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The Mind and Body of the Preterm Neonate

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Abstract: Neonatology, as a sub-division of medicine, has developed rapidly since its first establishment in the 1960s. Within this frame, the attention paid to the behaviour and psychological processes of the preterm neonate during the first four weeks of life has been very limited. The argument, based on diverse evidence, is advanced that the preterm neonate has a mind and thus mental life. A rationale is available through the application of Gottlieb's (1991) experiential canalization approach.

Zusammenfassung: *Seele und Körper des frühgeborenen Kindes*. Die Neonatologie hat sich als eine medizinische Disziplin seit ihren Anfängen in den 60er Jahren sehr rasch entwickelt. In diesem Zusammenhang hat man dem Verhalten und den psychologischen Prozessen der Frühgeborenen während der ersten vier Wochen ihres Lebens wenig Aufmerksamkeit geschenkt. Es werden die Gründe für die Annahme dargestellt, daß das frühgeborene Kind ein seelisches Erleben und seelisches Leben hat. Dabei ist insbesondere das Konzept von Gottlieb (1991) über "experiential canalization" (Bahnung des Erlebens) hilfreich.

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Introduction

The fundamental activities of the mind originate before birth (Preyer 1888), and the beginning of mind occurs when the individual first responds to an external stimulus; depending on the sense selected, this may range from 8–26 weeks (Carmichael 1941). Evidence has accumulated which indicates that the rudimentary mind emerges during gestation, and thereafter develops prenatally and postnatally until its adult form is attained (e.g. Hepper and Shahidullah 1994).

For any developmental age, the time spent in the womb is critical for normal development and function of the mind. Early delivery (< 37 weeks) implies dis-

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ruption of a "Biological Agreement" which is also an abrupt interruption of the psychobiological relationships between the mother and the foetus, a foetus that can activate a series of mechanisms of defense which will let him or her survive in the intrauterine environment (Zichella 1992). In reflecting upon possible precursors of premature labour, Carson (1997) included elevated concentration of corticotrophin-releasing hormone (CRH) in maternal plasma, compared to the normal range for the gestational age. Gupta (1992, 1989) stated that exposure of the foetus to higher or lower secretion of various hormones in the mother can effect the foetal and neonatal brain development; he consequently introduced the terms 'humor-humours interactions' and defended the existence of an "endocrine personality".

Since the 1960s, evidence has been accumulating that both the foetus and the preterm neonate behave as an inter-active and 'competent' being. Neonatology as a sub-discipline of Medicine has quickly developed and established itself, but this has not been accompanied by systematic study of either behavioural or psychological processes of the preterm neonate (born with less than 37 weeks gestation), and acknowledgment of both phenomena has been tardy. Undoubtedly, one reason for these lacunae is that many health professionals do not accept the preterm neonate as having a mind, and thus a mental life. Extraneous factors are that few Neonatal Units around the world employ a Psychologist on a permanent basis, and the psychological well-being of the preterm neonate, even where it is diffidently acknowledged, remains a low economic priority.

An extension of neonatology was due to Gottfried and Gaiter (1985) who introduced the term Environmental Neonatology to encompass the study of newborn special care facilities and their impact on the medical and developmental status of sick infants. Wolke (1987) shortly afterwards proposed a change by adding 'Developmental', thereby emphasising the study of developmental changes and progress of the preterm neonate or sick infant whilst still in the special care baby unit. According to Wolke this is an applied field, derived from several sources including neonatal environmental intervention studies (e.g., Korner et al. 1978; Tuck et al. 1982; Richards 1984), basic scientific investigations of the sensorimotor response systems of fullterm and preterm newborns (e.g., Palmer et al. 1982; Aylward 1982; Leijon 1982; Field 1977), investigations of iatrogenic consequences of medical treatment (e.g., Nelson 1976; Keating 1976; Grenough et al. 1984), and the architectural design of newborn intensive care units (Korones 1985). Wolke proposed a model of the transactions of the caretaking environment and the physiological and behavioural status of the infant at different developmental stages during hospitalization. This model appears to be based upon the system developmental theory of Sameroff and Chandler (1975), who argued for a "continuum of caretaker casualty" and proposed a circuitous process taking into account both the nature of the maintaining environment and the individual characteristics of the child. Such a theory implies belief in a principal of plasticity of the central nervous system, as argued by Isaacson (1976). However, the fields of study proposed above are concerned with babies during their hospitalization and extend to all ages whereas the neonatal period, by convention, is the first 28 days after birth (Gandy and Roberton 1987). It is the preterm baby during the neonatal period which is the concern of Neonatal Psychology.

