, but fussing or whimpering

[f] State 5 = Awake, active and fussing

[g] State 6 = Crying

[h] Aversive Stimuli = intrusive handling by staff, such as undressing, weighing, hanging up by heels to measure, resuscitation, etc.

so on. As was evident in Table IV.1. nearly one-quarter of the infant's time was spent being handled by medical staff, and most of these encounters were coded as "aversive" procedures. Not surprisingly, the typical response was to cry. About half of the infants always cried to such handling; only 10% never cried in these situations.

3. Perceptual Abilities During The First Hour

As was discussed earlier, numerous studies have documented the infant's perceptual skills during the first few weeks. Few, however, have described these abilities in the period immediately after delivery, although the manner in which the mother makes use of them in the first interactions has been discussed (Klaus and Kennell, 1970; MacFarlane, 1977). In this study five measures of visual adaptation and behaviour were observed in the first 20 minutes, followed by the administration of selected orientation items from the BNBAS sometime within the next hour. The presence or absence of two further indices of the integrity of the visual system were also noted at the end of this entire period.

There was great variation in the interval after birth before the baby first opened his eyes, and in the total length of time for which the eyes were open during the first 20 minutes. Although one-quarter of the sample had opened their eyes within the first 15 seconds, and a third within the first minute, more than one-third had not opened their eyes by the end of 10 minutes, including seven infants who had not opened their eyes by the end of the observation period. Slightly less than half of the sample kept their eyes open for more than 10 minutes, of whom eight had their eyes open most of the time. Blinking accounted for a further three minutes, usually in the first few minutes as the infant struggled to open his eyes fully.

It was rather more difficult to specify how well the infants were seeing things during this free-field observation, as there was often nothing near enough to the infant for him to focus on while unattended in the cot. Three-quarters of the infants did exhibit scanning, and half of them focussed during at least one 15-second time interval. However, although almost half of the infants showed scanning for 3 minutes, fewer than 10% focussed for as long. A summary of these spontaneous visual behaviours is presented in Table IV.3.

At the end of the observation period 88% of the infants could be coaxed into a quiet and alert state in which visual and auditory skills could be assessed using selected items from the BNBAS. Of these the majority showed evidence of response to sound, and of the ability to follow briefly a bright object or human face as shown in Table IV.4.

Mean auditory scores were slightly higher than visual ones. The mean BNBAS score in response to inanimate stimuli (rattle) was 5.3, with 89% of the infants alerting to, or turning their eyes to the sound, of whom 36% turned both their eyes and head in an effort to localise it. Responses to animate stimuli (the examiner's voice) were quite similar: a mean score of 5.2, with 84% responding by alerting or turning their eyes, 38% of whom turned both head and eyes.

83% of the sample managed to track an object in at least short, jerky arcs, but only 7% were able to follow with head and eyes for at least 60^{o}; the mean score was 3.9. Response to the examiner's face was slightly better, especially if he or she talked at the same time. To the face alone the mean score was 4.6, with 86% making at least short jerky arcs of movement, and 11% tracking with head and eyes in 60^{o} arcs. 89% of the sample showed some tracking of face and voice, of whom 14% followed well; the mean score was 4.8. Most infants maintained a reasonably alert state during this time (mean 4.6),

Table IV.3 VISUAL BEHAVIOURS RECORDED IN THE FIRST 20 MINUTES, AND RATINGS OF NON-OPTIMAL "EYE SIGNS" DURING THE FIRST 90 MINUTES AFTER BIRTH

	Intervals[a]		Group distribution (%) in real time			
	Mean	S.D.	0	≤15 sec	≤3 min	≥10 min
Latency Open Eyes	23.1	27.9	-	25	49	21
Total Time Eyes Open	30.6	23.5	9	11	31	40
Blinking	11.0	12.3	24	28	67	3
Focussing	4.3	9.4	50	59	91	3
Scanning	14.9	16.9	33	34	57	8

			None (1)	Occasional (2)	Frequent (3)
Rolling Eye Movements	1.4	0.6	69	23	8

			Yes (1)	No (2)
Blink Response To Bright Light	1.1	0.3	88	12

[a] Interval = 15 seconds

Table IV.4 ORIENTATION AND SOCIAL RESPONSIVENESS MEASURES FROM THE BNBAS ADMINISTERED IN THE FIRST HOUR AFTER BIRTH

	% Infants	Mean	S.D.	N
INANVIS[a]				
1-2	17			
3-4	52	3.9	1.6	89
5-6	25			
7-9	7			
Wrong state	(13)			
ANVIS[a]				
1-2	14			
3-4	36	4.6	1.7	88
5-6	39			
7-9	11			
Wrong state	(15)			
ANVISAUD[a]				
1-2	11			
3-4	32	4.8	1.6	85
5-6	44			
7-9	14			
Wrong state	(14)			
INANAUD[b]				
1-3	11			
4-6	53	5.3	1.6	93
7-9	36			
Wrong state	(11)			
ANAUD[b]				
1-3	16			
4-6	46	5.2	1.9	89
7-9	38			
Wrong state	(12)			
ALERT				
1-3	37			
4-6	38	4.6	2.1	84
7-9	25			
Wrong state	(12)			
EASE ELICIT[c]				
0-1	37			
2-3	30	2.4	1.8	121
4-5	33			

Contd/

Table IV.4 (Contd.)

ORIENTATION AND SOCIAL RESPONSIVENESS MEASURES FROM THE BNBAS ADMINISTERED IN THE FIRST HOUR AFTER BIRTH

---

a

Scores:		
	1-2	No following
	3-4	Brief, jerky following with eyes
	5-6	Smooth following, but brief with eyes or eyes plus head
	7-9	Good following, 60% arc or more with eyes and head

b

Scores:		
	1-3	No reaction, or just blink and respiratory changes
	4-6	Stills or brightens, or shifts eyes toward sound
	7-9	Head and eyes turn to sound

c

Scores:		
	0-1	Impossible or very difficult to elicit
	2-3	Brief responses to examiner
	4-5	Good, reliable responses to examiner

although for almost 40% the examiner had to work hard to prevent them losing attention.

At the end of this period two indices of visual reflexes were noted: a summary of the amount of "rolling" eyes (i.e. unco-ordinated movements), and whether the infant demonstrated an appropriate blink response to bright light. 31% of the sample had some degree of unco-ordination in eye movements, in 8% of which these were frequently observed. 12% of the infants failed to blink to bright light.

In summary, the infants in this study demonstrated a range of perceptual skills as early as the first hour of life. Most infants opened their eyes within three minutes of birth, and tried to scan their environment or focus on objects within close range. Although most of them still evidenced some degree of optical inco-ordination in the first few hours this did not prevent them from being attentive to both inanimate and animate visual stimuli when presented by the examiner. They also turned reliably to sounds, some infants even turning their head and eyes in a smooth movement. About 12% of the sample were either too fussy or sleepy to respond to the orientation items, but of those who were the majority attempted to attend to all of the items presented.

These burgeoning perceptual skills are likely to help the mother to consider her infant as a real person. For instance, Klaus and Kennell (1970) noted that nearly three-quarters of the mothers in their sample "asked" the infant to open his eyes, and spent increasing periods of time adjusting the infant so that they were in an <u>en face</u> position. Like Robson and Moss (1970) they also mention that mothers often commented on feeling closer to the baby after he had looked at them. Leboyer (1975) has suggested that both light and noise levels

should be substantially reduced in delivery rooms so as to enable the infant to come slowly awake and alert, and thus interact with his mother. We suspect that in some cases bright lights in our hospital might have prevented better visual behaviour, and where possible the administration of BNBAS items was carried out with the lights dimmed. However, our results do indicate that even under routine hospital conditions most infants are interested and receptive to the people and objects around them. It is important, however, to provide things near enough for them to focus on, and to interact with, or they are likely to relapse into a drowsy state, swaddled in a cot in a corner of the room. The most obvious source of appropriate stimulation and affection is the parents, and for this reason we turn next to their behaviour with the new baby immediately after birth.

4. Parent-Infant Interaction In The First Hour

Our observations suggest that the very first contact between mother and infant is not a very long or satisfying one (Table IV.5). Most mothers were given the infant within a few minutes of delivery, but 6% did not interact with him or her, and half of the sample interacted at this time for less than 5 minutes. Many mothers held the baby without actually relating at all; that is, they "discussed" the infant with their husband, with occasional glances as if to maintain him as the object of reference. Thus 18% never looked at their infant in the first 20 minutes, and fewer than 20% sustained visual contact for more than half the observation period. Talking was infrequent, nearly half of the mothers not talking to their infant at all during this period.

Table IV.5 PARENT-INFANT BEHAVIOURS RECORDED IN THE FIRST 20 MINUTES, AND RATINGS OF PARENT BEHAVIOUR AT THE END OF 90 MINUTES AFTER BIRTH

	Intervals[a]		Group distribution (%) in real time				
	Mean	S.D.	0	≤1 min	≤3 min	≤5 min	≥10 min
Held by Mother or Father	28.1	24.4	9	18	36	47	29
M Interacts w/ Infant	25.4	22.3	6	16	40	51	22
M Looks at I	18.2	18.5	18	33	50	61	14
M Talks to I	6.2	11.6	45	68	84	78	2
M Touches/ Examines I	3.8	6.7	55	74	89	96	0
			Yes	Not Able	Didn't Want To		
F Present at Birth	-	-	71	18	11		
			"Negative" (1)	"Indifferent" (2-3)	"Good" (4-5)		
Rating M Behaviour (1-5)	3.7	1.3	7	31	62		
Rating F Behaviour (1-5)	3.2	1.4	8	50	42		

[a] Interval = 15 seconds

The tactile exploration seen by Klaus and Kennell (1970) was very rare in this group of mothers; half of them never touched the infant or stroked him (although they may have held him), and only a very few stroked the hands or feet in the manner described by Klaus and Kennell. It is, of course, possible that mothers would have shown greater interaction if circumstances had been more favourable. For example, the infants were nearly always swaddled in this early period, and warnings about "cold" were frequent enough to discourage mothers from unwrapping or undressing the infants while staff were present. The baby often seemed to be given to the mother at times which suit the convenience of the medical attendants, but are not necessarily the most appropriate for the mother's comfort or to take advantage of the baby's state of alertness. In this study the two periods when contact was most likely were immediately after the cord was clamped, for a brief cuddle, and after the infant was cleaned up. At both of these times the baby was often crying as a result of the stressful handling he had just received, and probably does not give the mother much positive feedback. Mothers were also encouraged to hold their infant while being sutured after (almost routine) episiotomy, in order to give them a distraction from the discomfort. In a semi-recumbant position, and with their legs in stirrups, it is not surprising that mothers found it extremely difficult to devote their full attention to the baby.

Because we felt that parental behaviour in the first twenty minutes may well have been determined by circumstances of the delivery itself, and any immediate medical needs of the baby, we decided to rate the quality of the parental interactions at the end of the total period that we were with them in the delivery room. This time ranged from 45 minutes to about 2 hours, but was generally about an hour.

Their interactions were rated, albeit crudely, on a scale of 1-5, reflecting the amount of holding and contact, and its quality (Appendix I). The mean maternal score was 3.7, with a S.D. of 1.3. 62% of the mothers had a rating of "good" (rating 4-5), while 31% showed "indifferent" behaviour (2-3), marked by few interactions, although the mother may have talked quite positively about the baby with her husband. 7% of the mothers were rated "negative" (1), in that they refused to hold the baby at all.

Fathers too were involved in the delivery room, three-quarters of them being present for the birth of their infant. Of those not attending, 11% chose not to see the birth, while the rest were generally absent due to circumstances such as work obligations or insufficient warning. Of those attending, 42% were rated as having a "good" attitude to the infant, while half were "indifferent", again in the sense of not actively talking and interacting with the baby. 8% were rated as "negative". It seemed, in fact, that more fathers would have interacted with the infant had they been encouraged to actually hold him, rather than just gaze at him from afar. It is possible, therefore, that the fewer "good" scores may have been an artifact of the coding system, which specified "holding and talking" to the baby for the higher scores.

No importance can yet be attached to the father's attendance at the delivery, or his early attitude to the baby, and we were not able to follow up this topic in the present study. Richards, Dunn and Antonis (1977) noted a correlation between presence at birth and later participation in caretaking activities in their longitudinal study of 80 infants. However, they emphasise that this is not necessarily a causal relationship, particularly as Greenberg and Morris (1974) found that attendance or non-attendance at the birth did not have later effects on paternal attitude. This does not mean, of course, that

further efforts should not be directed toward making fathers feel welcome at the birth of their infant. Most of the fathers spoken to in this study were delighted to have had a part in the experience, and the mothers generally felt that their husband's support during labour had been rewarded by his being able to see the moment of birth.

Lastly in the delivery room we noted whether the mother had put the infant to the breast, and whether he had suckled. Only 14% tried to breastfeed the infant at this time, and only 8% of the infants were observed to suck, as opposed to just rooting or clamping on. Even during the time-sampled observations in the first 20 minutes the infants demonstrated very little "oral" behaviour. A third of the sample never placed their hands near their mouth, and the mean number of intervals in which this occurred was 6.2, with a S.D. of 10.4. Only about 10% of the infants showed swiping totalling more than 5 minutes, and only 10% sucked for periods totalling more than 1 minute.

Thus it is difficult to know whether the decision to try to suckle the infant, or the poor success rate in doing so, might have been due to the relative inexperience that the infants had in sucking, even though we know that the fetus sucks his fingers in utero. During the first hour, as mentioned before, most infants were swaddled, which meant that their hands were tightly wrapped against their body. A more likely explanation of the low frequency of breastfeeding, however, was that the mothers did not feel encouraged to attempt it, or to persevere long enough for the infant to "get the hang of it". As with the other facets of parent interaction, we were often struck by how "helpless" the parents seemed to be in the delivery room situation. It was as if there was an assumption that if holding or suckling the baby was the "right" thing to do then the medical staff would not have

swaddled the baby and put him out of sight on the other side of the room. In a large number of instances the psychologist (after recording had finished) would offer the baby to his parents, simply because no one else had done so. Those who advocate more immediate contact between mother, or father, and infant must realise that medical staff will have to actively encourage it and show their approval of the parent's involvement. At the end of a long and exhausting labour most mothers are not in a frame of mind to "rock the boat" and demand to hold their baby, and the father often seems to be grateful that he is allowed to be there at all. In addition, the medical staff will have to re-examine the importance of warmth versus parental needs in the first hour; in many units a radiant heat lamp allows the mother to nuzzle her nude infant without worrying about heat loss, although she may get rather warm. Certainly a fine balance needs to be struck between the needs of the infant, privacy for the parents to behave naturally with their new baby, and reassurance that their handling is both safe and advantageous to their offspring.

B. The Pharmacokinetics Of Pethidine And Bupivacaine In This Study

The mean total dose (163.0 mg) and number of injections of pethidine for the sample is illustrated in Fig. IV.1. Most patients received either a minimal dose of 100 mg or a single injection of 150 mg; 6 mothers received 300 mg, but only 1 each had 400 and 450 mg.

It is obvious that pethidine crosses the placenta (Table IV.6.) readily, since the mean fetal concentration is as high as 0.98 for the Ua/Mv ratio. A sub-sample of 10 mothers who were studied by the pharmacology department indicated that the concentration of pethidine

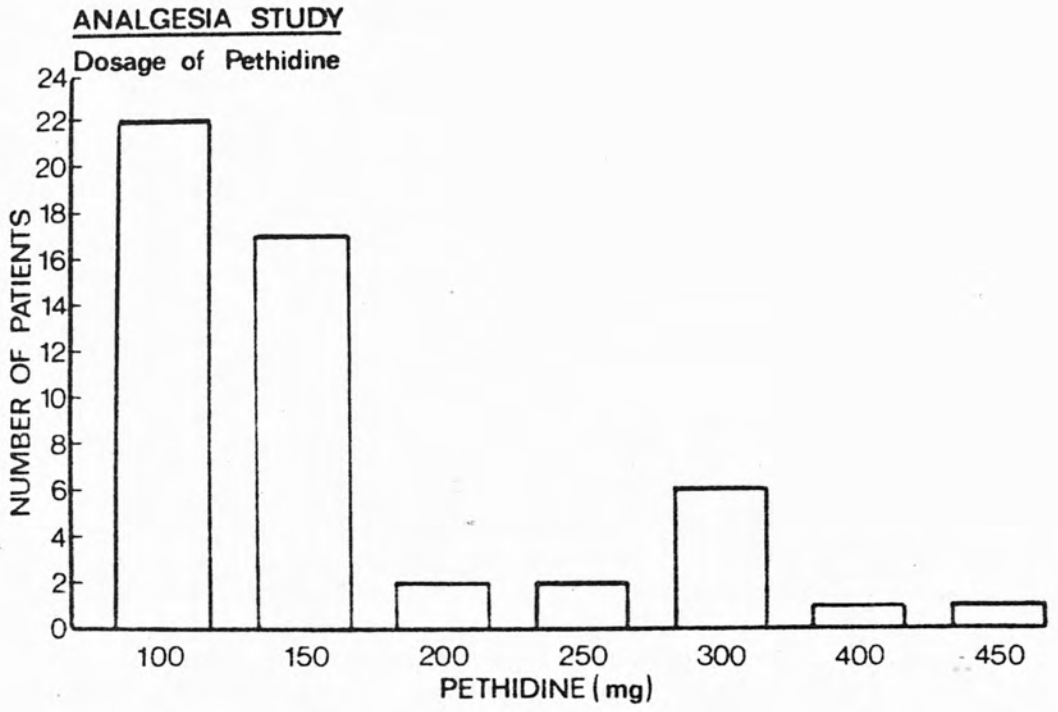

FIGURE IV.1 MEAN TOTAL DOSE OF PETHIDINE FOR SAMPLE MOTHERS

Table IV.6 CONCENTRATION OF PETHIDINE IN MOTHER AND INFANT AT BIRTH

	Pethidine (ng/ml)		
	Mean	S.E.	Range
Mean Total Maternal Dose (mg)	163.0	12.0	100-450
Maternal Vein (Mv)	256.3	23.4	81-640
Umbilical Vein (Uv)	213.2	18.5	--
Umbilical Artery (Ua)	222.0	22.4	28-540
Uv/Mv Ratio	0.83	--	--
Ua/Mv Ratio	0.98	--	0.16-3.21
Neonatal Elimination $t_{\frac{1}{2}}$ (half-life) (hours)	22.4	4.7	3.2 -38.1

in maternal venous blood fell monoexponentially with time between dose and delivery, yielding a maternal half-life of 2.8 hours (Caldwell, Wakile, Notarianni et al., 1978). This accords well with a value of 3.2 in adult volunteers in other studies (Mather, Tucker, Pflug, Lindop, and Wilkerson, 1975). In these 10 mothers the cord artery/maternal vein and cord vein/maternal vein concentration ratios rose with the increasing dose delivery interval. When the dose-delivery interval exceeded 2.2 hours the fetal concentration of pethidine was relatively higher than the maternal one.

Fig. IV.2. suggests that in the main sample there is no simple relationship between maternal dose and fetal concentration, since many of the infants whose mothers received a single dose of 100 mg. still had cord blood concentrations of greater than 200 ng/ml. The blood elimination half-life for pethidine in our group of babies was extremely long - 22.4 hours - with a large range. This is probably at least partly due to the newborn's impaired ability to metabolise drugs. Notarianni (1979) assayed the urine of a small number of these infants, and found that metabolites of their urine accounted for only 44% of the excreted material, compared with an adult value of 86%.

The distribution of total dosages for bupivacaine is illustrated in Fig. IV.3, with a mean of 120 mg. Bupivacaine crosses the placenta less readily than pethidine (Table IV.7.), as indicated by the lower fetal/maternal concentration ratios of 0.31 (arterial) and 0.35 (venous). More detailed investigations of placental transfer were made in 18 patients in the bupivacaine group by obtaining maternal vein samples at 0, 5, 10, 15, 30, 45, 60, and 90 minutes after the injection, and by fetal scalp samples at 10, 20, 30, 45, 60, and 90 minutes (Caldwell et al., 1978). Bupivacaine was rapidly absorbed into the maternal circulation as evidenced by peak levels observed within 10 minutes of

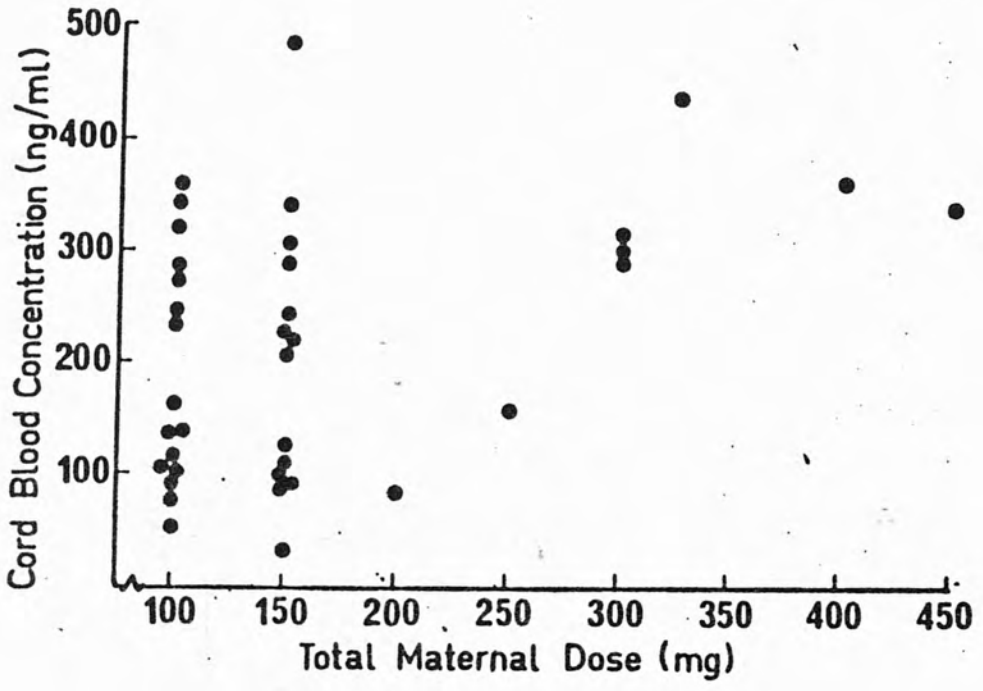

FIGURE IV. 2 RELATION BETWEEN UMBILICAL CORD BLOOD CONCENTRATION (ng/ml) AND TOTAL MATERNAL DOSE (mg) OF PETHIDINE

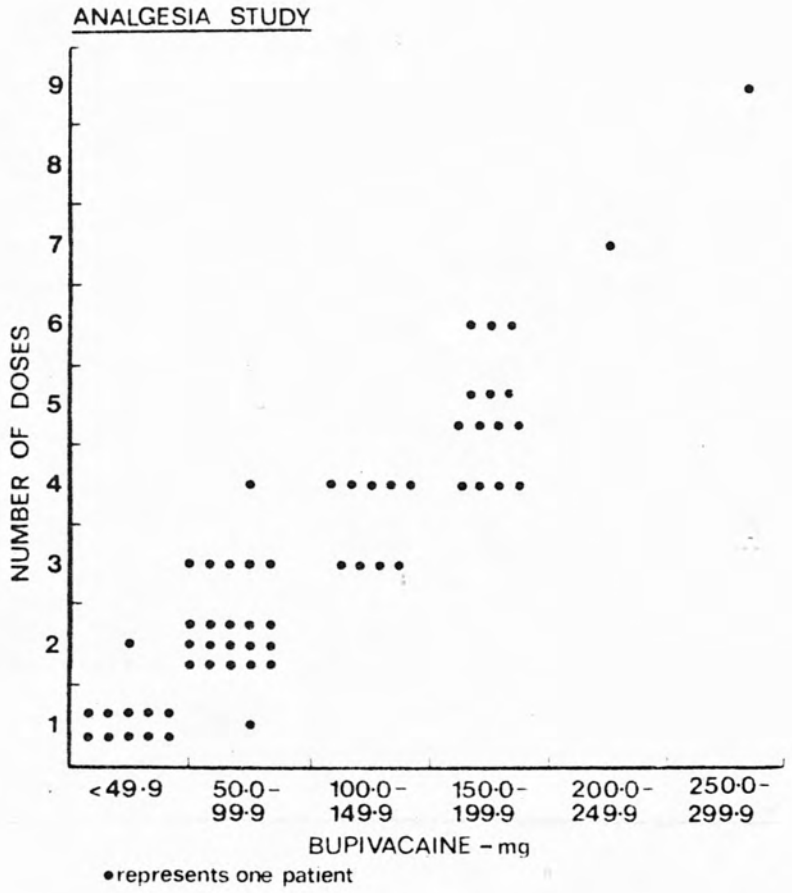

FIGURE IV.3 MEAN TOTAL DOSE OF BUPIVACAINE FOR SAMPLE MOTHERS

Table IV.7 CONCENTRATION OF BUPIVACAINE IN MOTHER AND INFANT AT BIRTH

	Bupivacaine (ng/ml)		
	Mean	S.E.	Range
Mean Total Maternal Dose (mg)	120.0	17.4	30-268
Maternal Vein (Mv)	231.2	14.0	63-485
Umbilical Vein (Uv)	80.5	6.6	--
Umbilical Artery (Ua)	79.3	6.8	21-160
Uv/Mv Ratio	0.35	--	--
Ua/Mv Ratio	0.31	--	0.04-0.67
Neonatal Elimination $t_{\frac{1}{2}}$ (half-life) (hours)	14.0	1.1	3.2 -50.2

the dose. This level fell monoexponentially with time to yield a mean half-life of 1.05 hours. Bupivacaine was also detected in the fetal circulation within 10 minutes, and then rose from 29 ng/ml to a plateau 44 ng/ml at 75 minutes.

The concentration of bupivacaine in the fetus seemed to rise and fall after each administration of the drug to the mother. Fig. IV.4. presents the relation between cord blood concentration and maternal dose for the full epidural anaesthesia group. Maternal concentrations of bupivacaine always exceeded that in cord blood, which was not the case for pethidine. The neonatal half-life in the larger sample was 14.0 hours, which is rather shorter than for pethidine, but with equally great individual differences between infants.

When the elimination curves of the 18 infants in the smaller sample were inspected 14 showed a bi-phasic pattern consisting of an initial rapid fall between 0-2 hours, followed by a slower exponential decline; the remaining 4 curves contained only the slow elimination phase. Such a rapid fall may be a result of the fetal change to a pulmonary circulation at birth, such that when the lungs are perfused for the first time they take up some of the drug. As the umbilical vein (placenta to fetal heart) concentration was higher than for the umbilical artery (fetal heart to placenta), fetal tissues may play some part in removing bupivacaine from the circulation.

C. Effects Of Maternal Medication On Delivery Room Measures

1. Between Group Differences In Physiological Status And Delivery Room Observations And Assessments

Table IV.8. shows that in addition to routine mucous extraction, 12 of the 51 infants in the pethidine group and six of the 59 in the epidural bupivacaine group were given oxygen by face mask. No babies

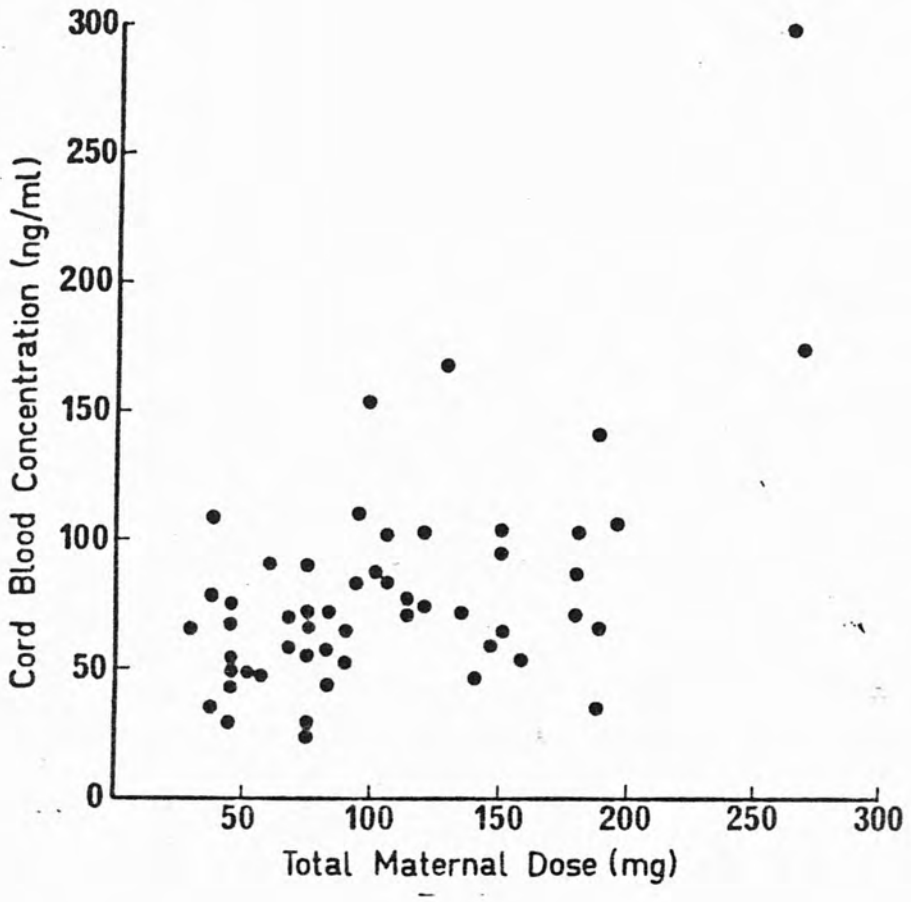

FIGURE IV. 4 RELATION BETWEEN UMBILICAL CORD BLOOD CONCENTRATION (ng/ml) AND TOTAL MATERNAL DOSE OF BUPIVACAINE (mg)

Table IV.8 INFANT STATUS AT BIRTH

Apgar at 1 minute	Resuscitation			TOTAL
	Suction	Oxygen	IPPV[a]	
No Drug				
7	0	0	0	0
8	2	0	0	2
9	27	0	0	27
10	6	0	0	6
Total	35	0	0	35
Pethidine				
7	2	5	3	10
8	9	6	0	15
9	20	1	0	21
10	5	0	0	5
Total	36	12	3	51
Bupivacaine				
7	0	0	2	2
8	15	4	0	19
9	30	2	0	32
10	6	0	0	6
Total	51	6	2	59

[a] IPPV = Intermittent positive pressure ventilation

in the control group required resuscitation. Three infants in the pethidine and two in the epidural groups required intermittent positive pressure respiration ($p < 0.001$). Ten infants in the pethidine group had a one-minute Apgar score of 7 or less as compared with none in the control group ($p < 0.001$). There were no significant differences in the five minute Apgar scores between the three groups.

Five measures were considered to indicate physiological response to stress immediately after birth: latency to cry, cyanosis, uncontrolled eye movements, tremulousness, and startles. In addition, the duration of particular medical interventions could reflect a poor physical condition: duration of mucous extraction, length of resuscitation, and the latest delivery-resuscitation interval. With these criteria, drug administration predicted a later need for resuscitation in the pethidine group ($p = 0.031$), but a decreased need in the epidural group ($p = 0.018$). Uncontrolled eye movements ("rolling eyes") was significantly related to pethidine use ($p = 0.025$). Tremor and startles were not affected by the use of medication.

There were few significant effects of the presence or absence of pethidine and bupivacaine in the area of attention and social responsiveness. Drugs "per se" affected the amount of blinking in the first 20 minutes ($p = 0.04$), but the effects were in opposite directions - increasing for epidural anaesthesia, decreasing for pethidine. Neither muscle tone nor hand-to-mouth behaviour was affected by drugs, and these were the only aspects of motor organisation assessed at delivery. Nor did medication affect the infant's control of state, including such measures as time asleep, alert, or crying, or frequency of disturbance to stressful stimuli.

The only relationship between drugs and maternal behaviour was toward reduced talking to the infant in the epidural group ($p = 0.009$), which was nearly significant in the pethidine group as well ($p = 0.06$). However, as talking to the infant in the first twenty minutes was a surprisingly rare occurrence, too much importance cannot be attached to this measure.

2. Other Obstetric Variables And Delivery Room Measures

The relationship between obstetric factors and behaviour in the delivery room is summarised in Table IV.9. Infants born after a short second stage of labour took longer to open their eyes ($p = 0.005$), and demonstrated decreased visual tracking skills to a face ($p = 0.028$). Obstetric variables did not determine performance on other orientation items, or the ease of eliciting responses from the infant.

First-born infants were less proficient at sucking their fingers after delivery ($p = 0.026$). Syntocinon was related to more time sleeping immediately after birth ($p = 0.009$), as were oxygen resuscitation ($p = 0.01$) and intubation ($p = 0.02$). The infants who received oxygen were less likely to "startle" ($p = 0.001$), which probably reflects their depressed state at the time. Increased startles were associated with an instrumental delivery, either by lift-out forceps ($p = 0.036$) or mid-cavity forceps ($p = 0.047$). First-born infants, however, startled less ($p = 0.037$). Rolling eye movements were associated with systocinon ($p = 0.008$).

Although obstetric variables did not influence the time spent crying overall, there was a decreased propensity to cry to intrusive handling in infants delivered by mid-cavity forceps ($p = 0.045$), or given oxygen ($p = 0.043$).

Table IV.9 RELATIONSHIP BETWEEN OBSTETRIC FACTORS AND INFANT BEHAVIOUR IN THE DELIVERY ROOM (ALL INFANTS)

		p = [a]
Pregnancy		
Infants of multiparae:	> observed startles	0.032
	> observed tremor	0.020
	> observed sucking	0.026
Labour		
Longer first stage:	> mucous extraction	0.025
second stage:	< latency open eyes	0.005
	> animate visual BNBAS[b]	0.028
Greater maximum syntocinon:	> time in state 1-2	0.009
	> rolling eye movements	0.008
Delivery		
Use of lift-out forceps:	> subsequent attendance of baby by medical staff	0.035
	: > startles (BNBAS)	0.036
Mid-cavity forceps:	< reaction to aversive stimuli	0.045
	: > startles (BNBAS)	0.047
Infant Condition and Intervention		
Low Apgar 1 :	> alert BNBAS	0.05
Low Apgar 5 :	> cyanotic	0.001
	: > resuscitation required	0.023
	: > time lapse to last resuscitative effort	0.002
	: > aversive stimuli	0.011
Use of mask oxygen:	> resuscitation	0.001
	: > time to last resuscitation	0.001
	: > state 1-2	0.01
	: > aversive stimuli	0.047
	: < observed startles	0.011
	: < startles (BNBAS)	0.001
	: < reactive to aversive stimuli	0.043
Use of IPPV oxygen:	> resuscitation	0.001
	: > time to last resuscitation	0.005
	: > state 1-2	0.02

[a] p refers to exact probabilities in a multiple regression model

[b] BNBAS = Brazelton Neonatal Behavioural Assessment Scale items scored in the delivery room

We would accept that part of the mother's behaviour toward her infant is probably determined by his condition, since infants were more likely to receive medical attention when cyanotic ($p = 0.001$) for instance. But the more medical attention he received the less likely he was to be held by either parent ($p = 0.001$), interacted with by his mother ($p = 0.004$), or talked to ($p = 0.036$). We suggest that this is not entirely related to neonatal condition, however, because there was no relationship between Apgar score at one or five minutes and maternal attention or stimulation.

When the mother's behaviour and attitude toward her infant was rated by the observer over the whole of the first 90 minutes after delivery, a low Apgar at 5 minutes was related to a lower maternal interest rating ($p = 0.045$). Several factors from the mother's answers on the Nowlis Mood Checklist during pregnancy were also related to the rating made by the observer, even though the observer was blind to these assessments. In particular, mothers who had felt depressed ($p = 0.004$) or anxious at 36 weeks of pregnancy ($p = 0.028$) received a lower rating on "attitude" exhibited to the baby. The father's attitude was lower toward the infant after his wife's longer first stage of labour ($p = 0.03$) or delivery of the infant by lift-out forceps ($p = 0.01$), which may have reflected his heightened concern for the infant and a tendency not to hold or touch an infant who may have had a "rough" time.

3. Pethidine: Within-Group Differences

These differences are summarised in Table IV.10. Although there were no significant differences in the delay to opening eyes or the total time during which the eyes were open, infants with high pethidine levels in the cord blood did less visual scanning of the environment ($p < 0.05$). Drugs did not affect any of the orientation items,

Table IV.10 SIGNIFICANCE AND DIRECTION (+ OR -) OF RELATIONSHIPS BETWEEN VARIABLES RECORDED AT DELIVERY AND MEASUREMENTS OF PETHIDINE

Delivery Time Sampling Variable	Total Maternal Dose		Cord Blood Concentration		Exposure	
	Significance	+/-	Significance	+/-	Significance	+/-
Latency to cry			*	+		
Intervals baby scans			*	-		
Intervals cyanotic					***	+
Intervals in drowsy state			*	+		
Intervals spent crying					*	-
Intervals in cot	*	+			**	+
Intervals held by mother/ father	*	-				
Intervals mother interacts with baby	**	-			*	-
Intervals mother looks	*	-				
Intervals mother examines					*	-

* $p < 0.05$

** $p < 0.01$

*** $p < 0.001$

alertness, or the ease of eliciting behaviour as assessed at the end of the delivery room session. Uncontrolled eye movements were associated with greater amounts of pethidine given to the mother ($p = 0.02$).

Drug measures were not related to either tone or hand-to-mouth movements, nor did they affect state control measures such as time asleep, or alert, crying, or number of state changes over the 20 minute period. However, a higher cord concentration of pethidine was associated with a greater time in a drowsy, yet awake, state ($p < 0.050$).

Infants with higher cord levels of pethidine evidenced more delay before the first cry ($p = 0.022$), while cyanosis was related to quicker dispersion ($t\ \frac{1}{2}$: $p < 0.01$). High exposure to pethidine was related to an increase in the length of time the infant was cyanotic ($p < 0.001$), and a decrease in the time spent vigorously crying ($p < 0.05$).

The mother's behaviour was also affected by pethidine; in particular by the amount of drug she received during her labour. The more pethidine she received, the less likely she was to hold her infant ($p < 0.05$), look at him ($p < 0.025$), or generally interact with him ($p < 0.005$). The infant was more likely to spend time in the cot ($p < 0.05$) rather than being held by either mother or father, but it is possible that this was due to the longer periods of cyanosis. Even so, this cyanosis was not associated with any medical intervention, and thus was probably not of any great significance in determining maternal interaction. One might also speculate that increased interaction would be dependent on the infant's state (i.e. whether asleep or awake) and his responsiveness to her attentions (i.e. visual alertness).

