THE ROOTS OF ENCULTURATION: THE CHALLENGE OF PRE- AND PERINATAL PSYCHOLOGY FOR ETHNOLOGICAL THEORY AND RESEARCH

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Abstract: A central question for ethnological theory has been: At what age do human beings begin the process of enculturation? An important consideration in answering this question is the now ample evidence from various quarters that the perceptual/cognitive competence of the pre- and perinatal human being is significantly greater than was once thought. The purpose of this paper is to discuss the theoretical and methodological implications of this emerging picture of early competence for ethnology. To this end I will present a review of some of the developmental neuropsychological, psychobiological and social psychophysiological research indicating pre- and perinatal perceptual/cognitive competence and learning. I will then suggest some issues that this competence raises for ethnological theory and research.

Résumé: Une question centrale pour la théorie ethnologique a toujours été: A quel âge l'être humain commence-t-il le processus d'apprentissage culturel? Une importante considération dans la réponse à cette question se trouve être l'évidence, maintenant accumulée par differents secteurs, que la compétence perceptuelle et cognitive de l'être humain aux stages prénatals et périnatals est significativement plus étendue qu'on ne pensait. Le propos de cet article est de discuter les implications théoriques et méthodologiques, pour l'ethnologie, de ces nouvelles possibilités de compétence précoce. A cette fin, l'auteur présente d'abord une revue de la recherche sur le développement neuropsychologique, psychobiologique et socio-psychophysiologique montrant les niveaux de compétence et de capacité d'apprentissage aux stages prénatals et périnatals. Puis il suggère quelques questions que cette nouvelle compétence soulève pour la théorie et la recherche ethnologique.

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Pre- and Perinatal Competence

It seems probable that consciousness of some kind is present in the prenatal child at least as soon as a functioning neural substrate is in place. "Substrate" is defined here as the neurophysiological structures requisite to the occurrence of perceptual experience, which includes at least intentionality, sensory objects, knowledge (however rudimentary) and learning. This does not mean that the prenatal child need be wholly "cortical" to be conscious or to learn, although adult consciousness is probably largely cortical in organization (Doty 1975:797-798). Rather, it means that as soon as a presiding, cybernetically active neural network is present in the developing nervous system, the child may be said to be conscious.[2] Cortical consciousness would appear to emerge sometime during the last trimester of gestation, or around the time of birth.

Thus, the extent and range of functions comprising pre- and perinatal consciousness will be determined in large part by the organization of the child's nervous system and its *cognized environment*[3] at each stage of its development. This development, particularly during gestation, is largely determined by the genotype (Imbert 1985) and unfolds in intimate dialogue with the *operational environment* — that is, with the actual nature of the individual organism and its world. The process of development of the nervous system, and its conscious network, tends toward greater differentiation of structure and function, and a greater hierarchy of control functions (Powers 1973; Gottlieb 1983:6).[4] Of course, development of the organization of consciousness continues for years after birth; e.g., development of the prefrontal areas of the cortex mediating the "higher cognitive functions," is not mature until the later teens or older (Becker, Isaac and Hynd 1987).

The Prenatal Child

The available data indicate that the cognized environment of the prenatal child is indeed one of rich sensory experience (Bornstein 1985), and that it is behaviourally very active, at least by the beginning of the second trimester:

> The fetus during the second trimester, while the amniotic sac is still rather roomy, now floats peacefully, now kicks vigorously, turns somersaults, hiccoughs, sighs, urinates, swallows and breathes amniotic fluid and urine, sucks its thumb, fingers and toes, grabs its umbilicus, gets excited at sudden noises, calms down when the mother talks quietly, and gets rocked back to sleep as she walks about.... The normal fetus rarely goes 10 minutes without some gross activity, either with fetal breathing spurts during REM-sleep periods or with other movements. It moves in regular exercise patterns, and one observer said it could be seen in ultrasound pictures "rolling from side to side [with] extension and then flexion of the back and neck, turning of the head and neck [and] waving of the arms and kicking of the legs. The feet were seen to