At the XV European Congress of Perinatal Medicine(1996), Neonatal Psychology was the name advanced for a new sub-discipline of Psychology concerned with studying the preterm neonate during the first 4 weeks of life, and defined as "the scientific study of the phenomena of mental life and the behaviour of the preterm neonate as an emergent, coactional, hierarchical system" (Adamson-Macedo 1997a, p. 292); this definition has contemporary continuity with Gilbert Gottlieb's 'probabilistic-epigenetic' systems theory (1976) and, from an earlier era, the William James 1890 definition of Psychology as "... the science of mental life, both its phenomena and of their conditions. The phenomena are such things as we call feelings, desires, cognition, reasoning, decisions and the like."

It is here argued that regardless of the age of the preterm neonate s/he has mind and thus a mental life. This is derived by applying the approach of Gottlieb's developmental systems to relevant findings of the effects of environmental interventions on the sensorymotor response systems and the other systems of the preterm neonate, both ventilated and non-ventilated; within this frame, Gottlieb's experiential canalization (1991) contributes explanation of how the development of the preterm neonate's mind and body can be facilitated. The recent emergence of Neonatal Psychology indicates that the time has come for psychology to make an effective contribution to the theory, the care, and the support of the preterm neonate.

Systems Approach to Developmental Psychology

During the past decades, developmental psychology has shown marked interest in the study of the relations between genes and behaviour. Corresponding systems analysis in developmental psychology include rationales and theories which have been called ecological (Bronfenbrenner 1979), transactional (Dewey and Bentley 1949; Sameroff and Chandler 1975; Sameroff 1983), contextual (Lerner and Kaufman 1985), interactive (Johnston 1987; Magnusson 1988) probabilistic epigenetic (Gottlieb 1970), individual-sociological (Valsiner 1987), and structural-behavioral (Horowitz 1987).

As defined by Gottlieb, epigenesis is probabilistic, and his particular treatment of development views the individual as an "emergent, coactional, hierarchical system." This definition of epigenesis declares that "individual development is characterized by an increase of complexity of organization, i.e., the emergence of new structural and functional properties and competencies, at all levels of analysis (molecular, subcellular, cellular, organismic) as a consequence of horizontal and vertical coactions among its parts, which includes organism $\leftrightarrow$ environment coactions" (Gottlieb 1992).

Horizontal coactions are those which occur at the same level, e.g,. gene to gene, cell to cell; vertical coactions occur between different levels, e.g., gene-cytoplasm, behavioural activity-nervous system, and are reciprocal in that they can influence each other in either direction. Thus the sensory experience of a developing organism affects the differentiation of its nerve cells such that greater experience produces more differentiation and vice-versa. The more highly-differentiated nervous system permits a greater degree of behavioural competency and the converse is true.

Gottlieb's systems view (1991b) of individual development defends the principle that "... canalization can take place not only at genetic level, but at all levels of the developing system, including the developing organism's usually occurring experiences. What makes development happen is the relationship of the two or more components and not the components themselves." Gottlieb's principal claim (1991a, 1991b) is that genetic activity does not mediate behaviour by itself but rather is part of a larger genes-behaviour-environment continuum that interacts in complex ways to produce finished traits.

The bidirectionality of structure-function relationships is paramount. The hierarchical, reciprocal, and coactive definition of epigenesis holds for anatomical, physiological, behavioural and psychological functioning; according to Gottlieb (1976, 1991a, 1991b, 1992) coactions or experiences can play different roles in anatomical, physiological and behavioural development, i.e., maintenance, facilitative, and induction functions. Within this frame, positive coactions are here defined as those appropriate experiences of the preterm baby which are crucial in order that development continues to occur of both the mind and the body .