4. Bupivacaine: Within-Group Differences

All significant associations between the assessments of infant behaviour made at delivery and the drug variables measured at that time are shown in Table IV.11. Higher pre-delivery exposure to bupivacaine resulted in shorter time intervals both before the infant cried ($p < 0.01$) and before he opened his eyes ($p < 0.05$). The number of 15-second intervals in which the infant blinked were directly associated with the umbilical cord blood concentration of bupivacaine ($p < 0.05$) while the number in which he scanned the room were inversely related to drug exposure ($p < 0.05$). Infants with higher exposure to the drug were also likely to be cyanotic ($p < 0.05$) and undergo mucous extraction for longer ($p < 0.05$) but spend less time in an alert state ($p < 0.05$) or in a cot ($p < 0.05$). Neither tone nor motor organisation was affected by drug levels. None of the measures of infant behaviour made at delivery were found to be dependent on the total maternal dose of bupivacaine.

Table IV.11 SIGNIFICANCE AND DIRECTION (+ OR -) OF RELATIONSHIPS BETWEEN VARIABLES RECORDED AT DELIVERY AND MEASUREMENTS OF BUPIVACAINE

Delivery Time Sampling Variable	Cord Blood Concentration		Exposure	
	Significance	+/-	Significance	+/-
Latency to cry			**	-
Latency to eyes open			*	-
Intervals baby blinks	*	+		
Intervals baby scans			*	-
Intervals cyanotic			*	+
Intervals mucous extraction	*	+	*	+
Intervals in alert state			*	-
Intervals in cot			*	-

* $p < 0.05$

** $p < 0.01$

*** $p < 0.001$

V THE NEXT SIX WEEKS: PERFORMANCE ON THE BNBAS

A. Neonatal Behaviour In The First Six Weeks

The characteristics of the testing situation and the distribution of the BNBAS scores across this study period is presented in considerable detail in Tables V.1. and V.2., so only particular points of interest will be discussed below.

1. Control Of States Of Consciousness

Looking first at the data about state control, it can be seen that in the first three days the majority of infants began the assessment asleep. State 1 ("deep sleep", with regular respirations, no movement) or State 2 ("light sleep", with irregular respiration and some movement, possible "rapid eye movements" (REM) seen) are essential for the testing of habituation, since otherwise the reaction to light or sound can be confused with an orienting response. However, by 3 and 6 weeks half or more of the babies were in a state unsuitable for doing the habituation items. This can be seen more clearly in the percentage of infants who were in the "wrong state" under items 1, 2, 3 in Table V.2 . Often this was an unavoidable result of our testing arrangements, because infants were brought to our unit, usually at a time which coincided with the mother's postnatal checks; the infants had usually had a long journey and we were not able to give them more than 30 minutes to settle back to sleep again before testing. Even so, 3-6 week infants are awake for a substantial part of the day, and it might have been difficult to start in a sleep state even if we had made home visits. A proportion (up to 15%) of babies who were asleep to start with still woke up before the 3rd decrement item, suggesting that the cumulative effects of intrusive stimuli can prevent habituation altogether.

Table V.1 TESTING CONDITIONS ON THE BNBAS

DAY	1	3	7	21	42
Age (hours)	26.7	73.0	163.2	-	-
(S.D.)	(10.3)	(14.3)	(20.5)	-	-
Age (days)	-	-	-	21.8	43.6
(S.D.)				(2.4)	(3.8)
Time since last feed (TLF) (hours)	2.2	1.9	1.7	1.8	1.8
(S.D.)	(1.2)	(0.8)	(0.8)	(0.8)	(0.8)
Duration of test (minutes)	22.3	21.9	20.8	19.9	18.1
(S.D.)	(5.7)	(5.4)	(5.2)	(6.3)	(6.3)
% Tests lasting $\geq$30 minutes	14	13	7	12	7
N =	131	130	127	131	128

TABLE V.2 MEANS AND DISTRIBUTIONS OF BNBAS DATA FOR ALL INFANTS, DAYS 1-42

DAY		1	3	7	21	42
a. Feed type, % infants day of testing	Bot	25	28	33	40	44
	Br	66	64	54	49	48
	Bot +Br	8	9	13	11	9
b. Initial State %	1	15	12	16	9	10
	2	56	58	51	43	21
	3	14	12	7	8	9
	4	14	16	20	30	48
	5	2	2	5	6	6
	6	0	1	2	3	7
c. Predomin. State % infants	1	0	0	0	0	0
	2	0	2	0	0	0
	3	34	18	7	5	2
	4	39	42	59	66	77
	5	2	8	4	6	6
	6	6	10	12	12	12
(too variable)	7	20	21	18	12	3
d. Time test: mean		22.3	21.9	20.8	19.9	18.1
(S.D.)		(5.7)	(5.4)	(5.2)	(6.3)	(6.3)
e. Jaundice % not 1		91	66	80	99	99
mild 2		8	27	16	1	0
severe 3		1	7	4	0	1
1. HAB-L % wrong state		26%	30%	32%	45%	60%
mean		6.5	6.6	6.9	6.8	7.1
(S.D.)		(1.8)	(1.8)	(1.7)	(1.6)	(1.4)
2. HAB-R % wrong state		35%	35%	38%	62%	72%
mean		7.1	7.1	6.7	6.9	7.5
(S.D.)		(1.8)	(1.8)	(2.2)	(1.9)	(1.7)
3. HAB-B % wrong state		39%	41%	44%	68%	76%
mean		7.0	7.0	6.6	7.3	7.4
(S.D.)		(2.0)	(1.9)	(2.2)	(1.6)	(1.1)
4. INANVIS % babies						
1-2		5	8	5	2	0
3-4		38	26	20	18	5
5-6		33	38	39	33	24
7-9		24	29	36	46	71
% wrong state		9	7	4	0	1
mean score		5.1	5.4	5.7	6.2	7.6
(S.D.)		(1.8)	(2.0)	(1.9)	(1.8)	(1.5)

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% don't all added up to 100

Table V.2 (Contd)

DAY		1	3	7	21	42
5. IN AN AUD	% 1-3	10	2	3	2	0
	4-6	29	27	33	37	30
	7-9	61	70	63	60	70
	% wrong state	6	1	4	0	1
	mean score	6.2	6.5	6.4	6.5	6.8
	(S.D.)	(1.7)	(1.2)	(1.5)	(1.3)	(1.3)
6. AN VIS	% 1-2	5	3	2	0	0
	3-4	23	22	16	16	3
	5-6	52	47	38	26	17
	7-9	19	27	43	48	80
	% wrong state	6	3	5	0	1
	mean score	5.2	5.4	6.0	6.6	7.7
	(S.D.)	(1.6)	(1.6)	(1.6)	(1.8)	(1.4)
7. AN AUD	% 1-3	10	5	6	6	2
	4-6	36	36	33	39	29
	7-9	54	59	61	54	69
	% wrong state	4	2	3	0	1
	mean score	6.0	6.2	6.3	6.1	6.8
	(S.D.)	(1.6)	(1.5)	(1.5)	(1.5)	(1.4)
8. AN VIS + AUD	% 1-2	5	5	2	1	0
	3-4	20	15	14	12	3
	5-6	39	44	28	21	13
	7-9	35	36	57	66	84
	% wrong state	7	3	3	0	1
	mean score	5.6	5.8	6.3	6.9	7.8
	(S.D.)	(1.8)	(1.7)	(1.6)	(1.7)	(1.4)
9. ALERT	% 1-3	30	21	21	8	3
	4-6	46	48	38	38	24
	7-9	23	31	40	54	73
	% wrong state	1	2	1	0	0
	mean score	4.7	5.1	5.3	6.3	7.1
	(S.D.)	(2.1)	(2.0)	(2.1)	(2.0)	(1.7)
10. TONE	% 1-4	33	30	38	17	11
	5-6	57	54	57	59	67
	7-9	10	16	15	24	22
	mean score	5.2	5.3	5.0	5.7	5.8
	(S.D.)	(1.4)	(1.4)	(1.4)	(1.3)	(1.0)
11. P-SIT	% 1-3	18	16	18	7	5
	4-6	54	57	58	45	19
	7-9	28	37	24	48	76
	mean score	5.1	5.6	5.1	6.2	7.2
	(S.D.)	(2.0)	(2.0)	(1.8)	(1.8)	(1.8)

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Table V.2 (Contd)

DAY		1	3	7	21	42
12. DEFENS	1-3	32	21	16	12	5
	4-6	29	33	40	33	45
	7-9	39	46	44	55	50
	mean score	5.2	5.9	6.1	6.2	6.3
	(S.D.)	(2.4)	(2.3)	(2.3)	(2.0)	(1.5)
13. CONSOL	1-3	5	12	15	12	16
	4-7	40	33	33	27	28
	8	28	35	28	21	17
	9	27	20	24	40	39
	mean score	5.8	6.7	6.5	6.9	6.6
	(S.D.)	(1.5)	(2.1)	(2.3)	(2.4)	(2.6)
14. PK-EXCITE	1-3	7	4	3	2	1
	4-7	82	84	78	75	82
	8-9	11	12	19	23	17
	mean score	5.9	6.0	6.0	5.8	5.6
	(S.D.)	(1.5)	(1.4)	(1.6)	(1.7)	(1.6)
15. RAP-BUILD-UP	1-3	34	29	35	53	56
	4-6	50	60	57	42	34
	7-9	16	11	8	5	10
	mean score	4.3	4.3	3.9	3.3	3.3
	(S.D.)	(2.1)	(2.0)	(2.0)	(2.1)	(2.4)
16. IRRITAB	1-3	33	26	44	58	64
	4-6	49	53	43	32	25
	7-9	18	21	13	10	11
	mean score	4.4	4.7	3.9	3.4	3.2
	(S.D.)	(2.0)	(2.1)	(2.0)	(2.2)	(2.2)
17. ACTIVE	1-3	19	17	15	9	2
	4-6	82	65	64	73	70
	7-9	9	18	21	18	28
	mean score	4.7	5.2	5.2	5.4	5.9
	(S.D.)	(1.4)	(1.6)	(1.6)	(1.5)	(1.2)
18. TREMOR	1-3	12	29	38	55	61
	4-6	55	55	50	35	26
	7-9	33	16	12	10	13
	mean score	5.7	4.7	4.2	3.3	3.1
	(S.D.)	(1.9)	(2.1)	(2.2)	(2.4)	(2.6)
19. STARTLE	1-3	37	34	37	66	83
	4-6	36	42	57	26	15
	7-9	27	24	16	8	2
	mean score	4.7	4.7	4.4	3.2	2.4
	(S.D.)	(2.4)	(2.2)	(2.0)	(1.9)	(1.2)

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Table V.2 (Contd)

DAY		1	3	7	21	42
20. LAB-STATE	1-3	48	43	58	78	79
	4-6	42	44	34	17	19
	7-9	10	13	8	5	2
	mean score	4.0	4.1	3.5	2.7	2.4
	(S.D.)	(1.9)	(2.0)	(1.8)	(1.7)	(1.6)
21. SELF-QUIET	1-3	19	19	22	23	20
	4-6	41	42	35	32	31
	7-9	40	39	43	45	49
	mean score	5.7	5.6	5.8	6.0	6.2
	(S.D.)	(2.3)	(2.1)	(2.4)	(2.6)	(2.6)
22. HAND-MOUTH	1-3	21	11	24	45	58
	4-6	26	21	24	23	13
	7-9	53	68	51	32	29
	mean score	6.1	6.9	5.9	4.6	3.8
	(S.D.)	(2.7)	(2.4)	(2.8)	(3.2)	(3.3)

However, after the habituation items were finished it was not difficult to rouse the babies, and none of them had a "predominant" sleep state, (Item C, Table V.2.). This is in marked contrast to our more recent work with preterm infants where it is fairly common to be unable to rouse the baby for orientation items even during a 45 minute assessment. The ability to remain alert for long periods (State 4) during the assessment steadily increased with age; on day 1 39% had 4 as their predominant state while at 6 weeks this figure rose to 77%. The percentage who were predominantly awake, but drowsy and unresponsive (State 3) had fallen to a low level ($<7\%$) by day 7. Also accounting for only a small percentage over the 6 weeks ($<8\%$) were babies who were active but not crying (State 5), another state which makes them relatively unresponsive to attempts at interaction. The last state, of insulated crying (State 6), was relatively uncommon on day 1, but from the third day on a small core of infants (10-12%) seemed to be irritable and inconsolable. We added another category to Brazelton's, (Code 7), for computing purposes, of "no predominant state", since a number of infants were equally divided during the session between several states. This category included about 20% of infants in the first week, but by 6 weeks was unusual (3%).

Working through the BNBAS scale the first items are the three habituation responses, to a torch light, rattle and lastly a bell. There was not much change in these scores from day 1 to day 42 (<0.5 point), but for some reason, habituation was slightly poorer on day 7 than in the previous two sessions. The mean score across the period hovered between 6 (shutdown of body movements, diminution in blinks and respiration after 7-8 stimuli) and 7, as above but after only 5-6 stimuli.

Peak of excitement (Item 14) reflects how easily the infant becomes roused or over-aroused during the session. The average baby over the six weeks had a score around 5.0-6.0, reaching a crying state after stimulation but returning to a lower state spontaneously. Though the group mean was lowest at 3 weeks there were actually more irritable babies then, with almost one-quarter of the group being either difficult or impossible to console. Only 7%, or fewer later on, failed to reach an alert state at least once. Rapidity of Build-up (Item 15) indicates how early in the session the infant started to cry (an episode lasting $>$ 15 seconds). The average score of 4.3 on day 1 fell to, and remained at, 3.3 by 3 weeks; this represents the difference between crying to being pulled to sit, or to only responding to the more stressful Moro ("dropping" the baby's head) or "defensive" manoeuvre (occluding his eyes and nose). A small group of babies (5-16%) cried to relatively non-invasive manoeuvres, such as the habituation stimuli or taking the baby's blanket off. Irritability scores (Item 16) - the number of stimuli which provoke crying - decreased from 4.4 to 3.2, a difference, however, of only 1 manoeuvre. Between 10% and 21% of the infants cried to at least six stimuli. The baby's skills at Self-quieting (Item 21) did not change much over the study period - hovering around 5.6-6.2, which means several brief or one sustained period of returning to State 4 from State 6. About one-fifth of the infants were unsuccessful, needing to be consoled by the tester. The last item in this dimension is Lability of States (Item 20), which represents a score for the number of changes over the testing period. On days 1 and 3 the average baby changed states 9-10 times (4.0-4.1), while by six weeks the score was only 2.4, about 4-7 swings. For comparison the typical newly born infant changed state about 12 times in the first twenty minutes after birth. In the first

week 8-13% shifted state more than 15 times during the (average) 20 minute session, but the figure had fallen to only 2% by six weeks.

2. Interactive Processes

The orientation items (5-9) in this dimension consist of the visual and auditory responses to inanimate and animate stimuli, and alertness. On days 1 and 3 the mean score for both visual stimuli (Items 4,6) was just over 5, indicating that an infant could track an object smoothly with his eyes in a 30^{o} arc; by six weeks he would usually be able to follow with head and eyes horizontally for 60^{o}, and vertically, perhaps 30^{o}. Few infants ($< 8\%$) failed to track the stimulus even in the first few days, but a small number ($< 10\%$) were in the wrong state (either too sleepy, or crying with eyes shut) to elicit visual responses.

Auditory responses (Items 5,7) averaged between 6 and 6.8 over the first six weeks, with a less dramatic improvement. This means that the average infant could turn his eyes to sound, (6) and perhaps turn his head and eyes, alerting to the source (7). On the first day 10% showed no reaction to the sounds (rattle or voice) or quieted only. This group dropped to 3% by day 3 and remained very low, but the proportion making no attempt to locate a human voice was slightly higher ($\approx 6\%$) until 3 weeks. Scores on Animate Visual and Auditory (Item 8) average slightly higher than the visual stimuli without sound. Also, more infants scored in the upper ranges of the scale (7-9. = 60^{o}-120^{o} arcs); for instance on day 1 Inanimate Visual = 24%, Animate Visual = 19%, Animate Visual and Auditory = 35%. This suggests that the sound source actually helps the infant to localise the moving object, or at least makes it a more potent stimulus. These orienting responses

are also cast in a slightly different fashion in Table V. 3. in order to distinguish very basic responses (a) from more competent ones (b).

Visual skills developed rapidly in the first week, particularly tracking inanimate objects as can be seen in Table V .3. It is interesting to note that very little change took place between 1 and 3 weeks in the sample, but at 6 weeks almost all the infants demonstrated reliable visual tracking. In the auditory sphere the number of babies who, at the least, alerted to sound increased steadily, but the number actually turning to the sound over that period increased rather erratically. From our observations of the infants in the testing situation their early response to sounds often seemed to be an automatic orienting response of reflex type.

The inconsistent progress of the group over the first six weeks might reflect the changing nature of this response as it gradually approximates to the true visual localisation under voluntary control that occurs around 3 months (Uzgiris and Hunt, 1975). In our interactions with the infants at 6 weeks we felt that their visual behaviour also was qualitatively different; they were interested not only in the immediate stimulus object, but in scanning the entire room and then fixating on items or people of particular interest. As noted in experimental studies, this is the age at which one would expect smooth object tracking (White et al., 1964; Dayton and Jones, 1964), accommodation to various distances, and the ability to maintain a "steady fixation on small centrally located stimulus elements" (Bronson, 1974).

Scores on Alertness improved consistently and markedly over the six weeks. On day 1 the average baby's responsivity was of brief or moderate duration, and slightly variable, though not delayed (4.7); a third of the group were inattentive with brief and delayed responses.

Table V.3 THE DEVELOPMENT OF ORIENTING SKILLS OVER THE FIRST SIX WEEKS: % OF INFANTS

DAY	DELIVERY	1	3	7	21	42
Visual Following:						
Object						
a. Brief, jerky	83	95	92	95	98	100
b. Smooth, $\geq 30^{o}$ arcs	50	57	67	75	79	95
Visual: Face						
a. Brief, jerky	86	97	97	98	100	100
b. Smooth, $\geq 30^{o}$ arcs	50	71	74	81	74	97
Visual and Auditory:						
Face + Voice						
a. Brief, jerky	89	95	95	98	99	100
b. Smooth, $\geq 30^{o}$	58	74	80	85	87	97
Auditory: Rattle						
a. Alert to, or eyes turn	89	90	98	97	98	100
b. Turn head and eyes	36	61	70	63	60	70
Auditory: Voice						
a. Alert to, or eyes turn	84	90	95	94	94	98
b. Turn head and eyes	38	54	59	61	54	69
N =	89	120	125	121	131	126

By six weeks alert episodes were of "sustained duration"; only 3% were now inattentive (1-3), while 73% had alert episodes of sustained duration with, perhaps, frequent and reliable alerting, and appropriate arousal or quieting to new stimuli.

"Consolability" (Item 13) refers to how easily the baby can be soothed after a crying spell. Although it sounds like a "state control" measure Brazelton intended it to capture one aspect of the interactive process, partly because the parent's feeling of self-confidence and competence can be greatly affected by their infant's response to being held and talked to, rocked etc., when upset. We slightly changed the 9 on Brazelton's scoring since he worded it "quiets to examiner's face alone" and we rarely tested a crying baby in the first week whose eyes were open to see our face. Thus we re-assigned 9 to those babies who "never needed to be consoled", either because they always remained quiet or because they quieted themselves by sucking on their fingers, changing position, etc. The number of babies meeting such criteria was variable over the study period, ranging from 20-40% - quite a high proportion. The mean scores did not show any clear age effect but ranged from quieting to a "hand on the tummy and restraining both arms" (5.8) to just a hand on the tummy (6.8). On day 1, 5% of the babies could either not be consoled or required a dummy to suck on, or to be fully dressed (the "swaddling" effect), held and rocked; from then on 12-16% were like this. At the top of the scale were those who didn't need consoling or the additional 20-35% who only needed the examiner's soothing voice to settle down again.

3. Motoric Processes

The infants' Tone (Item 10) improved only slightly over the study period (5.2-5.8), which mainly reflected whether the tone at rest was flaccid or variable. Although the average baby's tone was good when handled about a third of the babies in the first week were hypotonic ("limp" 75% of the time). In contrast fewer than 16% were hypertonic at this time. The number of hypotonic infants had dropped to 11% by day 42, while the number of hypertonic infants had increased to 22%. Pull-to-sit (Item 11) is a measure of resistance to movement using neck, back, and shoulder muscles. Scores were considerably poorer in the first week (5.1-5.6) than they would be in the sixth (7.2). This is a difference between bringing the head up once, and keeping it upright for 10 seconds. 18% of infants could not bring their head up at all in the first week, while more than a quarter could already keep it in position for at least 10 seconds.

Defensive movements and hand-to-mouth manoeuvres both reflect skill, tone and motor co-ordination. To occlusion of the eyes and nose (Defensive, Item 12) the average infant showed "rooting and lateral head turning" at first, and "neck stretching" by the third week. Nevertheless about 40% of the group were able to swipe with their arms in the first week too. At the other extreme were non-specific behaviours - no response, quieting or general activity after a long latency - that occurred in one-third of the group on the first day but decreased rapidly.

Hand-to-mouth behaviour was at its greatest in the first week, particularly on day 3, when 68% of the babies put their fingers in their mouth at least 3 times during the assessment (Item 23, mean 6.9). By 6 weeks the babies were less likely to console themselves in this way; more than half brought their hands near to the mouth fewer than 3 times

and did not insert their fingers at all (3.8). This distribution of scores across time underlines the fact that factors other than skill or ability govern many elicited behaviours in this assessment; obviously the babies did not "forget" how to suck over this short period. Instead, they were probably at their hungriest on day 3, particularly breastfeeding infants whose mothers were not fully lactating, and thus capitalised on primitive swiping skills to comfort themselves.

Lastly was Activity (Item 17) which includes both spontaneous and elicited movement, each on a 4-point scale, which are totalled and then scored. This means that a typical baby in the first week would have "moderate" spontaneous and elicited activity or "slight" of one and "much" of the other. In practice, the latter was uncommon so "good" scores usually indicated moderate amounts of movement. There was only a 1-point improvement over the six weeks but the distributions changed a great deal. The proportion of hypoactive infants decreased sharply between 1 and 3 weeks, while the number of hyperactive ones increased.

4. Organisational Processes: Physiological Response To Stress

Since we did not include colour lability there were only two items in this dimension. The first - Tremor (Item 18) - refers to the jittery movements or uncontrollable shaking seen in newborn infants, and it disappeared fairly rapidly in this sample. On the first day there was some tremulousness seen even when the baby was quiet and alert (5.7) but by day 7 it occurred only once or twice while the baby was crying (4.2). By the final assessment tremor was only seen after an elicited Moro reflex or spontaneous startle (3.1). However, there remained more than 10% who were tremulous 3 or more times in State 4. A startle

(Item 19) is an involuntary throwing-out-of-arms, similar to the response elicited in a Moro reflex. Like tremor this physiological immaturity was prominent in the first week and then faded. On days 1, 3, 7, babies startled about four times (including an elicited Moro) but this had dropped to 2 times by three weeks and only to an elicited Moro reflex by six weeks. More than a quarter of the group had seven or more startles (scores 7-9) on days 1 and 3, but the number scoring in this band by 3 weeks was only 2%.

B. The Use Of Dimension Scoring

We did not intend to use any of the "global" scoring systems in the analysis of drug effects because we were interested in even very slight variations in the individual behaviours. Nevertheless, we adapted one of the available "a priori" systems (Adamson, Als, Tronick and Brazelton, 1975) for our computer programme[1], in order to examine changes in behaviour according to age and drug group before proceeding to the main analysis.

For the first 3 dimensions each infant is assigned a score of 1, 2, or 3 and on 2 of the scales, 4: 1 = superior; 2 = average; 3/4 = deviant or worriesome. The last dimension - Physiological Response to Stresses scored either 1 = normal; 2 = deficient/worriesome. The scores are "weighted" with some "must" criteria plus a selection of "either/or" options. The scoring system can be found in Appendix I.

Adamson and colleagues anticipated that 50%-60% of normal infants would fall into the "average" category. The distribution of our scores for the whole group on each day of testing is indicated in Table V.4.

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1 I am indebted to Martin Packer for the design of this programme.

Table V.4 DISTRIBUTION OF SCORES ON EACH BNBAS DIMENSION FOR THE WHOLE GROUP ON EACH DAY OF TESTING : % OF INFANTS

I	Interactive Processes					
	DAY	1	3	7	21	42
1.	Superior	11	12	20	27	43
2.	Average	66	68	59	58	51
3.	Deviant	23	20	21	15	7
II	Motoric Processes					
1.	Superior	25	31	23	26	27
2.	Average	67	67	75	70	72
3.	Hypertonic	0	1	0	4	1
4.	Hypotonic	7	2	2	1	1
III	Organisational Processes: Control of State					
1.	Superior	16	12	21	18	31
2.	Average	62	65	63	61	52
3.	Labile	14	14	14	17	14
4.	Flat/Depressed	18	9	2	5	3
IV	Organisational Processes: Physiological Response to Stress					
1.	Normal	76	85	84	95	98
2.	Deficient	24	15	16	5	2

Most infants scored in the average range, although the percentage of deficient scores varied with the dimension being measured; in Interactive Processes, about 20% of infants in the first week were rated as deficient.

In contrast, very few infants demonstrated poor Motoric Organisation and Muscle Tone. The number of deficient scores was highest on day 1, where 7% of infants were, to some degree, hypotonic. Of the deficient scores in this area, it was not until 3 weeks of age that hypertonic responses accounted for the poor scores.

In the Control of State, about 15% were hyper-reactive to stimuli, as reflected in an inability to remain in a quiet alert state, and to habituate quickly to stimuli which interrupted their sleep. A smaller proportion of infants exhibited a "flat depressed" state from which it was difficult to arouse them to a suitable state for interaction. We did not expect the Response to Stress dimension to be very different from the raw Startle and Tremulous scores, since they are not "weighted" for this category. "Worriesome" indicated scores above 6 for the two items, and it is striking that a quarter of the babies had high scores on both.

We went on to plot the distribution of "worriesome" scores (3 and 4) in each of the drug groups, and these are presented for each dimension in Figures V.1, V.2, V.3. and V.4. For Interactive Processes there seemed to be no clearcut advantage to the babies in the No-Drugs group, except on days 3 and 7. In Motoric Processes there were no worriesome scores in that group on days 3 and 42, but even in the Pethidine and Bupivacaine babies deficient scores were rare. There is no obvious pattern of scores for either Control of State or Physiological Stress.

Figure V.1 Percent infants with 'worrisome' scores on Brazelton 'a priori' categories on each day of testing.

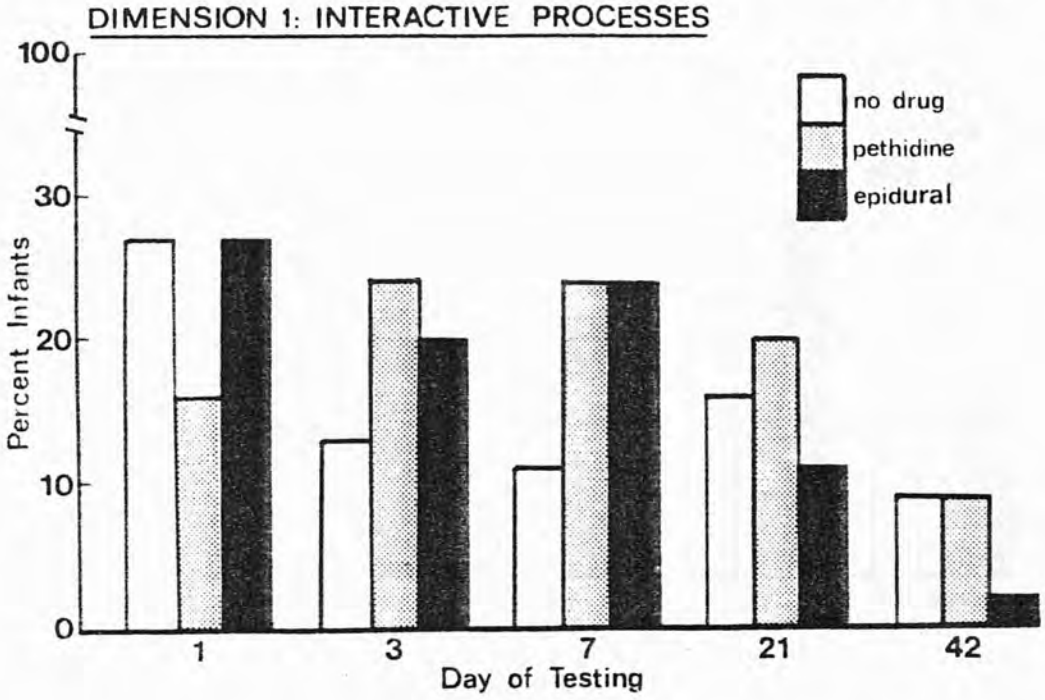


Figure V.2 Percent infants with 'worrisome' scores on Brazelton 'a priori' categories on each day of testing.

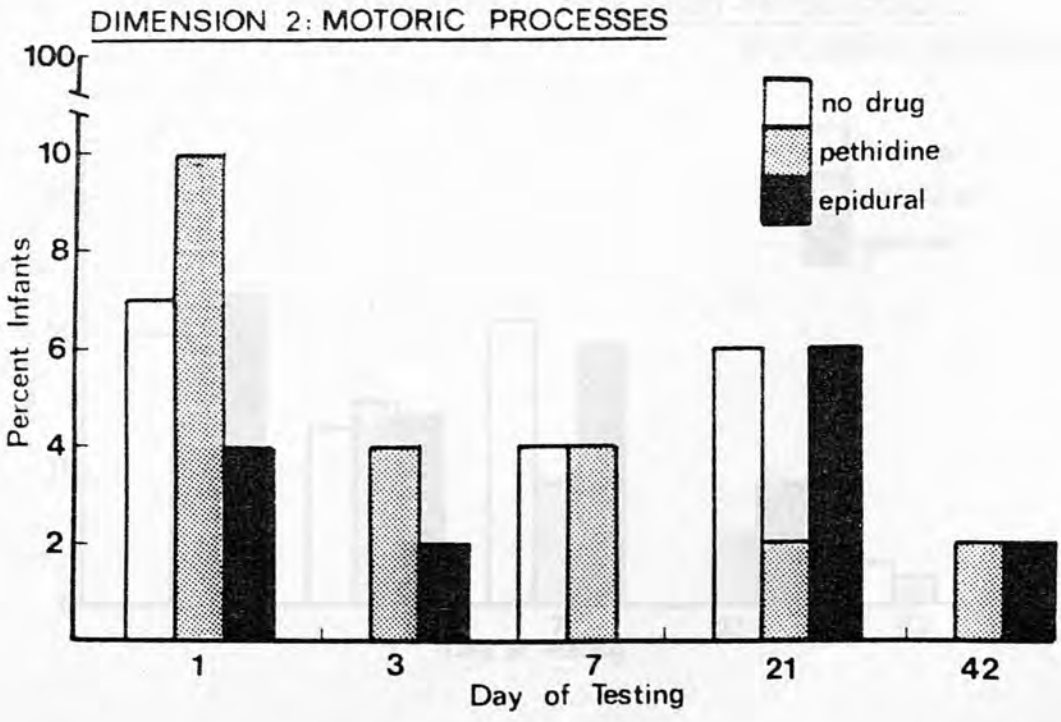


Figure V.3 Percent infants with 'worrisome' scores on Brazelton 'a priori' categories on each day of testing.

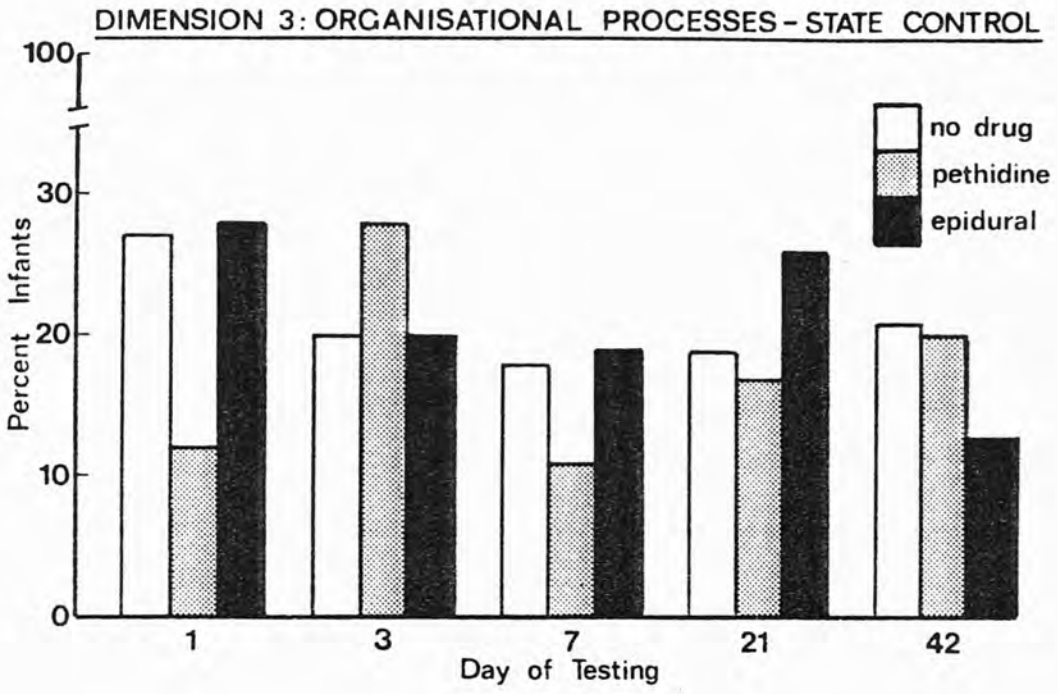
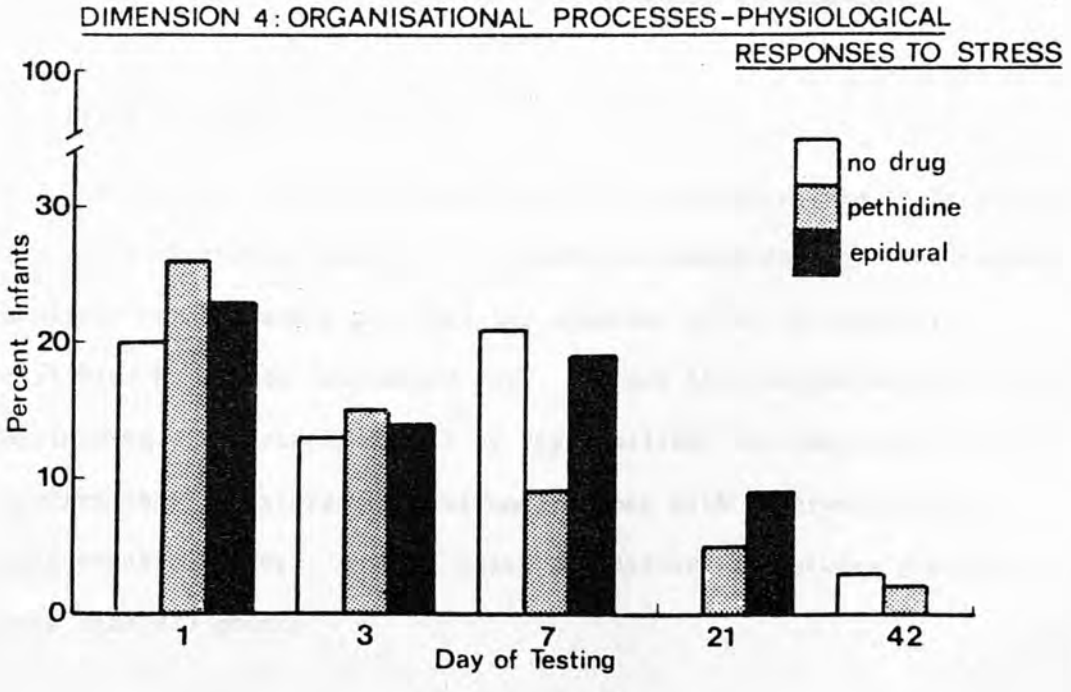


Figure V.4 Percent infants with 'worrisome' scores on Brazelton 'a priori' categories on each day of testing.



Lastly we analysed developmental trends for the 4 dimensions. Scores on Interactive Processes showed a significant improvement for the "all" babies group ($p < 0.001$), and for each of the three drug groups: no-drug ($p < 0.05$), pethidine ($p < 0.001$) and epidural ($p < 0.001$).

Motoric Processes did not show significant trends for all babies or drug groups. Control of State scores improved for the whole sample ($p < 0.01$), and the bupivacaine group ($p < 0.025$), but not for the other two. Physiological Response to Stress scores also indicated considerable maturation for all groups: all babies ($p < 0.001$), no-drug ($p < 0.01$), pethidine ($p < 0.001$) and bupivacaine ($p < 0.001$).

Although it was interesting to see what the profiles looked like, the analysis revealed few surprises about our sample. It was intriguing to see that drug group scores did not always follow the trends for "all babies", and that there were notable differences in the percentage of worriesome scores for each drug group but that they showed no internal consistency or particular time course. The exercise reinforced the feeling that an item by item analysis would be necessary.

C. BNBAS Scores By Drug Group

Tables V.5. and V.6. present all of the BNBAS scores by drug group for delivery through day 42. It should be remembered that the regression analysis enters each score into the equation after the obstetric variables have been "accounted for", so that this layout may be slightly misleading. Nevertheless just by "eye-balling" the data day by day it appears that the scores are extremely close with no group scoring consistently better. In most cases the difference between groups is less than 0.5 points.