> flex and extend as the fetus kicked the side wall of the gestation sac. In one fetus the jaw was seen to move up and down." The fetus in fact has quite regular activity cycles averaging about 45 minutes, cycles which later, in the third trimester, can be felt quite accurately by the mother. These fetal patterns become coordinated to some extent with the activity cycles of the mother—evidence that the fetus is quite sensitive to a wide range of the mother's activities and emotions. (deMause 1981:10-11)

This does not mean that the consciousness of the prenatal human being is the same as that of an adult, or even as that of a postnatal child. It is not, nor could it be, for the component systems of the network of cells producing consciousness are maturing at a rapid rate, especially during the second and third trimester of prenatal life and the first six months or so after birth. There are also considerable individual differences in the rate of development.

As a pictorial aid, Figures 1 and 2 illustrate the prenatal development of the human body and cerebral cortex, respectively.

Table 1 presents a summary of some of what we know about the course of prenatal physiological and psychological development.[5] This summary is uncomfortably sparse and the phase of gestation during which any particular function first begins to actually manifest itself is often uncertain. However, it will give the reader a quick sense of the course of prenatal neurobiological and psychological development.

Table 1
A Rough Summary of the Landmarks of Neurophysiological and Psychological Development during Human Prenatal Life by Approximate Month and Week of Gestation

Month	Week	What Is Known About Brain and Consciousness:
0	0	Conception.
	1	Blastocyst implanted in the uterine wall.
	2	Ectoderm forms from which the nervous system will differentiate; beginning of "embryo" stage.
	3	Nervous system begins to form; neural groove and tube, then optic vesicles and auditory placode present; acoustic ganglia appear; formation of cortical plate where cells of cortex produced.
	4	Neuroectoderm complete and begins differentiation into neural tissue; spinal cord, rhombencephalon, mesencephalon, diencephalon and telencephalon are all evident; rapid growth of the brain; heart begins to beat; autonomic nervous system (ANS) begins to form (cells migrate from neural crest to form sympathetic ganglia and trunk, cells from brain stem and spinal cord form parasympathetic nerves, including cranial nerves III, VII, IV and X); olfactory placodes arise.
1	5	Blood vessels begin to penetrate neural tissue; optic vesicle appears; cerebral vesicles distinct; ear begins to form; cerebral hemispheres begin to bulge.

Table 1 (continued)

