

# Pathways in the Emergence of Neonatal Health Psychology [NNHP], and Its Scope

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**Abstract:** For the last decade Health Psychology, has been a rapidly expanding discipline, now has formal professional recognition, a record of successful practice, and several avenues of promising study. It is noteworthy that attention devoted to pediatric and child health psychology has increased dramatically, but the great majority of published work refers to the child and not to the preterm neonate; yet being preterm means being born early, and sometimes too small, and is a stressful life event. Moreover, practice and abundant published evidence indicate that prematurity results in distress amongst infants, parents, and caregivers in varying degrees. In the field of Medicine, Neonatology has appeared as a sub-discipline, and both investigates and cares for at-risk babies, including risk for developmental disabilities.

The time is consequently opportune for psychology to make an effective contribution to both the theory and care of the preterm neonate, viewed as a unique, emergent, coactional and hierarchical human being. The formal framework for this is Neonatal Health Psychology (NNHP), which is defined in the paper as 'the scientific study of psycho-biological and behavioural processes in health, illness, and health care of the preterm neonate during his/her first 28 days of life, and the relationship of such processes with later outcome.' Early work in this category has shown that NNHP has profound interdisciplinary connotations, not least because of the diverse ways in which information has to be derived from the non-verbal neonates.

The pathways and scope of NNHP are identified, and many examples of work with preterm neonates are summarised in the paper. In making the case for the professional formalisation of NNHP, descriptions are given of Neonatal Assessments and very-early interventions; the interdisciplinary character of much of the early work is shown to have been essential. Indication of a theoretical framework for NNHP is given, and the penultimate section suggest a set of non-exclusive paradigms for further extension of NNHP.

**Resumo:** *Caminhos da psicologia da saúde do recém-nascido pretermo.* Na última década a psicologia da saúde que é uma disciplina que expandiu rapidamente e hoje em dia é

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aceita formalmente na sua categoria profissional, tem um histórico de prática com sucesso e muitos caminhos de estudos promissores. É importante notar que tem aumentado dramaticamente a atenção dada à pediatria e à psicologia da saúde da criança mas, a grande maioria dos estudos refere-se a criança e não ao recém-nascido pretermo; pretermo significa ter nascido mais cedo e algumas vezes muito pequeno e é um evento estressante na vida do bebê. Além disso, a prática e a abundante evidência publicada indicam que o nascimento pretermo resulta em dificuldades para os bebês, pais e todos envolvidos no seu cuidado de rotina, em graus diferentes.

No campo da medicina, neonatologia apareceu como uma sub-disciplina e ela investiga e cuida dos bebês em perigo, incluindo o risco de desenvolver defeitos físicos. A época é consequentemente oportuna para a psicologia dar uma contribuição efetiva para a teoria e o cuidado do bebê pretermo o qual é visto como um ser humano único, emergente, capaz de interações recíprocas e hierárquico.

A estrutura formal para essa contribuição é a psicologia da saúde neonatal (PSNN) a qual é definida no artigo como o estudo científico dos processos psico-biológicos e comportamentais na saúde, doença e no cuidado da saúde do pretermo durante os primeiros 28 dias de sua vida e a relação desses processos com o resultado futuro. Um trabalho anterior nessa categoria mostrou que o PSNN tem profundas conexões inter-disciplinares não só devido às diferentes maneiras em que a informação vem do não verbal dos recém-nascidos. Os caminhos e a possibilidade do PSNN são identificados e muitos exemplos do trabalho com pretermos foram sumarizados nesse artigo. Dando apoio para a formalização profissional do PSNN são dadas descrições do exame neonatal e intervenções no pretermo; o caráter interdisciplinar dos primeiros trabalhos nesse campo mostrou ser essencial. Indicação da estrutura teórica do PSNN é dada e a penúltima seção sugere um conjunto de paradigmas não exclusivos para uma maior expansão do PSNN.

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## Introduction

By 1994, Health Psychology had been established as a discipline, and defined by Johnston (1991) as the study of the psychological processes and behaviour in health, illness and health care. Health Psychology, so far, has mainly related to the adult population, although increasing attention is now being paid to both pediatric and broadly-based child health psychology (e.g., Johnson and Johnson 1991; Eiser et al. 1994; Collier 1997, 1998).

Preterm neonates are unusual patients in so far as they are essentially healthy, with many of them born free of organic pathology, yet at risk and with organ system immaturity's which anatomically and functionally may demand intensive care (Gorsky et al. 1991). During their first 28 days of life, preterm neonates thus manifest special physical and psychological characteristics, and hence propel those who study preterms' psychological processes and behaviour during health, illness and neonatal health care into a special role.

Consequently, and in accordance with the convention of Gandy and Robertson (1987), Adamson-Macedo (1997a,b, 1998a,b) proposed that, during the 28-day neonatal period, both the healthy and ill preterm babies should be the particular concern of Neonatal Health Psychology. As a sector of health psychology studies and practice, Neonatal Health Psychology draws on social, cognitive, clinical, physiological, developmental, and organizational psychology, and from several

other disciplines, especially epidemiology, physiology, immunology, and clinical medicine; it is also characterised by its methods and theoretical models, as well as its empirical findings. The material of this paper is concerned with the rationale for Neonatal Health Psychology (NNHP) and follows the schema of Johnston (1994).

In this paper, NNHP is defined as the scientific study of psycho-biological and behavioural processes in health, illness, and health care of the preterm neonate during his/her first 28 days of life, and the relationship of such processes with later outcome; particular importance is given to the first week of life for which systematic studies are still rare, and noticeably so if the baby is receiving oxygen therapy. The scope of NNHP covers three major areas, and these determine the structure of this paper, as follows:

- Assessment procedures and Diagnostic methods.
- Sensory nurturing interventions, including support for babies and their caregivers.
- Proposals for new paradigms.

### **Pathways in the emergence of Neonatal Health Psychology (NNHP)**

The origins of NNHP can be traced along four paths, although 3 and 4 are inevitably intermingled:

1. Prenatal and perinatal Psychology and Medicine.
2. Neonatology.
3. Environmental Neonatology.
4. Environmental and Developmental Neonatology.

#### *Prenatal and Perinatal Psychology and Medicine*

Fedor-Freybergh and Vogel (1988) edited “Encounter with the Unborn”, a comprehensive survey of research and practice which continues to be an inspiration to all who are committed to encourage cross-fertilisation amongst the disciplines so that prenatal life can be optimised. As Fedor-Freybergh (2000) recently pointed out, the integrative and transdisciplinary aspects of sciences and their harmony and entrée into the XXI century is the true vision for our common efforts.

The baby in the womb, his/her mother, and/or caregivers, and the environment constitute the steadily developing field of Pre-natal Psychology and Medicine. As such, the field is not new; Gupta and Datta (1988), for example, drew attention to fetal psychology being acknowledged by Indian Embryologists of antiquity. Much more recently, Marmot (1997) has discussed the circumstances impinging on the fetal state and during early infancy and childhood, all of which affect predisposition to disease and certain other consequences of adulthood.

In attempts to establish a developmental psychology related to the prenatal period, Chamberlain (1988), Schindler (1988) and Schusser (1988) provided important material which sustained their request for a revised opinion on development which should take into account aspects such as the unborn baby’s competence and wholeness. An accumulation of other diverse data shows the link between

'experiences' in the womb and later outcome (e.g., Gupta 1989, 1992); Zachau-Christiansen 1988; Baker 1997; Nathanielnisz 1999)

Regarding the effects on parents, examples include a study carried out by Lumley (1980) on 30 pregnant women; 9 (of the 30) each thought of the foetus as a real person as early as during the first trimester of pregnancy. Moreover, attitudes prevailed amongst the other 21 such as predictions that they would feel grief should the foetus be miscarried, anxieties about possible abnormality, willingness to abstain from intercourse to protect the foetus, persistent thinking that the foetus could affect the mother, less ambivalence or unhappiness when the pregnancy was confirmed compared with those of the group who did think of the foetus as a real person. The grief responses of the partners of women who did miscarry have recently been studied (Johnson and Puddifoot 1996; Paton et al. 1999).

The ability of the unborn baby to learn prenatally has been demonstrated by several investigators (e.g. De Casper and Fifer 1980; Fifer and Moon 1994); Hepper and Shahidullah 1994). Learning is a high psychological function and one has no hesitation in agreeing with Shatz (1992) that the foundations of mind are laid during prenatal development with the forming of neuronic interconnections, neural activity itself, and the stimulation, which is crucial to facilitating the process.