Table V.5 MEANS AND S.D. OF BNBAS SCORES IN THE FIRST WEEK BY DRUG GROUP

	Delivery		1		3		7	
	M	S.D.	M	S.D.	M	S.D.	M	S.D.
HAB-L								
N			6.04	1.56	6.78	1.70	7.46	1.39
P	--		6.71	1.90	6.43	1.77	7.00	1.78
E			6.55	2.05	6.62	1.99	6.59	1.70
HAB-R								
N			6.95	1.51	7.06	1.75	6.36	2.33
P	--		7.40	1.91	6.67	1.95	7.30	1.66
E			7.00	1.91	7.45	1.59	6.13	2.60
HAB-B								
N			7.06	1.92	7.42	1.38	6.81	2.09
P	--		7.21	1.82	6.00	2.00	6.29	2.28
E			6.68	2.25	7.76	1.54	6.62	2.27
INANVIS								
N	3.69	1.65	4.92	1.94	5.72	2.03	6.11	1.55
P	3.97	1.74	5.45	1.88	5.32	1.94	5.66	1.74
E	3.87	1.53	4.76	1.66	5.35	2.07	5.62	2.12
INANAUD								
N	6.00	1.41	6.55	1.66	6.65	1.73	6.22	1.60
P	5.59	1.74	6.11	1.68	6.41	1.33	6.27	1.33
E	4.96	1.54	5.96	1.76	6.60	1.10	6.58	1.36
ANVIS								
N	4.93	1.94	4.93	1.74	5.61	1.26	6.07	1.64
P	4.69	1.74	5.48	1.49	5.32	1.57	6.02	1.69
E	4.36	1.61	5.19	1.69	5.30	1.78	5.98	1.53
ANAUD								
N	6.07	1.39	6.21	1.61	6.52	1.15	6.07	1.49
P	5.42	1.86	5.94	1.63	6.04	1.66	6.47	1.69
E	4.74	1.94	5.83	1.73	6.08	1.45	6.22	1.42
ANVISAUD								
N	5.62	1.26	5.53	1.91	6.00	1.28	6.37	1.50
P	4.93	1.84	5.82	1.67	5.80	1.63	6.21	1.79
E	4.44	1.58	5.52	1.79	5.54	1.90	6.40	1.63
ALERT								
N	5.64	2.33	4.97	2.13	5.71	2.07	5.57	1.91
P	4.59	2.26	4.71	2.44	4.63	2.16	5.09	2.13
E	4.42	1.82	4.47	1.96	5.22	1.86	5.35	2.28
TONE								
N	5.71	0.73	5.20	1.47	5.33	1.52	5.36	1.31
P	5.19	1.36	5.17	1.32	5.24	1.51	4.93	1.47
E	4.78	1.49	5.12	1.50	5.18	1.33	4.94	1.34

CONTD/

Table V.5 (Contd)

	Delivery		1		3		7	
	M	S.D.	M	S.D.	M	S.D.	M	S.D.
P-SIT								
N			4.83	2.04	5.70	1.56	5.61	1.17
P	--		4.94	2.11	5.52	2.05	4.72	1.92
E			5.46	1.92	5.53	2.09	5.11	1.97
DEFENS								
N			5.17	2.48	5.83	2.23	5.82	2.26
P	--		5.16	2.43	5.63	2.30	5.96	2.52
E			5.17	2.52	6.08	2.43	6.44	2.08
CONSOL								
N			6.83	2.02	6.53	2.32	7.18	2.04
P	--		7.18	1.76	6.67	2.08	6.20	2.24
E			6.69	2.15	6.74	2.10	6.30	2.44
PK-EXCITE								
N			5.63	1.65	5.90	1.47	5.82	1.52
P	--		5.73	1.62	6.17	1.48	6.00	1.56
E			6.05	1.38	6.00	1.34	6.04	1.64
RAP-BUILD-UP								
N			3.87	2.11	4.10	1.84	3.75	2.17
P	--		4.34	2.11	4.33	1.97	3.76	1.69
E			4.40	2.00	4.37	2.06	4.04	2.16
IRRITAB								
N			3.97	1.97	4.53	2.22	3.82	1.96
P	--		4.34	2.14	4.89	2.06	3.89	1.89
E			4.73	1.94	4.74	1.99	4.06	2.11
ACTIVE								
N			4.73	1.20	5.20	1.21	5.25	1.32
P	--		4.41	1.35	5.24	1.85	5.02	1.58
E			4.89	1.53	5.21	1.57	5.30	1.71
TREMOR								
N			5.10	2.17	4.73	1.96	4.39	2.13
P	--		5.98	1.80	4.41	2.07	4.02	2.16
E			5.71	1.89	4.80	2.16	4.15	2.23
STARTLE								
N			4.90	2.59	4.70	2.26	4.21	1.79
P	--		4.73	2.49	4.63	2.22	4.36	2.04
E			4.58	2.18	4.74	2.24	4.52	2.03
LAB-STAT								
N			4.13	2.08	3.37	1.63	3.00	1.69
P	--		3.88	1.87	4.43	2.10	3.31	1.49
E			3.94	1.73	4.07	1.93	3.92	2.01

CONTD/

Table V.5 (Contd)

	Delivery		1		3		7	
	M	S.D.	M	S.D.	M	S.D.	M	S.D.
SELF-QUIET								
N			5.43	2.60	5.90	2.14	5.93	2.70
P	--		5.82	2.10	5.48	2.26	5.59	2.50
E			5.71	2.25	5.58	2.02	5.81	2.24
HAND-MOUTH								
N			6.63	2.44	7.17	2.73	6.25	2.77
P	--		5.88	2.72	6.65	2.39	5.28	2.87
E			6.08	2.80	7.02	2.13	6.19	2.68

-- not assessed in the delivery room

N = No drug

P = Pethidine

E = Epidural

Table V.6 MEANS AND S.D. OF BNBAS AT 3 WEEKS (DAY 21) AND 6 WEEKS (DAY 42) BY DRUG GROUP

	21		42	
HAB-L				
N	7.08	1.38	7.29	1.50
P	6.40	1.73	7.00	1.41
E	7.00	1.56	7.16	1.50
HAB-R				
N	7.28	1.80	6.33	2.31
P	7.06	1.84	7.86	1.07
E	6.54	2.21	7.67	1.87
HAB-B				
N	7.33	1.63	6.50	2.12
P	7.33	1.73	7.75	0.96
E	7.36	1.69	7.67	0.58
INANVIS				
N	6.00	2.02	7.24	1.80
P	5.91	1.77	7.64	1.49
E	6.65	1.72	7.68	1.40
INANAUD				
N	6.50	1.41	6.67	1.43
P	6.62	1.37	6.70	1.30
E	6.42	1.30	6.88	1.23
ANVIS				
N	6.38	1.62	7.52	1.46
P	6.22	1.92	7.60	1.44
E	7.04	1.79	7.86	1.32
ANAUD				
N	6.19	1.64	6.85	1.50
P	5.93	1.47	6.67	1.41
E	6.20	1.47	6.80	1.27
ANVISAUD				
N	6.81	1.55	7.58	1.60
P	6.64	1.94	7.67	1.41
E	7.24	1.66	8.06	1.23
ALERT				
N	6.25	1.95	7.12	1.95
P	6.18	2.04	7.16	1.72
E	6.35	1.93	7.12	1.62
TONE				
N	5.91	1.12	5.78	0.71
P	5.60	1.34	5.82	1.19
E	5.72	1.32	5.90	1.10

CONTD/

Table V.6 (Contd)

	21		42	
	M	S.D.	M	S.D.
P-SIT				
N	6.69	1.28	7.24	1.66
P	5.80	1.88	7.00	2.06
E	6.21	1.83	7.25	1.66
DEFENS				
N	5.88	2.39	6.16	1.64
P	6.78	1.79	6.61	1.37
E	5.94	1.99	6.00	1.61
CONSOL				
N	6.91	2.58	6.26	2.89
P	7.00	2.33	6.96	2.37
E	6.74	2.44	6.53	2.75
PK-EXCITE				
N	5.59	1.85	5.94	1.63
P	5.78	1.61	5.51	1.52
E	5.91	1.67	5.55	1.78
RAP-BUILD-UP				
N	2.91	1.96	3.58	2.37
P	3.27	1.94	3.56	2.46
E	3.46	2.37	2.94	2.29
IRRITAB				
N	3.12	2.28	3.79	2.37
P	3.42	1.94	3.24	2.36
E	3.50	2.28	2.86	1.96
ACTIVE				
N	5.56	1.78	6.21	1.32
P	5.38	1.39	5.98	1.29
E	5.42	1.46	5.57	1.08
TREMOR				
N	2.84	2.24	3.41	2.60
P	3.22	2.26	2.96	2.54
E	3.59	2.68	3.14	2.60
STARTLE				
N	3.09	2.05	2.36	1.27
P	3.56	1.84	2.56	1.29
E	2.98	1.74	2.35	1.16
LAB-STAT				
N	2.32	1.68	2.74	1.83
P	2.71	1.62	2.47	1.32
E	2.85	1.73	2.17	1.60

CONTD/

Table V.6 (Contd)

	21		42	
	M	S.D.	M	S.D.
SELF-QUIET				
N	6.56	2.71	5.79	2.36
P	5.71	2.45	6.02	2.80
E	5.85	2.67	6.57	2.43
HAND-MOUTH				
N	4.94	3.03	4.54	3.67
P	4.98	2.87	3.18	3.09
E	4.41	3.25	3.94	3.22

N = No drug

P = Pethidine

E = Epidural

D. Comparison Of "Analgesia Study" Scores With Other Samples

One check on the generalisability of data using the BNBAS is the maintenance of interscorer reliability to ensure that the instrument is being applied and scored similarly between testers in the same study, and between different centres. Both of these conditions had been strictly followed in the present study. However, the maternity populations being studied may well differ on a number of criteria which could also influence the result, even when "low-risk" populations are selected. Major differences could still occur in characteristics such as maternal parity, social class and labour length, and infant weight, type of feeding, medical problems in the first week and so on. Such factors may interact with the drug effects and may account for the varied outcomes noted in the review of other studies on maternal medication and neonatal behaviour.

It seemed worthwhile to inspect the BNBAS scores for our sample alongside those from other studies around the world. Unfortunately, not all published papers devote space to a presentation of their raw data and in some instances it was not possible to ascertain their sample characteristics. A few papers had the necessary information and/or presented scores from other units as well.

Both tables here consist of data on the offspring of low-risk mothers, where testing was carried out on day 3 with protocols similar to the present study. It was very difficult to find sufficient no-drug samples in the North-American studies, and the reader should note that those three samples tabulated include only a handful of infants.

Table V.7. is a tabulation of all babies in a given study irrespective of the medication status of the mother. For most items there is little apparent difference between the samples, despite their

Table V.7 CROSS-NATIONAL COMPARISON OF MEAN BNBAS SCORES ON D.3 OF ALL INFANTS TESTED IN EACH STUDY.[a]

Atten & Social	Present Sample	Kansas	Boston	Israeli	Uruguay
InAnVis	5.4	4.4	5.4	7.0	5.65
InAnAud	6.5	4.4	5.8	6.45	5.70
AnVis	5.4	5.35	6.5	7.15	6.55
AnAud	6.2	5.65	5.8	6.65	6.65
AnVisAud	5.8	5.6	6.9	7.4	7.15
Alert	5.1	4.6	5.5	6.15	6.2
Consol	6.7	4.2	6.2	8.15	7.5
Muscle Tone & Motor Organisation					
Tone	5.3	4.85	5.4	5.85	6.1
P-Sit	5.2	4.95	5.8	6.35	6.3
Active	5.2	4.85	4.6	5.2	5.35
Defens	5.9	5.9	6.9	5.85	6.25
Hand-Mouth	6.9	4.65	6.0	4.05	6.05
Control of State					
Hab-L	6.6	4.4	6.8	5.5	5.7
Hab-R	7.1	5.6	7.1	6.05	6.45
Hab-B	7.0	5.6	4.2	6.2	6.5
Build-Up	4.3	4.5	3.6	4.05	4.55
PK.Excit	6.0	5.9	5.8	5.95	6.2
Irritab	4.7	4.5	4.0	4.25	4.45
Self-Quiet	5.6	4.4	5.1	7.35	6.8
Lab-State	4.1	4.75	2.8	6.3	?
Physiological Response to Stress					
Startle	4.7	3.3	4.3	3.15	3.15
Tremor	4.7	3.6	4.4	4.3	4.1
N =	130	34	54	65	80

[a] The data for the Kansas, Israeli, and Uruguay samples have been extracted from Horowitz et al. (1977); the Boston sample is taken from Tronick et al. (1976).

"cross-national" status. Where there is greater variation our infants seem to behave most like their peers in Boston. The Kansas infants have slightly poorer scores on orientation and habituation items, but have a lower incidence of startles and tremulousness. This may be due to the fact that they were mainly "drug" babies, either moderate-heavy medication (24 different "cocktails") medication or general anaesthia in addition to pethidine - even for straightforward viginal deliveries. The Israeli infants seem to perform best, which might be because half of them were drug-free deliveries.

When we examine scores from infants whose mothers were drug-free, our scores still fit in well to the general pattern (Table V.8.). For some reason our babies are notably better at getting their hands to their mouth, but exhibit more startles and tremor. The only two items which show great variation between the groups, are consolability, hand-to-mouth skills and tremulousness.

Although statistical analysis was not performed on this data it would seem that our scores are similar enough to other studies to confirm our procedures and the applicability of the data.

E. Obstetric Factors And BNBAS Scores In The First 6 Weeks

Considering the number of Brazelton scores analysed for the five assessments during this period, there were few effects attributable to antenatal factors and obstetric events. These results are presented in Table V.9.

Antenatal factors were not related to early behaviour in a consistent fashion. Low socio-economic status was associated with poor animate visual and auditory scores on day 1 ($p = 0.045$) and with poor animate visual scores on day 21 ($p = 0.045$). On day 3 it was

Table V.8 CROSS-NATIONAL COMPARISON OF MEAN BNBAS SCORES ON D.3 OF INFANTS WHOSE MOTHERS DELIVERED WITHOUT MEDICATION.[a]

	Present Sample	Israeli	Washington	Uruguay	Kansas	Boston
Attention & Social Response						
InAnVis	5.7	6.9	6.1	5.5	5.2	6.0
InAnAud	6.7	6.3	6.4	5.6	4.2	6.1
AnVis	5.6	7.1	6.8	6.4	6.0	6.6
AnAud	6.5	6.6	6.5	6.7	4.8	6.5
AnVisAud	6.0	7.3	7.2	7.1	6.4	6.8
Alert	5.7	6.3	6.1	6.1	6.2	7.1
Consol	6.5	8.2	5.2	7.4	5.8	6.6
Muscle Tone & Motor Organisation						
Tone	5.3	5.7	6.0	6.1	5.4	5.5
P-Sit	5.7	6.3	5.4	6.0	4.4	6.1
Active	5.2	5.1	4.7	5.4	5.2	4.8
Defens	5.8	6.2	5.8	5.7	7.8	6.9
Hand-Mouth	7.2	4.0	6.7	5.7	5.6	5.8
Control of State						
Hab-L	6.8	5.8	-	6.2	-	-
Hab-R	7.1	6.5	-	6.7	-	-
Hab-B	7.4	6.7	-	6.9	-	-
Rap-Build-Up	4.1	4.3	2.6	4.9	4.4	4.3
PK-Excite	5.9	6.0	5.7	6.2	6.8	5.8
Irritab	4.5	4.3	2.7	4.7	4.4	3.6
Self-Quiet	5.9	7.6	4.0	6.6	5.8	5.5
Lab-State	3.4	6.1	3.2	?	3.8	3.1
Physiological Response to Stress						
Startle	4.7	3.3	2.5	2.9	3.2	3.3
Tremor	4.7	4.2	2.5	4.2	5.8	3.6
N =	35	34	7	51	5	6

[a] With the exception of the present sample all data have been taken from Horowitz et al. (1977).

Table V.9 RELATIONSHIP BETWEEN OBSTETRIC FACTORS AND BNBAS[a] SCORES DAYS 1-42 (ALL INFANTS)

	p^b =
Pregnancy factors	
Infants of multipara: > alert d.21	0.0
Infants of working class: < animate visual d.21	0.0
: < animate visual/auditory d.1	0.04
: > tone d.3	0.04
Labour	
Longer first stage: > habituation rattle d.7	0.0
: > habituation bell d.3	0.0
: > animate visual/auditory d.21	0.02
: < startles d.21	0.03
Longer second stage: none	
Greater maximum syntocinon: < tone d.7	0.0
: < pull-to-sit d.42	0.0
Delivery	
Use of lift-out forceps: > alert d.21	0.0
: > tone d. 7	0.0
Use of mid-cavity forceps: < habituation rattle d.7	0.01
: > tone d.21	0.02
: > pull-to-sit d.7	0.02
: > rapidity of build-up d.3	0.04
: < self-quieting d.21	0.01
Infant Condition and Intervention	
Low Apgar 1 : > animate visual/auditory d.7	0.02
: < pull-to-sit d.42	0.0
Use of mask oxygen: > startles d.1	0.02
Use of IPPV oxygen: none	

[a] BNBAS = Brazelton Neonatal Behavioural Assessment performed on days 1, 3, 7, 21, 42.

[b] p refers to exact probabilities in a multiple regression model.

associated with better tone ($p = 0.046$). At three weeks the infants of multiparous mothers were more alert ($p = 0.040$).

During labour a longer 1st stage was associated with better habituation to a bell on day 3 ($p = 0.19$) and to a rattle on day 7 ($p = 0.021$), as well as with higher animate visual and auditory scores ($p = 0.028$) and fewer startles ($p = 0.032$) on day 21. A long 2nd stage of labour, however, conferred neither advantage nor disadvantage on behaviour. Greater amounts of syntocinon were associated with poor truncal tone on day 7 ($p = 0.019$) and lower pull-to-sit scores on day 42 ($p = 0.048$).

The use of lift-out forceps was related to <u>better</u> behaviour: firm tone on day 7 ($p = 0.01$) and greater alertness on day 21 ($p = 0.039$). Mid-cavity forceps, however, was related to a cluster of state control measures, particularly on days 7 and 21. These were poor habituation to a rattle on day 7 ($p = 0.015$), and greater irritability ($p = 0.051$), overall crying ($p = 0.051$), and difficulties in self-quieting ($p = 0.014$) on day 21. As with lift-out forceps the use of mid-cavity forceps was again associated with better elicited tone on day 7 (pull-to-sit $p = 0.021$) and truncal tone on day 21 ($p = 0.021$).

The only effect of resuscitation was a relationship between the use of oxygen and more startles on day 1 ($p = 0.026$). Infants who were in poor condition at delivery, as reflected in the 1 minute Apgar score, demonstrated better animate visual and auditory tracking on day 7 ($p = 0.021$), but less head control in a sitting position on day 42 ($p = 0.048$). The 5 minute Apgar score was not predictive of later behaviour.

These results are not a very convincing argument for the importance of medical procedures in determining later infant behaviour. Only 6 negative effects were discernible with regard to events during labour or delivery, and these effects were not always consistent. Syntocinon seemed to affect state control and muscle co-ordination in the delivery room (see Section IV. C.2.) and was also related to poor tone on days 7 and 42. Supplementary oxygen was associated with lethargy immediately after birth - including more time asleep and few startles - but with more startles on day 1. The use of forceps was just as often associated with improved behaviour as with problems, apart from behaviour in the delivery room. It is also difficult to understand why the consequences of obstetric intervention should be at their greatest after the first week, rather than in the first few days following delivery.

F. The Effect Of Maternal Medication On BNBAS Scores

1. Between-Groups Analysis

With obstetric variables controlled, regression analyses for the presence or absence of pethidine or bupivacaine revealed no behavioural differences on days 1, 7, 21, and 42. On day 3 infants in the pethidine group were less able to habituate ("tune out") the repeated ringing of a bell ($p < 0.05$) compared with the control group. This is less than one would expect by chance with 26 items on five separate occasions going into the analysis.

2. Within-Groups Results: Pethidine

The results for this group are presented in Table V.10.

Table V.10 BRAZELTON ASSESSMENT ITEMS ON WHICH SCORES DETERIORATED (OR IMPROVED) WITH INCREASES IN MEASURES OF PETHIDINE

BRAZELTON ASSESSMENT ITEM	DAY 1 Dose	DAY 1 CBC	DAY 1 $t_{\frac{1}{2}}$	DAY 1 Exp.	DAY 3 Dose	DAY 3 CBC	DAY 3 $t_{\frac{1}{2}}$	DAY 3 Exp.	DAY 7 Dose	DAY 7 CBC	DAY 7 $t_{\frac{1}{2}}$	DAY 7 Exp.	DAY 21 Dose	DAY 21 CBC	DAY 21 $t_{\frac{1}{2}}$	DAY 21 Exp	DAY 42 Dose	DAY 42 CBC	DAY 42 $t_{\frac{1}{2}}$	DAY 42 Exp.
Attention and Social Responsiveness																				
Inanimate Visual		***			*		*		*											
Inanimate Auditory									*											
Animate Visual		*																		***
Animate Auditory												*								
Animate Vis.+Aud.		*																		
Alertness		**							**	(*)		*				***				***
Consolability												*	*			*				*
Muscle Tone and Motor Organisation																				
Tonus												*								
Pull-to-Sit							*													
Defensive Movements		*				(***)	(**)									**				*
Activity												***								
Hand to Mouth				**		**	(**)	***									**			
Controlling State of Consciousness																				
Peak of Excitement												**	*			*				*
Lability of States													*							*
Self-quieting							**						*			**				***

* $p \leq 0.05$
** $p \leq 0.01$
*** $p \leq 0.001$

Dose = Total maternal dose
CBC = Umbilical cord blood concentration
$t_{\frac{1}{2}}$ = Half-life of the drug
Exp. = Drug exposure

a. Attention and social responsiveness

The infant's level of attention and social responsiveness, as measured by six of the BNBAS scores, was adversely affected throughout the six weeks. Poor visual tracking of an inanimate object on day 3 was related to high maternal dose ($p < 0.05$) and longer drug exposure time ($p < 0.05$), and on day 7 to higher dose only ($p < 0.05$). Visual responses to a face (animate) were unaffected until the sixth week, when poor scores were highly correlated ($p < 0.001$) with neonatal exposure.

Both inanimate and animate auditory skills were depressed at 7 days, but poor turning to a rattle was associated with high maternal dose ($p < 0.05$), while not turning to a human voice was associated with high neonatal exposure ($p < 0.05$).

There was a significant depressive effect of medication on alertness on days 7, 21 and 42. On all three occasions there was an association with neonatal exposure ($p < 0.05$; $p < 0.001$; $p < 0.001$). On day 7 low scores were also predicted by larger maternal doses of pethidine. On days 7, 21, and 42 the consolability scores worsened with increases in pethidine exposure (all $p < 0.05$). A higher cord blood concentration on day 21 was also significantly correlated ($p < 0.05$) with difficulties in quieting the infant.

b. Muscle tone and motor organisation

All five items measuring muscle tone and motor organisation were found to be dependent on at least one of the drug variables on one or more occasions. The infant's elicited tone when pulled to sit was adversely affected on day 3 by pethidine exposure ($p < 0.05$). Greater exposure was also related to decreases in general tone ($p < 0.05$) and

activity ($p < 0.001$) on day 7. The infant's skill in getting his hands to, and into, his mouth was impaired in relation to pethidine exposure on days 1 ($p < 0.01$) and 3 ($p < 0.001$) and to cord blood concentrations on days 3 ($p < 0.01$) and 42 ($p < 0.01$).

Defensive movements to remove a cloth from the face were inconsistently affected. Infants in whom drug exposure was high made fewer and/or less well-directed movements on days 21 ($p < 0.01$) and 42 ($p < 0.05$), but increased cord blood concentration appeared to relate to improved responses on day 3 ($p < 0.001$).

c. Capacity for controlling states of consciousness

The infant's state control was found to be less dependent on the drug measures, with scores on only three of the eight relevant items being significantly impaired. The effects observed occurred mainly at three and six weeks. Infants with high pethidine exposure were more likely to cry when handled (Peak-of-Excitement) on days 7 ($p < 0.01$), 21 ($p < 0.05$), and 42 ($p < 0.05$). On day 21 a worse peak-of-excitement score was associated with higher cord blood concentrations ($p < 0.05$). Similarly, drug exposure reduced the infant's skill at quieting himself once aroused on days 3 ($p < 0.01$), 21 ($p < 0.01$), and 42 ($p < 0.001$). Increased lability of state was associated on day 21 with high cord blood concentrations ($p < 0.05$) and on day 42 with greater pethidine exposure ($p < 0.05$). There was no effect on the number of stimuli cried to (Irritability), the number of procedures performed before the infant became distressed (Rapidity-of-Buildup), or the three habituation items (to a light, rattle, and bell).

d. Physiological responses to stress

Drug measures were unrelated to the number of startles or the amount of tremulousness exhibited by the infant during the test.

e. Discussion

The influence of maternal analgesia during delivery on neonatal behaviour is not easy to examine, even in a carefully controlled study, because of the difficulties involved in finding a single measure which combines both the concentration of the drug in the baby and the duration of his exposure. For this reason, total maternal dose, umbilical cord blood concentration and neonatal blood elimination half-life were used together as independent drug variables in the set of analyses. The results indicate that neonatal behaviour is dependent to some extent on all of the measures chosen. Peak effects were observed on and after day 7, particularly in relation to drug exposure, which is probably the most sensitive of the variables used.

Looking back to the data collected immediately after birth, higher cord blood levels of pethidine, as well as greater exposure in utero, were associated with babies who were more prone to respiratory difficulties, and who remained in the cot in a drowsy and unresponsive state. High total dosage caused the mother to spend less time interacting with her infant, but it is difficult to determine the reasons for this. It could be due to the sedative effect of the drug on either the mother or the baby. Alternatively, the mother might have been less interested in her infant because factors associated with a higher dose, such as longer labour, led to her being more exhausted at the end of it.

It is of considerable interest that no relationship could be established between performance by the baby on these BNBAS items in the first hour and the measures of pethidine. This suggests that when the infant is aroused to an optimal alert state by the testing psychologist, his orientation skills and tone are not impaired by the degree of medication induced in this study. Brazelton (1961) suggests that birth itself may sufficiently stimulate the infant to cope with events in the first few hours, but that in the following period behavioural organisation may temporarily disintegrate. The "drugged" infant would take longer to recover from such disorganisation. This theory was apparently upheld in the cohort under study, with a longer half-life and/or greater exposure to pethidine reducing attentiveness to visual stimuli on the first day, and dampening alertness over the first six weeks.

At three and six weeks, the infant whose cord blood concentration or exposure to pethidine had been high tended to change state more frequently, to cry during the test, and to be less adept at self-quieting, or unresponsive to the adult's attempts to console him. This in turn is likely to make it more difficult for the mother to interpret the infant's needs, and may render him less accessible to interesting stimuli which might maintain an alert state. The reduced vigour and skill in removing an occluding cloth (defensive movements) probably has little to do with potential growth and development or eliciting optimal care-giving, but decreased hand-to-mouth behaviour may impair the infant's ability to console himself and thus lead to increased crying.

It seemed possible that the delay of approximately a week before many of the drug effects became apparent could be due to their having been masked previously by some predominant factor or factors. For example, if all infants in the pethidine group had been sleepy and unresponsive on days 1 and 3, the effects of differing drug levels would have been revealed only when infants with high exposure failed to become alert at the same time as those with low exposure. Alternatively, it seems reasonable to suggest that labour and delivery factors could have had more influence than pethidine levels on infant behaviour during the first week, but that their effects were of shorter duration than those of the drug. However, closer examination of the data failed to produce any such explanation of the delay.

3. Within-Groups Results: Bupivacaine

These results are presented in Table V.11.

a. Orientation and Social Responsiveness

The infant's visual tracking of an object was impaired on days 1 ($p < 0.001$), 7 ($p < 0.01$), 21 ($p < 0.05$), and 42 ($p < 0.05$). Long bupivacaine exposure was associated with poorer scores on days 7 ($p < 0.001$) and 42 ($p < 0.01$). Poor animate visual scores were correlated with high delivery cord blood concentrations on day 1 ($p < 0.05$) and 42 ($p < 0.001$), and with longer exposure on the same two days ($p < 0.001$; $p < 0.01$). The same relationship was also found for visual following of the examiner's face while talking (Animate Visual and Auditory) on days 1 and 42: high cord blood concentrations ($p < 0.05$; $p < 0.01$) and also long exposure times ($p < 0.01$; $p < 0.05$) predicting poorer responses.

Table V.11 BRAZELTON ASSESSMENT ITEMS ON WHICH SCORES DETERIORATED (OR IMPROVED) WITH INCREASES IN MEASURES OF BUPIVACAINE

BRAZELTON ASSESSMENT ITEM	DAY 1 Dose[a]	CBC[b]	$t_{\frac{1}{2}}$[c]	Exp.[d]	DAY 3 Dose	CBC	$t_{\frac{1}{2}}$	Exp.	DAY 7 Dose	CBC	$t_{\frac{1}{2}}$	Exp.	DAY 21 Dose	CBC	$t_{\frac{1}{2}}$	Exp.	DAY 42 Dose	CBC	$t_{\frac{1}{2}}$	Exp.
Attention and Social Responsiveness																				
Inanimate Visual	(**)	***								**	**	***		*				*		**
Inanimate Auditory						*		*				***								
Animate Visual		*		***											*			***		**
Animate Auditory										*										
Animate Vis.+Aud.		*		**					*						*			**		*
Alertness	(***)	***		***														**		*
Muscle Tone and Motor Organisation																				
Tonus			*					(***)		*										
Pull-to-Sit								(**)		(*)		(***)								
Defensive Movements		**		***		*		***		**		**								
Activity										*					*		*			
Hand to Mouth	*		*																	
Controlling State of Consciousness																				
Peak of Excitement																				*
Build up to Crying						*														
Irritability						*		***						(*)						
Lability of States				***		***		***												
Self-quieting								*												**
Physiological Response to Stress																				
Tremor				*						*		*		*						***
Startles						*		*								*	*			**

* $p \leq 0.05$
** $p \leq 0.01$
*** $p \leq 0.001$

a Dose = Total maternal dose
b CBC = Umbilical cord blood concentration
c $t_{\frac{1}{2}}$ = Half-life of the drug
d Exp.= Drug exposure

Decreased turning to the sound of a rattle on day 3 was associated with high cord blood bupivacaine concentrations ($p < 0.05$), and with exposure on days 3 ($p < 0.05$) and 7 ($p < 0.001$). Turning to the sound of a voice was only depressed by high cord levels, and only on day 7 ($p < 0.05$). The infants in the bupivacaine group were quite significantly less alert on day 1 in relation to high cord blood concentrations ($p < 0.001$) and exposure ($p < 0.001$). To a lesser extent this was still true at 6 weeks for those who had had high cord blood levels ($p < 0.01$) or greater exposure to bupivacaine ($p < 0.05$).

b. Muscle tone and motor organisation

Quite surprisingly, and in contrast to the reports in the literature (Tronick et al, 1976), muscle tone appeared to improve with increases in bupivacaine levels. Greater exposure to the drug resulted in better general tone on day 3 ($p < 0.001$), although cord blood concentration was inversely correlated ($p < 0.05$) on day 7. The infant's head and shoulder control when pulled-to-sit was significantly better with greater exposure on days 3 ($p < 0.01$) and 7 ($p < 0.001$), and on day 7 ($p < 0.05$) in relation to higher delivery cord blood concentrations.

However, other aspects of motor organisation were impaired by bupivacaine for at least one measure on every testing occasion. Infants who had had high cord blood concentrations were less successful in removing a cloth from their face (Defensive Movements) on days 1 ($p < 0.01$), 3 ($p < 0.05$) and 7 ($p < 0.01$). The same effect was significant for greater exposure, also on days 1 ($p < 0.001$), 3 ($p < 0.001$), and 7 ($p < 0.01$). Infants were less active in relation to high cord blood concentrations ($p < 0.05$), on day 7, greater exposure

on day 21 ($p < 0.05$) and high maternal dose on day 42 ($p < 0.05$). The infant's hand-to-mouth behaviour was impaired only on day 1, by total maternal dose ($p < 0.05$).

c. Capacity for controlling states of consciousness

Associations between drug levels and reductions in the infant's ability to control his own state were observed mainly on day 3, although scores on two items were still affected at six weeks. On day 3, infants whose cord blood concentration had been higher were likely to become distressed sooner (Rapidity of Build-up) during the test ($p < 0.05$), cry to more stimuli (Irritability) ($p < 0.05$), and change state more often ($p < 0.001$). There was also a direct association between bupivacaine exposure and greater state lability on days 1 ($p < 0.001$) and 3 ($p < 0.001$), and increased irritability to stimuli on day 3 ($p < 0.001$). High exposure levels also impaired the infant's ability to quiet himself on days 3 ($p < 0.05$) and 42 ($p < 0.01$), and his ability to maintain a quiet state when handled (Peak of Excitement) on day 42 ($p < 0.05$).

As in the pethidine group there were no associations between any of the three habituation measures (light, rattle, bell) and drug levels.

d. Physiological response to stress

Both items measuring physiological response to stress showed adverse drug effects throughout the six week period. Drug exposure was associated with increased tremulousness on days 1 ($p < 0.05$), 7 ($p < 0.05$), and 42 ($p < 0.001$), and more startles on days 3 ($p < 0.05$), 21 ($p < 0.05$), and 42 ($p < 0.01$). High cord blood concentrations were related to more startles on day 3 ($p < 0.05$) and tremor on day 7 ($p < 0.05$). A greater maternal dose of bupivacaine predicted tremulousness on day 21 ($p < 0.05$) and startles on day 42 ($p < 0.05$).

e. Discussion

The behavioural findings for infants whose mothers received bupivacaine are more easily interpreted than those for pethidine. Maximum effects of drug levels were observed on day 1. For some items these effects decreased with time, but in many cases they were still evident on the last assessment at six weeks. The most sensitive indicators of drug-related behavioural impairment were umbilical cord blood concentration and exposure; the total maternal dose only predicted five differences.

In the period immediately after delivery, those infants with a greater exposure to bupivacaine were apt to be cyanotic and unresponsive to the environment, although in fact they cried and opened their eyes earlier. There was no reduction in maternal interest towards these babies, nor were they at any disadvantage in performance on the Brazelton items in the first hour.

However, later on the first day visual skills and alertness were substantially depressed and these effects persisted over the next six weeks. It may be that an infant whose attention and social responsiveness are consistently dampened is missing opportunities to learn from his environment and interact with his caregivers. Because these infants also seemed less able to modify their states in the first few days, and to cry easily and often when tested on day 3, a mother might find such behaviour trying and unrewarding, and in turn be less likely to interact with him. (Murray et al, 1981) has shown that the mother's own scoring of her infant's interactive ability at one month was "saturated" with every aspect of her baby's behaviour from the first day. Thus the mother's encounters with a disorganised infant may build up a false picture which interferes with the development of a satisfactory relationship (Brazelton, 1971).

The findings in relation to tone and motor control cannot really be explained, although Scanlon et al, (1976) did not find any deleterious effects of bupivacaine on motor power and organisation using his own assessment. Because this scale runs from "hypotonic" to "hypertonic" with optimal, well-modulated movements in the mid-point, it may be that high scores reflected marginal increases in muscle tension. This would fit well with the more intense, irritable behaviour on day 3, particularly if they were actually crying while tone was being assessed. It would not, however, explain the continuance of "increased" tone on day 7 when the infants were no longer significantly more difficult to test.

4. Relationship Between Time Of Administration And Subsequent Behaviour

One of the implicit aims of this study of medication was to determine when a given drug could be administered to maximise maternal comfort while minimising fetal risk. The dose-related measures - maternal dose, cord blood concentration, $t_{\frac{1}{2}}$, and exposure curve - each measured one aspect of the pharmacokinetics of both pethidine and bupivacaine. However, it was still essential to relate the time of administration to behavioural effects. This was accomplished by correlating the obstetric measures with the length of time from first dose to delivery (TFD) and with length of time from last dose to delivery (TLD). Then these same two measures were correlated with the delivery and Brazelton scores. Pearson's "r" were used where data satisfied parametric requirements, otherwise Spearman's Rank correlations were computed. The analyses were done separately for each drug group just as with the previous multiple regression analyses performed within groups.

a. Pethidine: dose-delivery interval

The relationship between dose-delivery interval and obstetric factors is shown in Table V.12. A mother was significantly more likely to receive pethidine early in labour if she was primiparous ($p = 0.001$), and received a greater amount of syntocinon ($p = 0.027$) for the induction or acceleration of labour. An early initial dose of pethidine was also associated with a longer first stage ($p = 0.001$) and second stage of labour ($p = 0.001$), although this does not answer the question of whether the prospect of a long or painful labour determines early administration of drugs (i.e. because of induction perhaps), or whether pethidine actually lengthens the labour.

Primiparae also received their last dose of pethidine earlier in labour ($p = 0.001$), as did those patients with a long first ($p = 0.046$) and second stage of labour ($p = 0.001$). This means that they may have actually delivered the infant without the benefit of continuous pain relief.

There were a number of associations between an early first and/or last dose of pethidine and behaviour just after birth. These results are presented in Table V.13. Generally, the later in labour that a mother received pethidine (first and last dose) the greater the impairment to infant behaviour. For instance, pethidine close to delivery was associated with less time with eyes open (TFD $p = 0.016$; TLD $p = 0.035$) and more blinking (TFD $p = 0.018$; TLD $p = 0.034$), at the expense of focussing or scanning. More time was spent crying (TFD $p = 0.008$; TLD $p = 0.014$), and the infant was more likely to cry to aversive stimuli (TFD $p = 0.001$; TLD $p = 0.012$). State changes were also more frequent with later doses (TFD $p = 0.006$; TLD $p = 0.022$).

Table V.12 RELATIONSHIP BETWEEN OBSTETRIC FACTORS AND TIME FROM FIRST DOSE TO DELIVERY (TFD), AND TIME FROM LAST DOSE (TLD) TO DELIVERY, OF PETHIDINE

	TFD		TLD	
	r[a]	p=	r[a]	p=
Parity	-0.494[b]	0.001	-0.519[b]	0.001
Syntocinon	0.274	0.027	--	--
Length first stage labour	0.627	0.001	0.406	0.002
Length second stage labour	0.568	0.001	0.550	0.001

[a] r = Pearson's r unless specified

[b] = r in this case refers to Spearman's rho, because parity was put in as primip/multip only.

Table V.13 RELATIONSHIP BETWEEN NEWBORN BEHAVIOUR IMMEDIATELY AFTER DELIVERY AND TIME FROM FIRST DOSE TO DELIVERY (TFD), AND WITH TIME FROM LAST DOSE TO DELIVERY (TLD), OF PETHIDINE

	TFD		TLD	
	r[a]	p=	r[a]	p=
Latency open eyes	-0.361	0.009	--	--
Intervals w/eyes open	0.316	0.016	0.270	0.035
Intervals blinking	-0.310	0.018	-0.272	0.034
"Rolling eyes"	0.468	0.006	--	--
Intervals hand-to-mouth	--	--	-0.296	0.023
Intervals actual sucking	--	--	-0.260	0.040
Intervals St. 6 (crying)	-0.352	0.008	-0.325	0.014
Lability of states	-0.370	0.006	-0.302	0.022
Reaction aversive stimuli	-0.447	0.001	-0.342	0.012
Tremor	--	--	0.258	0.044
Ease eliciting behaviour	0.273	0.042	0.270	0.044

[a] r = Pearson's r

Although timing of pethidine administration did not affect elicited visual and auditory skills, it was more difficult to elicit such behaviour when pethidine was given late in labour (TFD $p = 0.042$; TLD $p = 0.044$).

Although later first dose usually acted in the same way as late last dose, this was not always so. A delay in the infant's opening his eyes was only related to a later first dose ($p = 0.009$), as were inco-ordinated eye movements ($p = 0.006$). When the last dose was given close to delivery, the infant showed decreased tremor ($p = 0.044$), and increased swiping at his mouth ($p = 0.023$) and actually sucking on his fingers ($p = 0.04$). These last correlations seem inexplicable.

The relationship between timing of pethidine and behaviour after the first 24 hours is less clear than the effects at delivery itself as can be seen in Table V.14. Only a quarter of the correlations involve both first and last dose intervals, and only 4 are evident on day 1, where one would expect timing to be at its most salient. During the day 1 BNBAS poor habituation to a bell was related to later administration of both the first ($p = 0.019$) and last dose ($p = 0.009$). Habituation to a light and rattle were also impaired by late pethidine administration, although not always in any logical sequence of days, and sometimes in relation to first, and sometimes to last, dose.