In preterm cases, the abrupt interruption of womb experiences can be terminal for a few, whereas for others their normal rate of growth and development can be jeopardised. Whether preterms are viewed as foetuses or underveloped fullterms, and whether they are sensory bombarded or deprived are issues which have been discussed elsewhere (e.g. Gottfried 1981; Wolke 1987; Korner 1990; de Roiste and Bushnell 1996; Adamson-Macedo 1997a). The view adopted here is that the preterm is a unique human being, who is born with a mind; appropriate environmental interventions will trigger beneficial horizontal and vertical coactions which will consequently facilitate development, and possibly whole or partial return of the mother/newborn psychobiological relationships which were suddenly interrupted because of early delivery.

The Mind and the Body of the Preterm Neonate

Precursory to mental life is Mind, and it is clear that foundations of mind are laid during foetal development with billions of neurons forming their connections, and with neural activity and stimulation crucial to completing this process (Shatz 1992). A study carried out by Lumley (1980) found that 9 out 30 women thought of the foetus as a real person as early as during their first trimester of pregnancy. Furthermore attitudes prevailed amongst the women such as predictions that they would feel grief should the foetus be miscarried, were more anxious about possible abnormality, more willing to abstain from intercourse to protect the foetus, thought that the foetus could affect the mother, and were less ambivalent or unhappy when the pregnancy was confirmed compared with those who did not think of the foetus as a real person.

Karmiloff-Smith (1995) recently stated "Cognitive development, starts in the womb. During the final 3 months of interuterine life, the foetus is capable of extracting invariant patterns across the complex auditory input that is filtered through the amniotic fluid". It also appears that human newborns can retain some memory trace of their acoustic prenatal experience (e.g. DeCasper and Fifer 1980; Fifer and Moon 1989). Other evidence comes from a study carried out by Hep-

per, Scott and Shahidullah (1993), who examined the movement response of the foetus and newborn to his or her mother's voice and a stranger female voice, and to voices speaking either normal or 'motherese'. The authors demonstrated that the foetus has the ability to learn prenatally, and argued about the possible role of prenatal experiences of voices in both language development and attachment.

Although the auditory sensory modality has been the most researched, a study carried out in 1996 by Varendi, Porter and Winberg investigated the responses of newborn babies to the odour of amniotic fluid (AF) during their initial attempts to locate mothers' nipple areola. The authors reported that 23 of 30 infants born of healthy non-smoking mothers who had had normal pregnancy and vaginal delivery, chose the AF-treated breast, thereby suggesting prenatal olfactory learning. They argued that because biological odours are so salient for the newborn, products that eliminate or mask such cues should be avoided during the perinatal period. There are also claims from different perspectives, that events before and/or during birth may be retained and lead to different kinds of disorders (e.g. Ploye 1973; Fedor-Freybergh and Vogel 1988; Marmot 1997).

It seems that there is no direct evidence of olfactory learning by human foetuses as with several non-human mammalian species. Nevertheless Chuah and Farbman (1995) reported that histological and histochemical studies suggest that human fetal chemoreceptors are well developed by the last trimester; this implies that by the last trimester, the mind of the foetus is becoming more complex with several senses quite well developed, particularly so for the tactile sense.

The Beginning of the Mind: the Tactile Sense

The tactile sense modality, or somatosensory system is the earliest maturing system (Turkewitz and Kenny 1985), and it has been argued that stimulation of the tactile variety is of maximal benefit to preterm infants as it matches the epigenetic sequence of development (Hunt 1979). The coding of information in the form of nerve impulse patterns is a fundamental concept in contemporary neurophysiology and psychology; information about the external world has to be transmitted from the skin to the central nervous system.