Mind is the precursor of mental life. It is here accepted that the mind emerges when tactile sensibility becomes apparent, i.e., 7.5 weeks gestation, and continues to develop prenatally and postnatally into childhood and later. The womb environment, and the horizontal and vertical coactions (Gottlieb 1970, 1991b) which therein occur, influence the development of the mind and will nurture, enrich or impoverish the phenomena of mental life. Issues central to mind's existence such as the presence of self-awareness and consciousness are beyond the scope of this paper.

### *Neonatology*

Neonatology as a sub-discipline of Medicine has quickly developed and established itself, but this has not been accompanied by systematic study of the psychological processes of the preterm neonate, and acknowledgment of such phenomena has been tardy. One noteworthy reason for this reluctance is that many health professionals do not accept the preterm neonate as having a mind, and thus a mental life; extraneous factors contributing to non-or limited-acceptance are that few Neonatal Units around the world accept a Psychologist on a permanent basis, and the psychological well-being of the preterm neonate remains a low economic priority, even where it is diffidently acknowledged.

### *Environmental Neonatology; Environmental and Developmental Neonatology*

Attempts have been made in the past to extend neonatology, such as the introduction by Gottfried and Gaiter (1985) of the term Environmental Neonatology, which sought to encompass the study of newborn special care facilities, together with their impact on the medical and developmental status of sick infants. Wolke (1987) shortly afterwards proposed further change by adding 'Developmental', thus emphasising studies of developmental changes and progress of the preterm neonate or sick infant whilst still in the special-care baby unit. Being specifically

concerned with babies during hospitalization and all ages, this definition subsumes the neonatal period.

### *Emergence of Neonatal Health Psychology (NNHP)*

The collaboration of Psychology and Medicine, specifically developmental psychology and pediatrics, has long been recognised for the purpose of providing for greater care of preterms and other high-risk infants, as well as encouraging the symbiosis essential for advancement of both disciplines. The developmental approach is very appropriate when applied to Child Health Psychology; in particular, the specialised case of Neonatal Psychology was defined (Adamson-Macedo 1997a) as “the scientific study of the phenomena of mental life and the behaviour of the preterm Neonate as an emergent, coactional, and hierarchical system.” Moreover, during the past decade, developmental psychology has witnessed a surge of interest in studying the relations between genes and behaviour.

Of several rationales of system analysis applied to developmental psychology, on grounds of comprehensive interdisciplinary plausibility the author favours the theory of experiential canalization (Gottlieb 1991b); Gottlieb defends the thesis that epigenesis is probabilistic and not predetermined, and that development occurs as the result of continuous horizontal (e.g., cell to cell) and vertical (e.g., cell to environment) coactions. In probabilistic epigenetic terms, individual development is thus characterized by increased complexity of organization, i.e., the emergence of new structural and functional properties and competencies, at all levels of analysis (molecular, sub-cellular, cellular, organismic); such phenomena include organism-environment coactions (Gottlieb 1992).

The pathways of NNHP having been identified, it is opportune to focus on the hospitalized preterm neonate and the three major areas into which the scope of NNHP may be divided (as given in the Introduction); in the view of the author, these constitute a challenge for Health Psychologists.

## **Assessments in the Neonatal Unit**

### *Assessments – an Introduction*

A major issue during the first weeks of life of the hospitalized preterms is continuous assessment of their physical and psychoneurological development. Whilst the physical assessment is systematically done by the medical and paramedical staff, psychoneurological phenomena are rarely assessed, and even then not usually by a psychologist attached to the Neonatal Unit. Yet a Neonatal Health Psychologist has a most significant three-part role in a Neonatal Unit, each part discussed below. Firstly, reference is made to types of Assessments which fall into two categories, one of which has psychometric properties and was developed by a Psychologist, a Korner in the 1970s (Korner and Thom 1990) whilst the other is qualitative and was developed by a Neurologist (Prechtl 1986); the former was specifically designed and evaluated longitudinally with a large population of preterm neonates. Secondly, a suggestion is made for an assessment, which could be developed by Neonatal Health Psychologists; this is best expressed as the Quality of Life of the Preterm Neonate (QoLoPNN). Thirdly, a brief outline is given

of an assessment of the perceived mastery of the mother and its relationship to the gestational age of the baby (Barnes and Adamson-Macedo 2000).

#### *Assessment with Psychometric properties; NAPI*

The Neurobehavioral Assessment of the Preterm Infant (NAPI) is a test of developmental maturity in the domains of scar sign, popliteal angle, motor development and vigor, alertness and orientation, irritability and state regulator; it also measures infant responses to handling. For more details see Dittrichová et al. and Constatinou in this special issue.

#### *Qualitative Assessment; General Movements (GMs)*

General movements (Prechtl 1990) have been described by numerous investigators as a reliable method of neurobehavioural assessment both for term and preterm infants. Normal movements are characterised by a complex pattern, which involve the head, neck, arms, legs and trunk. The movements should be reciprocal, smooth and elegant, and can best be observed when the baby is awake and lying supine. The quality of the movements differ with age; at 36 weeks postconceptional age (PCA) movements have a writhing character, whilst at 52 weeks movements are called "fidgety". "Fidgety" movements are an ongoing stream of small, circular and elegant dancing movements of neck, head, trunk and limbs; they appear to be a pleasurable activity, but are complex and variable.

Deviation from normal, as outlined above, is characterised by a limited repertoire of movements. The movements may be repetitive with synchronised patterns, rather than variable and reciprocal. Tremulous and flapping movements are more commonly seen at 36 weeks PCA. Monotonous stereotyped movements with few rotations lacking variability can be recognised as deviant from 'normality'.

#### *Comparison of Two Assessments Given Above*

A recent contribution (Constantinou, Adamson-Macedo, Mirmiran and Fleisher 1998a and 1998b) concerns methods of assessment of brain insult as early as possible, with prediction of outcome. Since the insult may manifest itself in several aspects of behaviour, several tests are currently being used to assess the neurobehavioural development of very low birthweight preterms, two of which are the NAPI (Korner and Thom 1990) and spontaneous GMs (Prechtl 1990). This longitudinal investigation is presently comparing the NAPI and GMs approaches.

The research aims to evaluate NAPI and GMs respective predictive values for later neurological outcome at 18 months age by comparing the alternative results with their respective Magnetic Resonance Image (MRI) data, taken during the time of the neuro-behavioural assessments; it is expected that MRI should provide information regarding brain insult and any changes in structure. Analyses of the coactions between structure and function, as measured by NAPI and GMs, may explain similarities and differences between the two assessments, whilst the MRI should be able to differentiate between injury caused by anoxia or ischemia versus injury as a result of intraventricular haemorrhage (IVH). Further assessment includes the Bayley Infant Neurobehavioural Screener (BINS) which will be used at 4 and 12 months.

Identifying delays and/or insults early may promote better quality of life and prevent further organic and psychological impairments. Thus as Turkewitz and Devenny (1993) pointed out, timing has a meaningful role in a model of development; i.e., when development consists of components or part-processes which are flexibly organized and can interact across domains, albeit with constraints, as expressed by Gottlieb's theory of Experiential Canalization of Behavioral Development (1991).

A good example of both the utility and veracity of this concept in health care has been given by Gorski, Huntington and Leukowicz (1991). These authors discussed physiologic trends in the heart rate of preterms, and oxygenation as related to the timing and content of caregiver stimulation. Specifically, they examined the amounts and types of touch (medical and social) in a group of hospitalized preterm infants, and how these forms of touch related to the particular physiologic crisis of bradycardia. Of major interest were their findings that touch was not responsible for cardiac instability, but that oxygenation was marginally lower after touch.

Two assessments were advanced by these authors. Firstly, it was argued that touch by itself did not necessarily lower  $pO_2$ , but that tactile stimulation when presented to an infant who was already physiologically compromised (i.e., with low  $pO_2$ ) may potentiate an underlying vulnerability to bradycardia. Alternatively, they proposed that touch prior to bradycardia may have been a chance occurrence, or even a caregiver's response to signs of distress in an infant. Whatever is the true or better interpretation, the importance of continuous assessment of the behaviours of the neonate whilst in special or intensive care is manifest and should never be underestimated; systematic observations and recording will also provide the caregiver with vital information regarding the self-regulatory efficacy of the neonate.

### *The Quality of Life of the Preterm Neonate (QoLoPNN)*

As Johal (1995, p. 7) pointed out "definitions of quality of life exist with no clear consensus of concept, as it continually evolves and is shaped by external demands." Jenkins and associates (1990) assign three dimensions to quality of life concepts: (1) Feelings (subjective levels of wellbeing; e.g., relief from physical and emotional pain), (2) Functions; e.g., level of productive activity according to age, (3) Futures; e.g., prognosis in terms of feelings and functions, with emphasis that duration of life must be balanced against quality.