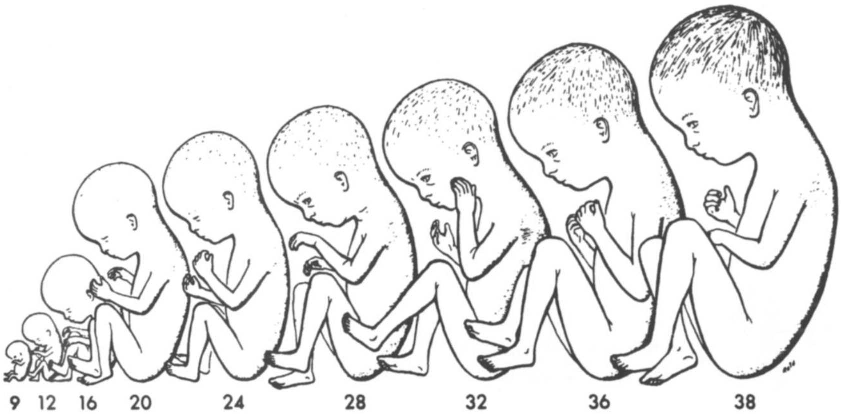
Month	Week	What Is Known About Brain and Consciousness:
	6	Primordium of cerebellum; cochlea appear; hypothalamus differentiates within diencephalon; nerve plexuses present; sympathetic ganglia forming segmental masses.
	7	First contralateral head flexion; telencephalon transforms to the cerebral hemispheres; basal ganglia appear; first commissure fibres form (anterior and hippocampal commissures); middle ear ossicles appear; sympathetic chains of the ANS more developed; nerve fibers invade optic stalk; eyelids forming.
	8	Sub-cortical synapses; cerebral cortex begins to obtain typical cells; movement of head, arms and trunk easily; rudimentary beginnings of most bodily organs apparent; taste buds apparent; end of "embryo" stage and beginning of "fetal" stage; fetus looks more "human."
2	9	Vestibular system immature, but operating; fully functioning kidneys secreting urea and uric acid into amniotic fluid; visual system, esp. the retina, develops rapidly between second and fourth months; sensory nerves have developed and now contact the skin; face has human appearance.
	10	Main parts of the brain differentiated; corpus callosum incomplete; cortex individualized within the mantle, but only four layers; lower visual pathway in place; adrenal medulla and the paraganglia of the ANS differentiated; spinal cord attains definitive internal structure.
	11	
	12	Fetus clearly moving — grasping, sucking, squinting; increased heart rate in response to touch by amniocentesis needle; swallowing and tongue movements; anterior corpus callosum forms; all parts of brain (except sulci) present by 12th week; first evidence of adrenal medulla chromaffin cells; neuroglial cells begin to differentiate.
3	13	Primary cortical sulci begin to appear; formation of major nuclear groups of the limbic system between third and fourth months; hypothalamic-pituitary-adrenal axis active.
	14	Taste apparatus in place.
	15	Corpus callosum complete; functional retinae; mothers first detect signs of life between 15 and 20 weeks.
	16	Frowning, grimacing; squinting if eyelids touched; beginning of cortical cell migration; cerebral hemispheres conceal much of the brain.
	17	
4	18	Gag reflex; hippocampus begins to differentiate.
	19	Cortical layers begin to form; different cortical functional areas may be distinguished; primitive body language indicating aversion to noxious stimuli (e.g., amniocentesis needle, ultrasound).
	20	Cortical dendritic branching and synapsing begins; hair cells in organ of Corti develop; produces catecholamines (related to ANS functioning) in increasing amounts from before now to end of gestation.

Table 1 (continued)

Month	Week	What Is Known About Brain and Consciousness:
	21	Audible crying.
5	22	Sensitive to touch as any one-year-old; aversive reactions to cold water injected into mother's stomach; myelinization begins; associative learning demonstrated (music w/relaxation) for fetuses between 22 and 36 weeks.
	23	
	24	Main mass of cortical cells in place and major convolutions form (frontal lobes poorly developed); hearing structures all in place; listening constantly, but immaturely, and keyed to mother's heartbeat; pupillary response.
	25	Moves in rhythm to orchestra drum; vestibular system fully mature.
6	26	Six layers of cortex evident by this time, and different areas clearly distinguishable by type of cells and cell layers; no more cortical cells will be produced; premature infant can survive because lungs can breathe on their own; NS capable of directing rhythmic breathing and regulating body temperature; memories from roughly six months on; discriminates mother's attitudes and feelings and reacts to them; eyelids can open and retinal fovea begin to form.
	27	Limited dendritic branching on pyramidal cells in visual cortex.
	28	Primary sulci deeper and better defined and secondary sulci begin to appear; neural circuits nearly as complex as a newborn; possible awareness (?).
	29	Asymmetries in cortex first visible.
	30	Myelinization of cerebellum begins.
7	31	
	32	EEG data showing all primary and secondary cortical association areas working; EEG's become distinct for sleep and wake; REM sleep apparent; clear evidence of visual attention.
	33	
	34	Habituation demonstrated in fetuses; active visual attention reported; significant dendritic branching of both pyramidal and stellate cells in visual cortex.
8	35	Cortical cells same as full term, but with less dendritic branching; evidence of visual recognition memory.
	36	
	37	
	38	
9	39+	Full term; auditory system reasonably mature; stories read to baby in utero recognized after birth.