Also on day 1, however, infants showed a more optimal level of activity with delayed administration of the first dose ($p = 0.028$) and last dose ($p = 0.001$), as well as more enhanced animate visual skills (TFD $p = 0.004$; TLD $p = 0.044$).

A later first dose also enhanced visual and auditory skills, improved tone, and reduced distress to stimuli, as well as improving self-quieting, and consolability, in several instances. Looking at it

Table V.14 RELATIONSHIP BETWEEN BNBAS SCORES ON DAYS 1-42 AND TIME FROM FIRST DOSE TO DELIVERY (TFD), AND TIME FROM LAST DOSE TO DELIVERY (TLD), OF PETHIDINE

		TFD		TLD	
		r[a]	p=	r[a]	p=
INANAUD	d.21	-0.392	0.004	-0.257	0.044
ANVIS	d. 1	--	--	-0.296	0.026
ANVIS	d.21	-0.251	0.048	--	--
ANVIS	d.42	-0.253	0.047	--	--
ANAUD	d. 7	-0.323	0.015	--	--
ALERT	d.21	-0.276	0.033	--	--
ALERT	d.42	-0.302	0.022	--	--
CONSOLE	d. 7	-0.257	0.042	--	--
TONE	d. 7	-0.278	0.031	--	--
TONE	d.21	-0.314	0.018	-0.393	0.004
TONE	d.42	-0.341	0.011	--	--
ACTIVITY	d. 1	-0.276	0.028	-0.423	0.001
HAND-MOUTH	d.42	--	--	-0.267	0.038
HABIT-L	d. 7	0.432	0.009	--	--
HABIT-R	d. 7	--	--	0.387	0.023
HABIT-R	d.42	0.722	0.034	--	--
HABIT-B	d. 1	0.479	0.019	0.537	0.009
HABIT-B	d. 3	--	--	0.437	0.024
PK-EXCITE	d.3	0.261	0.040	--	--
LAB-STATE	d.3	0.261	0.040	--	--
SELF-QUIET	d.21	-0.262	0.041	--	--
STARTLE	d. 1	-0.294	0.020	--	--
STARTLE	d. 3	--	--	-0.259	-0.041
STARTLE	d. 7	-0.281	0.031	-0.391	-0.004
STARTLE	d.42	--	--	-0.381	-0.005

a r = Pearson's r

the other way, it may be that an early first administration promoted a longer exposure to the drug, and thus impaired behaviour.

Startles were increased when pethidine was given close to delivery, but this generally only held true with either first or last dose, not both. The increased startles occurred on days 1, 3, 7, and 42.

b. Bupivacaine: dose-delivery interval

As with pethidine, early administration of bupivacaine was more likely in primiparae ($p = 0.001$) and with more syntocinon ($p = 0.001$), as can be seen in Table V.15. A longer first ($p = 0.001$) and second stage of labour ($p = 0.001$) were each associated with an earlier first dose of bupivacaine, as was delivery by forceps ($p = 0.001$).

There was no relationship between obstetric factors and timing of the last top-up of bupivacaine. Since there is a definite policy to avoid top-ups when the mother is nearly fully dilated (so that the mother retains enough feeling in her muscles to push the baby out without the aid of forceps), the timing may be governed by obstetric management considerations rather than characteristics of the mother.

There were fewer relationships between timing and behaviour in the epidural group than there were with pethidine (Table V.16.) The earlier the initial dose was given the sooner the infant opened his eyes ($p = 0.008$), the more time he spent crying ($p = 0.012$), and the less time he remained swaddled ($p = 0.036$). He was also more likely to evidence inco-ordinated eye movements ($p = 0.002$), a relationship which also held true with an earlier last dose of bupivacaine ($p = 0.001$). An early first dose produced a poorer Apgar at 5 minutes ($p = 0.018$).

Table V.15 RELATIONSHIP BETWEEN OBSTETRIC FACTORS AND TIME FROM FIRST DOSE TO DELIVERY (TFD), AND TIME FROM LAST DOSE TO DELIVERY (TLD), OF BUPIVACAINE

	TFD		TLD	
	r[a]	p=	r[a]	p=
Parity	-0.426[b]	0.001	--	--
Syntocinon	0.530	0.001	--	--
Length first stage labour	0.654	0.001	--	--
Length second stage labour	0.425	0.001	--	--
Forceps	0.481[b]	0.001	--	--
Apgar at 5 minutes	-0.277[b]	0.018		

[a] = Pearson's r unless specified

[b] = r in this case refers to Spearman's rho correlations because parity, forceps, and Apgar scores were coded as 1 or 2 only.

Table V.16 RELATIONSHIPS BETWEEN NEWBORN BEHAVIOUR IMMEDIATELY AFTER DELIVERY AND TIME FROM FIRST DOSE TO DELIVERY (TFD), AND WITH TIME FROM LAST DOSE TO DELIVERY (TLD), OF BUPIVACAINE

	TFD		TLD	
	r[a]	p=	r[a]	p=
Latency open eyes	-0.335	0.008	--	--
"Rolling eyes"	0.478	0.002	0.532	0.001
Intervals St.1-2 (sleep)	--	--	-0.258	0.031
Intervals St. 6 (crying)	0.310	0.012	--	--
Intervals in cot	--	--	0.296	0.016
Intervals swaddled	-0.250	0.036	--	--

[a] r = Pearson's r

When the last top-up occurred close to delivery (then) the infant was likely to spend more time in a sleep state in the delivery room ($p = 0.031$), but less time in the cot ($p = 0.016$). These results are inconsistent and do not seem to offer an advantage to giving bupivacaine early in labour as was true of pethidine.

The effects of timing on later behaviour can be seen in Table V.17. Initiating an epidural early in labour was related to poor scores on habituation to a light on day 7 ($p = 0.046$), day 21 ($p = 0.049$), and day 42 ($p = 0.039$), but not on habituation to either rattle or bell. Giving the last dose of bupivacaine early, however, improved habituation to light on day 7 ($p = 0.032$). An early first dose seemed to offer an advantage in improved tone ($p = 0.031$) and activity ($p = 0.004$) on day 1, but to increase the amount of tremulousness on day 21 ($p = 0.048$).

Giving the last dose of bupivacaine some time before delivery did not seem to offer many advantages to newborn recovery and behaviour. The earlier the last dose the poorer were the infant's orientation scores to an inanimate object on day 21 ($p = 0.049$), and to the sound of a rattle on day 42 ($p = 0.043$), as well as his ability to habituate to a rattle on day 21 ($p = 0.02$). But on day 42 he was more likely to be alert if the last dose had been given early in labour ($p = 0.032$). In terms of state control, the earlier the last dose of bupivacaine the earlier the infant cried during the test ($p = 0.045$), and the more frequently he changed states ($p = 0.022$).

Not only are there fewer relationships between dose-delivery interval and behaviour in the epidural group, but most of the results are only significant in relationship to BNBAS scores after the first week.

Table V.17 RELATIONSHIPS BETWEEN BNBAS SCORES ON DAYS 1-42 AND TIME FROM FIRST DOSE TO DELIVERY (TFD) AND WITH TIME FROM LAST DOSE TO DELIVERY (TLD), OF BUPIVACAINE

		TFD		TLD	
		r[a]	p=	r[a]	p=
INANVIS	d.21	--	--	-0.230	0.049
ANAUD	d.42	--	--	-0.250	0.043
ALERT	d.42	--	--	0.269	0.032
TONE	d. 1	0.263	0.031	--	--
ACTIVE	d. 1	0.363	0.004	--	--
HAB-L	d. 7	-0.324	0.046	0.354	0.032
HAB-L	d.21	-0.390	0.049	--	--
HAB-L	d.42	-0.415	0.039	--	--
HAB-R	d.21	--	--	-0.623	0.020
RAP-BUILD-UP	d.21	--	--	0.235	0.045
LAB-STATE	d.21	--	--	0.277	0.022
TREMOR	d.21	0.230	0.048	--	--

[a] r = Pearson's r

Therefore it seems that less attention should be given to them, as one would expect such effects to peak in the first week and then decrease, rather than the other way around.

G. The Effect Of Jaundice On Newborn Behaviour

1. Studies In The Literature

Several reports have suggested a relationship between physiological jaundice of the newborn (hyperbilirubinaemia) and alterations in infant behaviour. Telzrow, Snyder, Tronick, Als and Brazelton (1980) found decreased social responsiveness on the BNBAS in jaundiced infants at 3 days of age (before the decision to treat with phototherapy), which persisted during treatment and was still evident at 10 days. In their study it was not possible to separate the effects of jaundice and phototherapy, or the contributions of consequential changes in care-taking, such as separation of mother and infant, reduced maternal feeding of infant, eye patches on the infant, and the absence of swaddling when under the phototherapy lights.

Moderate hyperbilirubinaemia has also been found to alter newborn sleep patterns, significantly reducing awake time, and increasing the amount of time in State 2 sleep epochs (Prechtl, Theorell and Blair, 1973). Using data from the Perinatal Collaborative Study of infants born between 1959 and 1965, one group of researchers has shown correlations between increasing levels of hyperbilirubinaemia (10-20 mg/100 ml) and decreased motor scores on the Bayley Scale at eight months and one year of age (Boggs, Hardy and Frazier, 1967; Scheidt, Mellits, Hardy, Drage and Boggs, 1977). Disorders of hormonal rhythms in infants receiving phototherapy were found by Dacou-Voutetakis, Anagnostakis and Maisanioiis (1978), in relation to a control group who were jaundiced and blindfolded, but not undergoing phototherapy.

2. The Assessment Of Jaundice In This Study

We were prompted to look at the effects of jaundice in our group of infants by two findings. Firstly, in this study there was a fairly consistent relationship between particular obstetric interventions, notably syntocinon, and the development of jaundice in the first week (see next section). Secondly, data from an early pilot group of infants suggested that infants who were significantly jaundiced were less alert and responsive, while those with minor jaundice were at no disadvantage. We hoped to shed further light on this with larger numbers of infants.

However, a comprehensive investigation of neonatal jaundice was not intended in the present study, and certain limitations of the procedures and method of analysis warrant caution in interpreting the findings. The decision as to whether the infant was jaundiced rested with the clinical judgment of the psychologist who carried out the BNBAS on days 1, 3, or 7. On the BNBAS coding form the psychologist rated each infant for jaundice as 1 = not present, 2 = mild, or 3 = significantly jaundiced, serum bilirubin $>$ 10 mg/100 ml (205 mol/1). In practice, infants were usually noted to be mildly jaundiced if they were "yellow", in which case the paediatric house staff were notified. It was then up to the paediatrician to obtain a serum bilirubin level if he or she felt it necessary. "Clinically significant" jaundice was marked when it was known that the S.B. $>$ 10, and/or the infant was receiving phototherapy.

However, since S.B. levels are usually at their peak on day 4 it was quite possible that an infant would appear to be fine at the time of testing on day 3 and not come to the attention of the medical/ nursing staff until the day following our assessment. In that case

the infant's jaundice may also have faded by day 7 testing, and for our purposes he would not have been jaundiced. Thus our figures are likely to be an underestimate of the true number of infants in the cohort who became jaundiced.

The proportion of infants falling into each category on days 1, 3, and 7 is presented in Table V.18. (The serum bilirubin levels of those infants who had blood samples taken is presented in Table V.21 and will be discussed in Section G.5). It can be seen that infants were most likely to be jaundiced on day 3 when, by our criteria, 34% of the infants tested were mildly or significantly jaundiced. By day 7 this figure was 20% and those evidencing jaundice of clinical significance had fallen from 7% on day 3 to 4% on day 7. These figures are difficult to compare with other studies because of our "early" sampling. However, reported rates are very variable, ranging from 8.6 (taking 13 mg/100 ml: Jeffares, 1977) to 32.5% (> 10 mg: Calder, Ounsted, Moar and Turnbull, 1974). Jaundice can (eventually) clear spontaneously but was usually treated with phototherapy at levels above 10 mg in our unit during the period of the study. Since we do not have accurate figures for the numbers of babies receiving phototherapy in the sample, it is not possible to assess the significance of this change from day 3 to day 7.

3. Obstetric Practice And Neonatal Jaundice

Many studies have highlighted maternal and physiological factors as causes of neonatal jaundice. They include breast feeding (Newman and Gross, 1963), oral contraception (Wong and Wood, 1971), and vitamin K analogues (Lancet Leader, 1962). More recently it has been concluded that some aspects of the "active management" of labour - particularly

Table V.18 FREQUENCY OF JAUNDICE IN THE STUDY POPULATION WHEN ASSESSED WITH THE BNBAS ON DAYS 1, 3, AND 7.

	day 1		day 3		day 7	
JAUNDICE	N	%	N	%	N	%
None	119	91	86	66	102	80
Mild	11	8	35	27	20	16
Significant[a]	1	1	9	7	5	4
Not tested on that day	14	-	15	-	18	-
N =	145	100	145	100	145	100

[a] Serum bilirubin level >10 mg/100 ml = > 205 mol/l

induction - might contribute to higher serum bilirubin levels in the first week. Calder (1974) investigated 120 primigravidas who either started labour spontaneously, or had their labour induced by intravenous oxytocin, intravenous prostaglandin E_2, or extra-amniotic prostaglandin E_2. Significantly higher serum bilirubin levels on day 5 were found in the groups who were induced and given intravenous agents than in the spontaneous onset and extra-amniotic route group. The paper concluded that neonatal hyperbilirubinaemia is more likely due to the artificial interruption of pregnancy than the drugs themselves, but it was also noted that 6/7 infants whose mothers received both intravenous and extra-amniotic prostaglandin were jaundiced. In a much larger study of 981 infants Jeffares (1977) found a highly significant association between increased oxytocin dosage ("medium" or "high" doses) and jaundice in induced labour, but not in augmented labours, also implying that the "induction" itself is partly responsible. He considered that a dose of about 20 mU/minute is required before the effect is apparent. Others have also confirmed a relationship with dose (Chalmers, Campbell and Turnbull, 1975; Sims and Neligan, 1975).

Spearman's rho correlations were performed on the present data, as jaundice was assessed on a 3-point rating scale. Seven obstetric factors were significantly correlated with the jaundice apparent on days 1, 3, or 7 (Table V.19). There was an association between an induced onset of labour and increased jaundice on day 3 ($p < 0.05$). The higher the mean maximum infusion rate of syntocinon, the greater was the likelihood of jaundice on day 1 ($p < 0.005$), day 3 ($p < 0.05$), and almost still on day 7.

Table V.19 THE RELATIONSHIP BETWEEN OBSTETRIC FACTORS AND PHYSIOLOGICAL JAUNDICE OF THE NEWBORN ON DAYS 1, 3, AND 7 (SPEARMAN'S RHO)

Jaundice on	day 1	day 3	day 7
	rho	rho	rho
Induction	-	0.17^{*}	-
Syntocinon (mmu)	0.24^{***}	0.18^{*}	0.13^{o}
Parity	-	-0.16^{*}	-0.25^{***}
Length 1st stage	0.31^{****}	-	-
Length 2nd stage	0.17^{*}	-	0.23^{***}
Intervals Resuscitation	0.18^{*}	-	-
Mean Blood Pressure	-0.20^{*}	-	-
Maternal Dose Drug	$0.28^{*}a$		
$t_{\frac{1}{2}}$	$0.27^{*}a$	$0.20^{o}a$	

^{o} $0.05 < p < 0.1$

* $p < 0.05$

** $p < 0.01$

*** $p < 0.005$

**** $p < 0.001$

^{a} = Epidural (bupivacaine) group only

However, there were also delivery factors related to jaundice, which are themselves bound up with the use of syntocinon. Firstborn infants were more likely to be jaundiced on day 3 ($p < 0.05$) and day 7 ($p < 0.005$). A longer first stage of labour was associated with early jaundice, i.e. within 24 hours ($p < 0.001$), as was a longer second stage correlated with jaundice on day 1 ($p < 0.05$), and day 7 ($p < 0.005$). There was no relationship between jaundice and maternal age, social class, forceps delivery, Apgar at 1 or 5 minutes, or type of resuscitation for respiratory problems.

Infants who required longer periods of resuscitation in the delivery room were more likely to be jaundiced within the first 24 hours ($p < 0.05$). But higher maternal blood pressure seemed to "protect" against jaundice in the first day ($p < 0.05$).

When the drug groups were examined separately, there was an association between a longer half life of bupivacaine and jaundice on day 1 ($p < 0.05$), and, almost significantly ($0.05 < p < 0.1$) on day 3. High maternal dose of bupivacaine was related to jaundice on day 1 ($p < 0.05$). There were no dose-related effects evident for pethidine.

These figures do seem to confirm reports in the literature that induction and jaundice are related and that there is a dose-related effect of syntocinon. Although Friedman and Sachtleben (1976) suggested that "hidden bruising" due to forceps delivery may influence jaundice rates, our data supports Jeffares (1977) in not finding a significant relationship between instrumental deliveries and jaundice.

4. Behavioural Effects In The First Week

One-way ANOVA's were calculated for BNBAS scores on days 3 and 7. As can be seen in Table V.20, on day 3 there were three significant differences and two non-significant trends; no comparisons were

Table V.20 EFFECTS OF JAUNDICE ON BNBAS SCORES ON DAY 3

	None	"Mild"	Clinically Significant	ANOVA F	ANOVA p <
INANVIS (S.D.)	5.43 (2.04)	5.77 (1.73)	4.11 (2.20)	2.47	0.1
ANVIS (S.D.)	5.42 (1.62)	5.63 (1.36)	4.11 (1.69)	3.37	0.05
ANVISAUD (S.D.)	5.84 (1.59)	5.91 (1.44)	4.22 (2.54)	4.17	0.02
TONE (S.D.)	5.46 (1.35)	4.57 (1.38)	5.67 (1.65)	5.68	0.005
PK-EXCITE (S.D.)	6.24 (1.29)	5.60 (1.50)	5.78 (1.92)	2.82	0.1
N =	86	35	9		

significant on day 7. Visual behaviour was impaired in the case of infants with significant clinical jaundice, but mild jaundice actually bettered orientation scores. There was no effect of jaundice on auditory perception. There was also a difference between the three groups on general tone, with the mildly jaundiced babies being flaccid, while the more jaundiced infants were not affected. Mildly jaundiced infants were slightly less excitable, but this effect was not significant.

It is of note that the nine clinically jaundiced infants represented a greater range of scores than the other two groups. This suggests that although some infants may have demonstrated very depressed behaviour, others would not have been affected at all.

5. "Sampling" Problems

Since As the results of this post-hoc analysis were rather confusing, it would have been interesting to establish whether there was a direct relationship between serum bilirubin (S.B.) levels and behaviour. Computer printouts were obtained for all infants, which included the rating for jaundice on the day 3 BNBAS, the infant's age in hours at that assessment, scores for BNBAS items shown to distinguish the groups (as above) and the S.B. level recorded in the notes. It became clear that more detailed analysis of all the subjects would have been futile, since 27 out of the 35 subjects with a rating of "2" (mild jaundice) and 5 of those 9 with "3" (clinically significant jaundice) had not had their S.B. level measured. And yet, 4 infants that we had not considered as showing signs of jaundice were sampled. (The time of the sample (i.e. age in hours) was not usually noted). These levels, and the range, are presented in Table V.21. There were also 4 S.B. levels

Table V.21 SERUM BILIRUBIN LEVELS RECORDED IN THE MEDICAL NOTES IN RELATION TO "JAUNDICE" STATUS ON THE DAY 3 BNBAS

	No. with heelpricks	Mean S.B.	Range S.B.	No. without blood sample
Jaundice Rated				
1	4	41.8	34-50	82
2	8	170.6	43-231	27
3	4	248.8	193-317	5
N =	16			114

reported for infants that were not tested on day 3: (152, 174, 287, 278); the 2 highest of these infants were under phototherapy on day 3 and therefore missed out because of their jaundice, but there is no indication as to why the others were not tested. Although there is some overlap between the categories, the S.B. group means are in line with what would be expected for mild jaundice versus that requiring treatment.

There are several possible explanations for the low number of S.B. measurements recorded in the notes on infants about whom we were "suspicious". Firstly, it may be that by the time a paediatrician was available to take a sample, the jaundice was "fading"; Or, if the result was negative it may not have been recorded in the notes. Thirdly, because the "Analgesia" study involved a number of heelpricks to analyse the disposition of pethidine and bupivacaine, many mothers (and doctors) objected to further "unnecessary" samples. An experienced paediatrician would probably be able to gauge those infants in whom jaundice was "resolving itself" and take heelpricks from the remaining few. It is still curious, though, that 5 babies who seemed "very" jaundiced to us were not evaluated; their range of ages at BNBAS testing (66 - 94 hours) does not clarify whether it might have been "fading" 4-day jaundice or not.

H. Sex Differences In BNBAS Scores

The sex of the infant seems such an obvious variable to look at that most of the child development literature of the 1960's analysed it as a matter of course. Differences were reported for diverse behaviours; for instances, newborn girls were more sensitive to tactile stimulation (Bell and Costello, 1964), "wetness" (Wolff, 1969) and

electric currents applied to the skin (Lipsitt and Levy, 1959), and showed a number of behaviours considered to represent "oral dominance" (Korner, 1969, 1972; Nisbett and Gurwitz, 1970). Surprisingly, however, few of the later studies of neonatal behavioural assessment scales looked at, or bothered to report, these characteristics. Freedman (1974) analysed sex differences on an early version of the BNBAS. He argued that the enhanced "viability" of the female of the species is also reflected in behaviour; newborn girls exhibit more mature reflexes, less startle and tremulousness, better orientation skills and alertness, and greater overall organisation.

In order to assess the effect of sex in this sample, ANOVA's were calculated on the BNBAS items for each day. Since it is possible that smaller size exerts an influence (Als et al, 1976) - and girls tend to be lighter - weight was entered as a covariate. For scores on days 1 and 3 birthweight was used, while for days 7, 21 and 42 we took an average of the recorded weights on days 5 and 7.[2]

Weight was significant as a covariate for 10 items, although it was not always the heavier babies who had the advantage. Only 2 items occurred more than once across the five assessments: animate auditory scores were better in small babies on days 1 and 7, while animate visual and auditory scores contradicted each other on days 21 and 42. The contribution of infant sex was even less convincing. Only 7 items reached significance - animate auditory, tone and consolability on day 7, activity, startle and tone on day 21, tremor on day 42 - fewer than would be expected by chance. Tone was significant in opposite directions on day 7 versus day 21 and there were no consistent effects in the data.

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[2] Babies were only weighed every other day.

We would conclude that for this sample sex of the baby does not seem to be responsible for differences in behaviour during the first six weeks. It has been pointed out that the majority of American studies are confounded by the practice of circumcision, the discomfort of which could alter responsiveness and increase problems in state control, irritability and consolability (Richards, Bernal and Brackbill, 1976). It is also notable that the few sex differences here occurred on day 7 or later. This argues against innate differences and for the maternal contribution in shaping such behaviour into stereotyped masculine/feminine traits.

VI NEUROLOGICAL STATUS AS DETERMINED BY THE PRECHTL NEUROLOGICAL EXAMINATION ON DAY 6

As discussed in the methodology section, the Prechtl Neurological Examination (Prechtl, 1969) (known as PNE) was administered by one of several trained paediatric registrars or housemen, according to the procedures set out by Prechtl in his manual. However, in order to provide a more simplified scoring system for our purposes, the form was modified into one that could be scored and computer-coded directly for analysis. A copy of our modified form appears in Appendix I .

The means and standard deviations for each of the categories on the PNE are presented in Table VI.1., by each drug group, and for all the infants tested. (It can be seen that only 94 infants were assessed on the PNE; this was due to difficulties in arranging paediatric cover for the study during a 3 month period). The most striking aspect of this data is how normal ("optimal" = 0) the infants were.

For instance, on Spontaneous Motor Activity Awake, most of the infants demonstrated a normal range of movements, of a symmetrical nature, and of medium intensity, speed and amount, with no athetoid postures or tremor. While asleep their resting posture was normal, and they showed few or no movements. Throughout the exam they generally showed good strong reflexes, whether prone, supine, or upright, and the resistance, power and range of movements were all fine. Those items in which there was minor deviation from optimal generally reflected hypotonicity or hypoactivity, rather than exaggerated movements or reflexes.

Table VI.1 SCORES FOR PRECHTL NEUROLOGICAL EXAMINATION ON DAY 6 [a]

	NO DRUG		PETHIDINE		EPIDURAL		TOTAL SAMPLE	
	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.
1. Spont.Motor Activ. Asleep (range 0-16)	0.20	0.45	0.50	1.04	0.74	1.48	0.57	1.21
2. Facial Feat. (0-13)	2.72	1.56	3.32	1.31	3.20	1.52	3.16	1.45
3. Activ. Awake (0-16)	3.11	2.29	3.14	2.51	3.18	2.20	3.15	2.32
4. Skin & Superf. Reflexes (0-12)	3.00	1.57	2.16	1.30	2.70	1.36	2.55	1.40
5. Eyes (0-17)	0.67	1.41	0.62	1.19	0.68	1.05	0.65	1.16
6. Motor:Resist. (0-16)	0.65	1.93	1.18	2.33	1.20	2.39	1.10	2.27
7. Motor:Power (0-16)	0.18	0.39	0.43	1.76	1.02	2.50	0.63	1.98
8. Motor:Range (0-20)	0.53	1.94	0.62	1.53	1.05	2.08	0.78	1.85
9. Reflexes and Responses (0-22)	4.76	1.52	4.92	2.41	5.69	2.45	5.21	2.31
10. Oral (0-11)	3.67	2.17	2.61	1.59	2.41	1.94	2.73	1.90
11. Moro Reflex (0-15)	4.00	2.11	4.03	2.50	4.65	2.21	4.29	2.31
12. Prone (0-15)	5.83	2.09	6.84	1.82	6.80	1.83	6.63	1.90
13. Upright (0-11)	0.89	1.32	0.81	1.49	0.81	1.45	0.83	1.43
14. Crying (0-3)	0.44	0.78	0.49	0.73	0.54	0.85	0.50	0.79
	N=18		N=37		N=39		N=94	

[a] Modified "Optimality" scoring: Optimal = 0

A. Neurological Performance: Between Groups Analysis And Within-Group Analysis Of Pethidine And Bupivacaine

When obstetric factors are controlled for in a regression design, the effect of maternal medication on neurological performance is minimal, as evidenced in Table VI.2. In an analysis between the three groups, the only significant effect was on a sub-category of behaviour, presenting as slightly exaggerated tendon reflexes. Here the presence of medication accounted for the exaggerated reflexes ($p < 0.05$), but neither pethidine or bupivacaine administration in particular was responsible.

When each drug group was examined separately in relation to dose, a greater amount of pethidine administered to the mother was associated with less activity when awake ($p < 0.05$), and infants who were slow to excrete or metabolise pethidine had a greater number of non-optimal "eye signs" ($p < 0.025$), consisting of a weaker blink response, or transitory sunset sign, nystagmus, or strabismus. Those infants who had high delivery cord levels of pethidine actually had a more appropriate activity level while asleep ($p < 0.025$). In the epidural group a longer half-life of bupivacaine was associated with exaggerated tendon reflexes ($p < 0.005$).

B. Neurological Performance: Obstetric Factors

There were no significant effects of social class, length of first stage of labour, mid-cavity forceps, Apgar scores at 1 and 5 minutes, or resuscitation by face mask. The six remaining relationships between obstetric factors and neurology are presented in Table VI.3. Of these, the crying items involved so few abnormal scores as to be meaningless.

Table VI.2 SIGNIFICANT RELATIONSHIPS BY REGRESSION ANALYSIS BETWEEN PRECHTL OPTIMALITY SCORES AND DRUG MEASURES

(obstetric variables held constant)

Independent	Dependent	Sig.	Effect
Use of maternal medication	Exaggerated tendon reflexes	$p < 0.05$	Use of drug w/ exaggerated reflexes
Pethidine group: cord level	Motor activity asleep	$p < 0.025$	High cord w/ optimal activity score
Pethidine group: neonatal half-life	Eyes	$p < 0.025$	Longer half-life w/ non-optimal eye signs
Pethidine: amount given to mother	Motor activity awake	$p < 0.05$	Greater amount w/ non-optimal score
Epidural group: neonatal half-life	Exaggerated tendon reflexes	$p < 0.005$	Longer half-life w/ exaggerated reflexes

Table VI.3 SIGNIFICANT RELATIONSHIPS BY REGRESSION ANALYSIS BETWEEN PRECHTL OPTIMALITY SCORES AND OBSTETRIC VARIABLES

(total sample)

Independent	Dependent	Sig.	Effect
Length 2nd stage labour	Prone movements and reflexes	$p < 0.05$	Longer labours w/ non-optimal score
Multiparae	Exaggerated tendon reflexes	$p < 0.025$	Second + born infants w/ non-optimal score
Maximum concentration syntocinon	Crying	$p < 0.05$	Greater syntocinon w/ more optimal score
Lift-out forceps	Skin and superficial reflexes	$p < 0.05$	Lift-out forceps w/ non-optimal score
Lift-out forceps	Crying	$p < 0.05$	Lift-out forceps w/ non-optimal score
Intubation plus Oxygen	Resistance to passive movement	$p < 0.05$	Intubation w/ less resistance

The remaining effects are reduced activity and tone in a prone position, associated with a longer second stage of labour ($p < 0.05$), exaggerated tendon reflexes in second+ born infants ($p < 0.025$), and less resistance to passive movements in association with having been intubated at delivery ($p < 0.05$). Outlet forceps (but not mid-cavity forceps) were associated with non-optimal skin and superficial reflexes (usually jaundice or weak abdominal or cremaster reflexes) ($p < 0.05$), and with longer or more intense periods of crying during the test ($p < 0.05$). A greater concentration of syntocinon for induction or augmentation was associated with a more optimal crying score, meaning less crying, and a more normal pitch of the cry; but, as mentioned earlier, there were very few abnormal scores on this item.

As with the analyses between and within drug groups, the number of significant items obtained is very small compared to the number of analyses performed. For the analysis of drug effects, there were 5 relationships with a probability of less than 0.05 out of almost one hundred calculations; while in the analysis of obstetric factors there were only 6 probabilities of less than 0.05 out of more than one hundred calculations. These are both less than would be expected by chance, and therefore such results should be interpreted with extreme caution.

C. The Relationship Between Behavioural And Neurological Status

Since the Brazelton assessments and the Prechtl neurological exam are designed to assess different kinds of infant behaviour, and were performed independently, we wondered if there would be any relationship between the items in each test. Some items, such as amount of crying to stimulation, tone when pulled to a sitting position, and so on, were

overtly tested in both exams, while many of the behaviours might be expected to depend on the integrity and maturity of the neurological system.

In order to probe these relationships, Pearson's product-moment correlations were performed on the PNE and items from the BNBAS from the assessments on days 3 and 7, as these were the nearest in time to the neurological assessment on day 6. The significant associations are presented in Tables VI.4, VI.5, and VI.6. The first table lists the tone items as assessed by the PNE in relation to all of the items scored during the Brazelton NBAS. Those infants regarded as having poor tone by the paediatrician administering the PNE (as reflected in hypoactivity, poor resistance to passive movements, and hypotonus in the prone or upright position), were also rated as having poor tone on the BNBAS, although the results were not always present on both adjacent days of testing.

It was surprising to find significant relationships between neurological assessment of tone, and non-tone items of the Brazelton test (Table VI.4). For instance, those infants who were inactive during the PNE had also demonstrated poor visual tracking on days 3 ($p < 0.05$) and day 7 ($p < 0.05$), and had also been less alert on the same days (d.3 $p < 0.05$; d.7 $p < 0.05$). Non-optimal activity awake was also associated with a cluster of state control items such as being difficult to console ($p < 0.05$) and likely to cry earlier to aversive stimuli ($p < 0.05$) and to achieve an insulated crying state ($p < 0.05$). There were non-significant trends toward greater number of state changes, poor self-quieting, and more crying to stimuli on day 3, and to cry earlier in the test, and remain crying on day 7.

Table VI.4 CORRELATIONS BETWEEN PRECHTL NEUROLOGICAL NON-OPTIMAL SCORES ON DAY 6 AND BRAZELTON ITEMS AT DAYS 3 AND 7 (Motor)

Prechtl Non-optimal Score		Brazelton Score	Days [a]
Motor Activity Awake	vs.	Poor visual following (3 items)	3,7
		Less alert	3,7
		Poor defensive movement	3
		Difficult to console	3
		Cries early in test	3
		(More state changes)	(3)
		(Less self-quieting)	(3)
		Insulated crying state	3,7
		(Irritability)	(3)
Motor: Resistance	vs.	Poor response decrement: Light	3
		Rattle	7
		Poor tone when pulled to sit	7
		More state changes	7
Power		----	
Range	vs.	Poor response decrement: Light	3
		Rattle	7
		More active	3
Prone Position	vs.	Poor general tone	3
		(Poor defensive movement)	(7)
Upright Position	vs.	Poor general tone	7
		(Less active)	(7)

[a] p values are < 0.05, or where bracketed, $0.05 < p < 0.1$

There were also several significant associations between motor scores and habituation items on days 3 and 7. Slower habituation to a torch was related to poor resistance to passive movements on day 3 ($p < 0.05$) and to a restricted range of movements ($p < 0.05$). The same relation was true of habituation to a rattle and resistance ($p < 0.05$), and restricted range of movements ($p < 0.05$) on day 7.

Although there is no particular reason why motor and state control items should be related, it may well be that an inability to control movements and activity is a physical limitation which makes the infant more "vulnerable" to outside stimulation, and at the same time unable to modulate his state of arousal in order to take advantage of it.

The relation of non-optimal reflexes to BNBAS scores was more general, and scattered over day 3 and 7 (Table VI.5.). Less brisk reflexes were associated with decreased alertness and visual following of both an object and face on day 3, as well as reductions in tone on day 7, and increased startles on both days. As the distribution of reflexes across categories ("facial" versus "skin and superficial") is somewhat arbitrary it does not seem necessary to specify individual relationships.

Infants whose Moro response was less than optimal (poor abduction, extension, or adduction) were likely to have been the more active infants on day 3 ($p < 0.05$), with better head control when pulled to a sitting position ($p < 0.01$). Their increased tremor during the BNBAS on day 3 ($p < 0.01$) was likely related to increased tremor accompanying the Moro response, as it is also a part of the score on the PNE.

Table VI.5 CORRELATIONS BETWEEN PRECHTL NEUROLOGICAL NON-OPTIMAL SCORES ON DAY 6 AND BRAZELTON ITEMS AT DAYS 3 AND 7 (Reflexes)

Prechtl Non-optimal Score		Brazelton Score	Days [a]
Facial Features and Reflexes	vs.	Poor visual following of face	3
		Poor defensive movement	3
Skin and Superficial Reflexes	vs.	Less alert	3
		Poor visual following of object	3
		More startles	3
Reflexes and Responses	vs.	Poor response decrement to bell	7
		Poor tone when pulled to sit	7
		More startles	7
Moro	vs.	More active	3
		More tremor	3
		(More irritable)	(3)
		Better tone when pulled to sit	3
Oral	vs.	Poor visual and auditory orientation to human stimuli (3 items)	7
Crying	vs.	Poor response decrement: Rattle	7
		(Bell)	(7)
		Greater tone in general	3,7

[a] p values are < 0.05, or where bracketed, $0.05 < p < 0.1$

The association between non-optimal oral responses and poor orientation scores is unusual, and may be due to the fact that such scores were almost invariably due to increased, or over ly-vigorous, sucking near the end of the PNE, when the infant may well be agitated and hungry. Infants who were hungry during the BNBAS also seemed less inclined to attend to visual and auditory stimuli, so the correlation may be an artificial one, reflecting "hungry" babies.

It is notable that the strength of reflexes was generally not correlated with tone items on the BNBAS, with the exception of poor tone in a pull-to-sit position on day 7 in relation to general reflexes and responses - a category which includes arm and head traction within it. It is also somewhat surprising that poor "eye signs" and reflexes were not a determinant of poor visual tracking skills on either day 3 or day 7, since for instance, un-coordinated eye movements in the delivery room were associated with reduced orienting responses at the time.

Several "summary" items were also selected to compare with the BNBAS scores, including overall tremor, ease of examining the infant, and the presence of either weak or exaggerated tendon reflexes (Table VI.6.). Several of these correlations failed to reach significance, even though they were in the expected direction. For instance, weak tendon reflexes were associated with poor tone, while exaggerated tendon reflexes occurred in infants who were apt to over-react during the Brazelton exam with more frequent startles and difficulties in consoling themselves when aroused. Tremulousness during the PNE was significantly associated with tremor during the BNBAS on both day 3 ($p < 0.05$) and day 7 ($p < 0.05$). The presence of tremor throughout the neurological examination was also more likely in infants who were

Table VI.6 CORRELATIONS BETWEEN PRECHTL NEUROLOGICAL NON-OPTIMAL SCORES ON DAY 6 AND BRAZELTON ITEMS AT DAYS 3 AND 7 (Summary)

Prechtl Non-optimal Score		Brazelton Score	Days [a]
Weak Tendon Reflexes	vs.	(Poor tone when pulled to sit)	(7)
Exaggerated Tendon Reflexes	vs.	(More startles)	(7)
		(Less self-quieting)	(3)
Tremor	vs.	Greater tone	3
		(Difficult to console)	3
		More excitable	3
		Cries early in test	3
		More irritable	3
		More tremor	3,7
Ease of Examining (crying, consolability, state control)	vs.	More excitable	7

[a] p values are < 0.05, or where bracketed, $0.05 < p < 0.1$

hypertonic on day 3 on the BNBAS ($p < 0.05$), as well as being more excitable ($p < 0.05$), more irritable to stimuli ($p < 0.05$), and likely to cry earlier when stimulated ($p < 0.05$). A composite score of the overall amount of crying, ease of maintaining optimal states for testing, and consolability when crying was significantly associated with greater excitability on day 7 ($p < 0.05$). This close agreement on the summary scores probably indicates that the infant presents a fairly consistent picture to an examiner seeking specific responses to stimuli, and expecting an organism capable of controlling physiological stresses enough to maintain a quiet and alert state. The infant who is hyper-reactive to stimuli will evidence overly brisk reflexes and increased tremor in both assessments, which may induce a state of increased activity and more uncontrolled movements culminating in crying that is difficult to ameliorate either by the examiner or the infant himself.

VII SLEEPING AND FEEDING PATTERNS IN THE FIRST SIX WEEKS

As outlined in the procedures, data on sleeping and feeding were coded from a diary and chart kept continuously by the mother from birth to discharge on day 7. A single 24-hour diary was completed at home by the mothers for the day following the baby's assessment at 3 and 6 weeks. The feed chart was maintained only in hospital, but the number of feeds was available from the diary at the later ages.

The diary sheets and feed charts are in Appendix I as are the variable coding sheets from days 1-7; some additional variables not originally allowed for on these sheets (i.e. longest night sleep bout) and the 3 and 6 week variables were transferred directly to standard computer sheets. A list of the items finally used in the multiple regression analyses can be seen in Table VII.1. Some measures were discarded because they were highly intercorrelated, or because they were superceded by more meaningful ones.