Quality of life should further address levels at which human life is lived such as biological, psychological, interpersonal, social and economic; moreover, any comprehensive assessment of quality of life should bear a multidimensional approach in the assessment of the phenomena of pain. The literature reveals some quality of life measures suitable for use with children but as Collier (1997) pointed out they are disease specific. Collier developed a generic child quality of life measure with children aged 6, 11 and 13 years, who were approached at school and asked to identify what made their lives good or bad. They found that a large proportion of the answers was related directly to interpersonal relationships and how the children felt they were perceived by others whom they deemed to be important.

With pre-verbal children, and particularly with the preterm neonate this area of study is a new challenge; although verbal self-report is not possible, non-verbal

report through careful observations and recording of behaviours, physiology, endocrinology immunology and their coactions can be used as indicators of Quality of Life of the preterm neonate (QoLoPNN). Routine measurements may be taken in order to assess, e.g., pain and distress, with the assumption being made that QoL is greater when distress or pain are reduced. Measurements could also be taken as indicators of the effectiveness of on-going interventions and outcomes.

### *Assessing Neonatal Pain*

The experiences of the neonate in intensive care can be distressful or painful and, as such, have become a focus of considerable research; studies have been accumulating which indicate that the neonate is capable of displaying reliable non-verbal responses to painful stimuli (Grunau et al. 1990; Craig et al. 1993; Sparshott 1989). Other studies have reported possible impairments of the immune and endocrine systems where pain has not been treated (Aynsley-Green et al. 1985; Anand and Hickey 1987, Anand 1990). Neonatal pain and the measure of it are further discussed below.

A recent research review by Franck and Miaskowski (1997) of the measurement of preterm neonates' responses to painful stimuli concluded that (1) hitherto no instruments have been available which are valid, reliable, and clinically feasible, and (2) the majority of the instruments available are univariate measures. Such bleak conclusions reinforce the need for continuity of study of Pain as a multi-dimensional phenomenon, which yields its own confusion because, more often than not, it is expressed subjectively. With neonates, the overall problem is compounded since pain must be inferred through physiological, behavioural and experiential indicators. This necessity, of paramount importance from medical and psychological viewpoints, concurs with Gate Theory (Melzack and Wall 1965), which advocates the inclusion of such indicators for measurement of the multidimensional phenomenon of pain.

The Premature Infant Pain Profile (PIPP), a seven-item, four-point scale for assessment of pain in premature infants, has recently been developed (Stevens, Johnston, Peetryshen and Taddio 1996). PIPP is three-dimensional in that it employs upper facial activity, physiological activity and behavioral state, but is used only for acute procedural pain; it is nevertheless a positive step in the quest for reliable multidimensional assessment tools. Further and extensive validation is needed, by Neonatal Health Psychologists, to ascertain the degree to which this approach is sensitive and specific for measuring neonatal responses to painful stimuli, and for comparison with univariate measures. Such investigation are contiguous with other measurements, e.g., secretion of SIgA as means of expressing behavioural, behavioural state, physiological and immunological measurement of distress/pain, as demonstrated by Hayes (1996).

### *Assessing Maternal Perceived Parenting Mastery*

Fisher and colleagues (1997) found that the obstetric procedure which had the most adverse psychological effects on mothers of preterm babies was type of delivery; mothers who required caesarean section deliveries were significantly more likely to possess a negative mood and experience a fall in their self-esteem. Al-



though an extensive literature reports medical and developmental risks for the infants, there is relatively little attention focused on the intrapsychic development of the mothers of preterm babies; as Mothander (1999) pointed out, mothers of premature infants are premature mothers themselves. Albeit slowly, the impact of premature birth on the subsequent parenting of preterms babies has steadily come to be recognized by both clinicians and researchers (Teti and Gelfand 1991; Redshaw 1997; Sobotkova et al. 1996; Miles and Holditch-Davis 1997; see also McVey et al. in this special issue). Nevertheless, scientific studies which investigate mothers' perception of their parenting mastery or beliefs of self-efficacy (Bandura 1977) during the neonatal period have hitherto been neglected, although one such study has recently been carried out (Barnes and Adamson-Macedo 2000) with two aims:

- to develop and validate a parenting self-efficacy questionnaire for the neonatal period;
- to investigate whether the gestational age of the baby, mother's type of delivery and other perinatal factors such as birth correlates with maternal self-efficacy.

Results showed that the questionnaire, which was based upon Teti and Gelfand (1991), has internal consistency and that both gestational age and type of delivery are the two major factors significantly explaining the variance of the perceived parenting (maternal) self-efficacy scores during the neonatal period.

Undoubtedly this is an open and promising area of research, which deserve attention; the theory of self-efficacy is a robust one. As an example, measurements and enquiries such as this could also be used to evaluate the effectiveness of sensory nurturing interventions in enhancing maternal or/and paternal parenting mastery of hospitalized preterm neonates.

## **Sensory Nurturing Interventions: Supporting Babies and Caregivers**

### *Introduction*

A recent review by Anand and Scalzo (2000) provides evidence that perinatal brain plasticity increases vulnerability to early adverse experiences, thus leading to abnormal development and behaviour. Since the 1960s, on the positive side, evidence has been accumulating which shows the overall beneficial effects on outcome of preterm neonates (Adamson-Macedo 1997a,b; Wolke 1991; Masi 1978). In 1984, the author advocated that the preterm neonate is a unique human being who is neither over- nor under-stimulated, but is usually inappropriately stimulated; work of the last fifteen years has justified this earlier viewpoint.

Attention should consequently be directed not only towards outcomes but to processes in order to gain understanding of the development of such new, fragile but resilient members of the population. The auditory sensory modality is the one which has been most researched. For example, Karmiloff-Smith (1995) stated that Cognitive development starts in the womb; during the final three 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 is also apparent that human newborns can retain some memory traces of their acoustic prenatal experience (DeCasper and Fifer 1980; Fifer and Moon 1989; also

see Sjezer and Barbier, in this special issue). Further support for this view comes from Hepper, Scott and Shahidullah (1993) who examined the movement responses of foetua and newly-born to mothers' voices; these authors demonstrated the ability of the foetus to learn prenatally, and then discussed the possible role of prenatal voice experiences in both language development and attachment.

In 1986, Varendi, Porter and Winberg investigated the responses of newborn babies to the odour of amniotic fluid (AF) during initial attempts by the infants to locate mothers' nipple areola. It was reported that 23 out of 30 infants born of healthy non-smoking mothers, who had had normal pregnancy and vaginal delivery, chose the previously AF-treated breast, thus suggesting prenatal olfactory learning. These authors subsequently argued that, due to the saliency of biological odours for the newborn, products that eliminate or mask such cues should be avoided during the perinatal period. No direct evidence of olfactory learning by human foetuses is available, but Chuah and Farbman (1995, in Varendi, Porter and Winberg, 1996) reported that their histological and histochemical studies did suggest that human fetal chemoreceptors became well developed by the last trimester.

### *The Tactile Sense*

Of particular concern is the tactile sense, the importance of which is abundantly clear from the need of to handle the newborn. What has not been so clear are the relative advantages and disadvantages of tactile therapies, a field of investigation, which was and still is confused by a wide variety of treatments, most of them non-systematically defined and hence non-comparable, in a spectrum ranging from quite vigorous physiotherapy to gentle stroking actions; beneficial outcomes for tactile therapies are generally claimed. Hunt (1979) argued that tactile modes of stimulation have optimal benefit for preterm infants, and match the epigenetic sequence of development. The author's own work from the late seventies onwards, with a sample of more than 100 preterm babies, was specifically concerned with the role of light finger-tip stroking in producing beneficial developmental outcomes for these frail newcomers; the techniques were optimised and systematised as 'TAC-TIC therapy' (Macedo, 1984), and later have been used for further research work in the ramifications of the tactile sense.

Turkewitz and Kenny (1985) asserted that the tactile sense modally, or somatosensory system, is the earliest maturing system. Aside from the validity of this claim, in whole or part, it is manifest that the coding of information in the form of nerve-impulse patterns is fundamental to contemporary neurophysiology and psychology; information about the external world has to be transmitted from the baby's skin to the central nervous system.

Hooker (1969) showed that tactile sensibility is present from 7.5 weeks and that, in the interval between 7 and 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 part of the trunk. Since tactile sensitivity is probably the first to develop and is the modality of which infants are most deprived after preterm delivery, caution is needed not to expose the infant to sensory experience earlier in development than it would ordinarily become available (see Lickliter 1993). More recently, research has shown that functional

reorganisation of the somatosensory area occurs as a result of light touch (Owens 1992; Diamond et al. 1993).