Hooker (1969) has shown that tactile sensibility is present from 7.5 weeks. He found that between 7 to 8 weeks, light stroking of the skin in the immediate perioral region (upper and lower lips and the ale of the nose) elicited contralateral flexion of the neck and uppermost trunk. Since tactile sensitivity is the first to develop, and this is the modality of which infants are most deprived after preterm delivery, caution should be taken not to expose the infant to sensory experience earlier in development than when it would ordinarily be available whilst in the womb (Lickliter 1993). Recent research is showing that functional reorganisation of the somatosensory area occurs as a result of light touch (e.g. Diamond et al. 1993). This may explain the improved learning performance of preterm infants who were recipients of a tactile sense nurturing therapy, as described by de Roiste and Bushnell (1993) and intelligence and achievements at school age (Adamson-Macedo et al., 1993).

It is noteworthy that during approximately the same time, i.e., 8th to 9th month of gestation, the foetus begins to acquire biological individuality and at the same time the role of a "biological ego" resulting from the attainment by the immune

system of the capacity to discriminate between self and non-self (Burgio 1987). The foetus acquires partial immunocompetence so that s/he may be able to cope with the eventual transplacental passage of pathogenic microorganisms, and possibly also for the purpose of rejecting maternal cells occasionally crossing the placental barrier. This is nature wisdom known as "immunological compromise", i.e., an early acquisition of a complete immune competence could possibly endanger the delicate immunological equilibrium between the foetal graft and the mother as a host.

It is here accepted that the mind emerges at the moment that tactile sensibility is present, i.e., 7.5. weeks gestation, and continues to develop prenatally and postnatally into childhood and adult life. The womb environment and the horizontal and vertical coactions ocurring in it, influence the development of the mind and will nurture, enrich or impoverish the phenomena of mental life. Questions which are central to the existence of mind such as the presence of self-awareness, consciousness are beyond the scope of this paper.

However it is important to highlight that three theories currently prevail to explain the phenomenon of intermodal perception. Of these, Integration (Birch and Lefford 1963, 1967; Blank and Bridger 1964; Bryant 1974) asserts that the senses are independent at birth, whilst Differentiation or Invariant Detection (Gibson 1969; Bower 1974) advocates that the senses are unified at birth . The third is the Intensity hypothesis (Schneirla 1959, 1965; Turkewitz et al. 1983), which draws elements from both Integration and Invariant Detection theories and is favoured by the author of this paper; as such, it defends the proposition that multimodal relations can be detected early in development and that, with experience, infants can discern characteristics of stimulation ranging from the quantitative such as size, brightness, loudness, duration, or rate of stimulation, to the qualitative such as rhythm, melody, texture or shape.

Regardless of the theory of perception embraced, it is clear that a preterm baby born with e.g., 25 weeks gestational age or older has a mind. Even if s/he is receiving oxygen therapy, s/he not only can demonstrate his or her tactile sensibility but also sensitivity and susceptibility to deep or light touch. Adamson-Macedo and Hayes (1998a) reported on a study which indicated that the 'quality' of touch to be used, particularly with ventilated preterms, is crucial. The studies summarised below were all conducted by the author and/or associates in the 1990s decade.

Empirical Evidence of the Existence of a Mind: Study-1 (Ventilated Baby; First Week of Life)

As an extension to a larger study, a special case explored the responses of an extremely low birthweight (740 grams)infant, born with 27 weeks gestation age by emergency caesarean section; three different qualities of touching were employed. Apgar scores were four at one minute and eight at five minutes. Complications included severe respiratory distress (RDS), patent ductus arteriosis and jaundice. Surfactant therapy was given at birth.

A repeated-measures, counterbalanced design was employed. On each of three consecutive days the interventions were different and given twice daily. The three interventions were TAC-TIC [(Touching And Caressing; Tender In Caring); Adamson-Macedo et al. 1994], TAC-TIC (Adamson-Macedo et al. 1994) with

increased finger or palm pressure, and passive touch which the authors called 'Comfort'. Heart Rate (HR) and behavioural responses [frequency of 'distress' and 'non-distress' to a defined checklist (Hayes 1996)] were measured three minutes before and after each intervention. In addition these results were compared with placebo control condition or 'spontaneous activities' where the baby was lying in the incubator without any intervention. Behaviour video analyses were carried out using the Observer software developed by Noldus, in the Netherlands.