A. Methodological Problems Of Sleep And Feed Recording

Other aspects of the coding and analysis deserve comment. Firstly, the hospital and later diaries were not identical, as the later ones utilised 15 minute intervals, as well as distinguishing between evening and night sleep. It was not felt to be justifiable to record evening and night sleep separately because in hospital the nurses usually filled out the portions when the infant was in the nursery (which was routine at the time for the first 3 nights, optional for the rest of the week). Therefore, any differences between night and evening sleep might have reflected the nature of the recorder rather than the subject. Secondly, by 3 and 6 weeks parents begin to have expectations about their infant

Table VII.1 SLEEP AND FEED VARIABLES USED IN THE MULTIPLE REGRESSION ANALYSES

Sleeping

Days 1-7 :
1) % Time sleeping in 24 hours (T.S.)
2) Mean bout length of sleep when baby is awakened (MBL-A)
3) Mean bout length of sleep when baby wakes spontaneously (MBL-S)
4) Mean bout length of all sleep bouts (MBL-ALL)
5) Longest sleep bout (LSB)

Days 21,42 :
1) Number of (15 minute) intervals awake in 24 hours
2) Number of intervals asleep in evening (6-12 p.m.)(EST)
3) Number of intervals asleep at night (12-6 a.m.)(NST)
4) Number of night wakings (12-6 a.m.) (NW)

Feeding

Days 1-7 :
1) Number of feeds (F)
2) Feed rating (FR)

Days 21,42 :
1) Number of feeds (F)

---

sleeping through the night, and it seemed worth investigating whether there were any significant effects of obstetric factors on night waking. In addition, as the infant's sleep is likely to be more regular by this time, a 15-second interval seemed more appropriate.

A great number of feed measures were recorded and coded but not used in the analysis. For instance, we were interested in the extent to which breast fed infants also received complementary formula milk and dextrose, and expected that it might be due to depression of sucking skills after maternal analgesia. However, it turned out that intake was not solely determined by hunger, but also by maternal experience, whether the infant was "due" for another feed, and the advice of the nursing staff. Complementing with formula milk or dextrose was often determined by the infant's condition (jaundiced infants received hourly dextrose) or whether the night staff decided to give formula milk instead of waking the mother to breast feed.

We had also hoped to record and calculate the number of minutes that infants suckled on the breast at each feed. However, mothers were quite inaccurate in noting this information on the charts. Sometimes this was because they (sensibly) did not bother to time meticulously, or were uncertain as to whether to count non-suckling periods on the breast. More commonly, however, mothers deliberately under-calculated the sucking time because the nurses instructed them to limit sucking to 1 minute on the first day, 2 minutes on the second day, and so on. Mothers who felt that the infant was still hungry and they had exceeded their allowable time quite understandably suckled for longer, but marked a fictitous time to preclude scolding by the nurses!

Table VII.2. indicates some of the additional problems involved in describing the type of feeding that mothers used in the first week. From the antenatal interviews carried out by the midwives we know that 16% intended to bottle feed and 57% to breast feed. However, preference was not known in 28% of cases, and was often (but not reliably enough to code) recorded as "Mother uncertain". An adjusted percentage would suggest that about three-quarters wanted to breast feed, and about one-quarter to bottle feed. In fact, this agrees well with the finding that 76% put their baby to the breast at least once on the first day, but curiously this rose to 79% on day 4. It could be that the larger percentage of mothers had decided by the first day to try breastfeeding, but were unable to do so for some reason (i.e. tiredness, sore nipples, etc.) before the fourth day. Alternatively, a few more mothers were persuaded of the advantages of breastfeeding after delivery and started putting their infant to the breast by the middle of the week.

Obviously, from the figures in Table VII.2, it can be seen that even breastfeeding mothers were offering other "drinks", since more than half of the infants were receiving at least one dextrose feed per day for the first 4 days. The mean daily dextrose intake (in those receiving any) ranged from 94.1 mls on day 1 to a highest of 183.4 mls on day 3, before dropping to a low of 46.2 mls on day 7. One infant was recorded as having 485 mls on day 3. There are marginally acceptable reasons for giving dextrose as a first feed on day 1 or when a baby is very jaundiced on days 3-4. However, since 1981 it has become policy in this unit not to offer dextrose feeds unless authorised by a paediatric registrar, since the ingestion of sweet fluids can satiate the baby's hunger and discourage suckling.

Table VII.2 CONFOUNDING ASPECTS OF FEED PATTERNS

Intended Feeding (when mothers questioned at 36 wks. of pregnancy)

	%	Adjusted %
Uncertain or missing data	28	-
Bottle	16	22
Breast	57	78

% Infants having the following at least once a day on each of days:

	1	2	3	4	5	6	7
a) Breast feed	76	77	78	79	79	79	76
b) Bottle:Dextrose	83	76	65	56	32	17	6
c) Bottle:Formula	40	42	48	50	52	57	53

Infant Feeding at Discharge:

	%
Bottle (formula)	28
Breast (no formula)	52
Breast + formula	20

Some "breastfed" babies were also being supplemented by formula milk in a bottle; at least 40% received at least one formula feed a day, and 57% had a bottle of formula on day 6. Mean formula intake (again, for those who received any) ranged from 126.1 mls on day 1 to 404.7 mls on day 7; obviously the totally bottle fed babies were the ones ingesting the maximums such as 770 mls per day. As with dextrose feeds, supplements of formula are currently discouraged in breastfeeding infants.

By discharge 28% were feeding their baby entirely by bottle, 52% were entirely breastfeeding, and 20% were complementing breastfeeds with formula milk. Informal counts from the known feeding patterns of non-study mothers during the project period mirrored these figures for the sample.

B. Descriptive Measures Of Sleeping And Feeding

The means and distributions of some of these feed and sleep variables are shown in Tables VII.3. and VII.4, and a few of the patterns will be described briefly below.

Babies spent less time asleep on the first day (71%), despite the fact that they received fewer feeds than on subsequent days, and the range was great - from one baby who remained asleep for only 8 hours to another who slept for 23. Babies were at their sleepiest on the second and third days. By 3 weeks their total sleeping time over 24 hours was 69%, and this had fallen to 67% by 6 weeks.

In calculating the mean bout length of sleep (MBL) we distinguished between those periods in which the baby woke spontaneously (MBL-S) from those in which he was awakened (MBL-A) (for example, for a feed or to be weighed), since the latter could potentially be artificially shorter.

Table VII.3 SELECTED SLEEP VARIABLES, DAYS 1-7

% Time Sleeping in 24 hours (TS)

Days	1	2	3	4	5	6	7
Mean	70.6	74.4	74.0	72.4	73.5	71.1	71.4
S.D.	11.9	9.5	10.0	9.4	9.0	9.1	10.4
Range	33-96	50-97	44-98	42-94	44-92	43-90	20-90

Mean Bout Length (minutes) (when awakened) (MBL-A)

Days	1	2	3	4	5	6	7
Mean	149.9	156.1	141.5	144.2	139.7	131.0	129.0
S.D.	62.7	54.4	59.2	57.5	77.4	62.1	63.2
Range	35-360	43-350	30-285	20-330	20-520	30-450	20-305

Mean Bout Length (minutes) (spontaneously wakes) (MBL-S)

Days	1	2	3	4	5	6	7
Mean	144.8	147.6	150.9	146.4	156.2	145.4	159.8
S.D.	78.9	73.6	55.0	57.0	51.4	42.6	48.5
Range	23-440	20-480	40-360	40-365	30-320	50-267	30-243

On the first day infants woke up spontaneously (MBL-S) each time after an average 2.4 hours, with a range of 23 minutes to 7 hours; they were awakened (MBL-A) after 2.5 hours, with a range from 35 minutes to 6 hours. Only on and after day 3 were the spontaneously ending bouts any longer, although the upper and lower limits of these were usually more generous when the infant was left to his "natural" cycle. One would also have expected there to be greater variance on the first day, since many mothers slept a great deal and were often uncertain as to what "routines" they should follow, but this did not seem to be the case.

Feed frequency was at its lowest on the first day as well, probably because of the reasons just mentioned: 13% of babies received 4 or fewer feeds on this day. They "drank" most often on day 4 (mean of 6.9 feeds), which, at least for those breastfeeding, would fit in with the known advantages of offering frequent suckling when the true milk begins to flow. More than a third of the infants were receiving 8 or more feeds a day on day 4, with frequency decreasing slightly until discharge. At 3 and 6 weeks infants fed, on average, 5.4 times per day.

As mentioned earlier, feeding "skills" were noted by the mother or nurse doing the feed, and we then rated these according to the following criteria:

1 — Disinterested in all feeds

2 Some disinterest

3 Great variety over the day

4 Feeds usually taken well

5 Feeds always taken well

By this criteria on the first day there was some variety in feeding performance, tending toward good feeding (mean rating 3.8). There was steady improvement until day 5, when the ratings reached a plateau of 4.5; the standard deviations were largest in the first few days.

Table VII. 4 SELECTED FEED VARIABLES

Number of Feeds (F)

Days	1	2	3	4	5	6	7
Mean	5.5	6.2	6.5	6.9	6.8	6.8	6.5
S.D.	0.9	1.0	1.1	1.4	1.1	1.2	1.2
4 (%)	13	4	0	3	1	0	2
5-7 (%)	86	87	82	61	76	70	76
8 (%)	1	9	18	36	23	30	22

Feed Rating (FR)

Days	1	2	3	4	5	6	7
Mean	3.8	4.0	4.3	4.4	4.5	4.5	4.5
S.D.	1.1	1.1	1.0	0.9	0.8	0.9	0.9

C. Between-Groups Analysis Of Sleep And Feed Measures

The presence of drugs during labour had no effect on sleep patterns in the first six weeks, except that on day 3 only infants in the pethidine group had a shorter mean length of (spontaneous waking) sleep ($p = 0.03$). Of the feeding measures the only significant effect was that bupivacaine was associated with fewer feeds ($p = 0.019$) on day 5.

D. Other Obstetric Variables

Obstetric factors were seldom related to either sleep or feed. Higher blood pressure during pregnancy was associated with less time asleep on day 2 ($p = 0.034$), with better feeding on day 5 ($p = 0.048$), and with fewer feeds on day 6 ($p = 0.032$). The use (or need for) mid-cavity forceps was associated with longer mean episodes of sleep (averaged over all bouts) on day 2 ($p = 0.041$) but more time awake over a 24-hour period at 3 weeks ($p = 0.021$), and more specifically between 12 and 6 a.m. ($p = 0.002$). The use of mid-cavity forceps was also associated with less interest in feeding on day 7 ($p = 0.032$).

Length of labour was significantly predictive of sleep and feeding in only two instances: a longer first stage of labour was associated with more sleep between 12 and 6 a.m. at 3 weeks ($p = 0.02$), and a longer second stage of labour with poor feeding on day 5 ($p = 0.004$). Infants with a low Apgar score at 5 minutes after delivery fed less frequently on day 2 ($p = 0.041$). First-born infants slept for briefer episodes (spontaneous waking) on day 2 ($p = 0.029$) and fed more vigorously on day 7 ($p = 0.014$).

More consistent predictors of feed and sleep, however, were the i) method of feeding, and ii) social class. Infants whose breastfeeding was supplemented by formula milk had longer sleep episodes (all) on day 4 ($p = 0.018$), and day 6 (spontaneous waking) ($p = 0.015$), while infants who were entirely formula-fed had more night sleep at 6 weeks ($p = 0.028$) and woke less often between 12 and 6 a.m. ($p = 0.001$). There was a significant relationship between poor feeding on day 1 and supplementing by formula ($p = 0.019$), suggesting that even early "failure to suck" invited bottle feeding. Bottle feeders fed more often on day 3 ($p = 0.031$). These results do not support Richards' (1974) finding that infants on the breast require feeding more frequently, but do not allow an analysis of whether frequent feeding results in more successful breast feeding.

Lower socio-economic status was associated with longer "longest sleep bout" on day 2 ($p = 0.015$), day 5 ($p = 0.01$), and day 6 ($p = 0.005$), as well as longer mean episodes of sleep (spontaneous waking) on day 5 ($p = 0.01$) and day 6 ($p = 0.031$), and more time asleep at 6 weeks ($p = 0.02$). It is possible that socio-economic status confers some disposition toward sounder sleep, but it seems much more likely that working-class mothers have greater expectations that the newborn infant's only occupation is sleep, and thus make certain that he is not disturbed. It is also possible that working-class mothers made greater use of the nursery at night, and thus prevented interruptions to his sleep, or that by putting him in the nursery they, or the nursing staff, were less attentive to changes in sleeping and waking states.

E. Pethidine: Within-Group Differences

When each drug group was examined separately in a multiple regression design,with the obstetric factors controlled, a higher cord blood concentration of pethidine was associated with a longer mean bout length of sleep (spontaneous waking) on day 1 ($p = 0.024$), and more time asleep on day 3 ($p = 0.02$). There were no effects of pethidine on feeding.

F. Bupivacaine: Within-Group Differences

High cord concentrations of bupivacaine were associated with greater sustained periods of sleep on day 3 ($p = 0.05$), and a longer mean bout (spontaneous waking) on day 4 ($p = 0.041$). Higher maternal dosage was related to poor feeding on day 1 ($p = 0.038$), day 2 ($p = 0.036$), and day 3 ($p = 0.033$), but not on days 4-7. On day 7 a poor feed rating was related to high delivery cord concentration of bupivacaine ($p = 0.001$), but not before this time. This is a puzzling finding, particularly since maternal dosage was seldom related to any of the newborn behaviours. One explanation might be that mothers who required greater amounts of bupivacaine were less adept at feeding the baby, and so he received a poor rating. However, in that case it is surprising that neither parity nor psychosocial factors exerted an effect. The other possibility is that bupivacaine passed through the breast milk but this is also unlikely as 1) not all of these infants were breastfed, and 2) dispersion of bupivacaine is so rapid in the adult that such effects should not have persisted in the mother beyond 24 hours.

G. Sleeping And Feeding: Summary Of Effects

These results suggest that early patterns of sleeping and feeding are relatively impervious to maternal medication or other obstetric factors. Working class status, and to a lesser extent, bottle feeding, is associated with more uninterrupted sleep in the first week, but even this effect is not strikingly consistent. In the absence of alternative explanations it seems that individual differences probably account for variation in such patterns.

VIII. MATERNAL PSYCHO-SOCIAL FACTORS AND INFANT BEHAVIOUR

Throughout the planning of this study on obstetric medication we were continually aware of the fact that infant behaviour is a product of many factors. The most important determinant of a child's development has been shown to be family influences, and in most cases it is the mother who provides the backbone of experience and stimulation in the early months and years. As pointed out in the literature review, there is a wealth of evidence that what the mother brings to her labour and delivery may determine how it proceeds, how she copes, her feelings of success or failure, and ultimately her perception and mothering of the baby who emerges from it. This "background" is likely to include her emotional experiences as a child, her personality, attitudes to the pregnancy and parenthood, and her relationship with her partner or husband.

It is not easy to quantify such complex psychological factors, and the measures we selected must reflect only a very limited part of the repertoire. Nonetheless, their selection represents an attempt to focus on a) the interdependence of psycho-social, obstetric and situational factors in modern childbirth, b) whether such indices of psychological adjustment change over time, and c) how much maternal characteristics can influence neonatal behaviour.

A. Aspects Of The Psychological Scales

1. Intercorrelations Of Items Within Each Psychological Scale

Although complete scales were used in the administration of psychological items to the mothers, individual items were used in most analyses. Thus the intercorrelations of items within each test were examined to estimate the validity of particular constructs, and

to gain an idea of the redundancy within each scale.

a. Eysenck Personality Inventory (EPI)

Since the "lie" factor was not computed in this study, only the total extroversion and neuroticism measures could be compared. Women who were more neurotic during pregnancy also had lower extroversion scores ($p < 0.05$).

b. Nowlis Mood Adjective Check List (NMACL)

For this sample of patients we found that all of the measures were highly interrelated; some measures were related to all, or all but one, of the other measures (see Table VIII.1). We selected "anxiety" and "depression" for analysis in relation to obstetric and newborn data because of their face value and suggestions in the literature of their contribution to complications of pregnancy or the puerperium (Brown, Grodin and Manning, 1972). It is reassuring, therefore, that there are significant associations between these and the other measures of mood, suggesting a constellation of negative feelings. Specifically, women who were anxious at 36 weeks gestation also expressed more feelings of aggression ($p < 0.01$), deactivation ($p < 0.001$), depression ($p < 0.001$), scepticism ($p < 0.001$), shock ($p < 0.001$), and angst ($p < 0.001$). However, anxiety was also significantly associated with some more "positive" mood characteristics, such as concentration ($p < 0.001$), affection ($p < 0.05$), and egotism ($p < 0.1$). Feelings of depression were associated with much the same items, and more significantly so: aggression ($p < 0.001$), deactivation ($p < 0.001$), anxiety ($p < 0.001$), scepticism ($p < 0.001$), shock ($p < 0.001$), and angst ($p < 0.001$), affection ($p < 0.005$), and egotism ($p < 0.005$).

Table VIII.1 INTERCORRELATION OF ITEMS FROM THE NOWLIS MOOD ADJECTIVE CHECK LIST AT 36 WEEKS OF PREGNANCY

ITEMS	1	2	3	4	5	6	7	8	9	10	11	12	13
1. Aggression													
2. Concentration	.187*												
3. Sluggish		.181*											
4. Affectionate	.288**	.360**											
5. Anxiety	.210**	.300**	.378**	.194*									
6. Depression	.331**		.267**	.248***	.554**								
7. Egotism	.451**			.152*	.121+	.242***							
8. Elation	.363**	.181*	-.212**	.620**			.355**						
9. Activation	.269**		-.449**	.400**	-.118+		.244***	.568**					
10. Nonchalance	.528**		-.152*	.429**			.404**	.568**	.568**				
11. Scepticism	.297**	.217**	.207**		.352**	.454**	.186*			.135+			
12. Shocked	.496**			.180*	.229***	.461**	.265**	.134+		.239***	.242***		
13. Angst	.334**	.127+	.266**	.170*	.614**	.751**	.194*			.133+	.455**	.544**	

+0.05 < p < 0.1 *p < 0.05 **p < 0.01 ***p < 0.005 ****p < 0.001

c. Expected Labour Questionnaire (ELQ)

Only one of these inter-correlations was significant at the 5% level, although there were also 5 trends at the 10% confidence level (Table VIII.2). Women who expected to be very excited at the birth assumed that their husbands would feel the same ($p < 0.005$). There were trends in the data for expectations of more pain and difficulties in coping, as well as less excitement. Women who expected to be embarrassed during labour thought they would receive less help from the staff, and that their husband would be less excited to see the baby. Anticipation of a long labour was also associated with less excitement on the father's part, but again, not significantly so.

d. Expected Baby Questionnaire (EBQ)

When it came to anticipated characteristics of the infant-to-be-born, the women were more consistent across the items; half of the measures were significantly correlated with a further 4 trends at the 10% level (Table VIII.3). Women who expected to have a crying baby also expected him or her to have feeding problems ($p < 0.1$), sleeping problems ($p < 0.05$), "bowel" problems ($p < 0.05$), and difficulties in settling to a predictable pattern of sleeping and feeding ($p < 0.01$). Feeding problems were also related to bowel problems ($p < 0.1$). Mothers who expected their babies to vomit a great deal also anticipated sleeping problems ($p < 0.01$), bowel problems ($p < 0.1$), and difficulties in settling to a pattern ($p < 0.1$). Anticipated sleep and bowel problems were related ($p < 0.001$), as were sleep and general difficulties in becoming predictable ($p < 0.001$). It is, of course, difficult to know whether this reflects general pessimism on the part of the mother-to-be, or astute judgment that early patterns of behaviour may be dependent on one another.

Table VIII.2 INTERCORRELATIONS OF ITEMS ON THE "YOUR EXPECTED LABOUR QUESTIONNAIRE" AT 36 WEEKS

ITEMS	1	2	3	4	5	6	7	8	9
1. Relief into labour									
2. Coping									
3. Length labour									
4. Painful		.274^{+}							
5. Amount drugs									
6. Excited at baby				.259^{+}					
7. Husband excited			-260^{+}			.498**			
8. Staff help									
9. Embarrassed							-265^{+}	.288^{+}	

$^{+}0.05 < p < 0.1$

$^{*}p < 0.05$

$^{**}p < 0.01$

$^{***}p < 0.005$

$^{****}p < 0.001$

Table VIII. 3 INTERCORRELATIONS OF ITEMS WITHIN THE EXPECTED BABY QUESTIONNAIRE AT 36 WEEKS

	1	2	3	4	5	6
1. Crying						
2. Feeding	.168^{+}					
3. Vomiting						
4. Sleeping	.281*		.299*			
5. Bowels	.261*	.170^{+}	.199^{+}	.492$^{**}_{**}$		
6. Predictable pattern	.299*		.166^{+}	.648$^{**}_{**}$	.566$^{**}_{**}$	

$^{+}$ $0.05 < p < 0.1$

* $p < 0.05$

** $p < 0.01$

*** $p < 0.005$

**** $p < 0.001$

2. Correlations Between Different Antenatal Measures Of Psychological Well-Being And Adaptation To Pregnancy

Since many of the available scales purport to measure adaptation to the pregnancy, and expectations of coping, one would expect there to be some degree of overlap. We analysed the significance of correlations between similar items in the different scales, or those which seemed to tap part of a larger dimension (i.e. fear or embarrassment of a new situation); only the more meaningful relationships will be discussed here.

The construct of "extroversion" from the EPI was related to only 1 item from the Nowlis Mood Adjective Check List, and this was not significant; "extroverts" reported a more "aggressive" mood at 36 weeks of pregnancy ($p < 0.1$). Women who scored as "neurotic" had greater scores on the NMACL for deactivation ($p < 0.001$), scepticism ($p < 0.005$), anxiety ($p < 0.001$), depression ($p < 0.05$), and angst ($p < 0.001$). Neurotic patients according to the EPI were also likely to have a higher "malaise" score on the Rutter Malaise Inventory (RMI) ($p < 0.001$).

Women who had a higher malaise score also reported greater anxiety ($p < 0.001$) and depression ($p < 0.001$) on the NMACL. High malaise scores were significantly correlated with greater deactivation ($p < 0.001$), less elation ($p < 0.005$), greater scepticism ($p < 0.005$), greater shock ($p < 0.01$), and greater angst ($p < 0.001$).

Surprisingly, however, a greater degree of anxiety on the NMACL was not related to expectations of a more difficult labour. And, more curious, depressed patients were likely to expect a shorter labour ($p < 0.1$), with fewer drugs ($p < 0.05$), and to cope better ($p < 0.1$).

Women reporting a greater degree of malaise in their pregnancy expected to feel extremely relieved to go into labour ($p < 0.005$), even though they anticipated a longer labour ($p < 0.05$).

There were some predictable relationships between state of mind and anticipated problems of motherhood. Anxious women thought they would have a baby who experienced more problems with sleeping ($p < 0.1$), bowels ($p < 0.1$), and vomiting ($p < 0.05$). "Depressed" women expected an infant who would also have sleeping difficulties ($p < 0.1$), and problems with bowels ($p < 0.01$) and settling into a predictable routine ($p < 0.01$). A high malaise score was also associated with expectations of a difficult infant in the areas of feeding ($p < 0.05$), vomiting ($p < 0.05$), and sleeping ($p < 0.1$).

Correlations were also performed between expectations of labour and expectations of the coming infant. There were only four significant relationships and another four which did not quite reach the 5% confidence limit. Patients who expected to have a long labour thought that their infant would have more problems with feeding ($p < 0.005$) and elimination ($p < 0.05$). More vomiting in the infant was related to expectations of a less painful labour ($p < 0.1$) and fewer drugs ($p < 0.05$). Possible problems with feeding were associated with anticipated relief at finally going into labour ($p < 0.1$), a longer labour ($p < 0.005$), feelings that the father would be less excited at seeing the baby deliver ($p < 0.1$), and worries about greater embarrassment during labour ($p < 0.1$).

From these results it would be possible to argue that the various scales do pick out the women who are experiencing difficulties in adapting to pregnancy, or, at least, identify those who already are emotionally troubled. That is, "neurotic" patients on the EPI were

more likely to report moods of anxiety, depression, and deactivation, and to have more "malaise" of pregnancy. This would support the view that the Malaise Inventory reflects anxiety when the total number of symptoms is particularly high. On the other hand it is just possible that patients who have had an unusually difficult time in the first two trimesters (such as vomiting, cramps, extreme tiredness) might feel fairly anxious and depressed, and "deactivated" by 36 weeks. This alternative explanation might be supported by the finding that "malaise" was associated with an overwhelming anticipation of being relieved when pregnancy finally ended with the birth, tempered by acceptance that the labour might be longer. The true causal implications of these findings could only be revealed by more refined "State"/"Trait" Anxiety Scales or a prospective administration of psychological profiles before conception - an impractical methodology for most obstetric research.

Whatever the cause of the mood states in the third trimester, women who were already anxious and depressed had a more negative image of their baby still in utero, particularly with regard to sleeping. The importance of such negative expectations in relation to actual behaviour will be discussed in Section VIII.D. It is interesting in this context that "crying" did not often figure in the significant correlations with other data, even though women anticipated more crying than they actually reported later about their own infant.

As will also be discussed in Section VIII.B.4, there was no significant relationship between expectations of crying and the reality when women were questioned at 7 and 42 days post-partum, while there was continuity within some of the other infant measures.

In the absence of an "a priori" hypothesis about attitudes to the impending delivery and new baby, no conclusions can be drawn from the correlations between the "expected labour" and "expected baby" characteristics. The few significant associations seemed entirely contradictory and are probably due to chance.

B. Psychological "Well-Being" In The Analgesia Study Mothers

1. Antenatal Differences Between The Groups

The main reason for assessing personality variables, feelings about pregnancy and expectations of childbirth was to reveal any bias in the three samples of mothers. In particular, it was important to discover whether the group who did not request drugs had experienced a less troublesome pregnancy or were less anxious about their imminent delivery.

However, unfortunately, this part of data collection was fraught with problems. Firstly, because of a need to avoid knowledge of the maternal characteristics, it was left to the midwives to distribute, explain, and verify these questionnaires. For a number of (understandable) reasons they failed to make certain that compliance remained high and did not realise, for instance, that fully three-quarters of the mothers did not receive the expected Labour Questionnaire. In addition, when a number of mothers objected to the "personal", "cross-examining", "nosy" nature of the Eysenck Personality Inventory (EPI) the midwives simply stopped giving it. The majority of patients completed the Rutter Malaise Inventory (RMI) (89%) and the Nowlis Mood Adjective Check List (NMACL) (86%). The "attrition" however, is equally distributed between the drug groups, so any differences, or lack of, should not be biased.

The Eysenck Personality Inventory (EPI) was only given to the first 77 subjects, as it was unpopular with the patients. On this subsample of 77 there were no significant differences between the 3 groups, although the no-drugs group had marginally lower "extroversion" and "neuroticism" scores (Table VIII. 4). The variance on these two measures in the no-drugs group was also greater. The no-drugs group also had fewer pregnancy symptoms on the Rutter Malaise Inventory (RMI), although these differences were not significant. If, as Rutter suggests, such symptoms reflect underlying anxieties about pregnancy, then, the 129 subjects in the 3 groups were equally anxious.

A very small subsample (31) were also administered the Expected Labour Questionnaire (ELQ), probing their expectations of labour. Table VIII. 5 shows that the groups did not differ significantly on any of the 9 items, including such questions as "How will you cope?" "How painful do you expect it to be", and so on. Even though none of the differences reached significance, the no-drug group expected to cope better in labour, and to need less medication, even though they did not anticipate either a longer or a more painful labour.

Nor were there differences between the 125 subjects by drug group on any of the 13 Nowlis Mood scores (Table VIII. 6): In particular, the no-drug group were no less anxious or depressed.

The Expected Baby Questionnaire (EBQ) was filled in by 63 subjects during pregnancy, revealing no consistent or significant bias between the groups (Table VIII. 7).

Thus we would conclude that there was no evident bias in the 3 groups as regards antenatal mood, adaptation to pregnancy, and expectation of the delivery or baby characteristics. It must, however, be remembered that the small samples who answered some of the questionnaires render further analyses less robust than other parts of the study.

Table VIII.4 MEANS AND STANDARD DEVIATIONS OF PSYCHOSOCIAL DATA FROM MATERNAL QUESTIONNAIRES ADMINISTERED AT 36 WEEK GESTATION: EYSENCK PERSONALITY INVENTORY (EPI) AND RUTTER MALAISE INVENTORY (RMI)

EPI	All	No Drugs	Pethidine	Epidural	F-test Sig.
Extroversion (S.D.)	11.64 (3.29)	10.76 (4.04)	12.31 (2.54)	11.67 (3.25)	N.S.
Neuroticism (S.D.)	9.53 (4.04)	8.86 (4.30)	9.69 (4.14)	9.87 (3.85)	N.S.
Lie Score (S.D.)	2.75 (1.72)	2.86 (1.59)	3.04 (1.93)	2.43 (1.61)	N.S.
N =	77	21	26	30	
RMI					
Number of Symptoms (S.D.)	8.16 (5.06)	7.35 (4.96)	7.96 (5.05)	8.86 (5.14)	N.S.
N =	129	31	49	49	

Table VIII.5 MEANS AND STANDARD DEVIATIONS OF ANSWERS TO EXPECTED LABOUR QUESTIONNAIRE ADMINISTERED AT 36 WEEKS GESTATION BY DRUG GROUP

	All	No Drugs	Pethidine	Epidural	F-test Sig.
1. Relief into labour	1.19	1.00	1.50	1.00	N.S.
(S.D.)	(1.08)	(1.00)	(1.24)	(0.94)	
2. Coping	1.48	1.22	1.58	1.60	N.S.
(S.D.)	(0.68)	(0.67)	(0.79)	(0.52)	
3. Length labour	2.07	2.00	1.92	2.33	N.S.
(S.D.)	(0.59)	(0.53)	(0.67)	(0.50)	
4. Painful	2.30	2.33	2.33	2.22	N.S.
(S.D.)	(0.70)	(0.87)	(0.65)	(0.67)	
5. Amount drugs	1.52	1.12	1.33	2.11	N.S.
(S.D.)	(0.99)	(0.83)	(0.89)	(1.05)	
6. Excited at baby	0.32	0.22	0.42	0.30	N.S.
(S.D.)	(0.75)	(0.67)	(0.90)	(0.67)	
7. Husband excited	0.19	0.22	0.00	0.40	N.S.
(S.D.)	(0.54)	(0.67)	(0.44)	(0.70)	
8. Staff help	1.35	1.22	1.25	1.60	N.S.
(S.D.)	(0.84)	(0.97)	(0.97)	(0.52)	
9. Embarrassed	0.84	1.11	1.00	0.40	N.S.
(S.D.)	(0.93)	(1.27)	(0.74)	(0.70)	
N =	31	9	12	10	

Table VIII.6 MEANS AND STANDARD DEVIATIONS OF NOWLIS MOOD ADJECTIVE CHECK LIST AT 36 WEEKS OF PREGNANCY

	All	No Drugs	Pethidine	Epidural	F.test Sig.
1. Aggression	0.88	1.00	0.83	0.85	N.S.
(S.D.)	(1.63)	(1.58)	(1.85)	(1.44)	
2. Concentration	5.18	4.61	5.50	5.24	N.S.
(S.D.)	(2.98)	(2.16)	(3.04)	(3.37)	
3. Sluggish	2.23	2.42	2.00	2.35	N.S.
(S.D.)	(2.30)	(2.03)	(2.21)	(2.56)	
4. Affectionate	5.90	5.42	5.56	6.57	N.S.
(S.D.)	(3.38)	(3.10)	(3.63)	(3.25)	
5. Anxiety	2.14	1.97	2.02	2.37	N.S.
(S.D.)	(2.50)	(2.54)	(2.30)	(2.70)	
6. Depression	0.65	0.74	0.48	0.76	N.S.
(S.D.)	(1.37)	(1.59)	(0.87)	(1.62)	
7. Egotism	1.43	2.16	1.19	1.20	N.S.
(S.D.)	(1.96)	(2.22)	(1.78)	(1.88)	
8. Elation	5.24	5.00	5.21	5.43	N.S.
(S.D.)	(3.16)	(3.44)	(3.09)	(3.08)	
9. Activation	3.74	3.55	3.96	3.65	N.S.
(S.D.)	(2.91)	(2.88)	(3.04)	(2.84)	
10. Nonchalance	2.34	2.55	2.23	2.30	N.S.
(S.D.)	(2.20)	(2.53)	(2.32)	(1.86)	
11. Scepticism	0.82	0.97	0.85	0.69	N.S.
(S.D.)	(1.34)	(1.58)	(1.11)	(1.39)	
12. Shocked	0.10	0.16	0.02	1.52	N.S.
(S.D.)	(0.45)	(0.45)	(0.14)	(0.63)	
13. Angst	0.60	0.87	0.52	0.50	N.S.
(S.D.)	(1.54)	(1.78)	(1.20)	(1.68)	
N =	125	31	48	46	

Table VIII.7 MEANS AND STANDARD DEVIATIONS ON THE EXPECTED BABY QUESTIONNAIRE AT 36 WEEKS

	All	No Drug	Pethidine	Epidural	F-test Sig.
1. Crying	2.25[a]	2.14	2.36	2.22	N.S.
(S.D.)	(0.62)	(0.53)	(0.66)	(0.64)	
2. Feeding difficulty	1.22	1.13	1.18	1.31	N.S.
(S.D.)	(0.66)	(0.64)	(0.66)	(0.68)	
3. Vomiting	1.49	1.50	1.32	1.63	N.S.
(S.D.)	(0.62)	(0.52)	(0.65)	(0.63)	
4. Sleeping difficulty	1.24	1.07	1.32	1.26	N.S.
(S.D.)	(0.66)	(0.73)	(0.57)	(0.71)	
5. Bowels	1.13	1.29	0.91	1.22	N.S.
(S.D.)	(0.79)	(0.99)	(0.68)	(0.75)	
6. Predictable pattern	1.41	1.43	1.50	1.33	N.S.
(S.D.)	(0.82)	(0.85)	(0.86)	(0.78)	
N =	63	15	22	27	

[a] Higher scores represent more difficulties

2. Group Differences In The Post-Natal Period

When it was discovered that so few of the antenatal questionnaires had been completed, it was decided to only analyse those post-natal forms with corresponding antenatal data. We also arbitrarily selected a similar 1/3rd of the Nowlis Mood Adjective Check List replies since this was roughly the percentage at which the others had been returned. As in the antenatal data there was an equal distribution of respondants between the three drug groups.

Unlike the antenatal period, there were a few differences between the three groups on some of the postnatal variables: the data on each separate questionnaire follows in Tables VIII. 8, 9, 10, 11 and 12. As one might expect, obstetric events that in part led to the choice of a particular drug during labour (and thus to group inclusion) were recalled differently in the day 1 Your Labour Questionnaire (YLQ). For instance, mothers who received epidural anaesthesia or pethidine reported having had a longer labour, which was significantly so between the 3 groups ($p < 0.0007$). They were also more likely to report having used more medication ($p < .00001$). Notably, there was a significant difference in feelings about "coping in labour" ($p < 0.008$), with the no-drug group feeling the greatest satisfaction.