### *Self-Regulation*

The preterm neonate is here viewed as a functioning interactive organism with self-regulatory abilities. Walcher and Peters (1971, pp. 232) declare that self-regulation is a “dynamic process of adaptive functioning operating through a large number of individually distinct mechanisms which may be hierarchically arranged or classified.” This dynamic process of adaptive functioning occurs amongst the various systems of the infant born too early, and may be consistently explained by Gottlieb’s experiential canalization theory, Bandura’s (1978) reciprocal deterministic view of human action, and sociogenesis (Vygostky 1986).

Self-regulatory constructs are now being used in many sub-disciplines of Psychology (e.g., health psychology/behavioural medicine, and experimental psychology), but interest in unravelling relationships amongst the various organic and psychological systems is not new; the literature yields several examples of both animal and human studies which have sought to elucidate, for example, the role of early sensory stimulation (or lack of it) on self-regulation (see Adamson-Macedo 1997a).

### *Equilibrium or Desequilibrium Amongst the Various Systems of the Preterm Neonate: the Role of Coactions*

The Equilibrium Model, **ThEM** explained elsewhere (Adamson-Macedo 1997a,b op cit ) in detail, has been advantageously used to represent those beneficial coactions which promote temporary equilibrium of the neonate; when one system is arranged to supply the independent variables, the corresponding changes in the other systems are displayed. This Model is a graphical display designed to represent on a set of axes the relationship between the various systems; in the following, letters or letter groups simply denote the various axes.

As an example, should the sense of touch be the appropriate stimulation, which would offer comfort for the ventilated, or non-ventilated preterm, the vertical coactions consequentially expected (and duly displayed) would be beneficial.

This implies that the behavioural system (NB) would reorganise and the babies would display more comforting or non-distress behaviours than otherwise, the physiological system (E/P) would stabilise, the endocrinological system (E) would be balanced, and the immunological system (IM) would be enhanced i.e., (in the last case) secretory immunoglobulin A (SIgA) would increase after the sensory nurturing programme.

The systems are said to be in equilibrium when their coactions are beneficial to the current state of the baby. For example, there is no sharp increase or decrease of heart rate, there are more ‘organised’ or ‘comfort’ behaviours and the secretion of secretory immunoglobulin A is higher; if otherwise, it is presumed that the systems are in disequilibrium. Although a multidimensional measure of the state of equilibrium of the baby is most desired, it has been unknown/unavailable hitherto.

Phenomena which occur within the various systems mentioned above have been separately tested by using the sense of touch, but using different types of tactile stimuli such as handling, rubbing, massage, gentle human touch (GHT), individualised touch, or the gentle/light and systematic stroking known as TAC-TIC therapy; the experimental incompatibilities here have already been mentioned in the introduction to *The Tactile sense*, but examples of common results are given below:

- Endocrinological phenomena (E)

In a series of studies, de Roiste and Bushnell (1996) measured gastric pH, hydrochloric acid (HCl), and stomach lipase concentration, i.e., lingual and gastric lipase before and after tactile stimulation. Their results overall suggested that gentle/light stroking improves gastro-intestinal functioning in preterms and that better digestion and greater nutrient absorption is facilitated by stroking prior to feeds. Similar examples are to be found in Scott and Richards (1979); Schanberg and Field (1987); Rausch (1981); Scafidi et al. (1990); Acolet et al. (1993); Berezin et al. (1993); Hayes (1996).

- Physiological phenomena (P)

Harrison et al. (1991) reported that gentle human touch, for 15 min. daily, did not have adverse effects on the oxygen saturation of small preterm infants. In 1994, 81 sessions of TAC-TIC therapy were administered to 11 ventilated small preterms; the results showed stabilisation of oxygen saturation (Adamson-Macedo et al. 1994a, 1997b). Other examples are to be found in Gorski et al. (1991); Acolet et al. (1993); Morrow et al. (1991); de Leeuw et al. (1991); de Roiste and Bushnell (1996); Adamson-Macedo et al. (1997); Adamson-Macedo and Hayes (1998); see also de Roiste and Bushnell in this special issue.

- Immunological phenomena (IM)

The Immunological system attracts increasing interest, one important consequence of being able to investigate coactions of the preterm neonate. Hayes, Adamson-Macedo, Perera and Anderson (1999) showed that secretory Immunoglobulin A (sIgA) can be detected during the first week of life of the very small ventilated preterm, and Hayes, Adamson-Macedo and Perera (1999) reported that concentrations of sIgA are greater three minutes after intervention by gentle/light stroking (TAC-TIC). These results suggested that beneficial vertical coactions between the sensory and the secretory immune system were occurring, thereby facilitating development of the Immune system. Self-regulation efficacy was apparent.

- Neuro-behavioural phenomena (NB)

Systematic studies which observe and record both behaviour and behavioural state, prior and during intervention, are rare. In the author's experience, gentle/light stroking tends to elicit a greater number of organising rather than disorganising behaviours, a further indication that beneficial coactions are occurring (Adamson-Macedo et al. 1994b; Hayes 1996). Constantinou, Adamson-Macedo, Mirmiran and Fleisher (1999) found that skin-to-skin holding does not interfere with the rest-activity period of low birthweight infants.

There was no evidence that the touch stimulation used by various authors had deleterious effects (medically unacceptable) such as significant increase in cortisol level (Acolet et al. 1993), or sharp fall in Tc PO<sub>2</sub> (Acolet et al. 1993; Gorsky et al. 1991; Morrow et al. 1991; Harrison et al. 1991; Adamson-Macedo et al. 1994a,b, 1997), or decrease in secretory Immunoglobulin A (SIgA) (Hayes et al. 1996), or significantly higher frequency of disorganised behaviours (Adamson-Macedo et al. 1994a,b, *op. cit.*).

These records suggest that beneficial coactions were occurring within the sensory system of the preterm baby and between the sensory system and the baby's other systems; self-regulatory efficacy is again apparent. However, in this sector, as already mentioned, general problems of comparability arise in that different systems of tactile stimulation are being employed; the area remains controversial.

### *Simultaneous Two- and Three-Systems Investigations*

To provide a carefully controlled input and then observe the consequences on any one system, however it is scientifically defined, is important but insufficient; for the human being, it is the interaction, which is crucial. Accordingly, recent research has turned to testing two systems simultaneously; e.g., Hayes 1996; McVey, Niven, Ibhanebhor and Al-Roomi 1998; Adamson-Macedo and Hayes 1998a,b; Harrison et al. in this special issue, and slightly later, to three systems simultaneously (Hayes 1996; Hayes and Adamson-Macedo 1997a,b, 1998a,b). The number of systems (and their virtual representation on axes) may be continued indefinitely, but at the expense of experimental complexity (Adamson-Macedo 1997a).

#### Neuro-behavioural and Physiological systems simultaneously

The responses of an extremely low birthweight (740 g) infant, born with 27 weeks gestation age by emergency caesarean section were investigated (Adamson-Macedo and Hayes 1998a,b; Hayes and Adamson-Macedo 1998c).

On each of three consecutive days, three different interventions were given twice daily, these being TAC-TIC therapy (Macedo 1984; Hayes and Adamson-Macedo 1998c) with increased finger or palm pressure, and a 'passive touch' intervention which the authors called 'Comfort'. Heart Rate (HR) and behavioural responses [frequency of distress' and 'non-distress' to a well-defined checklist (Hayes 1996)] were measured three minutes before and after each intervention. These results were compared with a placebo control condition, defined as 'spontaneous activities', where the baby was lying in the incubator without any intervention; behaviour video analyses were carried out.

There were no significant effects between the three interventions for the percentage of time spent in non-distress behaviours; however there was a significant effect by intervention on the percentage of time spent in distress behaviour. TAC-TIC with increased pressure induced significantly greater percentage of distress behaviours than either 'Comfort' or spontaneous activities, and had to be stopped after 4 sessions because the infant was overly distressed. This merited immediate consideration, because it was known that the skin is extremely sensitive to light-touch 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 re-

sults of both deep and light coetaneous 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. Further systematic investigations together with a wider agreement on touch therapy techniques are needed for effective therapies to emerge, especially for ventilated preterm neonates during their first week of life.

McVey, Niven, Ibhanebhor and Al-Roomi (1998), working in Scotland, used individualized touch with very premature babies; most of the samples (13 of 16) were mechanically ventilated. The investigators hypothesised that individualized touch would reduce the recovery time of those babies from blood sampling procedure; behaviour, oxygen saturation and heart rate were adopted as measures of recovery.