A repeated measures analysis of variance (ANOVA) showed that although HR increased after TAC-TIC with increased pressure, changes were not statistically significant either between the different interventions ($F = 1.7$; $df = 3$; $p < 0.3$) or before and after each of the interventions ($F = 0.46$; $df = 2$; $p < 0.5$). Repeated measures ANOVA showed that there were no significant effects between the three interventions for the percentage of time spent in non-distress behaviours ($F = 3.6$; $df = 3$; p 0.08); however there was significant effect by intervention on the percentage of time spent in distress behaviours ($F = 11.8$; $df = 3$; $p < 0.006$). Post-hoc analysis using related t-test indicated that TAC-TIC with increased pressure induced significantly greater percentage of distress behaviours than either 'Comfort' ($t = 5.9$; $df = 3$; $p < 0.03$) or spontaneous activities. TAC-TIC with increased pressure had to be stopped after 4 sessions because the infant was overly distressed by the procedure. Further systematic investigations together with a wider agreement on touch therapy techniques are needed for effective therapies to emerge. The skin is extremely sensitive to light pressure (Schiffman 1995). Cutaneous receptors include both deep lying proprioceptors and tactile receptors, both of which are sensitive to pressure. Moreover, different responses in the preterm neonate have been elicited as results of both deep and light cutaneous pressure (Carmichael 1970; Obrzut and Hynd 1986); hence speculation arises that two distinct functional systems may be at work, the one elicited by light and the other by deep stroking.

The results of this single-case exploratory study indicated that deep pressure was distressing to this ventilated baby. Using the representation of the Equilibrium Model (ThEM) (Adamson-Macedo 1997a, 1997b) to exhibit the data, the authors showed that a number of negative rather than positive or beneficial coactions have occurred between the sensory and the behavioural system of the infant. This neonate has demonstrated that he has a mind; he has also learned that various tactile stimuli affect him differently. Moreover he has learned that he can have an effect on his caregiver, since the session ceased as a result of his discrimination between both stimuli.

Empirical Evidence of the Existence of a Mind: Study-2 (Ventilated Babies; First Week of Life)

With a larger sample, Hayes and Adamson-Macedo (1998b) reported on coactions between the physiological, behavioural and immunologic systems of the ventilated preterm neonate; this extension into Psychoneuroimmunology explored interactions between the mind and body of the neonates. Adamson-Macedo (1997b) had already defined Neonatal Developmental Psychoneuroimmunology as "the scientific study of the complex horizontal and vertical coactions of the phenomena of mental life, behaviour, neural, endocrine and immune processes of the preterm

neonate and their consequential role in the facilitation and maintenance of health and treatment of disease" (p. 435).

Inter-related neurobehavioural, immunological and endocrine/physiological data were obtained from each neonate, and represented simultaneously on orthogonal axes in ThEM, acronym for The Equilibrium Model (Adamson-Macedo 1997a, 1997b). The aim of ThEM is to make a succinct display of coactions, scales being selected for the chosen phenomena, one of which is represented on each axis of the model; for this purpose, zero(s) may be suppressed as required, and scales chosen so as to yield a 3-dimensional display, showing with maximum emphasis the consequences of changing one or other independent variable. For the neurobehavioural axis, a video analysis of distress and non-distress behaviours (frequency) was used; for the immunological axis, secretory immune function as quantified from saliva using an Enzyme Linked Immunosorbant Assay (ELISA) was employed; for the endocrine/physiological axis, alterations in cardiovascular parameters utilising heart rate (beats per minute) were used as the index. All participants (N = 25) were ventilated and were less than seven postnatal days of age on the first day of the study. The main hypothesis was that TAC-TIC would induce positive coactions between the measured phenomena for each baby. Statistical analysis, using a one-tailed related t-test, of the application of TAC-TIC version-3 (Hayes 1996), a gentle and light systematic stroking therapy for the ventilated preterm neonate, had scores which were significantly higher than matched control sessions of spontaneous activity ($t = -1.84$; $df = 24$; $p < 0.04$), and indicated enhanced and more stable responses. The results were interpreted through the proposition of a theoretical model of the hypothalamic self-regulatory mechanism of tactile stimulation following Gottlieb's experiential canalization approach (see also Adamson-Macedo 1997b).