There were 2 significant differences in the mothers' perceptions of their infant at day 7 and 1 at 6 weeks. At the end of the first week, sleeping was more likely to be perceived as a problem in the two drug groups ($p < 0.003$), and their babies seemed to have more difficulty settling into a "predictable pattern" ($p < 0.015$). In the first week feeding difficulties were more likely to be reported in the drug groups, but not significantly so; at 6 weeks it was significant ($p < 0.014$) but the actual differential was very much smaller. Interestingly, the

Table VIII.8 MEANS AND STANDARD DEVIATION OF ANSWERS TO "YOUR LABOUR" ADMINISTERED ON THE FIRST DAY AFTER BIRTH

	All	No Drugs	Pethidine	Epidural	F-test Sig.
1. Relief into labour	0.85	1.18	1.05	0.50	N.S.
(S.D.)	(1.03)	(1.25)	(1.23)	(0.52)	
2. Coping	1.38	0.73	1.40	1.68	0.008
(S.D.)	(0.86)	(0.79)	(0.75)	(0.84)	
3. Length labour	1.91	1.00	1.80	2.45	0.0007
(S.D.)	(1.10)	(0.77)	(0.77)	(1.18)	
4. Painful	2.68	2.54	2.85	2.59	N.S.
(S.D.)	(0.85)	(0.82)	(0.59)	(1.05)	
5. Amount Drugs	1.77	0.18	1.50	2.82	0.0000
(S.D.)	(1.20)	(0.60)	(0.61)	(0.73)	
6. Excited at baby	0.41	0.18	0.45	0.50	N.S.
(S.D.)	(0.91)	(0.60)	(0.89)	(1.06)	
7. Husband excited at baby	0.23	0.45	0.15	0.19	N.S.
(S.D.)	(0.64)	(1.04)	(0.49)	(0.51)	
8. Staff help	0.43	0.45	0.55	0.32	N.S.
(S.D.)	(0.72)	(0.69)	(0.89)	(0.57)	
9. Embarrassed	0.53	0.36	0.45	0.68	N.S.
(S.D.)	(0.89)	(0.81)	(0.69)	(1.09)	
N =	53	11	20	23	

Table VIII.9 MEANS AND STANDARD DEVIATION OF NOWLIS MOOD ADJECTIVE CHECK LIST AT 5 DAYS AFTER BIRTH

	All	No Drugs	Pethidine	Epidural	F-test Sig.
1. Aggression	1.04	1.20	1.10	0.91	N.S.
(S.D.)	(1.65)	(1.32)	(1.85)	(1.66)	
2. Concentration	6.18	4.60	7.63	5.64	N.S.
(S.D.)	(8.80)	(3.10)	(13.99)	(3.03	
3. Sluggish	3.10	3.40	2.84	3.18	N.S.
(S.D.)	(2.63)	(2.76)	(2.77)	(2.56)	
4. Affectionate	8.12	8.40	7.95	8.14	N.S.
(S.D.)	(3.17)	(3.10)	(3.42)	(3.11)	
5. Anxiety	2.82	1.70	2.63	3.50	N.S.
(S.D.)	(3.76)	(3.20)	(4.60)	(3.17)	
6. Depression	0.86	0.50	1.21	0.73	N.S.
(S.D.)	(1.56)	(1.08)	(1.93)	(1.39)	
7. Egotism	2.10	2.30	1.47	2.54	N.S.
(S.D.)	(2.58)	(2.63)	(2.24)	(2.82)	
8. Elation	8.35	8.00	8.05	8.77	N.S.
(S.D.)	(3.62)	(3.30)	(4.36)	(3.13)	
9. Activation	3.96	3.80	3.95	4.04	N.S.
(S.D.)	(3.07)	(3.16)	(3.44)	(2.82)	
10. Nonchalance	2.10	2.80	2.16	1.73	N.S.
(S.D.)	(2.10)	(2.62)	(2.29)	(1.64)	
11. Scepticism	0.32	0.70	0.26	0.36	N.S.
(S.D.)	(1.04)	(1.06)	(0.65)	(1.29)	
12. Shocked	0.33	0.30	0.42	0.27	N.S.
(S.D.)	(0.86)	(0.67)	(1.07)	(0.77)	
13. Angst	1.20	1.10	1.26	1.18	N.S.
(S.D.)	(2.26)	(1.97)	(2.44)	(2.32)	
N =	51	10	19	22	

Table VIII.10 MEANS AND STANDARD DEVIATION OF NOWLIS MOOD ADJECTIVE CHECK LIST AT 6 WEEKS AFTER BIRTH

	All	No Drugs	Pethidine	Epidural	F-test Sig.
1. Aggression	0.77	1.00	0.89	0.47	N.S.
(S.D.)	(1.90)	(2.49)	(2.23)	(0.87)	
2. Concentration	3.94	3.09	4.53	3.82	N.S.
(S.D.)	(2.97)	(2.21)	(3.10)	(3.26)	
3. Sluggish	2.06	1.64	1.05	3.47	.007
(S.D.)	(2.43)	(1.80)	(1.35)	(3.08)	
4. Affectionate	7.19	7.27	7.26	7.06	N.S.
(S.D.)	(3.41)	(2.97)	(3.65)	(3.50)	
5. Anxiety	1.51	1.27	1.16	2.06	N.S.
(S.D.)	(2.28)	(1.74)	(1.46)	(3.19)	
6. Depression	0.45	0.18	0.15	0.94	N.S.
(S.D.)	(1.33)	(0.60)	(0.50)	(2.04)	
7. Egotism	1.60	1.09	1.74	1.76	N.S.
(S.D.)	(2.16)	(2.30)	(2.08)	(2.25)	
8. Elation	6.04	5.18	6.84	5.71	N.S.
(S.D.)	(3.20)	(2.60)	(3.06)	(3.64)	
9. Activation	4.55	5.09	5.05	3.64	N.S.
(S.D.)	(2.77)	(2.55)	(2.44)	(3.16)	
10. Nonchalance	2.72	2.82	3.16	2.18	N.S.
(S.D.)	(2.07)	(2.18)	(2.19)	(1.84)	
11. Scepticism	0.36	0.54	0.32	0.29	N.S.
(S.D.)	(0.79)	(1.04)	(0.67)	(0.77)	
12. Shocked	0.06	0.09	0.05	0.06	N.S.
(S.D.)	(0.25)	(0.30)	(0.22)	(0.24)	
13. Angst	0.47	0.09	0.37	0.82	N.S.
(S.D.)	(1.46)	(0.30)	(0.83)	(2.24)	
N =	47	11	19	17	

Table VIII.11 MEANS AND STANDARD DEVIATION OF ANSWERS TO YOUR BABY QUESTIONNAIRE ADMINISTERED AT 7 DAYS AFTER BIRTH

	All	No Drugs	Pethidine	Epidural	F-test Sig.
1. Crying	1.94	1.64	2.00	2.04	N.S.
(S.D.)	(0.75)	(0.67)	(0.71)	(0.81)	
2. Feeding difficulties	1.16	0.64	1.18	1.39	N.S.
(S.D.)	(0.88)	(0.81)	(0.64)	(0.99)	
3. Vomiting	0.91	0.55	0.94	1.04	N.S.
(S.D.)	(0.63)	(0.52)	(0.66)	(0.62)	
4. Sleeping difficulties	1.15	0.45	1.18	1.46	0.003
(S.D.)	(0.85)	(0.68)	(0.64)	(0.88)	
5. Bowels	0.65	0.64	0.47	0.79	N.S.
(S.D.)	(0.97)	(1.03)	(0.87)	(1.02)	
6. Predictable pattern	1.55	0.90	1.47	1.88	.015
(S.D.)	(0.92)	(0.57)	(0.87)	(0.95)	
N =	52	11	17	24	

Table VIII.12 MEANS AND STANDARD DEVIATION OF ANSWERS ON YOUR BABY QUESTIONNAIRE ADMINISTERED AT 6 WEEKS AFTER BIRTH

	All	No Drugs	Pethidine	Epidural	F-test Sig.
1. Crying	1.98	1.92	2.16	1.84	N.S.
(S.D.)	(0.82)	(0.67)	(0.83)	(0.89)	
2. Feeding difficulties	0.60	0.17	0.53	0.95	0.014
(S.D.)	(0.76)	(0.39)	(0.61)	(0.91)	
3. Vomiting	1.38	1.33	1.26	1.53	N.S.
(S.D.)	(0.75)	(0.98)	(0.56)	(0.77)	
4. Sleeping difficulties	1.32	1.33	1.32	1.32	N.S.
(S.D.)	(1.04)	(1.30)	(0.94)	(1.00)	
5. Bowels	0.60	0.75	0.47	0.63	N.S.
(S.D.)	(0.78)	(0.75)	(0.70)	(0.89)	
6. Predictable pattern	1.50	1.42	1.53	1.53	N.S.
(S.D.)	(1.05)	(1.24)	(1.02)	(1.02)	
N =	50	12	19	19	

"deactivation" measure on the Nowlis Mood Adjective Check List at 6 weeks discriminated between the groups ($p < 0.007$), with the epidural mothers feeling much more "sluggish".

Taken as a whole these results are quite interesting, but they do not present a coherent picture of post-partum disadvantage for the "drugged" mothers. To be convincing one would have expected greater depression and anxiety, at least in the first week where psychological morbidity might be reflected in exaggerated "baby blues".

3. Before And After The Birth: Changes In Scores

Because of the less-than-perfect match between antenatal and post-natal respondants, and the small sample, size statistical treatment of before and after measures did not seem justified. However, because of its relevance to many issues raised in this project it is presented here in tabular form (Tables VIII. 13, 14 and 15), with a few brief comments.

a. Nowlis Mood Adjective Check List (NMACL)

Numerous authors (Hamilton, 1962; Pitt, 1973; Stein, 1979) have specified the 3-5 day period as one of rapid mood swings, sadness, and feelings of being overwhelmed by the "newness" of the baby, the situation and the awesome nature of parenthood.

Thus the scores on the NMACL at 36 weeks, and 5 and 42 days post-partum, are what one might expect. At 5 days mothers seemed more aggressive, deactivated, anxious, depressed and full of angst than antenatally or later at six weeks (Table VIII. 13). At the same time their answers indicated greater affection, egotism and elation than during the earlier or later periods. There have long been suggestions that altered hormone levels may be at least partly responsible for

Table VIII.13 COMPARISON OF NMACL SCORES AT 36 WEEKS OF PREGNANCY 5 DAYS AND 42 DAYS POSTPARTUM

	Pregnancy	(S.D.)	5 Days	(S.D.)	42 Days	(S.D.)
1. Aggression	0.88	(1.63)	1.04	(1.65)	0.77	(1.90)
2. Concentration	5.18	(2.98)	6.18	(8.80)	3.94	(2.97)
3. Deactivation	2.23	(2.30)	3.10	(2.63)	2.06	(2.43)
4. Affection	5.90	(3.38)	8.12	(3.17)	7.19	(3.41)
5. Anxiety	2.14	(2.50)	2.82	(3.76)	1.51	(2.28)
6. Depression	0.65	(1.37)	0.86	(1.56)	0.45	(1.33)
7. Egotism	1.43	(1.96)	2.10	(2.58)	1.60	(2.16)
8. Elation	5.24	(3.16)	8.35	(3.62)	6.04	(3.20)
9. Activation	3.74	(2.91)	3.96	(3.07)	4.55	(2.77)
10. Nonchalance	2.34	(2.20)	2.10	(2.10)	2.72	(2.07)
11. Scepticism	0.82	(1.34)	0.32	(1.04)	0.36	(0.79)
12. Shock	0.10	(0.45)	0.33	(0.86)	0.06	(0.25)
13. Angst	0.60	(1.54)	1.20	(2.26)	0.47	(1.46)

symptoms of the blues, but results have been contradictory. For instance, George, Copeland and Wilson (1980) found a relationship between prolactin and anxiety, tension and depression, while Nott, Franklin, Armitage and Gelder (1976) failed to substantiate any link between symptoms on several questionnaires and levels of oestrogen, progesterone, follicle stimulating hormone, luteinising hormone or prolactin.

b. "Expectations" (ELQ) vs. "experience" of labour (YLQ)

Antenatal expectations of labour versus recall of the experience at 24 hours are presented in Table VIII. 14 . When they looked back on their own labour, mothers seemed to have been more relieved to finally go into labour than they had anticipated at 36 weeks. The group scores indicate a labour of about the length they had expected it to be, although slightly more painful and requiring more medication. The postnatal "coping" scores were similar to those antenatally. The same was true of excitement scores for both the patients and their husbands, but all four sets of scores were already at the extreme end of the scale.

c. "Expectations" (EBQ) vs. "experience" of the baby (YBQ)

The "Your Baby" Questionnaire (YBQ) was given at 2 time periods after birth and data is presented in Table VIII. 15 . Surprisingly, it seems that mothers had fewer difficulties with their baby in the first week than they had anticipated; this was particularly true for "vomiting" and "bowels". The only increased score was "settling to a predictable pattern", which remained about the same at 6 weeks too. Feeding was seen as very little problem by 6 weeks (about half as great as expected), and so were bowels, while "vomiting" and sleep difficulties were more problematic at 6 weeks than at 7 days.

Table VIII.14 COMPARISON OF EXPECTATIONS OF LABOUR (ELQ) AND PERCEPTIONS AT 1 DAY POSTPARTUM (YLQ)

	Before	S.D.	After	S.D.
1. Relief into labour	1.19	(1.08)	0.85	(1.03)
2. Coping	1.48	(0.68)	1.38	(0.86)
3. Length labour	2.07	(0.59)	1.91	(1.10)
4. Painful	2.30	(0.70)	2.68	(0.85)
5. Amount Drugs	1.52	(0.99)	1.77	(1.20)
6. Excited at Baby	0.32	(0.75)	0.41	(0.91)
7. Husband Excited at Baby	0.19	(0.54)	0.23	(0.64)
8. Staff help	1.35	(0.84)	0.43	(0.72)
9. Embarrassed	0.84	(0.93)	0.53	(0.89)

Table VIII.15 COMPARISON OF ANTENATAL EXPECTATIONS OF INFANT BEHAVIOUR (EBQ) AND POSTPARTUM DESCRIPTIONS OF THE INFANT (YBQ)

	Pregnancy	1 Week	6 Weeks
1. Crying	2.25	1.94	1.98
(S.D.)	(0.62)	(0.75)	(0.82)
2. Feeding difficulties	1.22	1.16	0.60
(S.D.)	(0.66)	(0.88)	(0.76)
3. Vomiting	1.49	0.91	1.38
(S.D.)	(0.62)	(0.63)	(0.75)
4. Sleeping difficulties	1.24	1.15	1.32
(S.D.)	(0.66)	(0.85)	(1.04)
5. Bowels	1.13	0.65	0.60
(S.D.)	(0.79)	(0.97)	(0.78)
6. Predictable pattern	1.41	1.55	1.50
(S.D.)	(0.82)	(0.92)	(1.05)

4. Continuities From The Antenatal To The Post-Partum Period

There were sufficient numbers of mothers tested at each of the data points to make Pearson Product Moment Correlations valid for the NMACL and the YBQ; these values are presented in Tables VIII. 16 and 17.

a. Nowlis Mood Adjective Check List (NMACL)

These mood traits showed very good stability between the antenatal and postnatal period: 8 of the 13 were significantly correlated (+1 trend) from pregnancy to the first week, and 11 were significant between the antenatal period and six weeks post-partum (Table VIII. 16). Natably, the variables we were particularly interested in - anxiety and depression - showed no relationship. It may well be that since anxiety was common at 5 days, individual continuities were "swamped" by the larger number of mothers showing the more transient symptoms of the "blues". The strong correlation between the antenatal period and six weeks for anxiety ($p < 0.001$) and depression ($p < 0.005$) suggests a core of mothers, however, whose symptoms continue once they are already at home and supposedly "settled into" caretaking routines. There was also a lesser correlation between the two post-partum time samples for anxiety ($p < 0.05$).

However, postulating that the stressful event of birth is an intervening variable that produces a "hiccup" in the data at 5 days is not wholly satisfactory, since most other mood scores were consistent across time. Certainly those items with high correlations throughout the whole time period - affection, egotism, activation, nonchalance, and scepticism suggest more enduring personality "traits" than was implied by Green's (Nowlis and Green, 1965) notion of a "tendency to respond".

Table VIII.16 PEARSON'S PM CORRELATIONS OF NOWLIS MOOD ADJECTIVE CHECK LIST SCORES ACROSS TIME

	Antenatal to 5 days	Antenatal to 6 weeks	5 days to 6 weeks
1. Aggression	.303*	.705****	
2. Concentration	-	.583****	.523****
3. Deactivation	.357**	.453****	.301*
4. Affectionate	.593****	.538****	.740****
5. Anxiety	-	.611****	.280*
6. Depression	-	.416***	-
7. Egotism	.338**	.557****	.616****
8. Elation	.297*	.343*	-
9. Activation	.259*	.274*	.521****
10. Nonchalance	.250*	.367**	.640****
11. Scepticism	.572****	.454****	.569****
12. Shock	-	-	.326*
13. Angst	.218+	.229+	-
N =	49	45	39

+ $0.1 > p > 0.05$

* $p < 0.05$

** $p < 0.01$

*** $p < 0.005$

**** $p < 0.001$

b. "Your Baby" Questionnaire (YBQ)

There were 4 continuities (including 1 trend) from the antenatal to the postnatal period for this data (Table VIII. 17), although only expectations of poor sleeping were significantly correlated with reported difficulties at both one ($p < 0.05$) and six weeks ($p < 0.005$). Anticipated crying almost matched real-life crying at one week ($0.05 < p < 0.1$), and mothers who expected a "vomiting" baby were likely to report this in their own infant at six weeks ($p < 0.005$). There were also significant correlations between difficulties with crying, feeding, and vomiting at one week and six weeks, and a trend in the correlation for bowel problems too.

C. Obstetric Factors And Psychological Aspects Of Pregnancy

There were several interesting associations between obstetric factors and psychological state and expectations during pregnancy, which are indicated in Table VIII. 18. In this respect social class and maternal age are treated as obstetric data because they are accepted indices of perinatal risk, although they might also be considered in other ways.

Older mothers expect to have longer labours ($p < 0.05$), and to receive more medication ($p < 0.05$), although they do not expect the labour to be more painful. This is commensurate with what older primipara are told to expect, but not all of these patients were primipara. However, when mothers were asked the following day about their experience in labour, there did not seem to be any difference with respect to age.

Table VIII.17 PEARSON'S PM CORRELATIONS OF YOUR BABY SCORES ACROSS TIME

	Antenatal to 1 week	Antenatal to 6 weeks	1 week to 6 weeks
1. Crying	.231^{+}	-	.452***
2. Feeding difficulties	-	-	.302*
3. Vomiting	-	.391***	.508****
4. Sleeping difficulties	.300*	.416***	-
5. Bowels	-	-	.241^{+}
6. Predictable pattern	-	-	-

$^{+}$ $0.1 > p > 0.05$

* $p < 0.05$

** $p < 0.01$

*** $p < 0.005$

**** $p < 0.001$

Table VIII.18 RELATIONSHIP BETWEEN SELECTED OBSTETRIC VARIABLES AND PERSONALITY INDICES, EXPECTATIONS AND EXPERIENCES OF LABOUR, AND MOOD SCORES (ALL BABIES)

		Age	S.C.	Parity	1st Stage	2nd Stage	Apg 1	Apg 5
EPI : E								
EPI : N								
RMI				.208**				
L:Relief	a[1]							
	p[2]							
L:Coping	a							
	p							.237*
L:Length	a	.323*	-.348*		.351*			
	p				.363***	.361***		
L:Painful	a			.410*	-.342*			
	p				-.248*			
L:Drugs	a	.477***		.361*				
	p							
L:Excited	a							
	p							
L:Husband excited	a							
	p	.381***						
L:Help	a		.339*			.335*		-.302*
	p							
L:Embarr-assment	a	-.354*	.377*					
	p	.32	.326					
N:Anxiety	a	-.151*		.194*				
	p5[3]					.251*		
	p42[4]				-.274*			
N:Depression	a	-.186*	.193*	.237***				
	p5	-.228+				.238*	-.319*	-.384***
	p42			.339**	-.350**			

+p<0.1 *p<0.05 **p<0.05 ***p<0.005 ****p<0.001

[1]a = antenatal, [2]p = postnatal 1 day, [3]p5 = postnatal 5 days

[4]p42 = postnatal 42 days (CONTD/)

Table VIII.18 (CONTD)

Key to Questionnaires:

EPI: E = Eysenck Personality Inventory, Extraversion

EPI: N = Eysenck Personality Inventory, Neuroticism

RMI = Rutter Malaise Inventory

L = Labour Questionnaire

N = Nowlis Mood Adjective Check List.

According to the NMACL, older women are significantly less anxious ($p < 0.05$) and depressed ($p < 0.05$) during pregnancy, and are slightly less likely to experience post-natal depression ($p < 0.1$). They expect to feel less "embarrassed" during labour than their younger counterparts ($p < 0.05$), but do not subsequently report having been more at ease. After delivery, however, they reported that their husbands had been less excited to see the baby ($p < 0.005$) than younger couples were.

Similar relationships were found for social class, with middle class mothers anticipating a longer labour ($p < 0.05$), but also expecting more help and support from the staff in the delivery room ($p < 0.05$). They also expect to be less embarrassed during labour ($p < 0.05$), which is confirmed by their reporting less embarrassment afterwards ($p < 0.01$). They are also less likely to be depressed during the pregnancy ($p < 0.05$). Thus, middle class and older mothers have a more realistic expectation of their forthcoming labour, and approach it with less trepidation and greater maturity. This may be due to wider reading about pregnancy and birth, or the fact that they are more likely to ask for, and receive, answers from doctors. Less prurient attitudes to sexual matters and their own bodies may make them more acceptant of the indignities during labour and the presence of unnamed strangers monitoring their progress. Kitzinger (1982) has recently made some of these same points.

Multipara had a higher "malaise" score during pregnancy ($p < 0.05$), and they were more likely to be anxious ($p < 0.05$) or depressed ($p < 0.001$) at 36 weeks. Rather surprisingly, they expected more pain ($p < 0.05$) and medication ($p < 0.05$) during labour even though, obstetrically, they are less likely to require them, since multipara tend to have shorter

labours. When questioned after delivery, however, parity was not associated with length of labour as they remembered it, or the amount of pain or medication received. Multipara continued to have a higher depression score at 6 weeks post-partum ($p < 0.01$). This might be due to the emotional adjustment needed to adapt to extra responsibilities at home, or to the extra physical demands of coping with two or more young children in the early weeks after birth.

Looking next at the length of labour, it is interesting that women who expected a longer labour did in fact end up with a longer first stage ($p < 0.05$), and were more likely to report having had a longer labour ($p < 0.005$). A long second stage of labour was not usually anticipated by patients, but was significantly associated with reports of having experienced a longer labour ($p < 0.005$). A longer first stage of labour was also associated, rather surprisingly, with both expectations ($p < 0.05$) and recall ($p < 0.05$) of less pain. It may be that women expect or recall more pain with regard to an induced labour (which in theory should be shorter) (Kitzinger, 1975; Oakley, 1980). However, in our sample of patients there was a significant association between higher maximum doses of syntocinon (whether it be for induction or augmentation) and increased length of both first ($p < 0.001$) and second stages ($p < 0.001$) of labour.

A longer first stage of labour was also associated with less anxiety ($p < 0.05$) and depression ($p < 0.01$) at 6 weeks post-partum, but not with the mood scores at any other time. Thus longer labour is not a pre-disposing factor in post-partum depression, nor does it seem to be related to antepartum worries.

Women who expect to receive less help from the staff end up having a longer second stage of labour ($p<0.05$). There is no ready explanation for this, except that less trust and confidence in the midwifery staff may be a general indicator of tension which could delay prolong expulsion of the baby. Or, knowledge of the mechanics of labour may go hand in hand with faith in the medical attendants; and thus ineffectual pushing during second stage and an unwillingness to listen to the midwife may together delay delivery. Patients with a longer second stage were much more likely to be both anxious ($p<0.05$) and depressed on day 5 ($p<0.05$).

Post-partum depression was also associated with the infant having a low Apgar score at 1 minute ($p<0.05$) and 5 minutes ($p<0.001$). Since a longer second stage was itself correlated with low Apgar scores at 1 minute ($p<0.05$) and 5 minutes ($p<0.005$) (as was a first stage of labour), it is not possible to determine which factor affected the post-partum mood scores. However, it is an intriguing finding in view of the fact that most mothers were unaware of the recording or significance of Apgar scoring, but they may perceive something amiss with the baby. Since low Apgar scores in this sample, and generally, were usually due to respiratory difficulties, the mother's distress and worry were probably caused by the use of oxygen or other resuscitative measures. It is also possible that an infant with a low Apgar score has greater difficulties with feeding, sleeping, etc. which make it more difficult to care for him, and that this makes her more anxious and depressed in the first week.

Mothers whose babies had low Apgar scores at 5 minutes later reported having coped better with their labour ($p<0.05$), and had anticipated less support from the staff ($p<0.05$). Neither of these correlations has an obvious explanation.

And, despite other studies suggesting that anxious mothers require more medication, none of the psychological indices here were related to the dose given to the mother during labour. In fact, as has been mentioned earlier, anxious mothers did not even expect to endure a more difficult labour.

In summary, extroversion and neuroticism, as measured by the Eysenck Personality Inventory during pregnancy, were not related to obstetric factors. Women going into labour for the second time were more likely to report psychosomatic symptoms on the Malaise scale, but this too was not associated with obstetric measures. However, the expectations and recollected experience of labour differed according to age, social class, and parity of the sample, as well as to some of the actual parameters of birth as recorded by the medical researchers.

Antenatal anxiety and depression seem to be partly determined by age, social class, and parity as well, but post-partum depression is more strongly associated with a longer second stage of labour and poor condition of the infant at birth, as reflected in low Apgar scores at 1 and 5 minutes. Once again, caution should be exercised regarding these conclusions, since only subsamples of the study group completed the different psychological instruments.

D. The Relationship Between Antenatal Psychological Indices And Behaviour Of The Infant And His Parents In The Delivery Room

There are several mechanisms by which maternal factors might operate to alter neonatal behaviour. Firstly, psychological stress or "malaise" might affect the infant's physiology, and in turn his behaviour, for instance through elevated catecholamine levels or high blood pressure reducing oxygenation of the fetus during labour.

Or, anxiety and fears of the birth process might lead to a more difficult and prolonged labour for the mother, which in turn would be accompanied by more medical interventions (such as higher drug dosage, syntocinon to regulate contractions, or forceps), which could increase the risk to the infant. Finally, differences in psychological outlook on parenting may directly influence the way in which the mother interacts with her infant; for instance, a more relaxed mother may stimulate the infant by bringing objects within his narrow visual field, thus increasing his orienting skills. She may also indirectly affect his learning opportunities if tension or depression makes her more inept at feeding him, or less able to console his crying, leading to increased hunger and less sleep, or fraught situations in which playful interaction is unlikely. And we cannot wholly disclaim possibilities that inheritance of genes predisposing to tension and, say, maldregulation of homeostatic mechanisms, determines early infant behaviour.

In order to examine the relationships between psychological factors in the mother and neonatal behaviour, Pearson's p-m correlations were computed between EPI extroversion and neuroticism, number of malaise symptoms, and the Nowlis mood factors of anxiety and depression, and observed and elicited infant and parental behaviours immediately after delivery. Since we were interested in global measures of psychological state, rather than making use of each item in the expected baby and expected labour questionnaires, the individual items were totalled for each instrument to yield "an expected difficulties" with "labour", or with "the baby". The potential range of scores for the labour questionnaire was from 0-36, and for the baby questionnaire from 0-24.

1. Spontaneous And Elicited Neonatal Behaviour

The correlation co-efficients for this data appear in Tables VIII. 19 and 20. Table VIII. 19 includes measures of behaviour during the first 20 minutes, while Table VIII. 20 contains elicited behaviour at the end of the first hour. Considering first the EPI measures, there appear to be few associations with newborn behaviour. Infants of more "extroverted" mothers fussed (but not cried) less in the first 20 minutes ($p < 0.05$), and changed state less frequently ($p < 0.05$). However, it was more difficult to elicit responses from their infants to the Brazelton items immediately following the free-field observations ($p < 0.05$). The infants of mothers who were "neurotic" during pregnancy were less likely to remain in a "drowsy" in-between state after birth ($p < 0.05$).

Higher malaise scores were associated with a number of infant behaviours. Infants of these mothers were also less likely to be cyanotic ($p < 0.05$) or drowsy ($p < 0.05$). Instead, they spent longer periods alert ($p < 0.001$) and with their eyes open ($p < 0.05$), during which they were more likely to scan the immediate environment ($p < 0.001$).

Anxiety as reflected in the NMACL was associated with increased startles ($p < 0.005$) and tremulousness ($p < 0.05$) in their offspring. Depression, however, was correlated with more time focussing and following stimuli in the first 20 minutes ($p < 0.05$), but greater difficulties for the examiner in eliciting the same behaviours later on ($p < 0.05$).

The infants of women who had anticipated a difficult labour were, in fact, less likely to be cyanosed ($p < 0.05$) or to suck their fingers ($p < 0.05$) in the first 20 minutes, but there were no significant associations between this measure and elicited behaviours.

Table VIII.19 RELATIONSHIP BETWEEN MATERNAL PSYCHOLOGICAL MEASURES DURING PREGNANCY AND INFANT BEHAVIOUR OBSERVED IN THE FIRST TWENTY MINUTES AFTER BIRTH

	EPI: E	EPI: N	RMI	EBQ	ELQ	N: Anx	N: Dep
LAT CRY							
LAT EYES							
EYESOP			.213*				
SCANS			.308****	.354**			
FOC/FOL							.179*
STARTLE						.286***	
TREMOR						.174*	
CYANOS			-.191*		-.406*		
H-MOUTH			.170*		-.360*		
SLEEP							
DROWSY		-.257*	-.211*				
ALERT			.301****				
CRY							
FUSS	-.288*			-.290*			
LAB-STATE	-.245*						

$^{+}0.1 > p > 0.05$ $^{*}p < 0.05$ $^{**}p < 0.01$ $^{***}p < 0.005$ $^{****}p < 0.001$

Key to Questionnaires:

EPI: E = Eysenck Personality Inventory, Extraversion
EPI: N = Eysenck Personality Inventory, Neuroticism
RMI = Rutter Malaise Inventory
EBQ = Expected Baby Questionnaire
ELQ = Expected Labour Questionnaire
N:Anx = Nowlis Mood Adjective Check List, Anxiety
N:Dep = Nowlis Mood Adjective Check List, Depression

Table VIII.20 RELATIONSHIP BETWEEN PSYCHOLOGICAL MEASURES DURING PREGNANCY AND ELICITED BEHAVIOUR OF THE INFANT IN THE FIRST HOUR AFTER BIRTH

	EPI: E	EPI: N	RMI	EBQ	ELQ	N: Anx	N: Dep
INANVIS				.278*			
INANAUD							
ANVIS							
ANAUD							
ANVISAUD							
ALERT							
EASE-ELICIT	-.241*			.299*			
REACTIV							-.206*

$^{+}0.1 > p > 0.05$ $^{*}p < 0.05$ $^{**}p < 0.01$ $^{***}p < 0.005$ $^{****}p < 0.001$

Key to Questionnaires:

EPI: E = Eysenck Personality Inventory, Extraversion
EPI: N = Eysenck Personality Inventory, Neuroticism
RMI: = Rutter Malaise Inventory
EBQ = Expected Baby Questionnaire
ELQ = Expected Labour Questionnaire
N: Anx = Nowlis Mood Adjective Check List, Anxiety
N: Dep = Nowlis Mood Adjective Check List, Depression

Contrary to what one might hypothesise, mothers-to-be who expected to have a difficult baby gave birth to one who scanned his immediate surroundings ($p < 0.01$) and fussed less ($p < 0.05$) immediately after birth. Even the examiner found them easier to test ($p < 0.05$), and they demonstrated better tracking of an inanimate object ($p < 0.05$) than their peers born to nothers who held a more "optimistic" view of baby behaviour.

2. Parental Behaviours In The Delivery Room

In addition to any effects of antenatal anxiety on the infant, one would also expect relationships between these antenatal feelings or expectations and the mother's behaviour with her infant immediately after she has given birth to him. In the analysis we considered the number of intervals in which the mother held, looked at, talked to, or interacted with the infant in the first 20 minutes and an overall rating of both mother's and father's quality of interaction over the entire time that they were observed. This period generally lasted between 1 and 1½ hours; the ratings were made after this because occasionally the mother, and often the father, did not get to hold the baby for long enough in the initial 20 minutes for us to form any impression of their interactions.

Extrovert mothers spent a greater amount of time talking to their infants ($p < 0.05$), but there were no associations with neuroticism (Table VIII. 21). The husbands of women with a high malaise score were rated more favourably on the quality of their own interaction with the baby ($p < 0.05$) even though malaise in the women themselves did not seem to be reflected in their behaviour. Women who expected

Table VIII. 21 RELATIONSHIP BETWEEN MATERNAL PSYCHOLOGICAL MEASURES DURING PREGNANCY AND BEHAVIOUR OF THE PARENTS AFTER THE BIRTH OF THEIR INFANT

	EPI: E	EPI: N	RMI	EBQ	ELQ	N: Anx	N: Dep
M/F holds I						$-.149^{+}$	
M interacts I						$-.168^{*}$	
M looks I						$-.136^{+}$	
M talks I	$.220^{*}$						
M examines I				$-.255^{*}$		$-.187^{*}$	
Rating M						a^{*}	a^{***}
Rating F			$.215^{*}$				

$^{+}0.1 > p > 0.05$ $^{*}p < 0.05$ $^{**}p < 0.01$ $^{***}p < 0.005$ $^{****}p < 0.001$

M = Mother; F = Father; I = Infant

a = These significance levels are from a special regression analysis carried out later; actual R values are missing.

Key to Questionnaires:

EPI: E = Eysenck Personality Inventory, Extraversion
EPI: N = Eysenck Personality Inventory, Neuroticism
RMI = Rutter Malaise Inventory
EBQ = Expected Baby Questionnaire
ELQ = Expected Labour Questionnaire
N: Anx = Nowlis Mood Adjective Check List, Anxiety
N: Dep = Nowlis Mood Adjective Check List, Depression

a difficult infant spent less time touching or examining ($p < 0.05$) their own infant in the delivery room. Expectations of a difficult labour were not related to maternal behaviour with the infant, which is not altogether surprising.

The most frequent associations with maternal behaviour were due to anxiety on the Nowlis checklist, with anxious mothers seeming more "inhibited" with their infant. They interacted less with their infant ($p < 0.05$), looked at him less ($p < 0.1$), and were less likely to touch or examine him ($p < 0.05$). The infant was less likely to be held by either parent during this period ($p < 0.1$), although the correlation failed to reach significance. Even on the ratings made later there was a significant relationship between low maternal scores and both anxiety ($p < 0.05$) and depression ($p < 0.005$).

There were a number of modest, but meaningful, associations between prenatal psychological factors and neonatal and maternal behaviour in the hour following birth. Extroverted women talked more to their infants, and the infants were less fussy and changeable in state, although it was difficult to elicit behaviour from them. Expectations of a more difficult baby, however, were not matched by such behaviour on the part of the infant; these infants were more responsive, even though their mothers showed a reluctance to touch or examine them in the delivery room. Expectations of a difficult delivery were not related to either maternal or neonatal behaviours.

Women who were noted as anxious during the last trimester of pregnancy seemed more "inhibited" in their interaction with their infant, although if they appeared unsure of themselves it may be that the nursing or medical staff were less likely to put the infant into their arms in the first place.

Infants of anxious mothers were more "jittery" during the first twenty minutes, and some might argue for the inheritability of nervous tension, but it does seem far-fetched. However, "malaise" or psychosomatic tension during pregnancy is associated in this study with more positive infant behaviours, in particular, visual alertness. The correlation between antenatal malaise in the mother and better interaction between the father and his infant is a curious one, but it may be that such fathers become more accustomed to "coping" during pregnancy, which is then carried over to their behaviour with their infant. Depression in the mothers antenatally is associated with only two infant behaviours, on the one hand with enhanced visual behaviour, and on the other, with the tester's difficulty in eliciting responses.

Because we cannot be certain of the reasons for antenatal stress we can only speculate about its association with behaviour immediately after delivery. Mothers who are worried only that the baby "won't be all right" but find that he or she is perfect and healthy might not show any continuity of anxiety symptoms once the birth itself is over and their fears are disconfirmed. In contrast, a woman who is neurotic and anxious about her capability as a mother may continue to be uncertain and self-deprecating about herself during labour, birth, and for some time after.

E. Correlations Between Antenatal Psychological Indices And Brazelton Neonatal Behavioural Assessment Scale (BNBAS) Scores

We arbitrarily selected day 3 for an analysis of the impact of maternal psychological factors on neonatal behaviour; results are presented in Table VIII. 22. It is clear that the frequency and power

Table VIII. 22 RELATIONSHIP BETWEEN PSYCHOLOGICAL MEASURES DURING PREGNANCY AND NEONATAL BEHAVIOUR ON THE BNBAS ON DAY 3

	EPI: E	EPI: N	RMI	EBQ	ELQ	N: Anx	N: Dep
TONE				-.278*			
DEFENS					.385*		
IRRITAB					-.344*		
ACTIVTY		-.237*					
S-QUIET				.235*		.223**	

$^{+}0.1 > p > 0.05$ $^{*}p < 0.05$ $^{**}p < 0.01$ $^{***}p < 0.005$ $^{****}p < 0.001$

Key to Questionnaires:

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EPI: N = Eysenck Personality Inventory, Neuroticism
RMI = Rutter Malaise Inventory
EBQ = Expected Baby Questionnaire
ELQ = Expected Labour Questionnaire
N: Anx = Nowlis Mood Adjective Check List, Anxiety
N: Dep = Nowlis Mood Adjective Check List, Depression

of such correlations is extremely low. Out of 26 BNBAS items only 5 showed any relationship - tone, defensive movements, irritability, activity and self-quieting - and 4 out of these 5 were at the 0.05 level only. "Neurotic" symptoms (EPI) were related to less active babies, while "anxious" mothers (NMACL) had babies who quieted more easily. Mothers expecting a more difficult infant had one whose tone was poorer but who consoled easily. The infants of mothers anticipating a more difficult labour had better defensive movements and were less irritable.

The items seem to have little internal consistency (3 are "motor", 2 are "state control") nor are they similar to those correlations between the same psychological variables and infant behaviour in the first hour.

Because these findings were a bit surprising a more comprehensive correlation matrix was performed on the NMACL — Anxiety and Depression items from the antenatal period, day 5, and 6 weeks versus all 26 of the BNBAS items on days 1, 3, 7, 21 and 42. This still failed to yield anything of interest, and only produced 15 correlations of significance - again fewer than would be expected by chance. There were also only a few contiguous relationships; for instance, babies tested at 6 weeks whose mothers were still anxious had poorer tracking and alertness, and were more tremulous.

Therefore it seems possible only to conclude that there is little apparent relationship between a mother's psychological state and her baby's behaviour after the birth itself.

IX CONCLUSION

A. To What Extent Does Maternal Medication Affect Neonatal Behaviour?

Based on the literature, our initial hypothesis was that both pethidine (intramuscular) and bupivacaine (epidural anaesthesia) would deleteriously alter neonatal behaviour in the first weeks of life. It was expected that such effects would be most marked in the first few hours and days of life, but we chose six weeks as our final testing point in order to document the waning of any effects. According to existing studies, pethidine should have depressed respiration, made feeding more difficult and unpredictable, and altered habituating responses. Bupivacaine is reputed to be most disruptive to tone and motor organisation and control of state. A neurological assessment in the first week was included in the protocols to establish that the infants were not markedly abnormal and to have an independent paediatrician's assessment of any subtle changes in reflex status. However, we anticipated fewer effects here than on the "higher order" skills such as orientation, alertness, social interaction, and the organisation of sleeping and feeding.

1. First Comparisons: Pethidine, Bupivacaine And No-Drugs

Our findings did not entirely support these hypotheses. The first analysis took account only of the presence or absence of drug, i.e. it was a "between-groups" multiple regression design. At 1 minute the Apgar scores were lower in the infants exposed to pethidine or bupivacaine than in the controls, but this difference was no longer significant at 5 minutes. A few physiological sequelae were also noted by the psychologists in their 20-minute time-sampling observation; in the pethidine

group infants received oxygen for longer and showed uncontrolled rolling eye movements, but less blinking. There was no effect of medication on attention and social responsiveness, motor organisation, state control or reactions to stress during the continuous observation or the BNBAS items administered at the end of the first hour. Mothers who had had an epidural talked significantly less to their infants, and those with pethidine slightly less. However, since the mean time spent talking (for all mothers) was only 1½ minutes (out of 20) the impact of this "disadvantage" is questionable.

Examination of the BNBAS data for the 22 items on each of 5 occasions over the next 6 weeks indicated virtually no differences between the three groups. On day 3 only, infants in the pethidine group were slower at habituating to a bell than the control group. On the Prechtl Neurological Examination (PNE) infants in the two drug groups demonstrated slightly exaggerated tendon reflexes only.

Drugs did not affect sleep cycles and feeding patterns in the first 6 weeks, with two exceptions: on day 3 infants in the pethidine group had a shorter mean sleep bout and infants in the bupivacaine group took fewer feeds on day 5.

Despite the fact that significant differences were absent in these comprehensive records over the first 7 days, and at 3 and 6 weeks, drug group membership did seem to alter a mother's perception of her baby's feeding and sleeping. On the day 7 questionnaire babies in the two drug groups were more likely to be rated as having sleeping difficulties and in settling to a predictable pattern; this was particularly so in the epidural group. At 6 weeks mothers in the pethidine, and, again, even more so in the epidural group, indicated their babies to be having significantly greater feeding problems. However, because the numbers of mothers who

completed the forms did not meet the criteria for multiple regression, these differences may be partially attributable to labour and delivery variables rather than just pethidine or bupivacaine. A series of correlations between the questionnaire and the sleep and feed diaries suggested that shorter sleep bouts throughout the first week and the need for frequent feeds were consistently associated with maternal perceptions, even though these items were not always correlated with drug use.

2. Dose-Related Measures And Neonatal Outcome

In the second analysis, behavioural measures were the dependent variables in a multiple regression design which examined a series of dose-related measures of each drug: total maternal dose, concentration in the neonate's cord blood at delivery, half-life, and an equation of "exposure", both pre- and post-delivery.