Significant differences for behaviour recovery time and heart rate recovery time were found in favour of individualised touch as compared with control (without touch), but individual patient differences were noteworthy

#### *Neuro-Behavioural, Physiological, and Immunological Systems, Simultaneously*

35 ventilated preterms were recruited during their first week of life to investigate the mind/body coactions arising from these three systems (Hayes and Adamson-Macedo (1998a,b). An opportunity was thus created for investigating Neonatal Developmental Psychoneuroimmunology, which had earlier been speculatively defined (Adamson-Macedo 1997b) 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.”

Hayes, Adamson-Macedo and Perera (2000) showed that 68% of the babies demonstrated equilibrium amongst the systems above; as an example of a pattern which emerged from this research, the mean Heart Rate did not significantly change, but there was an increase of the secretion of SIgA after the sensory nurturing programme from and there were significantly more organised (or non-distress) than disorganised (or distress) behaviours. In general these results can again be interpreted as an example of beneficial horizontal and vertical coactions which facilitate self-regulatory efficacy.

The infants in this study were under stress. Stress and emotions have been known for some time to be associated with substantial physiological changes, including activation of the sympathetic adrenal-medullary (SAM) system, the hypothalamic-pituitary-adrenocortical (HPAC) system, and other endocrine systems (see O’Leary 1990, p. 365). Frankenhauser 1983 described SAM and HPAC as the ‘effort’ and ‘distress’ systems, respectively. Activation of the adrenocortical system often accompanies chronic stress, however changes in SIgA were observed and recorded only after 3 minutes of TAC-TIC therapy; this short interval of time may suggest that it is activating SAM. As O’Leary pointed out, several mechanisms of sympathetic influence on immune function have been elucidated, e.g., the release of catecholamines.

However, Adamson-Macedo and Carson (personal communication) suspect that it might be an opioid activation, i.e. beta-endorphin, which is released from the pituitary acting by decreasing the secretion of catecholamines. Beta-endorphin

(“endogenous morphine”) has been demonstrated to correlate with social behaviour in mammals and birds (Hinde 1990). It is interesting to note that Gottlieb (1993) had earlier hypothesised a difference in beta-endorphin levels between ducklings separated in social and in tactile-isolated groups, with the former inclining to show higher levels than the latter.

Although the existence of a human endorphin mechanism for reducing pain is generally accepted, direct evidence is scarce (Bandura, O’Leary, Taylor, Gauthier and Gossard 1987). Endorphins may “close” the spinal gate<sup>1</sup> and thereby suppress pain; this may be the result of coactions, as described above. Early sensory stimulation programmes have been used, for example, to compensate for stimulus deprivation or enrichment of the preterm infant’s environment, to alleviate distress, and to recover from pain. Both actions aim at facilitating self-regulatory efficacy, enhancing growth and development of the preterm neonate, and consequentially promoting neonatal health. It is likely that further work requires proposal and acceptance of new paradigms.

### **Proposal of New Paradigms**

The evidence assembled above is sufficient to indicate that Neonatal Health Psychology now has an established place, and commands attention as a specialist approach. A prime difficulty in further establishing a living canon of practice and valid theory lies in training/education, and formal professionalism, since the Psychologist cannot be alone and must borrow from and associate with specialists from diverse disciplines, some of whom have been emphasised above. John Locke, in his ‘Dedication to an Essay on the Human Understanding’ wrote “New opinions are always suspected, and usually opposed, without any other reason but because they are not already common”; this is certainly true for NNHP, but it also serves to hide the deep reluctance of many diverse professionals when they have to collaborate outside their own formally-established agendas and routines. The difficulties are considerable, but this section lists five paradigms to which Health Psychologists could contribute major inputs.

#### *The Assertion that ‘Touch Increases Likelihood of Infection and thus Should Be Kept to a Minimum*

There is widespread reluctance to discard this widely and persistently held article of faith. Since the results of tactile therapy studies in 1984 (Macedo) conducted on premature babies in their incubators, and thereafter, a change of paradigm has been proposed. Over the past 15 years, studies by the author and her collaborators have shown that the type and quality of touch, when appropriate, did not increase the rate of infection; to the contrary, it facilitated both the transport and strengthening of the secretory immune system A of the preterm neonate. The rationale of these results includes observations that the babies generally were less distressed and apparently happier; the role of tactile nurturing alleviated their pain or/and distress.

The implications of such studies are twofold:

- (1) promoting current better quality of life by decreasing adverse neonatal experiences.
- (2) avoiding complications possibly linked to neonatal adverse experiences (Anand and Scalzo 2000).

Corroborative evidence is available from diverse sources, but notably from a study, in the early 1970s, carried out at the University of Stanford Medical Center which allowed mothers to handle and care for their babies; this showed that the rates of infection did not increase when compared with previous periods during which mothers were not allowed into the nursery (Leiderman, Grobstein and Klaus 1970). In the view of Goldberg and DiVitto (1995), the hospital practice shifted towards allowing and encouraging parents to come into the NICU, in order to handle and care for their babies. Such a shift in NICU policies is significantly uncommon, either inside or outside the USA; it is hoped that the results of our studies (Hayes, Adamson-Macedo, Perera and Anderson 1999; Hayes, Adamson-Macedo and Perera in press) on secretory immunoglobulin A will encourage neonatal health psychologists to pursue this promising and important area of research.

#### *Touch, as in TAC-TIC Therapy, as Semiotic Mediation*

Werner (1996, and also in this special issue) has reflected upon the role and importance of TAC-TIC therapy; based upon the historical-cultural approach of Vygotsky, he suggested that this particular therapy was acting as semiotic mediation between behavioural, physiological and immunological systems.

According to this approach children either full term or preterm, from the beginning develop through the mediation of sign. The light strokes might become a very important and powerful sign for the babies, which may imply the meaning of less distress. Regarded as signs, TAC-TIC can be considered equivalent to the "finger alphabet" used with the blind child, who needs access to culture through alternative instruments of interaction such as Braille; by analogy, a preterm high-risk neonate needs appropriate instruments to interact with others, thereby steadily constructing its intrapsychological functions and, by implication, acquire ability to regulate its own psychoneuroimmunological systems. So far, there is no empirical evidence to support such a notion, but experiments could be designed and Vygotskian Psychologists could explore further this paradigm.

#### *Separation: the Experience of the Highly Preterm Neonate*

According to Szejer (1999) the newborn suffers from 'Lack of Words'; the psychoanalyst defends the view that babies understand language before they can speak themselves. This author reported case studies illustrating how she proceeds on a maternal ward in Paris, seriously explaining the problems in the family to newborns (fullterm and preterms) and asks for reorganizing thoughts. Szejer claims successful outcomes for babies and their families.

Szejer and Barbier (this special issue) propose that a highly preterm baby strives to rediscover those antenatal sensations which have been memorized, because they are for him/her (who is separated from everything s/he knows), the only identity



references that can bring a feeling of security and continuity. A Health Psychologist with psychoanalytical interests could formulate and work on the complementary research questions (see also Attree and Adamson-Macedo 1997, 1998).

### *A New Concept of Play?*

Play is an important tool to facilitate the development of both cognitive and social processes. Can babies in incubators 'play'? Could sensory nurturing interventions be interpreted by the healthy preterm baby, who is not in distress or pain, as "time to a silent play"? Could we provide a more ecological-satisfactory environment for their incubators and/or cots, so that the appropriate type of objects would facilitate their coactions with caregivers and the environment? It is the author's opinion that the concept of play needs to be re-defined in order to accommodate the competence and needs of this new and incubated population (see Walker et al., in this special issue). This new paradigm is clearly open for development further by Health Psychologists. The management of the environment of the incubator or cot where some babies spend many months of their early lives is indeed essential.

### *The Infant Voice in Adult Speech*

Heinl, in this special issue, reflects upon a widespread belief that access to early experiences in adults requires the framework of a long-term therapeutic relationship and the use of language in order to allow unconscious material about early life experiences to 'break' into consciousness.

It is argued that access to early life experiences may be achieved surprisingly rapidly, even in the absence of a long-term therapeutic relationship and without the need to resort to elaborate verbal exploration. Heinl refers to this as 'intuitive perception and the use of simple objects' (Object Sculpting), an approach which could be explored further by Neonatal Health Psychologists in partnership with Psychiatrists.

## **Conclusions**

The need for better understanding of the Neonate is paramount, but it is psychology with 'communications' and interdisciplinary connotations which underlie the powerful claim of NNHP to be an identifiable sub-discipline; NNHP cannot exist without posing questions to the Neonate, yet the answers are to be found in neural activity, behavioural responses, biochemical and physiological changes, etc., all of which require decoding and careful interpretation. From an investigative standpoint, the examples given in this paper illustrate this view of NNHP, and serve to discuss the ramifications of this emergent sub-discipline, which unlike Psychology per se, cannot derive its data without interrelating with other diverse disciplines.