Empirical Evidence of the Existence of a Mind: Study-3 (Non-ventilated Babies)

A further example of coactions between the mind and the body of the preterm neonate is the report published by de Roiste and Bushnell (1995) on the immediate gastric effects of tactile stimulation on 20 premature babies (10 experimental; 10 control) matched for birthweight (mean = 1.67 kg), gestational age (mean = 31 weeks), Apgar at 1 and 5 minutes (Mean 7.2 and 8.7, respectively). The authors suggested that the greater drop in pH in the stimulated group may be an effect of the stimulation; they argued that the infant may have associated the sensations accompanying the aspiration procedure with feeding, resulting in the stomach preparing for food ingestion with the aspiration itself acting as a conditioned stimulus. The authors viewed this as particularly significant "in that all infants were being tube-fed and thus may have been sensitive to the sensations of the passage of air in the tube and tube suctioning/pressure, all of which are components of the feeding process." In this case, the coaction between the sensory system and the digestive system appears to be positive since a more suitable stomach environment for digestion was established after stimulation of the infants. These results support the contention of Rausch (1981) that tactile stimulation improves gastrointestinal functioning in preterms, and that better digestion and greater nutrient absorption is facilitated by stroking prior to feeds.

Empirical Evidence of the Existence of a Mind: Study-4 (Non-ventilated Babies)

Another example but with older preterm babies has been reported by de Roiste, Bushnell and Burns (1995); they recruited 9 male and 6 female subjects with a mean gestational age (GA) of 36 weeks (S.D. = 2.82), mean birthweight of 2.67 kg. (S.D. = 0.89), and with none suffering from any debilitating condition other than jaundice. For this experiment the authors taught the parents how to apply TAC-TIC therapy (version-2), as shown in Figs. 1–4). The authors aimed to investigate whether the babies would respond differently to various stroking actions (head, trunk or limb), and whether parents (mother and father) would differ in the number and kind of responses they elicited from their own particular infant. Significant positive (Pearson) correlations were found between the number of reactions seen by the investigator, mother and father for both the maternal and paternal stroking sessions, implying validity in the reaction frequency data. The authors found neither significant difference in the percentage number of responses elicited by head as compared to trunk or limb stroking movements, nor between the number of responses elicited by maternal as compared to paternal stroking across the same body areas.

The feelings of parents about the therapy were noted. 100% (N = 15) enjoyed stroking their babies, and also a great majority thought that the babies had enjoyed the experience. 9 parents felt that the therapy had enhanced their confidence, and 12 thought that some stroking movements were better than others.

Having both mothers and fathers providing the programme of sensory nurturing, the father-infant relationships, as well as mother-infant relationships also benefited. As the authors pointed out, early paternal tactile contact and interaction had previously been deemed essential by many, including Pederson (1980), as well as possibly enhancing feelings of 'fatherliness' (Hines 1971). Since both father and mother enjoyed, and thought that their babies also enjoyed the experiences, the authors argued that the programe was positive; such a pleasant means of parent-infant interaction may be of particular benefit in Special Care Baby Unit settings, where parents tend to feel inhibited in interacting with their infant because of his/her vulnerable and 'at risk' health status. Whether such involvement by parents would help to dissipate prematurity stereotyping is a question which remains to be anwered. The above study, carried out during the first week of life of the preterm neonate, is viewed by the author of this paper as a good example of the occurrence of positive vertical coactions (sensory system/environment) which thereafter will continue to influence the development of the mind of the preterm neonate; it provides social 'encounters' through environmental opportunities for nurturing the relationship between the parents and the baby after abrupt interruption of the 'Biological Agreement' due to early delivery.