When the drug variables were analysed for the first hour of life no effect of pethidine was found on elicited orientation skills or alertness, motor organisation or control of state. However, in the first 20-minute period there was a longer delay to first cry, increased time cyanotic, decreased crying, less visual scanning, and more uncontrolled eye movements. The more pethidine that the mother had received the less likely she was to hold her infant, look at him, or interact generally over that period.

Over the following 6 weeks Attention and Social Responsiveness items were diminished: out of seven items in this category, four were worse on day 1, one on day 3, five on day 7, two on day 21, and three on day 42. All 5 items measuring Tone and Motor Organisation were adversely affected by at least 1 of the drug variables on 1 or more occasions: two on days 1, 2 and 3; one on day 21, and two again on day 42. However, on day 3

cord levels and a longer half-life were associated with better defensive movements and better hand-to-mouth skills.

Of the 8 State Control items, only peak of excitement, lability of states, and self-quieting were dependent on the drug measures. None were significantly worse on the first day, but there was 1 association on days 3 and 7, and all of the 3 on days 21 and 42. There were no effects of drugs on the habituation items. There was also no dose-related contribution to the variance on the startle and tremulousness items which make up Physiological Response to Stress. Probably because it did reflect both drug concentration and the rate of elimination, "exposure" to pethidine proved to be the most sensitive measure; the exception to this was on day 1, where simple half-life was most predictive.

Even dose-related drug measures were minimally associated with neurological integrity; the only significant effect being a greater number of "non-optimal" eye signs and less activity when awake. No drug effects were evident in feeding intake or skills at any sample period. Higher cord blood concentrations of pethidine were only associated with longer sleep bouts on day 1 and more time asleep on day 3.

There were 8 significant associations between cord blood concentrations of bupivacaine or pre-delivery exposure and responses in the first hour. Although a greater drug exposure was correlated with a shorter latency to cry, some minor respiratory stress was probably indicated by prolonged periods of mucous extraction and cyanosis. Greater exposure was also associated with less time spent alert and scanning the environment, and, probably inversely, reflected in more blinking instead. The total dose of bupivacaine given to the mother was unrelated to behaviour and there were no effects of the drug on maternal interaction measures.

Over the next six weeks drug effects were particularly marked, widespread, and fairly consistent. This was especially so in the dimension of Attention and Social Responsiveness, where, with the exception of consolability, every item was affected on at least 2 occasion - 4 associations on day 1, one on day 2, four on day 7, three on day 21, and four on day 42. Poor Motor Organisation (less activity, less hand-to-mouth behaviours, and defensive reactions) was related to one or more drug measures in the first week, but only activity was still diminished at 3 and 6 weeks. There seems no explanation for the fact that muscle tone - both general tonus and elicited pull-to-sit - improved with bupivacaine levels on days 3 and 7, though it was poor in relation to a longer half-life on the first day.

State Control was affected to a lesser extent than the other dimensions, although on day 3 babies with a high cord blood level or greater exposure cried earlier in the assessment, were more irritable overall, changed state more frequently and were less likely to quiet themselves. They still tended to become more upset and unable to comfort themselves at 6 weeks if their exposure to bupivacaine had been longer. In the Physiological Response to Stress dimension, drug exposure curves were associated with marked tremulousness or startles on each of the 5 assessment sessions. As with pethidine, the exposure measure was most consistently related to unfavourable BNBAS behaviours over the 6 week period, but cord blood concentration of bupivacaine was almost as predictive.

The only neurological effect was exaggerated tendon reflexes associated with a longer half-life. Data from the sleep and feed records indicated that babies with high delivery cord blood levels of bupivacaine continued to be sleepier on day 3, and to average a longer sleep bout on day 4. On each of the first 3 days babies whose mothers received

larger doses of bupivacaine were rated as poorer feeders on the daily charts. If this reflects a dose effect on maternal skill then it is surprising not to find a similar dose-related effect on maternal behaviour in the delivery room in the first hour observations and ratings. Also, if it indicates problems on the mother's part one might expect to see similar correlations with parity or social class, which there were not. In contrast it may be a neonatal difficulty, since total maternal dose - which was seldom related to infant behaviour - was significantly associated with fewer hand-to-mouth movements on day 1.

The effects of pethidine in the neonate are very similar to those expected from its known actions in the adult (Jaffe and Martin, 1975). Thus in adults it causes drowsiness and, at higher doses, more generalised CNS depression, and depresses respiration. Drowsiness and respiratory depression occur after doses similar to those used in this study. These findings and the behavioural evidence presented here suggest that the neonate responds to the drug in the same way as does the adult. The blood levels of pethidine in the fetus and neonate are similar to those seen in the mother, but are sustained for longer.

It is hard to relate the observed effect of bupivacaine in these infants to those seen in adults after the administration of this and related local anaesthetics. In adults systemic and central effects are only seen after overdose by inappropriate routes (Ritchie and Cohen, 1975). Bupivacaine is a central nervous system depressant, which first causes stimulation, by inhibition of inhibitory pathways, followed by depression and convulsion. These effects are seen only at high plasma concentrations in adults; the same is true of the few cases of reported mepivacaine toxicity in neonates.

It is clear, then, that the newborn infant differs from the adult in sensitivity, since the plasma levels obtained in the newborn are very low. He also differs in the nature of the effects, since primarily depressant actions are evident, although it could be argued that increased tremor, startles, and heightened irritability are "stimulant" actions. The presence of altered behaviour despite low circulating plasma levels of bupivacaine, and the persistence of these for many weeks after the drug was no longer measurable, may be due to the greater ease of penetration of the blood-brain barrier in the neonate.

No realistic comparison can be made between the results of this and other studies, because of differences in design or aim: for example, pethidine has been administered with another analgesic or anaesthetic (Brackbill et al, 1974a), recoded in analysis as "weighted means" or "potency scores" (Conway and Brackbill, 1970; Standley et al, 1974; Stechler, 1964), or investigated in relation to behaviour substantially different from that measured by BNBAS items (Borgstedt and Rosen, 1968). One coincident finding is that when pethidine was administered in addition to epidural anaesthesia, using prilocain (Brackbill et al, 1974a), infants of the "no-pethidine" group were more alert and responsive, and were consoled more easily.

The overall conclusion is that greater "exposure" to pethidine and bupivacaine results in neonatal behaviour which is significantly depressed in areas of functioning that might affect the ability of the mother to adjust to her baby in the first few weeks of his life. The present data cannot answer Richards and Bernal's claim (1971) that early difficulties with the infant may lead to an altered mode of interaction and thus have developmental consequences for the infant, particularly since the observations here were made in an artificial situation which may not be

first hour of life, no one factor exerted a consistently marked effect: For instance, although obstetrically the primiparous patient faces a more unpredictable and difficult labour, the firstborn infants in our sample did not suffer any untoward morbidity. Neither were long labours (first or second stage) particularly very detrimental to the baby's subsequent behaviour. However, when long, both stages were associated with the administration of syntocinon, which at greater amounts led to babies who were sleepier in the first 20 minutes and had rolling eye movements. Forceps were more likely to result in frequent startles.

Although low Apgar scores and the need for resuscitation did not affect neonatal skills and responsiveness, an Apgar score which remained low at 5 minutes was associated with a low rating of the mother's overall interest in, and attitude toward, the infant. A father was more likely to receive a lower score on this rating too when his wife had had a long labour or required a forceps delivery. When the Apgar score was still low at 5 minutes, the baby was more likely to need "intrusive" handling in the form of sudden movement, resuscitation maneuvers, and so on. Such handling was significantly related to a decreased time spent in either parent's arms, or interacting with mother. Although our sample were all low-risk normal deliveries, the nature of the above sequence of events suggests that "high risk" deliveries could potentially alter parental behaviour by removing some of the opportunities for involvement and by making the mother and father more hesitant in their interaction with the new baby.

Obstetric effects on behaviour over the next six weeks were equally patchy. Parity and social class were related to only 4 social responses and 1 motor item out of the 60 items analysed in these 2 dimensions over the 5 assessments. A longer labour correlated with better scores on 4

items, although more syntocinon did predict poor general tone on day 7 and poor pull-to-sit on day 42. Like long labours, forceps seemed to "improve" some responses and diminish one or two others. Even the infant's respiratory condition had unremarkable sequelae; low Apgar scores at 1 minute predicted one improved visual and auditory score on day 7 and one diminished tone item on day 42, and the use of mask oxygen at delivery was associated with more startles on the first day.

We also examined the effect of hyperbilirubinaemia (jaundice) on BNBAS scores on days 3 and 7, since our pilot testing had indicated an excess of low scores in those with significantly high bilirubin levels. However, only 3 items on day 3 differentiated the groups (non-jaundiced, "mild" jaundice, "clinical" jaundice) at all, and in two of these comparisons those infants with mild jaundice performed better than the controls, even though those with clinically significant jaundice did worse. With only nine infants in the clinically jaundiced group, it is unlikely that their low scores have confounded the drug effects. The sex of the baby contributed little to the variance in behavioural scores either. Only a few BNBAS items were affected over the weeks, and the significance value was usually minimal when infant weight was taken into account.

C. How Much Does The Mother Herself Determine Her Infant's Behaviour?

Lastly, we looked at psychosocial characteristics of the mother which might determine the kind of labour and amount of medication she receives and more directly, influence her baby's behaviour. Before the study began we were concerned that the three groups would differ in their attitudes and expectations of childbirth and a new baby, or in their psychological make-up. Although our assessment of these factors

was less comprehensive than desired, scores on the 5 instruments (Eysenck Personality Inventory, Rutter Malaise Inventory, Nowlis Mood Adjective Checklist, an Expected Labour Questionnaire, and an Expected Baby Questionnaire) at 36 weeks of pregnancy indicated no significant differences on any of the 32 measures.

When these items were analysed in relation to obstetric events and outcome there were no significant associations between the EPI "Extraversion" and "Introversion", total Malaise score, NMACL "Anxiety" and "Depression", or expectations of "Coping" and either maternal drug dose, length of labour, or the baby's Apgar scores. Thus, for example, "anxious"[1] mothers did not require greater analgesia or anaesthesia to get through a difficult labour, culminating in a "compromised" baby.

However, maternal characteristics partly determined initial behaviours to the infant. "Extraverted" women talked more to their infants, who were (perhaps in turn) less fussy and labile in state, though they were in fact less responsive to the examiner during administration of the selected BNBAS items in the delivery room. "Anxious" women were more "inhibited" in their responses to the infant, looking and touching less, and interacting for a shorter period. Their infants were more tremulous and startled frequently in the first 20 minutes. Infants of "depressed" mothers, however, were more visually attentive in the first 20 minutes, though, in fact, less so during the elicited BNBAS items just after that. Ratings of maternal attitude and interaction were lower in those mothers scoring as anxious or depressed during pregnancy.

To assess the continued impact of pre-delivery psychological variables the BNBAS scores on day 3 were analysed in detail. Few of the correlations were significant and those that were seemed inconsistent,

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[1] It should be remembered that these descriptions are based on a continuum of scores, and do not indicate discrete labels.

low-powered and dissimilar to the earlier delivery room items. For example, "neurotic" mothers had less active babies while infants of "anxious" mothers quieted more easily. When the NMACL depression and anxiety items from 36 weeks, 5 days postpartum and 6 weeks postpartum, were correlated with all the BNBAS items from 1 to 42 days, there was still little of significance or interest. This would suggest that a mother's degree of adaptation to pregnancy and expected childbirth may determine her initial responses to the baby, and perhaps, some of his responses to her, but that there is little evidence that her personality characteristics directly altered the social, motoric, or organisational skills that were measured during the subsequent weeks.

D. The Implications Of Research On Medication And Behaviour

The precise nature of the way in which drugs alter physiological processes or behaviour is difficult to determine. Effects could be attributed to either a direct (primary or secondary) action of the drug during labour on the immature brain, or by residual amounts after delivery interfering with recovery from the stresses of labour. As has already been suggested, the mother may develop different modes of interaction with the infant in response to his disorganised behaviour, and these less "optimal" styles might in turn lead to later problems. If, as Stratton (1977) suggests, the function of the neonatal period "is to establish in the mother an understanding of her baby and an appropriate set of attitudes towards him" then these could be distorted by her beliefs about the effect of obstetric events on her infant.

However, it is extremely difficult to single out one influence among a host of co-varying perinatal factors, as Fig. IX:1 illustrates. And, quite apart from any effects of delivery, the newborn is himself

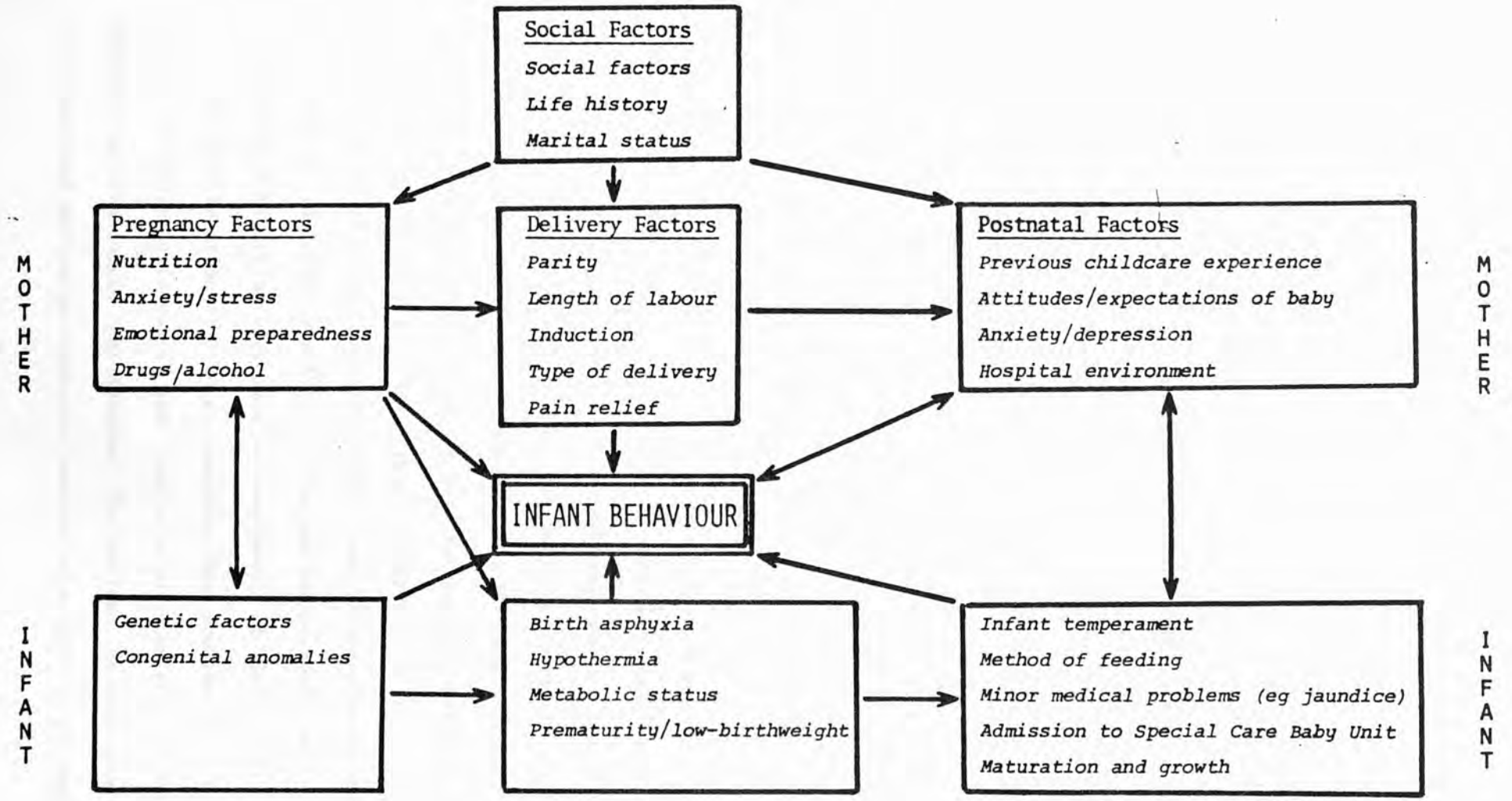

FIGURE IX:1 POSSIBLE INFLUENCES OF NEONATAL, MATERNAL AND PERINATAL FACTORS ON INFANT BEHAVIOUR

a rapidly changing and maturing organism, involved in continuing complex transactions with his environment. It is important to remember too that behavioural differences which are "significant" in statistical terms may go completely unnoticed by the mothers themselves, the investigators, and the attending paediatricians. For instance, we were often surprised to discover in the analysis that a dopey, unresponsive infant we had tested was the product of a straightforward, "no drug" delivery, and vice versa. Setting the "between-groups" analysis against the "within-groups" one also implies that many mothers who received either bupivacaine or pethidine had babies who performed as well, and sometimes better, than those who had not been given drugs. On the other hand it is clear from some of our data that mothers can <u>believe</u> their babies are more "difficult" even when comprehensive and standardised tests fail to reveal systematic differences.

Whether these results are applicable to other populations remains to be tested. For example, for a healthy full-term infant these minor and transient changes in physiology or behaviour may be unimportant, but for the already compromised infant (e.g. preterm, small-for-gestational-age baby, or delivered by caesarean section), the administration of analgesics and anaesthetics may have more far-reaching and long-lasting consequences. However, in longitudinal studies of children differing in their perinatal "risk" status, social class has usually outweighed the effect of all other variables by the pre-school years, with a stimulating environment overcoming a long period of birth anoxia.

The proliferation of studies examining drug combinations, particularly on top of "anaesthetic bases" adds little to our knowledge of pharmacokinetics or behavioural consequences. To conclude, as many have done, that "maternal medication depresses newborn behaviour" is as meaningless

as proclaiming that "food can cause allergies". In the absence of systematically collected long-term data on individual compounds, it is simply not possible to specify the safest choice of drugs and course of administration. However, it seems prudent to keep the total dosage of medication to a minimum and to administer it early in labour.

Among many women in recent years there has been a desire for a less technological and more "natural" childbirth, including a move away from the use of medication for pain relief in labour. In the absence of an "ideal" drug, the medical profession could do more to endorse and encourage maternal relaxation techniques which may help make patients comfortable with low doses of medication.

We have seen that psychological traits in the mother determine many of her expectations of the birth to come and the baby she is carrying, as well as influencing some of her adjustments to him after birth. Safe delivery of this infant marks the climax of nine months of hopes and plans, and often of anxieties and irrational fears about his well-being. For some women, present antenatal care and hospital confinements have come to represent an enforced regime with perceived disadvantages for themselves and deleterious consequences for the baby; unfortunately, a conviction that their baby shows "drug effects" is often one of them. It is really up to midwives and obstetricians to give every mother a sense of achievement about her labour and a level of confidence in her interaction with the baby which will serve to enhance his positive attributes and compensate for any transient problems whatever their cause.

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APPENDIX I SAMPLE FORMS FOR DATA COLLECTION AND ANALYSIS

Summary Sheet (mother)

		Obs	Reason if not taken
Midwife Package 1 (drugs)			
2 (baby)			
Antenatal Interview *			
Delivery Rating			
Day 1:			
Labour Q			
Ratings			
Interview *			
Day 5:			
Video feed *			
Nowlis checklist			
Day 7:			
"Your baby" Q			
Ratings			
3 and 6 week diary given			
3 weeks:			
Daily Diary			
6 weeks:			
Daily Diary			
"Your baby" Q			

Name_____ Hosp. no. _____ A/S _____

b.d. _____ time _____ Sex _____

* = Nuffield Patient

Summary Sheet

Antenatal Questionnaire Pack 1		Obs.	Reason if not taken
2			
Delivery: Time - Sample			
Record			
Non-Nutritive			
Day 1 : Brazelton			
Non-nutritive Sucking			
Interaction Video			
Day 3 : Brazelton			
Non-nutritive			
Nutritive feed			
Day 6 : Prechtl			
Day 7 : Brazelton			
Non-nutritive			
Nutritive feed			
Day 21 : Brazelton			
Auditory Discrimination			
(Visual Discrimination)			
Day 42 : Brazelton			
Auditory Discrimination (same condition)			
(Visual Discrimination)			

Name: _____ Hosp. No._____Subject_____

b.d. _____ time:_____ Sex_____

HEALTH QUESTIONNAIRE (= RUTTER MALAISE INVENTO

For
Us

PLEASE RING THE CORRECT ANSWER

1 Do you often have back-ache?	Yes No
2 Do you feel tired a lot of the time?	Yes No
3 Do you often feel miserable or depressed?	Yes No
4 Do you often have bad headaches?	Yes No
5 Do you often get worried about things?	Yes No
6 Do you worry a lot of the time?	Yes No
7 Does worrying make you cross or edgy with people?	Yes No
8 Do you usually have great difficulty in falling or staying asleep?	Yes No
9 Do you usually wake unnecessarily early in the morning?	Yes No
10 Do you cry easily?	Yes No
11 Do you ever get in a panic?	Yes No
12 Do you often get into a violent rage?	Yes No
13 Do people often annoy and irritate you?	Yes No
14 Do you often suddenly become anxious for no good reason?	Yes No
15 Do you get upset at being alone when there are no friends near you?	Yes No
16 Are you easily upset or irritated?	Yes No
17 Are you frightened of going out alone or of meeting people?	Yes No
18 Are you sleeping well?	Yes No
19 Are you constantly keyed up and jittery?	Yes No
20 Do you suffer from indigestion?	Yes No
21 Do you often suffer from an upset stomach?	Yes No
22 Is your appetite poor?	Yes No
23 Have you enough energy?	Yes No
24 Does every little thing get on your nerves and wear you out?	Yes No
25 Are you troubled with rheumatism or fibrosis?	Yes No
26 Have you ever had a nervous breakdown?	Yes No
27 Have you felt you weren't up to talking to people and that you wanted to be alone?	Yes No
28 Have things ever got so bad you felt like ending it all?	Yes No
29 Do you have quite rigid routines for doing things?	Yes No
30 Are you fussy or finicky about anything?	Yes No

74 (=EYSENCK PERSONALITY INVENTORY)

PLEASE RING THE CORRECT ANSWER

		For Use
1. Do you often long for excitement?	~~Yes~~ No	
2. Do you often need understanding friends to cheer you up?	~~Yes~~ No	
3. Are you usually carefree?	~~Yes~~ No	
4. Do you find it very hard to take no for an answer?	~~Yes~~ No	
5. Do you stop and think things over before doing anything?	Yes ~~No~~	
6. If you say you will do something do you always keep your promise, no matter how inconvenient it might be to do so?	~~Yes~~ No	
7. Does your mood often go up and down?	~~Yes~~ No	
8. Do you generally do and say things quickly without stopping to think?	~~Yes~~ No	
9. Do you ever feel "just miserable" for no good reason?	~~Yes~~ No	
10. Would you do almost anything for a dare?	~~Yes~~ No	
11. Do you suddenly feel shy when you want to talk to an attractive stranger?	~~Yes~~ No	
12. Once in a while do you lose your temper and get angry?	Yes ~~No~~	
13. Do you often do things on the spur of the moment?	~~Yes~~ No	
14. Do you often worry about things you should not have done or said?	~~Yes~~ No	
15. Generally, do you prefer reading to meeting people?	~~Yes~~ No	
16. Are your feelings rather easily hurt?	~~Yes~~ No	
17. Do you like going out a lot?	~~Yes~~ No	
18. Do you occasionally have thoughts and ideas that you would not like other people to know about?	~~Yes~~ No	
19. Are you sometimes bubbling over with energy and sometimes very sluggish?	Yes No	
20. Do you prefer to have few but special friends?	~~Yes~~ No	
21. Do you daydream a lot?	~~Yes~~ No	
22. When people shout at you, do you shout back?	~~Yes~~ No	
23. Are you often troubled about feelings of guilt?	~~Yes~~ No	
24. Are all your habits good and desirable ones?	Yes ~~No~~	
25. Can you usually let yourself go and enjoy yourself a lot at a lively party?	Yes ~~No~~	

		For Off. Use Only
26. Would you call yourself tense or "highly-strung"?	~~Yes~~ No	
27. Do other people think of you as being very lively?	Yes No	
28. After you have done something important, do you often come away feeling you could have done better?	~~Yes~~ No	
29. Are you mostly quiet when you are with other people?	Yes ~~No~~	
30. Do you sometimes gossip?	Yes No	
31. Do ideas run through your head so that you cannot sleep?	~~Yes~~ No	
32. If there is something you want to know about, would you rather look it up in a book than talk to someone about it?	~~Yes~~ No	
33. Do you get palpitations or thumping in your heart?	~~Yes~~ No	
34. Do you like the kind of work that you need to pay close attention to?	~~Yes~~ No	
35. Do you get attacks of shaking or trembling?	~~Yes~~ No	
36. Would you always declare everything at the customs, even if you knew that you could never be found out?	Yes ~~No~~	
37. Do you hate being with a crowd who play jokes on one another?	~~Yes~~ No	
38. Are you an irritable person?	~~Yes~~ No	
39. Do you like doing things in which you have to act quickly?	~~Yes~~ No	
40. Do you worry about awful things that might happen?	~~Yes~~ No	
41. Are you slow and unhurried in the way you move?	~~Yes~~ No	
42. Have you ever been late for an appointment or work?	Yes ~~No~~	
43. Do you have many nightmares?	~~Yes~~ No	
44. Do you like talking to people so much that you never miss a chance of talking to a stranger?	~~Yes~~ No	
45. Are you troubled by aches and pains?	~~Yes~~ No	
46. Would you be very unhappy if you could not see lots of people most of the time?	~~Yes~~ No	
47. Would you call yourself a nervous person?	~~Yes~~ No	
48. Of all the people you know, are there some whom you definitely do not like?	~~Yes~~ No	

TIME..... NAME..... HOSP.No.....DATE.....

MOOD CHECK LIST

Each of the words in the following list describes feelings or mood. Please use the list to describe your feelings at this moment. Mark each word according to these instructions:

If the word definitely described how you feel at the moment you read it, circle the double cross (xx) to the right of the word. For example, if the word is calm and you are definitely feeling calm at the moment, circle the double cross as follows:

calm (xx) x ? no

(This means you definitely feel calm at this moment.)

If the word only slightly applies to your feelings at the moment, circle the single cross as follows:

calm xx (x) ? no

(This means you feel slightly calm at the moment.)

If the word is not clear to you or if you cannot decide whether or not it describes your feelings, circle the question mark as follows:

calm xx x (?) no

(This means you cannot decide whether you are calm or not.)

If you clearly decide that the word does not apply to your feelings at this moment, circle the no as follows:

calm xx x ? (no)

(This means you are sure you are not calm at this moment.)

Work rapidly. Your first reaction is the best.
Work down the first column before going to the next.
Please mark all the words. This should take only a few minutes.

worthless	xx	x	?	no	sad	xx	x	?	no
angry	xx	x	?	no	earnest	xx	x	?	no
concentrating	xx	x	?	no	sluggish	xx	x	?	no
drowsy	xx	x	?	no	forgiving	xx	x	?	no
affectionate	xx	x	?	no	tensed up	xx	x	?	no
apprehensive	xx	x	?	no	lonely	xx	x	?	no
blue	xx	x	?	no	cocky	xx	x	?	no
boastful	xx	x	?	no	lighthearted	xx	x	?	no
elated	xx	x	?	no	energetic	xx	x	?	no
active	xx	x	?	no	playful	xx	x	?	no
nonchalant	xx	x	?	no	suspicious	xx	x	?	no
sceptical	xx	x	?	no	startled	xx	x	?	no
shocked	xx	x	?	no	defiant	xx	x	?	no
bold	xx	x	?	no	engaged in thought	xx	x	?	no
helpless	xx	x	?	no	hopeless	xx	x	?	no

empty	xx	x	?	no
tired	xx	x	?	no
kindly	xx	x	?	no
fearful	xx	x	?	no
regretful	xx	x	?	no
egotistic	xx	x	?	no
overjoyed	xx	x	?	no
vigorous	xx	x	?	no
witty	xx	x	?	no
rebellious	xx	x	?	no
serious	xx	x	?	no
warmhearted	xx	x	?	no
insecure	xx	x	?	no
self centred	xx	x	?	no
pleased	xx	x	?	no

Name _____ A/S _____

Date_____

YOUR LABOUR A

Can you please tick the spaces that best describe what you expect your labour to be like.

Will you feel relieved when you go into labour?

not at all | a little | moderately | a good bit | very much

How do you think you'll cope?

badly | poorly | alright | pretty well | very well

How long do you think labour will be?

very long | longish | moderate | shortish | very short

Do you expect your labour to be painful?

very | pretty painful | moderately | a bit | no

How much drugs do you think you'll need?

lots | a good bit | some | a little | none

How excited will you feel to see your baby?

not at all | a bit | moderately | a good bit | very much

And how excited do you think your husband will be?

not at all | a bit | moderately | a good bit | very much

How much help do you expect the staff to give you?

none | very little | moderate amount | a good bit | a great deal

Do you think you'll be embarrassed?

very much | pretty much | moderately | a bit | no

Name _____ A/S _____

DATE _____

YOUR LABOUR B

Can you please tick the spaces that best describe what your labour was like.

Did you feel relieved when you went into labour?

not at all	a little	moderately	a good bit	very much

How did you cope?

badly	poorly	alright	pretty well	very well

How long was your labour?

very long	longish	moderately	shortish	very short

Was your labour painful?

very	pretty painful	moderately	a bit	no

How much drugs did you have?

lots	a good bit	some	a little	none

How excited did you feel to see your baby?

not at all	a bit	moderately	a good bit	very much

How excited was your husband to see the baby?

not at all	a bit	moderately	a good bit	very much

How much help did the staff give you?

none	very little	moderate amount	a good bit	a great deal

Were you embarrassed?

very much	pretty much	moderately	a bit	no

Name_____ A/S _____

Date _____

YOUR BABY A

Although of course you don't know, you probably have some idea of what your baby will be like. Please tick the space you think best describes him or her.

How much crying do you think your baby will do?

a great deal | a good bit | moderate amount | very little | none

How much trouble do you think your baby will have in feeding?

a great deal | a good bit | moderate amount | very little | none

How much spitting up or vomiting do you think your baby will do?

a great deal | a good bit | moderate amount | very little | none

How much difficulty do you think your baby will have in sleeping?

a great deal | a good bit | moderate amount | very little | none

How much difficulty will your baby have with bowel movements?

a great deal | a good bit | moderate amount | very little | none

How much trouble do you think your baby will have in settling down to a predictable pattern of eating and sleeping?

a great deal | a good bit | moderate amount | very little | none

YOUR BABY (B)

You have had a chance to live with your baby for about a week now. Please check the blank you think best describes your baby.

How much crying has your baby done?

a great deal	a good bit	moderate amount	very little	none

How much trouble has your baby had feeding?

a great deal	a good bit	moderate amount	very little	none

How much spitting up or vomiting has you baby done?

a great deal	a good bit	moderate amount	very little	none

How much difficulty has your baby had in sleeping?

a great deal	a good bit	moderate amount	very little	none

How much difficulty has your baby had with bowel movements?

a great deal	a good bit	moderate amount	very little	none

How much trouble has your baby had in settling down to a predictable pattern of eating and sleeping?

a great deal	a good bit	moderate amount	very little	none

YOUR BABY (C)

You have had a chance to live with your baby for about 6 weeks now. Please check the blank you think best describes your baby.

How much crying has your baby done?

a great deal	a good bit	moderate amount	very little	none

How much trouble has your baby had feeding?

a great deal	a good bit	moderate amount	very little	none

How much spitting up or vomiting has your baby done?

a great deal	a good bit	moderate amount	very little	none

How much difficulty has your baby had in sleeping?

a great deal	a good bit	moderate amount	very little	none

How much difficulty has your baby had with bowel movements?

a great deal	a good bit	moderate amount	very little	none

How much trouble has your baby had in settling down to a predictable pattern of eating and sleeping?

a great deal	a good bit	moderate amount	very little	none

NAME _____

STUDY _____

OBSTETRIC CODING FORM

Study Number — 1 [ ][ ][ ] 3

Hospital number — 4 [ ][ ][ ][ ][ ][ ] 9

Age — 10 [ ][ ] 11

Social Class / Occupation of Father
1)
2)
3)
4)
5)
[ ] 12

Number of T.O.P.s [ ] 13

Number of Spontaneous Abortions [ ] 14

Parity [ ] 15

Smoker
1) Yes
2) No
[ ] 16

Antenatal Complications
1) P.E.T.
2) U.T.I.
3) A.P.H.
4) Threatened Abortion
5) Anaemia
6) F.G.R.
7)
8)
9)
[ ] 17

Gestation at Onset of Labour [ ][ ] 18 19

Type of Onset
1) Spontaneous
2) Induced
3) Augmented
[ ] 20

Syntocinon Maximum m.u. [ ][ ] 21 22

Indication for Induction
1) Not
2) P.E.T.
3) Post-Term
4) Diabetic
5) Social
6) F.G.R.
7) Other
8)
9)
[ ] 23

Analgesia
1) None
2) Entonox
3) Pethidine
4) Epidural
□ 24

Type of Delivery
1) Normal
2) Lift Out Forceps
3) Mid-Cavity Forceps
□ 25

Infant Sex
1) Male
2) Female
□ 26

Infant Weight (gms.) 27 □□□□ 30

Apgar at one minute 31 □□ 32

Apgar at five minutes 33 □□ 34

Resuscitation
1) Suction
2) Oxygen by mask
3) IPPR/V
□ 35

Duration of 1st stage (min) 36 □□□ 38

Duration of 2nd stage (min) 39 □□□ 41

BLOOD PRESSURE
Second trimestre highest noted
SYSTOLIC 42 □□□ 44
DIASTOLIC 45 □□□ 47

Admission blood pressure
SYSTOLIC 48 □□□ 50
DIASTOLIC 51 □□□ 53

Post-Natal blood pressure
SYSTOLIC 54 □□□ 56
DIASTOLIC 57 □□□ 59

Type of Feed in First Week
1) Bottle thoughout
2) Breast throughout
3) Breast changing to bottle
4) Bottle and breast throughout
□ 60

BLANKS 61-77

Card Number □□□ 78 80

DELIVERY ROOM ASSESSMENT

Name _____ Hosp._____ Study_____

Sex _____ b.d._____ time_____ START_____

MIN.	INFANT BEHAVIOUR							EXTERNAL		
	LOCAT	VISUAL	VISUAL	MOTOR	ORAL	DISTRS.	STATE	PERSON	AVER.	INTR
1										
1										
1										
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Finish Time _____ Sample_____

ANALGESIA STUDY - DELIVERY CODING FORM 1 : TIME SAMPLE

Name: b.d. time: obs:

Study number [ ][ ][.] 1

Data type [D] 4

Time to start of record (mins) (00 if less than 1 min) [ ][ ] 5

Length of record (intervals) (00 = no record) [ ][ ] 7

1. Intervals to first cry [ ][ ] 9

2. Intervals to eyes open [ ][ ] 11

VISUAL

Total intervals -

3. eyes open [ ][ ] 13

4. blinks [ ][ ] 15

5. scans [ ][ ] 17

6. focusses [ ][ ] 19

DISTRESS

Total intervals -

7. with startle [ ][ ] 21

8. tremour [ ][ ] 23

9. cyanotic [ ][ ] 25

10. mucous extr. [ ][ ] 27

11. assisted breath [ ][ ] 29

12. when last oxygenation given [ ][ ] 31

ORAL

Total intervals -

13. hand to mouth [ ][ ] 33

14. actual sucking [ ][ ] 35

STATES

Total intervals -

15. 1-2 [ ][ ] 37

16. 3 [ ][ ] 39

17. 4 [ ][ ] 41

18. 5: thrash/high activity [ ][ ] 43

19. 6: crying [ ][ ] 45

20. fussing [ ][ ] 47

LOCATION

Total intervals -

21. in cot [ ][ ] 49

22. held by M/F [ ][ ] 51

23. swaddled [ ][ ] 53

24. attended by N [ ][ ] 55

25. applied aversive stim. [ ][ ] 57

INTERACTION

Total intervals -

26. with M [ ][ ] 59 16

27. looking [ ][ ] 61

28. talking [ ][ ] 63

29. examining/touching [ ][ ] 65

[ ][ ] 67

[ ][ ] 69

[ ][ ] 71

[ ][ ] 73

Card number [0][2][1] [ ][ ][ ]

ANALGESIA STUDY - DELIVERY CODING FORM 2 : SCORES & RATINGS

Name: b.d. time: obs:

Study number [| |] 1

Data type [D] 4

BRAZELTON ITEMS

1. Inanimate visual [ ] 5
2. " auditory [ ] 6
3. Animate visual [ ] 7
4. " auditory [ ] 8
5. " vis + aud. [ ] 9
6. Alertness [ ] 10
7. Tonus [ ] 11
8. Ease of eliciting [ ] 12
9. Uncontrolled rolling eyes? [ ] 13
   - None 1
   - Occasional 2
   - Frequent 3
   - Don't know 9
10. blinking/closing to light? [ ] 14
    - Yes 1
    - No 2
    - Don't know 9
11. Reaction to aversive stimuli? [ ] 15
    - Always calm 1
    - Occasional cry 2
    - Cries only to extreme stimuli (weigh, cord, measure) 3
    - Always cries 4
12. Father present 2nd stage? [ ] 16
    - Yes 1
    - No: circumstances 2
    - No: excluded by staff 3
    - No: didn't want to 4
    - No. mother's request 5
13. Baby to breast? [ ] 17
    - No 1
    - Yes, no sucks 2
    - Sucks well 3
14. Mother's interaction rated [ ] 18
15. Father's interaction rated [ ] 19

Card number [| |] 78 80

ANALGESIA STUDY - BRAZELTON CODING FORM 1

Day 1, 7, 42

Name: | Age days. hrs. T.L.F.

b.d. time: date of testing: time: hosp.

Study Number [ ][ ][ ] (1 3)

Examiner M.M. 1
D.R. 2
M.P. 3 [ ] (4)

Sex of baby: male 1
female 2 [ ] (5)

Feed type: bottle 1
breast 2
breast + complem 3 [ ] (6)

Age in days [ ][ ] (7 8)

Initial state (numbers) [ ] (9)

Predominant state [ ] (10)

Total time of exam (minutes) [ ][ ] (11 12)

Jaundice present: none 1
mild 2
severe 3
(> 10) [ ] (13)

1. Response Decrement to Light [ ] (14)
2. Response Decrement to Rattle [ ] (15)
3. Response Decrement to Bell [ ] (16)
4. Orientation Inanimate Visual [ ] (17)
5. Orientation Inanimate Auditory [ ] (18)
6. Orientation Animate Visual [ ] (19)
7. Orientation Animate Auditory [ ] (20)
8. Animate Visual and Auditory [ ]
9. Alertness [ ] (22)
10. Tonus [ ] (23)
11. Pull to Sit [ ] (24)
12. Defensive movements [ ] (25)
13. Consolability [ ] (26)
14. Peak of Excitement [ ] (27)
15. Rapidity of Buildup [ ] (28)
16. Irritability [ ] (29)
17. Activity [ ] (30)
18. Tremulousness [ ] (31)
19. Startle [ ] (32)
20. Lability of States (Correct Time) [ ] (33)
21. Self-quieting [ ] (34)
22. Hand to mouth [ ] (35)
23. Smiles: none 1
some 2
many 3 [ ] (36)

Session Number [ ] (37)

Card Number [ ] (38) [ ][ ] (39 40)

ANALGESIA STUDY - BRAZELTON CODING FORM 2 Day 3, 21

Name: Age days hrs. T.L.F.

b.d. time date of testing: time hosp.