One of the major challenges for Neonatal Health Psychologists is to demonstrate that the preterm neonate has a mind and hence a psychology. Our studies have shown that even babies in ventilators during their first days of life are able to show 'competence' in discriminating between a comforting or discomforting stimuli.

This signifies that if a caregiver takes into account the baby's message of discomfort and ceases the stimulus, then that baby acquires the opportunity to learn that his/her behaviour does have an effect in the local environment; the baby will begin to develop his/her self-regulatory efficacy which will contribute to an early belief in 'self-efficacy expectancy', as identified by Bandura (1977). Despite the present surge of interest in infant observation, systematic studies of the complex behaviours of the preterm neonate whilst confined to incubators during the first weeks of life, have been rare. Two of the reasons for this near lacunae have been the sheer difficulty of working with preterm neonates and the lack of recognition that the preterm neonate even has a psychology. There are others, but these have been prime factors hitherto in deterring the emergence of NNHP.

The techniques of the Neonatal Psychologist are primarily non-invasive, which corresponds to desirability, if not necessarily a trend in modern medical practice; the corollary of this is preparation of the neonate for invasive procedures and/or surgeries. Albeit anecdotal, those who work with preterm neonates are familiar with accounts whereby, for example, mothers would say that their individual babies were less distressed physiologically if the small hands were held during invasive procedures. It is noteworthy that Gorsky et al. (1991) demonstrated that neonates would respond to a certain type of touch differently if they were already under physiological distress; the scope is considerable for the Neonatal Health Psychologist to play a part in establishing good economical and safe practice. This may even be regarded as a contribution to the Quality of Life of the preterm neonate (NNQoL), a promising area for Neonatal Health Psychologists who may wish engage themselves in developing and validating QoL measures suitable for the preterm during their first 28 days of life. However regarded, the development of appropriate interventions and procedures which will enhance the quality of the outcome is a necessary objective. Studies aiming to improve the perceived parenting self-efficacy of mothers of preterm neonates during hospital confinement should be carried out by Neonatal Health Psychologists.

In its broader context, Neonatal Health Psychology lies in a spectrum with two poles. One of these is its relationship with Medicine, where the position exactly parallels the role of Health Psychology in contributing to health, illness prevention and treatment, patient recovery and general well being. Avenues continually open one of the most promising fields of inquiry being Neonatal Psychoneuroimmunology.

The scope for Neonatal Health Psychologists is demonstrable since the need is evident for identification of non-pharmacological techniques arising from psychology as a contribution to medical advance and consequential good health of the preterm neonate. A further example has been given, in the text, of a field to which Neonatal Psychologists are contributing, and which requires further investigation; this concerns the validity of early assessments which can predict brain insult, as early as possible.

The second pole of the Neonatal Health Psychologist's spectrum of activity is in the human relations and reactions of those amongst whom the neonate exists. Sjezer and Barbier, Walker et al., and Heintl are examples, in this special issue. It has so happened that the studies pursued by the author of this paper, and her associates, have been orientated directly on the neonate. It is nevertheless clear

that NNHP should also evolve along routes of study and practice which involve the family, and which attend to the psychological as well as the physical environment of neonates, their families and their caregivers ( see also de Silva in this special issue).

The question arises as to whether or not there is an intellectual frame, which could encompass all such activity; to these aims, the author avers that the most promising line of follows Gottlieb's probabilistic epigenetic system development theory, when applied to neonatal health during the first 28 days of life. Bandura's view of reciprocal determinism to human action and Vygotsky's sociogenesis view are consistent with Gottlieb's view of experiential canalization, thus Neonatal Health Psychology has strong theoretical underpinning to continue its journey towards a 'mature science'.

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## References

- Acolet D, Modi N, Giannakouloupoulos X, Bond C, Weg W, Clow A, Glover V (1993) Changes in plasma cortisol and catecholamine concentrations in response to massage in preterm infants. *Archives of Diseases in Childhood* 68: 29–31
- Adamson-Macedo EN (1985) Effects of Tactile Stimulation on Low and Very Low Birth Weight Infants During The First Week of Life. *Current Psychological Research and Review* 6: 305–308
- Adamson-Macedo EN, de Roiste A, Wilson A, de Carvalho F, Dattani I (1994a) TAC-TIC therapy with High Risk, Distressed, Ventilated Preterms. *Journal of Reproductive and Infant Psychology* 12(2): 249–252
- Adamson-Macedo EN, Hayes JA, Simcock J (1994b) Distressed Infant: Early responses to gentle systematic touching therapy. *Infant Behavior and Development* 17: 258
- Adamson-Macedo EN, de Roiste A, Wilson A, Hayes JA, Eaton B, de Carvalho F (1997) Systematic Gentle/Light Stroking and Maternal Random Touching of ventilated preterms: A Preliminary Study. *Int J of Prenatal and Perinatal Psychology and Medicine* 9(1): 17–31
- Adamson-Macedo EN (1997a) Neonatal Psychology: system development, Chapter 34, *Advances in Perinatal Medicine*. Lancs.: Parthenon Publishing, pp. 292–301

- Adamson-Macedo EN (1997b) Neonatal Psychoneuroimmunology: Emergence, Scope and Perspectives. *Int J of Prenatal and Perinatal Psychology and Medicine* 9(4): 421–440
- Adamson-Macedo EN, Hayes JA (1998) Sensitivity and susceptibility to deep or light touch? *Infant Behavior & Development* 21(ICIS Issue): 4
- Adamson-Macedo EN (1998a) Emergence and scope of Neonatal Health Psychology. The BPS Division of Health Psychology Annual Conference, p 30, 1–3 July 1998, University of Wales, Bangor
- Adamson-Macedo EN (1998b) The Mind and Body of the Preterm Neonate. *Int J Prenatal and Perinatal Psychology and Medicine* 10(4): 1–18
- Anand KJS, Hickey PR (1987) Pain and its effects in the newborn neonate and foetus. *New England Journal of Medicine* 317(21): 1321–1329
- Anand KJS (1990) The Biology of Pain Perception in Newborn Infants. *Advances in Pain Research Therapy* 15: 113–121
- Anand, KJS, Scalzo FM (2000) Can Adverse Neonatal Experiences Alter Brain Development and Subsequent Behavior? *Biology of the Neonate* 77: 69–82
- Attree JA, Adamson-Macedo EN (1997) Looking at the Pre-Adolescents' and Adolescents' Verbal and Physiological Responses to Birth-Related Stimulus: A Pilot Study. *Int J Prenatal and Perinatal Psychology and Medicine* 9(1): 45–57
- Attree JA, Adamson-Macedo EN (1998) Assessing Early Memories of Youngsters Born Pre-Term: a Follow-up Study. *Int J Prenatal and Perinatal Psychology and Medicine* 10(1): 39–48
- Aynsley-Green A, Soltesz G, Jenkins PA et al. (1985) The metabolic and hormonal milieu of the human fetus at 18–21 weeks gestation, II, Blood glucose, lactate, pyruvate and ketone body concentrations. *Biology of the Neonate* 47: 19–25
- Bandura A (1977) Self-efficacy: Towards a unifying theory of behavioural change. *Psychological Review* 84: 191–215
- Baker JPD (1997) Fetal nutrition and cardiovascular disease in later life, In: Marmoth ME, Wadsworth EJM (eds) *Fetal and early childhood environment: long-term health implications*, The Royal Society of Medicine Press Limited, London, pp 96–108
- Bandura A, O'Leary A, Taylor CB, Gauthier J, Gossard D (1987) Perceived self-efficacy and pain control: Opioid and nonopioid mechanisms. *J of Personality and Social Psychology* 63: 563–570
- Banett C, Leiderman P, Grobstein R, Klaus M (1970) Neonatal separation: the maternal side of interaction deprivation. In: Bornstein MH (ed.) (1995) *Handbook of Parenting*, Vol. 1, Chapter 9, by Goldberg S, DiVitto B, Lawrence Erlbaum, pp 209–231
- Barnes CR, Adamson-Macedo EN (2000) Correlates of self-efficacy of mothers of preterm babies during their first 28 days of postnatal life in hospital confinement. Paper to be presented at the International Conference on Infant Studies (ICIS) 16–18 July, Brighton
- Berezin A, Rodrigues FPM, Gallace CB, Soares CX, Da Silva Guedes ML (1993) Resultado de um Programa de Estimulação de Prematuros com Estimulos de Sucção Não-Nutritiva e Interação M<sup>ã</sup>e-RN. Avaliação de Ganho Ponderal. *Revista Paulista de Pediatria* 11(2): 178–181
- Carmichael L (1970) The onset and early development of behavior. In: Mussen P (ed.) *Carmichael's Manual of Child Psychology*. Vol 1, Wiley, New York, pp 447–563
- Chamberlain DB (1988) The mind of the newborn: increasing evidence of competence, In: Fedor-Freybergh, PG and Vogel VML (eds) *Prenatal and Perinatal Psychology and Medicine, Encounter with the unborn*. The Parthenon Publishing Group, Lancs. UK, pp 5–22
- Collier J, MacKinley D (1997) Developing a generic child quality of life measure. *Health Psychology Update* 28: 12–16