Empirical Evidence of the Existence of a Mind: Study-5 (Non-ventilated Babies)

There are many cognitive effects of a premature birth. Preterms, by comparison with fullterms, have been found to show poorer learning abilities e.g., slower habituation (Fox and Lewis 1983; Friedman et al. 1981), and a group of preterms

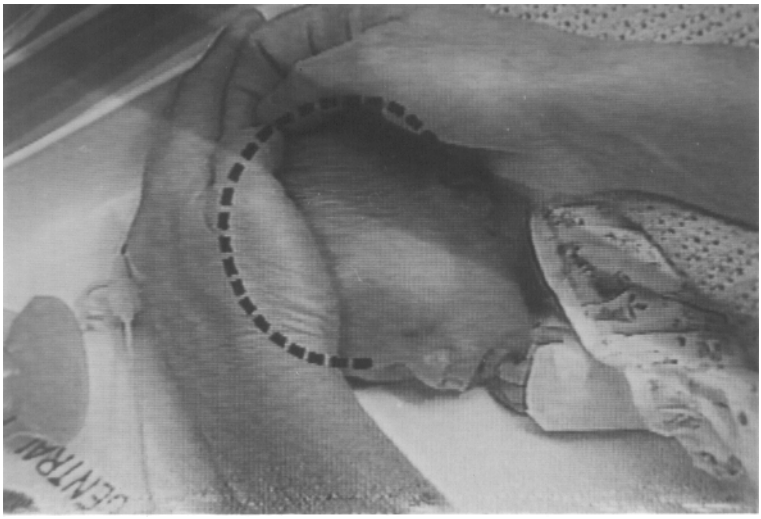

Fig. 1. Comfort position: Both hands lightly and gently cover the baby's head for six seconds; from the middle of the crown towards the forehead with one hand and towards the neck with the other hand.

Fig. 2. Forehead and temple movements: Keeping one hand gently on the head of the baby, a finger tip of the other hand strokes, gently and lightly, between the eyebrows in a circular movement and then the side temples.

Fig. 3. Hands and fingers: With one hand holding (do not lift it) gently baby's hand, with the fingertips of the other hand stroke across the hand and each of the baby's fingers gently and lightly.

Fig. 4. Back movement: With one hand covering gently baby's head, the fingertips of the other hand stroke across the shoulders and down the sides of the baby's back, gently and lightly.

were examined by de Roiste and Bushnell (1993). Adopting an instrumental learning paradigm, the authors hypothesised that preterms who received supplemental tactile stimulation as compared with controls would show better learning and better sucking behaviour. Sucking latency and percentage increase in sucking pressure were taken as measures of instrumental learning and threshold and overall sucking pressure were taken as measures of maturity of sucking. Results showed that once the contingent stimulation became available, the experimental group responded with higher sucking pressures over the conditioning phases. Results overall suggested a possibility of improved learning on an instrumental learning task in stimulated infants when compared to their matched controls. Thus, detriments in learning exhibited by preterms (e.g. Rose 1981; Friedman et al. 1981; Adamson-Macedo et al. 1993) may be diminished by the provision of supplemental tactile stimulation. Whether it is learning ability per se which can account for the improved learning performance of the experimental infants, or factors as suggested by other studies such as improvements in responsivity (Siqueland 1969), alertness (Rosenfield 1980) and state organisation (Degen-Horowitz 1990; Field et al. 1986), remains to be demonstrated. This is however an example of vertical coactions occurring between the sensory system, in this case the tactile sense, and the environment with the experimental babies displaying a more adaptive behaviour. Since developing systems continually change, statements of causality involve time (Gottlieb 1992); with appropriate and positive coactions occuring when the stimulation is relevant to the needs and actions of the baby. On such occasions, the organism temporarily reaches equilibrium.

According to Gottlieb's 'epigenesis probabilistic' theory of development, the studies reported above can be seen as examples of experiential canalization made possible by the occurrence of both horizontal and vertical coactions. As J. Lionel Taylor (1921 in Montagu 1978, p. 1) pointed out "the greatest sense in our body is our touch sense. It is probably the chief sense in the processes of sleeping and waking; it gives us our knowledge of depth or thickness and form; we feel, we love and hate, are touchy and are touched, through the touch corpuscles of our skin".

Sociogenesis holds that all higher psychological processes, such as learning, cognition, and personality are results of early social interactions. This concept has been recently used in the animal literature (Gottlieb 1993). For example, social induction of malleability in ducklings has been studied; it was found that malleability was absent when ducklings were tactually isolated from one another. Such experimental results indicate that tactile contact, even when provided by artificial ducklings, is the sensory basis of malleability (Gottlieb 1993).