Study Number [41 43]

Examiner: M.M. 1
D.R. 2
M.P. 3 [44]

Sex of baby: male 1
female 2 [45]

Feed type: bottle 1
breast 2
breast + complem 3 [46]

Age in days [47 48]

Initial state (numbers) [49]

Predominant state [50]

Total time of exam (minutes) [51 52]

Jaundice present: none 1
mild 2
severe 3
(> 10) [53]

1. Response Decrement to Light [54]

2. Response Decrement to Rattle [55]

3. Response Decrement to Bell [56]

4. Orientation Inanimate
Visual [57]

5. Orientation Inanimate
Auditory [58]

6. Orientation Animate Visual [59]

7. Orientation Animate
Auditory [60]

8. Animate Visual and Auditory [61]

9. Alertness [62]

10. Tonus [63]

11. Pull to Sit [64]

12. Defensive movements [65]

13. Consolability [66]

14. Peak of Excitement [67]

15. Rapidity of Buildup [68]

16. Irritability [69]

17. Activity [70]

18. Tremulousness [71]

19. Startle [72]

20. Lability of States
(Correct Time) [73]

21. Self-quieting [74]

22. Hand to mouth [75]

23. Smiles: none 1
some 2
many 3 [76]

Session Number [77]

Card Number [78] [79 80]

Brazelton Scoring Scales

1. Response Decrement to Light (States 1,2,3)
   1. No diminution in high responses over the 10 stimuli.
   2. Delayed startles and rest of responses are still present, i.e. body movement, eye blinks, respiratory changes continue over 10 trials.
   3. Startles no longer present but rest are still present, including body movement in 10 trials.
   4. No startles, body movement delayed, respiratory and blinks same in 10 trials.
   5. Shutdown of body movements, some diminution in blinks and respiratory changes in 9-10 stimuli.
   6. ——— in 7-8 stimuli
   7. ——— in 5-6 stimuli
   8. ——— in 3-4 stimuli
   9. ——— in 1-2 stimuli

   NA No response hence no decrement.

2. Response Decrement to Rattle (1,2,3)
   1. No diminution in high responses over the 10 stimuli.
   2. Delayed startles and rest of responses are still present, i.e. body movement, eye blinks, respiratory changes continue over 10 trials.
   3. Startles no longer present but rest are still present, including body movement in 10 trials.
   4. No startles, body movement delayed, respiratory and blinks same in 10 trials.
   5. Shutdown of body movements, some diminution in blinks and respiratory changes in 9-10 stimuli.
   6. ——— in 7-8 stimuli
   7. ——— in 5-6 stimuli
   8. ——— in 3-4 stimuli
   9. ——— in 1-2 stimuli

   NA No response hence no decrement.

3. Response Decrement to Bell (1,2,3)
   1. No diminution in high responses over the 10 stimuli.
   2. Delayed startles and rest of responses are still present, i.e. body movement, eye blinks, respiratory changes continue over 10 trials.
   3. Startles no longer present but rest are still present, including body movement in 10 trials.
   4. No startles, body movement delayed, respiratory and blinks same in 10 trials.
   5. Shutdown of body movements, some diminution in blinks and respiratory changes in 9-10 stimuli.
   6. ——— in 7-8 stimuli
   7. ——— in 5-6 stimuli
   8. ——— in 3-4 stimuli
   9. ——— in 1-2 stimuli

   NA No response hence no decrement.

4. Orientation Response-Inanimate Visual (4 only)

1. Does not focus on or follow stimulus
2. Stills with stimulus and brightens
3. Stills, focuses on stimulus when presented, brief following
4. Stills, focuses on stimulus, following for 30° arc, jerky movements
5. Focuses and follows with eyes horizontally for at least a 30° arc. Smooth movement, loses stimulus but finds it again.
6. Follows for 30° arcs, with eyes and head. Eye movements are smooth
7. Follows with eyes and head at least 60° horizontally maybe briefly vertically, continuous movement, loses stimulus occasionally, head turns to follow
8. Follows with eyes and head 60° horizontally and 30° vertically
9. Focuses on stimulus and follows with smooth, continuous head movement horizontally, vertically, and in a circle. Follows for 120° arc

5. Orientation Response-Inanimate Auditory (4,5)

1. No reaction
2. Respiratory change or blink only
3. General quieting as well as blink and respiratory changes
4. Stills, brightens, no attempt to locate source
5. Stills, brightens, attempts to locate source
6. Shifting of eyes to sound as well as stills and brightens
7. Head and eyes turn to source alerting
8. Alerting prolonged, head and eyes turn to stimulus repeatedly
9. Turning and alerting to stimulus presented on both sides on every presentation of stimulus

6. Orientation-Animate Visual (4 only)

1. Does not focus or follow stimulus
2. Stills with stimulus and brightens
3. Stills, focuses on stimulus when presented,brief following
4. Stills, focuses on stimulus, follows for 30° arc, jerky movements
5. Focuses and follows with eyes horizontally for at least a 30° arc. Smooth movement, loses stimulus but finds it again.
6. Follows for two 30° arcs, with eyes and head
7. Follows with eyes and head at least 60° horizontally, maybe briefly vertically, partly continuous movement, loses stimulus occasionally, head turns to follow
8. Follows with eyes and head 60° horizontally and 30° vertically
9. Repeatedly focuses on stimulus and follows with smooth, continuous head movement horizontally, vertically, and in a circle. Follows for 120° arc

For all orientation, 0 = Wrong state (not 4) (nb rarely used)

7. Orientation-Animate Auditory (4,5)

1. No reaction
2. Respiratory change or blink only
3. General quieting as well as blink and respiratory changes
4. Stills, brightens, no attempt to locate source
5. Stills, brightens attempts to locate source
6. Shifting of eyes to sound as well as stills and brightens
7. Head and eyes turn to source
8. Alerting prolonged, head and eyes turn to stimulus repeatedly
9. Turning and alerting to stimulus presented on both sides on every presentation of stimulus

8. Orientation Animate-Visual and Auditory (4 only)

1. Does not focus on or follow stimulus
2. Stills with stimulus and brightens
3. Stills, focuses on stimulus when presented, brief following
4. Stills, focuses on stimulus, follows for 30° arc, jerky movements
5. Focuses and follows with eyes horizontally for at least a 30° arc. Smooth movement, loses stimulus but finds it again
6. Follows for two 30° arcs, with eyes and head
7. Follows with eyes and head at least 60° horizontally, maybe briefly vertically, partly continuous movement, loses stimulus occasionally, head turns to follow.
8. Follows with eyes and head 60° horizontally and 30° vertically
9. Repeatedly focuses on stimulus and follows with smooth, continuous head movement horizontally, vertically and in a circle. Follows for at least a 120° arc

9. Alertness (4)

1. Inattentive - rarely or never responsive to direct stimulation
2. When alert responsivity brief and generally quite delayed - alerting and orientation very brief and general
3. When alert responsivity brief and somewhat delayed - quality of alertness variable
4. When alert responsivity somewhat brief but not generally delayed though variable
5. When alert responsivity of moderate duration and response generally not delayed and less variable
6. When alert responsivity moderately sustained and not delayed. May use stimulation to come to alert state.
7. When alert episodes are of generally sustained duration etc
8. Always has sustained periods of alertness in best periods. Alerting and orientation frequent and reliable. Stimulation brings infant to alert state and quiets infant.
9. Always alert in best periods. Stimulation always elicits alerting, orienting. Infant reliably uses stimulation to quiet self or maintain quiet state

10. General Tonus (4,5)
    1. Flaccid, limp like a ragdoll, no resistance when limbs are moved, complete head lag in pull to sit.
    2. Little response felt as he is moved, but less than about 25% of the time.
    3. Flaccid, limp most of the time, but is responsive about 25% of the time with some tone.
    4. Some tone half the time, responds to being handled with some tone less than half the time.
    5. Tone when handled, lies in fairly flaccid state in between handling.
    6. Variable tone in resting, responsive with good tone as he is handled approximately 75% of the time.
    7. Is on the hypertonic side approximately 50% of the time.
    8. When handled he is responsive with hypertonicity about 75% of the time.
    9. Hypertonic at rest (in flexion) and hypertonic all the time (abnormal).

11. Pull-To-Sit (3,5)
    1. Heads flops completely in pull to sit, no attempts to right it in sitting.
    2. Futile attempts to right head but some shoulder tone increase is felt.
    3. Slight increase in shoulder tone, seating brings head up once but not maintained, no further efforts.
    4. Shoulder and arm tone increase, seating brings head up, not maintained but there are further efforts to right it.
    5. Head and shoulder tone increase as pulled to sit, brings head up once to midline by self as well, maintains it for 1-2 seconds.
    6. Head brought up twice after seated, shoulder tone increase as comes to sit, and maintained for more than 2 seconds.
    7. Shoulder tone increase but head not maintained until seated, then can keep it in position 10 seconds.
    8. Good shoulder tone, head up while brought up; maintains head for around 30 seconds or repeatedly rights it.
    9. Head up during lift and maintained for 1 minute after seated, shoulder girdle and whole body tone increases as pulled to sit.

12. Defensive Movements (4)
    1. No response
    2. General quieting
    3. Nonspecific activity increase with long latency.
    4. Same with short latency.
    5. Rooting and lateral head turning
    6. Neck stretching.
    7. Nondirected swipes of arms
    8. Directed swipes of arms.
    9. Successful removal of cloth with swipes.

13. Consolability with Intervention (6 to 5, 4, 3, 2)

1. Not consolable.
2. Pacifier in addition to dressing, holding and rocking.
3. Dressing, holding in arms and rocking.
4. Holding and rocking.
5. Picking up and holding.
6. Hand on belly and restraining both arms.
7. Hand on belly steadily.
8. Examiner's voice and face alone.
9. Never needs consoling.

14. Peak of Excitement (6)

1. Low level of arousal to all stimuli. Never above state 2, does not awaken fully.
2. Some arousal to stimulation - can be awakened to state 3.
3. Infant reaches state 4 briefly, but predominantly is in lower states.
4. Infant reaches state 5, but is predominantly in state 4 or lower.
5. Infant reaches state 6 after stimulation once or twice, but predominantly is in state 5 or lower.
6. Infant reaches state 6 after stimulation, but returns to lower states spontaneously.
7. Infant reaches state 6 in response to stimuli, but with consoling is easily brought back to lower states.
8. Infant screams (state 6) in response to stimulation, although some quieting can occur with consoling, with difficulty.
9. Infant achieves insulated crying state. Unable to be quieted or soothed.

15. Rapidity of Buildup (from 1, 2 to 6)

1. Not upset at all.
2. Not until moro and defensive reactions.
3. Not until moro or defensive reactions.
4. Not until pull-to-set, or prone.
5. Not until first pull to sit.
6. Not until undress.
7. Not until uncover.
8. At first auditory and light stimuli.
9. Never quiet enough to score this.

16. Irritability (3, 4, 5)

Aversive Stimuli

uncover	prone
undress	moro
pull to sit no. 2	defensive
pull to sit no. 1	removal of teat

16. (Continued)

1. no irritable crying to any of the above
2. irritable crying to one of the stimuli
3. irritable crying to two of the stimuli
4. irritable crying to three of the stimuli
5. irritable crying to four of the stimuli
6. irritable crying to five of the stimuli
7. irritable crying to six of the stimuli
8. irritable crying to seven of the stimuli
9. to all of them.

17. Activity (alert states)

Score spontaneous and elicited activity separately on a four point scale: 0 = none, 1 = slight, 2 = moderate, 3 = much. Then add up the two scores.

1 = a total score of 0
2 = a total score of 1
3 = a total score of 2
4 = a total score of 3
5 = a total score of 4
6 = a total score of 5
7 = a total score of 6
8 = continuous but consolable movement
9 = continuous, unconsolable movement.

18. Tremulousness (all states)

1. No tremors or tremulousness noted.
2. Tremors only during sleep.
3. Tremors only after the Moro or startles.
4. Tremulousness seen 1 or 2 times in states 5 or 6.
5. Tremulousness seen 3 or more times in states 5 or 6.
6. Tremulousness seen 1 or 2 times in state 4.
7. Tremulousness seen 3 or more times in state 4.
8. Tremulousness seen in several states.
9. Tremulousness seen consistently in all states.

19. Amount of Startle During Exam (3-6)

1. No startles noted.
2. Startle as a response to the examiner's attempts to set off a Moro reflex only.
3. Two startles, including Moro.
4. Three startles, including Moro.
5. Four startles, including Moro.
6. Five startles, including Moro.
7. Seven startles, including Moro.
8. Ten startles, including Moro.
9. Eleven or more startles, including Moro.

20. Lability of States (all states)

The score corresponds to the frequency of swings:

1	= 1-2 swings over 30 minutes		
2	= 3-5	6	= 14-15
3	= 6-8	7	= 16-18
4	= 9-10	8	= 19-22
5	= 11-13	9	= 23 on up

21. Self-quieting Activity (6, 5 to 4, 3, 2, 1)

1. Cannot quiet self, makes no attempt, and intervention is always necessary.
2. A brief attempt to quiet self (less than 5 secs.) but with no success.
3. Several attempts to quiet self, but with no success.
4. One brief success in quieting self for a period of 5 secs. or more.
5. Several brief successes in quieting self.
6. An attempt to quiet self which results in a sustained successful quieting, with the infant returning to state 4 or below.
7. At least 2 sustained and several brief successes in quieting self.
8. Consistently quiets self for sustained periods.
9. Never agitated enough to quiet self.

22. Hand to Mouth Facility (all states)

1. No attempt to bring hands to mouth.
2. Brief swipes at mouth area, no real contact.
3. Hand brought to mouth and contact, but no insertion, once only.
4. Hand brought next to mouth area twice, no insertion.
5. Hand brought next to mouth area at least 3 times, but no real insertion, abortive attempts to suck on fist.
6. One insertion which is brief, unable to be maintained.
7. Several actual insertions which are brief, not maintained, abortive sucking attempts, more than three times next to mouth.
8. Several brief insertions in rapid succession in an attempt to prolong sucking at this time.
9. Fist and/or fingers actually inserted and sucking on them for 15 seconds or more for several brief insertions.

23. Smiles (all states)

Recorded number observed.

ANALGESIA STUDY VERSION OF BRAZELTON A PRIORI PROFILES

DIMENSION I : INTERACTIVE PROCESSES

(1) - Orientation : 4 of 5 score 7 or above
None below 4 if done (ie. not x)
- Alertness 6 or above
- consolability NA (ie. 9) or 6 or above

---

(3) two of: orientation : 3 of 5 NA (ie. 0) or 5 and below
alertness : 1 - 4 ; 0
consolability: 1 - 4

DIMENSION II : MOTORIC PROCESSES

(1) - Motor tone : 5 or 6
- two of: 7 or above on pull-to-sit
7 or above on defensive
5 or above on hand-to-mouth
- activity : 4 - 6

---

(3) Type I - strong and active
- Motor tone : 7 - 9
- Three of: pull-to-sit 1 - 4 ?
defensive 1 - 4
activity 8 - 9
hand-to-mouth 1 - 3 ?

---

(4) Type II - weak and quiet
- Motor tone : 1 - 3
- Three of: pull-to-sit 1 - 4
defensive 1 - 4
activity 1 - 3
hand-to-mouth 1 - 3

DIMENSION III : ORGANIZATION PROCESSES : STATE CONTROL

(1) - 4 as predominant state
- Habitration : if all done, all are 5 or above
  if two done, both are 5 or above
  if only one done, don't consider
- Peak of excitement : 5 - 7
- Three of - lability of states 3 or less
  rapidity of build up 4 or less
  irritability 4 or less
  self-quieting 6 or more

---

(3) Type I - very labile

Three of:
- rapidity of build up 7 - 9
- irritability 7 - 9
- self-quieting 1 - 4
- lability of states 7 or more
- peak of excitement 8 or 9
- habitration all 4 or less if done

(4) Type II - flat, depressed
- peak of excitement 1 - 4
- one of:
  - rapidity of build up 3 or less
  - irritability 4 or less
  - lability 1 or 2
- predominant state not 4 or 6

DIMENSION IV : ORGANIZATION PROCESSES : RESPONSE TO STRESS

(2) - tremor 6 or more
- startle 6 or more

OBSERVATION SCALE SHEET

NAME AGE(DAYS) HRS. DLF

B.D. TIME | TODAY'S DATE: TIME

S.	SC		ACTIVITY
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
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51			
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56			
57			
58			
59			
60			

	1	2	3	4	5	6	7	8	9	10
L										
R										
B										

IV	
IA	
AV	
AA	
AAV	

ST.	IN	OUT	CRY
U/C			
U/D			
P-S			
P-S			
Pro			
Def			
Mor			

Startles

Tremour:

sleep
alert
crying
Moro

H-M

swipe
suck

M. Maturity

Cuddliness

Lab. Skin

Attract

Tone

REFLEX	RESP.	CRY
Plantar		
Hand G.		
Ank. Cl.		
Bab		
Stand		
Aut.Wlk.		
Place		
Incurv.		
Crawl		
Glab.		
TN Dev.		
Nystag.		
TNR		
Moro		
Root		
Suck		
PASSIVE	MOVEMENT	
Arms R		
L		
Legs R		
L		

P-S 1.
2.

Defensive

Do not Write in this Column CODING

PRECHTL NEUROLOGICAL EXAMINATION

Name..... (Subject number) 1

Examiner..... 4

Date of test..... time..... (age in hours) 5

Jaundice: 1. absent 2. mild 3. severe 8

Type of last feed: 1.Bottle 2.Breast 3.Breast + Complement 9

Time since last feed..... 10

PLEASE CIRCLE ANSWER, ADDING 'Y' IF ASSYMETRICAL
(essential 'state' info. is under heading or individual items)
This order seems most useful, not imperative.
If possible do one S. Motor Activity in 1 or 2, the other in 3 or 4.

I. OBSERVATION OF BABY IN COT (should be 1 or 2 ideally) 13

State..... (before removing blankets)

State..... (after removing blankets)

Spontaneous Motor Activity pp.6-8, 13-15 some items

1. Resting Postube: normal (0), abnormal (1)
2. Type movement: none(0/1)*, flexor(1), normal range(0), extensor (1)
3. Speed movement: none(0/1), slow(1), medium(0),high(1)
4. Intensity: none(0/1), low(1), medium(0),very intensive(1)
5. Amount in 3 min: none(0/1), a few isolated movements (1), medium, continual movements (0), high, great deal of movement (1)
6. Symmetry of movements: yes (0), no (1)
7. Athetoid postures: absent(0), occasional athetoid postures (1), occasional movements of arms,etc.(2), continual athetoid movements (3)

* Note on coding: If in state 1 or 2 (sleep) no movement is Optimal (0); if in 3 or 4 it is non-optimal (1). Same applies to Section III although baby should not really be in 1 or 2.

Tremor p.8

8. Incidence: absent(0), rare (1), marked (2)
9. Frequency: absent(0), rare (1), marked (2)
10. Amplitude: absent(0), rare (1), marked (2)
11. Other movements (overshooting, etc.): absent (0), present (1)

II. FACIAL FEATURES AND REFLEXES pp.9-12(Supine on table) 15

State.....

1. Expression: bland(0), alert(0), fuss/cry (1), frowning (1)
2. Palpebral Fissures: normal (0), assymmetrical (1)
3. Nasolabial Folds: symmetrical (0), assymmetrical (1)
4. Mouth: symmetrical (0), assymmetrical (1)
5. Oedema: absent (0), some (1), much (2)
6. Malformations: absent (0), present (1)
7. Chvostek Reflex: absent(0), weak (1), strong (2)
8. Lip Reflex (St.2,3): absent(2), short weak(1),good(0)
9. Glabella (not 5): absent (2), weak (1), good (0), sustained closure more than 1 sec (1)

III. EXAMINATION IN SUPINE POSITION (Undress, lay in supine position on table with head in midline) 17

State.....

Spontaneous Motor Activity pp.13-15 Optimal St.4, not 1 or 2)

1. Posture: normal (0), abnormal (1)
2. Type movement: none(0/1)*, flexor (1), normal (0), extensor (1)
3. Speed: none(0/1), slow (1), medium (0), high (1)
4. Intensity: none(0/1), low(1), medium(0), v. intensive (1)
5. Amount: none(0/1), low (1), medium (0), high (1)
6. Symmetry: yes (0), no (1)
7. Athetoid movements: absent (0), occ. postures (1), Occ. movement (2), continual movements(3)

Tremor p.8

8. Incidence: absent (0), rare (1), marked (2)
9. Frequency: absent (0), rare (1), marked (2)
10. Amplitude: absent (0), rare (1), marked (2)
11. Other movements: absent (0), present (1)

IV. SKIN AND SUPERFICIAL REFLEXES pp.15-18 (Supine) 19

State.....

1. Respiration (not St.1 or 5): normal (0), other(1)
2. Skin Colour: normal (0), abnormal (1)
3. Elasticity: normal (0), fold remains (1)
4. Abnormalities: absent (0), present (1)
5. Perspiration: absent (0), mild (1), marked (2)
6. Abdominal Reflex (St.2,3): absent(2),weak(1),good(0)
7. Cremaster (2,3): N/A (0),absent(2),weak(1),good(0)
8. Anal Reflex(2,3): absent (2), weak (1), good (0)

V. EYES pp.19-22 (Eyes open and baby supine. Optimal St. 3 or 4, not in 5 for items 8,9,11) 21

State.....

1. Position: normal (0), constant deviation (1)
2. Sunset Sign: absent(0), transitorily present (1), constant (2)
3. Strabismus: absent(0), inconstant(1),constant (2)
4. Nystagmus: absent (0), inconstant (1),sustained(2)
5. Pupils, shape: round (0), irregular (1), oval (1)
6. Pupils, size: pinpoint(1), normal (0), dilated (1)
7. Reaction to light: absent (2), weak (1), good (0)
8. Optical Blink: absent(2), weak(1), full,repeatable(0)
9. Acoustic Blink: absent(2), weak(1), strong repeatable (0)
10. Corneal Reflex: absent (1), present (0)
11. Doll's Eye: absent, i.e. eyes move w/head (1) present (0)

VI. MOTOR SYSTEM pp.24-31 (Supine, head in midline. Optimal 3,4)

(Resistance 1-8) 23

(Power 1-8) 25

(Range 1-11) 27

State.....

	Resistance	Active Power	Range
	- none (2) + weak (1) ++ moderate(0) +++ strong (1) ++++ v. strong (2)	- none (2) + active, not resis(1) ++ overcome resis(0) +++ dif. to restrain (1)	0 normal(0) + increase (1) ++ mark inc (2)
1. Neck			
2. Trunk			
3. Shoulders			
4. Elbows			
5. Wrists			
6. Hips			
7. Knees			
8. Ankles			

9. Limitation of Hip: absent (0), present (1)
10. Recoil of Forearm: absent(2), weak(1), quick normal (0) rapid, forceful (1)
11. Muscle Consistency: normal (0), abnormal (1)

VII. REFLEXES AND RESPONSES pp.33-39 (Optimal 3 or 4)

State.....

29

1. Biceps: absent(2), weak(1), good(0),exaggerated(1)
2. Kneejerk: absent(2),weak(1), good(0),exag. +clonus (1)
3. Ankle Clonus: absent (0), present (1)
4. Palmar grasp: absent(2), short weak(1), strong sustained (0), sustained, fingers white (1)
5. Plantar: absent(2), weak(1), good(0),prolonged (1)
6. Babinski: absent(2),weak(1), good(0), sustained(1)
7. Magnet: absent(2), weak(1), good(0),exaggerated(1)
8. Crossed extensor: absent(2), short(1),sustained(0) long sustained(1)
9. Withdrawal: absent(2), weak(1), strong(0), alternating flexion and extension, v. vigorous (1)
10. Traction, Arms: no resistance (2), moderate flex(1), strong resistance (0)
11. Traction, Head Control: lag(3), returns to upright once, twice (2), head up more 3 sec (1), constantly up (0).

VIII. ORAL BEHAVIOUR pp.39-43 (Optimal 3, or 3 and 4) 31

State.....

1. Rooting: absent(2), weak turn(1), turn+grasp (0), vigorous (1)
2. Sucking, Stripping: absent(2), low(1), normal(0), exagger.(1)
3. Sucking, Rate: absent(2), less 8 sucks/10 sec(1), 9-12 sucks (0), more than 12 sucks/10 sec(1)
4. Sucking, Suction: absent(2), low(1), normal(0), exaggerated (1)
5. Sucking, Grouping: absent(2), 1-6sucks/group(1), 7-14 sucks(0), 15-30 sucks/group (1)
6. Jawjerk: absent(1), present(0), exaggerated w/clonus (1)

IX. MORO. p.45 (Ideally do a 'head drop', optimal State 3 or 4; if contraindicated then do as p.47 or p.56. Do 3 times as specified to observe all components) 33

State.....

1. Abduction at shoulder: absent(3), to shoulder (2), 45 degrees (1), 90 degrees(0)
2. Extension at elbow: absent(2), 90°(1), 135°(0), 180°(1)
3. Adduction at shoulder: absent(3), half abduction and back(2), full adduction(1), across midline(0)
4. Threshold: low (1), medium (0), high (1)
5. Tremor during Moro, Incidence: absent(0), rare(1), marked(2)
6. Tremor, Frequency: absent(0), low(1), high(2)
7. Tremor, Amplitude: absent(0), low(1), high(2)

X. PRONE POSITION pp.48-52 35

State.....

1. Inspection of vertebral column: normal(0), abnormal(1)
2. Spont. head movements: absent(3), short lift(2), few seconds(1), good, more 10 sec(0)
3. Crawling: absent(3), weak(2), coordinated crawling(1), good locomotion for 30 cm within 1 min. (0)
4. Bauer's (stimulated): absent(3), weak(2), some(1), v. good (0)
5. Anklejerk: absent(1), present(0), brisk with clonus(1)
6. Incurvation: absent(2), weak(1), good(0), exagg.(1)
7. Prone suspension: flaccid(3), head lag but flexion(2), lift, semiflexion(1), sustained lift, ext.(0)

XI. BABY UPRIGHT pp.53-55 (Optimal State 4) 37

State.....

1. Placing: absent (1), present (0)
2. Stepping: absent (2), intention, 1-2 steps (1), good (0)
3. Rotation, Right Free: absent(2), weak(1),good (0)
4. Rotation, Right Fixed:absent(2), weak(1),good (0)
5. Rotation, Left Free: absent(2), weak(1),good (0)
6. Rotation, Left Fixed: absent(2), weak(1),good(0)

XII. CRYING p.57 (elicited crying starting from St. 3 or 4 39

State.....

1. Type: normal (0), abnormal (1)
2. Intensity: low (1), medium (0), high (1)
3. Duration: short (1), medium (0), long (1)

XIII. SUMMARY 40

1. Overall threshold for responses: low,easily elicited (0) medium (1), difficult (2)
2. Reaction type: apathetic (1), normal (0), hyperexcitable (1)
3. Any assymmetrical responses: no (0), yes (1)
4. Overall amount of crying, i.e. 'irritability': little (0), moderate (1), great deal (2)
5. Ease of maintaining optimal states: easy (0), sometimes difficult (1) usually difficult(2)
6. 'Consolability' when crying: easy(0), sometimes difficult (1), usually difficult (2)
7. Hpotonia: absent (0), occasional (1), always (2) 42
8. Hypertonia: absent(0), occasional(1), always (2) 43
9. Hypoactivity: absent(0), occasional(1), always (2) 44
10. Hyperactivity: absent(0), occasional(1),always(2) 45

Initial State..... 46

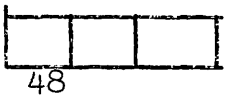
Final State..... 47

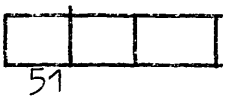
Known paediatric problems.....

Comments about baby (unusual appearance, behaviour not covered in test, etc.....

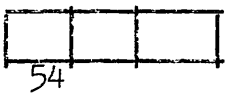
.....

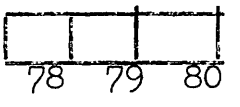
.....





PLEASE CHECK THAT a) all items are answered
b) any assymetry is noted 'Y'
c) time of test is noted
d) time since last feed is noted





SLEEP RECORD

NAME: _____ B.d.: _____ Time: _____ Day: _____

Study: _____ Hosp. _____

IMPORTANT - NURSES AND MOTHERS

Please could you fill in this sleep record so we know when your baby is sleeping, awake and being fed. Each mark means 10 min, starting from the time of delivery, and continuing over the 7 pages until discharge.

12 am	12:30	1 am	1:30	2 am	2 30	3 am	3:30	4 am	4:30
5 am	5:30	6 am	6 30	7 am	7·30	8 am	8:30	9 am	9:30
10 am	10:30	11am	11:30	12am	12:30	1 pm	1:30	2 pm	2:30
3 pm	3:30	4 pm	4:30	5 pm	5:30	6 pm	6:30	7 pm	7:30
8 pm	8:30	9 pm	9:30	10pm	10:30	11pm	11:30	12pm	

The smallest line represents 10 minutes. The symbols are: ——> Solid line = sleep in cot

XX = feed time

A = baby awakened by adult

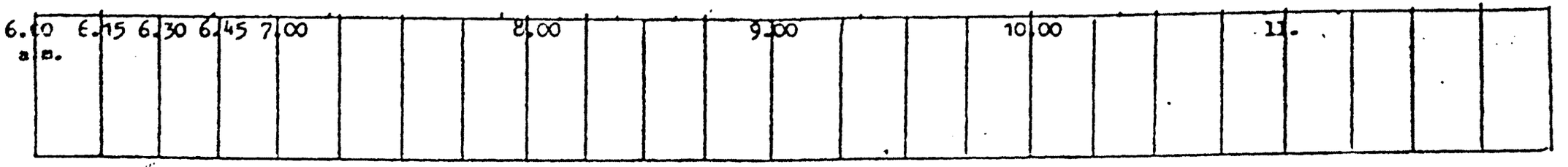
S = spontaneously wakes

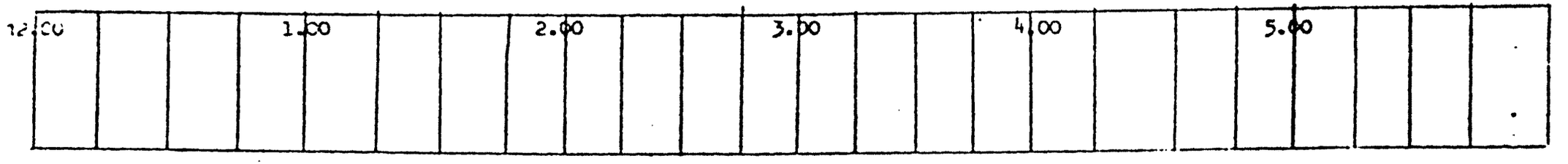
404

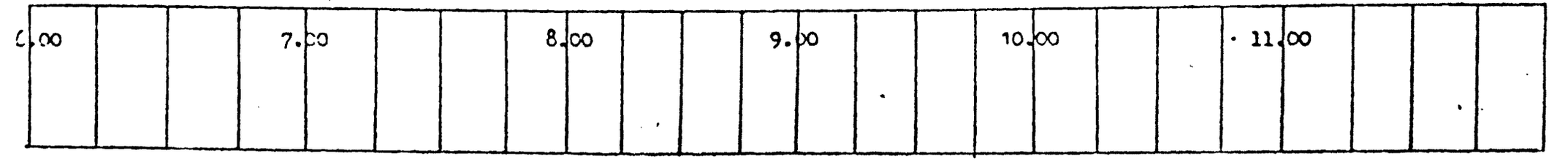
SLEEP CHART

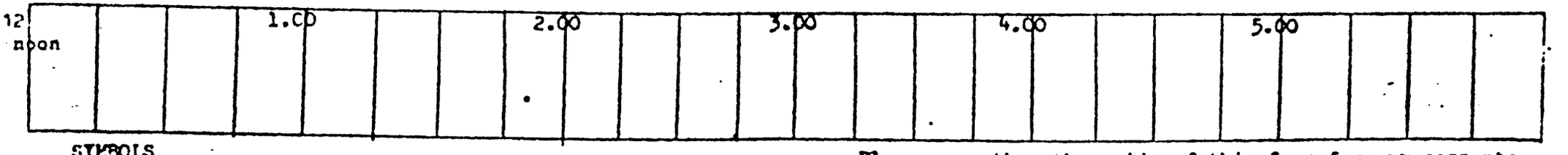
NAME.....

DATE.....









SYMBOLS

S Sleeping
A Awake
F Feeding
C Crying
X Woken up deliberately

Please use the other side of this form for any comments you want to make, and to explain any extra symbols you have used. Can you also say whether this day is typical for your baby: if so, how; if not, why not.

ANALGESIA STUDY - SLEEP RECORD

Name _____ b.d. _____ number of days record _____

Comments _____

Study Number [1 3]

Data [4]

Day 1 (0-24 hrs.)

1. Total sleep (% time) [5 6]
2. Awakened bouts [7]
3. Spontaneous bouts [8]
4. Mean bout length 'A' (min) [9 11]
5. Mean bout length 'S' (min) [12 14]

Day 2 (24-48 hrs.)

6. Total sleep (% time) [15 16]
7. 'A' bouts [17]
8. 'S' bouts [18]
9. MBL 'A' (min) [19 21]
10. MBL 'S' (min) [22 24]

Day 3 (48-72 hrs.)

11. Total sleep (% time) [25 26]
12. 'A' bouts [27]
13. 'S' bouts [28]
14. MBL 'A' (min) [29 31]
15. MBL 'S' (min) [32 34]

Day 4 (72-96 hrs.)

16. Total sleep (% time) [35 36]
17. 'A' bouts [37]
18. 'S' bouts [38]
19. MBL 'A' (min) [39 41]
20. MBL 'S' (min) [42 44]

Day 5 (96-120 hrs.)

21. Total sleep (% time) [45 46]
22. 'A' bouts [47]
23. 'S' bouts [48]
24. MBL 'A' (min) [49 51]
25. MBL 'S' (min) [52 54]

Day 6 (120-144 hrs.)

26. Total sleep (% time) [55 56]
27. 'A' bouts [57]
28. 'S' bouts [58]
29. MBL 'A' (min) [59 61]
30. MBL 'S' (min) [62 64]

ANALGESIA STUDY - SLEEP RECORD

Day 7 (144-168 hrs.)

31. Total sleep (% time) [65 66]

32. 'A' bouts [67]

33. 'S' bouts [68]

34. MBL 'A' (min) [69 71]

35. MBL 'S' (min) [72 74]

Card number [78 79 80]

ST. MARY'S

FEED CHART

NURSES COMMENTS

No. 408

Surname

First Names

D. of B. Sex

Date and Time	Feed Offered	Feed Taken	Vom.	Type of Feed	Method of Feeding	B.O.	P.U.	Remarks
								P.T.O.

Name

Date and Time	Feed Offered	Feed Taken	Vom.	Type of Feed	Method of Feeding	B.O.	P.U.	Remarks

Name

Study

Data

Intenc

Feed c

Day 1

1. To

2. To

3. To

4. Amo

5. Amo

6. Rat

Day 2 (

7. Tot

8. Tot

9. Tota

10. Amou

11. Amou

12. Rati

ANALGESIA STUDY: FEEDS

Name: b.d. days recorded

Study [1 3]

Data [4]

Intended feed 1 2 3 [5]

Feed on discharge [6]

Day 1 (0-24)

1. Total feeds [7]
2. Total Breast feeds [8]
3. Total Formula feeds [9]
4. Amount Formula [10 12]
5. Amount Dextrose [13 15]
6. Rating: [16]
   1 Disinterested
   2 Some disinterested
   3 Great variety
   4 Usually taken well
   5 Always taken well

Day 2 (24-48)

7. Total feeds [17]
8. Total Breast feeds [18]
9. Total formula feeds [19]
10. Amount Formula [20 22]
11. Amount Dextrose [23 25]
12. Rating: [26]

Day 3 (48-72)

13. Total feeds [27]
14. Total Breast feeds [28]
15. Total Formula feeds [29]
16. Amount Formula [30 32]
17. Amount Dextrose [33 35]
18. Rating: [36]

Day 4 (72-96)

19. Total feeds [37]
20. Total Breast feeds [38]
21. Total Formula feeds [39]
22. Amount Formula [40] [42]
23. Amount Dextrose [43 45]
24. Rating: [46]

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Day 5 (96-120)

25. Total feeds [47]

26. Total Breast feeds [48]

27. Total Formula feeds [49]

28. Amount Formula [50 52]

29. Amount Dextrose [53 55]

30. Rating: [56]

Day 6 (120-144)

31. Total feeds [57]

32. Total Breast feeds [58]

33. Total Formula feeds [59]

34. Amount Formula [60 62]

35. Amount Dextrose [63 65]

36. Rating: [66]

Day 7 (144-168)

37. Total feeds [67]

38. Total Breast feeds [68]

39. Total Formula feeds [69]

40. Amount Formula [70 72]

41. Amount Dextrose [73 75]

42. Rating: [76]

[77]

Card number [78 79 80]

APPENDIX II

Publications from the "Analgesia Study"

Lieberman, B.A., Rosenblatt, D.B. and Belsey, E.M. (1978). The effects of pethidine or bupivacaine on the fetus and neonate: A preliminary communication. In Proceedings of the Victor Bonney Society, Wales.

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Packer, M. and Rosenblatt, D. (1979). Issues in the study of social behaviour in the first week of life. In Dunn, J. and Shaffer, D. The First Year of Life. London: Wiley, 7-35.

Lieberman, B.A., Rosenblatt, D.B., Belsey, E.M., Packer, M., Redshaw, M., Mills, M., Caldwell, J., Notarianni, L., Smith, R.L., Williams, M. and Beard, R.W. (1979). The effects of maternally administered pethidine or epidural bupivacaine on the fetus and newborn. British Journal of Obstetrics and Gynaecology, 86, 598-606.

Rosenblatt, D.B., Redshaw, M.E. and Notarianni, L.J. (1980). Pain relief in childbirth and its consequences for the infant. Trends in Pharmacological Sciences, 365-369.

Belsey, E.M., Rosenblatt, D.B., Lieberman, B.A., Redshaw, M., Caldwell, J., Notarianni, L., Smith, R. and Beard, R.W. (1981). The influence of maternal analgesia on neonatal behaviour: I. Pethidine. British Journal of Obstetrics and Gynaecology, 88, 398-406.

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