- Constantinou JC, Adamson-Macedo EN, Stevenson DK, Mirmiran M, Fleisher, BE (1999) Effects on skin-to-skin holding on general movements of preterm infants. *Clinical Pediatrics* 38: 467–471
- Constantinou JC, Adamson-Macedo EN, Mirmiran M, Fleisher BE (1998a) Assessment of spontaneous general movements as a measure for brain maturation in preterm infants. *Infant Behavior & Development* 21(ICIS Issue) 5
- Constantinou JC, Adamson-Macedo EN, Mirmiran M, Fleisher BE (1998b) Neurobehavioural assessments of the fragile preterm neonate. The BPS Division of Health Psychology Annual Conference, p 36, 1–3 July 1998, University of Wales, Bangor
- Craig KD, Whitefield MF, Grunau RVE, Linton J, Hadjistravopoulos H (1993) Pain in the preterm neonate: behavioural and physiological indices. *Pain* 52: 287–300
- Cripps AW, Gleeson M, Clancy RL (1991) Ontogeny of the Mucosal Immune Response in Children. *Advances in Experimental Medicine and Biology* 310: 87–92
- De Casper AJ, Fifer WP (1980) Of human bonding: newborns prefer their mothers' voices. *Science* 208: 1174–1176
- de Leeuw R, Colin EM, Dunnebie EA, Mirmiran M (1991) Physiological Effects of Kangaroo Care in Very Small Preterm Infants. *Biology of the Neonate* 59: 149–155
- Denenber VH (1969) The effects of early experience, In Hafez ESE (ed.) *The behavior of domestic animals*. Bailliere, Tindall and Casell, London, pp 95–130
- de Roiste A, Bushnell IWR (1996) Tactile stimulation: Short- and long-term benefits for pre-term infants. *British Journal of Developmental Psychology* 14: 41–53
- Diamond ME, Armstrong-James M, Ebner FF (1993) Experience-dependent plasticity in adult rat barrel cortex. *Proceedings National Academy of Science, USA* 90: 2082–2086
- Eiser C, Havermans T, Eiser JR (1994) What do children mean by “Quality of Life”? *Update* 16: 10–13
- Evoniuk GE, Kuhn CM, Schanberg SM (1979) The effect of tactile stimulation on serum growth hormone and tissue ornithine decarboxylase activity during maternal deprivation in rat pups. *Communication in Psychopharmacology* 3: 363–370
- Fedor-Freybergh PG (2000) Prenatal experiences and their relevance to prevention of psychological, emotional and physical disorders in postnatal life. Paper presented at the Royal Society of Medicine, the Forum on Maternity & the Newborn meeting on 23rd February
- Fedor-Freybergh PG, Vogel VML (eds) (1988) *Prenatal and Perinatal Psychology and Medicine, Encounter with the unborn*, The Parthenon Publishing Group, Lancs. UK
- Fifer WP, Moon C (1989) Psychobiology of new-born auditory preferences. *Seminars in Perinatology* 13: 430–433
- Fisher J, Astbury J, Smith A (1997) Adverse Psychological impact of Operative Obstetric Interventions: a prospective longitudinal study. *Australian and New Zealand Journal of Psychiatry* 31: 728–738
- Frankenhauser M (1983) The sympathetic-adrenal and pituitary- adrenal response to challenge: Comparison between the sexes. In: Dembroski TM, Schmidt TH, Blumchen G (eds) *Biobehavioral bases of coronary heart disease*. Karger, New York, pp 91–105
- Franck LS, Miaskowski C (1997) Measurement of Neonatal Responses to Painful Stimuli: A Research Review. *Journal of Pain and Symptom Management* 14(6): 343–378
- Gandy GM, Robertson NRC (1987) *Lecture Notes on Neonatology*. Blackwell Scientific Publications, Oxford, UK
- Goldberg S, DiVitto B (1995) Parenting Children Born Preterm. In: Bornstein M (ed) *Handbook of Parenting*, Vol. 1. Lawrence Erlbaum, pp 209–231
- Gibson EJ (1969) *Principles of perceptual learning and development*. Appleton-Century-Crofts, New York

- Gorsky PA, Huntington L, Lewkowicz (1991) Handling Preterm Infants in Hospitals: Stimulating Controversy About Timing of Stimulation. *Clinics in Perinatology* 17(1): 103–112
- Gottfried AW, Gaiter YL (eds.) (1985) *Infant Stress Under Intensive Care: Environmental Neonatology*. University Pub. Press, Baltimore
- Gottlieb G (1993) Social induction of malleability in ducklings: sensory basis and psychological mechanism. *Animal Behavior* 45: 707–719
- Gottlieb G (1991b) Experiential Canalization of Behavioral Development: Theory. *Developmental Psychology* 27(1): 4–13
- Gottlieb G (1992) *Individual Development and Evolution: The Genesis of Novel Behavior*. Oxford University Press, New York, p 163
- Grunau RV, Craig KD (1990) Facial activity as a measure of neonatal pain expression. *Advances in Pain Research Therapy* 15: 147–155
- Gupta D (1992) Humors and Hormones in Pregnancy: Determinants for Personality Development in the Child. *Int J Prenatal and Perinatal Studies* 4(1/2): 1–15
- Gupta D, Datta B (1988) The cultural and historical evolution of medical and psychological ideas concerning conception and embryo development In: Fedor-Freybergh PG, Vogel VML (eds) *Prenatal and Perinatal Psychology and Medicine, Encounter with the unborn*. The Parthenon Publishing Group, Lancs. UK, pp 507–534
- Gupta D (1989) Prenatal exposure to hormones and drugs: consequences for postnatal development of body and mind. *The International Journal of Prenatal and Perinatal Studies*, 1(2):151-165
- Harrison LL, Leeper J, Yoon M (1991) Preterm Infants' Physiologic Responses to Early Parent Touch. *Western Journal of Nursing Research*, 13(6): 698-713.
- Hayes JA, Adamson-Macedo EN, Perera S (1996) Secretory Immune responses of ventilated preterms to gentle/light systematic stroking. *Infant Behavior and Development (ICIS issue)* 19: 7
- Hayes JA (1996) TAC-TIC: a non-pharmacological approach to the alleviation of neonatal pain, Unpublished doctoral dissertation, University of Wolverhampton, Wolverhampton: UK.
- Hayes JA, Adamson-Macedo EN (1998a) Coactions between the physiological, behavioural and immunologic systems of the ventilated preterm neonate. *Infant Behavior & Development (ICIS Issue)* 21: 6
- Hayes JA and Adamson-Macedo EN (1998b) The coactive systems of the ventilated preterm neonate. *Proceedings of the Annual Conference of BPS Division of Health Psychology, University of Wales, Bangor, 1–3 July*: 44–45
- Hayes JA, Adamson-Macedo EN (1998c) Tactile stimulation in the ventilated preterm: a single case study. *British Journal of Midwifery* 6(11): 720–724
- Hayes JA, Adamson-Macedo EN, Perera S (1999) The Mediating role of Cutaneous Sensitivity within Neonatal Psychoneuroimmunology. *International Journal of Prenatal and Perinatal Psychology and Medicine*, 11(4): 459-468
- Hayes JA, Adamson-Macedo EN, Perera S, Anderson J (1999) Detection of Secretory Immunoglobulin A (SIgA) in saliva of ventilated and non-ventilated preterm neonates. *Neuroendocrinology Letters* 20(1): 109–113
- Hepper PG, Shahidullah S (1994) The beginnings of mind- evidence from the behaviour of the fetus. *Journal of Reproductive and Infant Psychology* 12: 143–154
- Hinde RA (1990) The interdependence of the behavioral sciences. *Phil. Trans. R. Soc. Lond. B* 329: 217–227
- Hooker D (1969) *The Prenatal Origin of Behavior*. Hafner, New York
- Horowitz FD (1987) *Exploring developmental theories: Towards a structural/behavioral model of development*. Erlbaum, Hillsdale, New Jersey