Conclusion

It is now clear that the newer sub-disicipline of Neonatal Psychology, particularly concerned with the first 28 days of the preterm neonate, may be sharply differentiated from both Environmental Neonatology (Gottfried and Gaiter 1985) and Environmental and Developmental Neonatology (Wolke 1987). This paper has presented supporting evidence and argued that the preterm neonate has a mind, and thus is a cognitive, social and sensitive being. The coactions themselves are to

be seen as examples of social 'encounters' between the organic and the psychological being of the resilient, 'competent' preterm neonate.

The skin of the neonates is the prime way of relating to the environment provided by care-givers, and provides means of communication for mutual relationships between genetic activity in the sense of DNA ↔ RNA ↔ Protein, structural, maturational, functional and experiental development to occur both horizontally and vertically; for the cases quoted above, the babies have shown that they were able to differentiate between comforting or non-stressful stimuli on the one hand, and those which are not comforting or stressful on the other, and that this serves a purpose in learning how to cope with their environment. The initial disequilibrium due to the disruption of the 'Reproductive Agreement', as proposed by Zichella (1992), is followed by temporary equilibrium; continuity of the intervention may lead to a re-establishment of the psychobiological relationships between the mother and the newborn who are now at the second phase of the 'Biological Agreement'.

Exposure of the foetus to higher or lower than normal secretion of various hormones in the mother, as Gupta pointed out (1989; 1992), can effect the foetal and neonatal brain development and may cause significant changes in certain areas even when adult; Gupta, in calling such phenomena humor-humours interactions, reflected upon the development of the concept of "endocrine personality" (EP). In further examining the behaviour patterns presaged by various hormones and humors, Gupta linked them to Gray's (1987) proposition of three factors which contribute to the development of EP and cited dopamine participation in the approach system which responds to rewarding stimuli thereby facilitating behaviour which encourages exposure, gamma-aminobutyric acid (GABA), serotonin and endorphins which serve to oppose the fight-flight system which responds to aversive stimuli, and the behavioural inhibition system which responds to those stimuli giving rise to unpleasant consequences. Moreover, this influential author suggests that the precise meaning of 'humor-humour interactions' is that any hypo- or hyperpresence of humors and hormones in the foetus has potential for altering the so-called "tuning" of the subject when it becomes adult.

If the consequences of the abrupt disruption of the first part of the reproductive agreement, due to preterm labour, are to be attenuated then greater understanding is required of both the body and the mind of this resilient human being, the preterm neonate during first four weeks of life. A more profound understanding would guide psychologists to provide experiences which may well enhance the growth and development of the preterm, and simultaneously may also nurture the early mother-child relationship which has been so abruptly interrupted. Nor does close the matter, since such interruption is usually accompanied by prematurity stereotyping, with consequential effects on Mother-Infant Interaction.

A major input to the solution of this range of problems is the recognition that Mind is present, and that the mental life of these neonates is a necessary study for Neonatal Health Psychologists. To this objective, Neonatal Health Psychology has been proposed and defined as "the scientific study of the complex horizontal and vertical coactions of the phenomena of mental life with the various systems, the behaviour of the preterm neonate and their consequential role in the facilitation and maintenance of health and treatment of disease". (Adamson-Macedo 1998b).

In the U.K. alone 40,000 babies are born prematurely each year and amounts to 60% of all neonatal deaths, an outcome with profound financial, sociological and psychological implications. From an epidemiological point of view, the incidence of preterm labour is higher in lower socio-economic groups, which suggests a link with poverty (McLean, Walters and Smith 1993). Overall the phenomena is a major public health problem, as discussed recently by Carson (1998). There are many and various approaches towards amelioration of this situation, and the role of Psychologists within groups of multidisciplinary Neonatologists is needed to contribute knowledge and understanding of the problem at source, at the same time practically providing a base for the psychological well-being of the preterm neonates during their exceptionally sensitive first weeks of life.

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