- Hunt JM (1979) Psychological development: Early Experience. *Annual Review of Psychology* 30: 102–144
- Johal S (1995) Quality of Life: An Evaluation Alternative for Genetic Services. *Health Psychology Update* 20: 7–10
- Johsnton M (1994) Current trends. *The Psychologist* March, 114–118
- Johnson MP, Puddifoot JE (1996) The grief response in the partners of women who miscarry. *British Journal of Medical Psychology* 69: 313–327
- Johnson JH, Johnson SB (1991) *Advances in Child Health Psychology*. University of Florida Press, Florida
- Karmiloff-Smith A (1995) Annotation: The Extraordinary Cognitive Journey from Foetus through Infancy. *J Child Psychol & Psychiat* 36(8): 1293–1313
- Korner AF, Thom VA (1990) *Neurobehavioral Assessment of the Preterm Infant*. Psychological Corporation, Harcourt, Brace & Jovanovich, San Antonio
- Lickliter R (1993) Timing and the Development of Perinatal Perceptual Organization, in Developmental Time and Timing. In: Turkewitz G, Devenny DA (eds) *Developmental Time and Timing*. Lawrence Erlbaum Associates, Hillsdale, New Jersey, pp 105–123
- Lumley J (1980) The Image of the Fetus in the First Trimester. *Birth and the Family Journal* 7(1): 5–14
- Macedo EN (1981) The Effects of a Tactile Stimulation Programme on Pre-term Infants. Annual Conference of the British Psychological Society Postgraduate Psychology, University of Durham, (BPS Bulletin March, 1982, p 121)
- Macedo EN (1984) Effects of very-early Tactile Stimulation on very-low birthweight Infants – a 2-year follow-up study. Unpublished doctoral dissertation, University of London, Bedford College
- Marmot MG (1997) Early life and adult disorder: research themes. In: Marmot ME, Wadsworth EJ (eds.) *Fetal and early childhood environment: long-term health implications*. *British Medical Bulletin* 53(1): 3–9
- Masi W (1979) Supplemental Stimulation of the Premature Infant, In: Field TM, Sostek AM, Goldberg S, Schuman HH (eds) *Infants born at risk, Behavior and Development*, SP Medical & Scientific Books, New York, pp 367–387
- McVey CJ, Niven CA, Ibhanebehbor S, AlRoomi L (1998) Reducing ‘pain’ in very premature babies; the use of touch and mother’s voice. *Health Psychology Update* 32: 22–26
- Melzack R and Wall PD (1965) Pain mechanisms: A new theory. *Science* 150: 971–979
- Miles MS, Holditch-Davis D (1997) Parenting the Prematurely Born Child: Pathways of Influence. *Seminars in Perinatology* 2(3): 254–266
- Milla PJ, Bissett B (1988) The Gastrointestinal Tract. *British Medical Bulletin* 44(4): 1010–1024
- Morrow CJ, Field TM, Scafidi FA, Roberts J, Eisen L, Larson SK, Hogan AE, Bandstra ES (1991) Differential Effects of Massage and Heelstick Procedures on Transcutaneous Oxygen Tension in Preterm Neonates. *Infant Behavior and Development* 14: 397–414
- Mothander PR (1999) Premature mothers of premature infants – a relationship trauma. *Int J Prenatal and Perinatal Psychology and Medicine* 11(1): 33–40
- Nathanielsz PW (1999) *Life in the Womb, the Origin of Health and Disease*. Prometheus Press, Ithaca, NY, pp 1–363
- Obrzut JE, Hynd GW (1986) *Child Neuropsychology*. Vol. 1, Theory and research. Academic Press, London
- O’Leary A (1990) Stress, Emotion, and Human Immune Function. *Psychological Bulletin* 108(3): 363–382
- Owens CM, Zhang D, Willis WD (1992) Changes in the Response States of Primate Spinothalamic Tract Cells Caused by Mechanical Damage of the Skin or Activation of Descending Controls. *Journal of Neurophysiology* 67(6): 1509–1527

- Padden T, Glenn S (1997) Maternal experiences of preterm birth and Neonatal Intensive Care. *Journal for Reproductive and Infant Psychology* 15: 121–139
- Paton F, Wood R, Bor R, Nitsun M (1999) Grief in miscarriage patients and satisfaction with care in a London hospital. *Journal of Reproductive and Infant Psychology* 17(3): 301–315
- Prechtl HFR (1990) Qualitative changes of spontaneous movements in fetus and preterm infants are a marker of neurological dysfunction. *Early Human Development* 23: 151–159
- Rausch PB (1981) Effects of tactile kinaesthetic stimulation on premature infants. *J of Obstetrics, Gynecology and Neonatal Nursing* 10: 34–37
- Redshaw ME (1997) Mothers of babies requiring Special Care: attitudes and experiences. *J for Reproductive and Infant Psychology* 15: 109–120
- Scafidi FA, Field TM, Schanberg SM, Bauer CR, Tucci K, Roberts J, Morrow C, Kuhn CM (1990) Massage stimulates growth in preterm infants: a replication. *Infant Behavior and Development* 13: 167–188
- Schanberg SM, Field TM (1987) Sensory deprivation and supplemental stimulation. *Developmental Psychology* 13: 69–76
- Schiffman HR (1995) The Skin, Body, and Chemical Senses. In: Gregory RL, Colman AM (eds.) *Sensation and Perception*. Longman, London, pp 70–96
- Schindler S (1988) A new view of the unborn: toward a developmental psychology of the prenatal period. In: Fedor-Freybergh PG, Vogel VML (eds) *Prenatal and Perinatal Psychology and Medicine, Encounter with the Unborn*. The Parthenon Publishing Group, Lancs. UK, pp 23–33
- Schusser G (1988) The connection between the course of pregnancy and postnatal mother-child interaction In: Fedor-Freybergh PG, Vogel VML (eds) *Prenatal and Perinatal Psychology and Medicine, Encounter with the Unborn*. The Parthenon Publishing Group, Lancs. UK, pp 35–51
- Scott S, Richards MPM (1979) Nursing Low-Birthweight babies on Lambswool. *The Lancet*, 12 May, 1028
- Shatz CJ (1992) The developing brain. *Scientific American* 267(3): 35–41
- Sobotková D, Dittrichová J, Mandys F (1996) Comparison of maternal perceptions of preterm and fullterm infants. *Early Development and Parenting* 5(2): 73–79
- Sparshott M ( ) Pain and the Special Care Baby Unit. *Nursing Times* 85(41): 61–64
- Stevens B, Johnston C, Petryshen P, Taddio A (1996) Premature Infant Pain Profile: Development and Initial Validation. *Clinical J of Pain* 12: 13–22
- Stratton P (ed) (1982) *Psychobiology of the Human Newborn*. John Wiley and Sons, Chichester, UK, pp 1–456
- Szejer M (1999) Das Leiden des Neugeborenen am Fehlen der Worte. *Int J of Prenatal and Perinatal Psychology and Medicine* 11(3): 365–377
- Teti DM, Gelfand DM (1991) Behavioural competence among mothers of infants in the first year: the mediational role of maternal self-efficacy. *Child Development* 62: 918–929
- Turkewitz G, Devenny DA (1993) (eds.) *Developmental Time and Timing*. Lawrence Erlbaum Associates, Hillsdale, N.J.
- Turkewitz G, Kenny PA (1985) The role of developmental limitation of sensory input on sensory perceptual organization. *J of Developmental and Behavioral Pediatrics* 6: 302–306
- Varendi H, Porter RH, Winberg J (1996) Attractiveness of amniotic fluid odor: evidence of prenatal olfactory learning. *Acta Paediatrica* 85: 1223–1227
- Vygotsky L (1987) Thinking and speech. In: Rieber R, Carton A (eds.) *The collected works of L. V. Vygotsky*. Plenum Press, New York



- Walcher DN, Peters DL (1971) (eds) *Early Childhood; The development of self-regulatory mechanisms*. Academic Press, New York, London, pp 232
- Wolke D (1987) Environmental and developmental neonatology. *J of Reproductive and Infant Psychology* 5: 17-42
- Wolke D (1991) Annotation: Supporting the development of lowbirthweight infants. *J of Child Psychology and Psychiatry* 32(5): 723-741
- Zachau-Christiansen B (1988) Perinatal hazards and later schooling, In: Fedor-Freybergh, PG, Vogel VML (eds) *Prenatal and Perinatal Psychology and Medicine, Encounter with the Unborn*. The Parthenon Publishing Group, Lancs. UK, pp 53-71