Sources of Data: Verny (1982), Chamberlain (1983), Larroche (1966), Walton in Stave (1978), Rosen and Galaburda in Mehler and Fox (1985), Busnel and Granier-Deferre (1983), Hollander (1979), Balashavo (1963), Klosovskii (1963), Parmelee and Sigman (1983), Spreen et al. (1984), Kjellmer (1981), DeCasper and Fifer (1980), Moore (1982), Barrett (1982), articles in Gootman (1986).

Figure 1
The Physical Development of the Prenatal Child from Nine Weeks Gestation to Full Term, approximately 1/6 actual size



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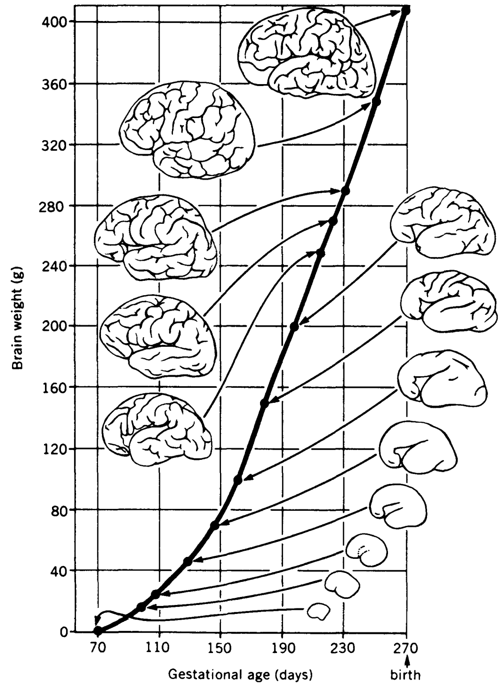
Encapsulating a bit, among the various sensory systems of the human nervous system, the somatosensory systems begin to develop first, followed in turn by the vestibular, the auditory and finally the visual systems. All of these systems become functional during gestation (Gottlieb 1971, 1976b). Furthermore, the cerebral cortex is in place and functioning before birth, providing the substrate for many of the precocious perceptual/cognitive functions now being documented for the neonate (see Visser et al. 1985; Weiskrantz 1988:69-70).

Of special interest to anthropologists is the development of the prefrontal cortex. Anatomically, this area is intimately connected to subcortical limbic and autonomic structures (mediating motivation and emotion), brain stem reticular activating systems (mediating arousal), posterior sensory and association cortex (producing sensory phenomena), and the frontal and cerebellar motor areas (controlling behaviour). The prefrontal cortex is known to service intentionality and modulation of affect and behaviour and to constitute temporal relations and plan goal directed cognitive and motor activity (Stuss and Benson 1986; Laughlin 1988). Unfortunately, our understanding of the functions and development of the prefrontal lobes is far from complete, and the developmental neuropsychology required to clear the picture has only just emerged. It is instructive, however, that just as with other cognitive functions of the nervous system, the age at which prefrontal synaptic development and rudimentary functioning is considered to begin is being moved back into early infancy, and some authorities would go so far as to say near birth (Diamond 1988; Welsh and Pennington 1988). Moreover, it is becoming apparent

Figure 2
Development of the Cerebral Cortex Relative to Brain Weight and Gestational Age



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that different components of the prefrontal complex of functional areas mature at different rates (Nonneman et al. 1984). It seems likely that some prefrontal functions actually begin to emerge in prenatal life.

Learning and the Environment of the Womb

The universality of sequencing and emergence of cognitive and perceptual functions in prenatal life are due to two factors:

1. the brains of all people seem to develop in a relatively invariant manner during pre- and early perinatal life (Turkewitz and Kenny 1982; Larroche 1966; Glassman and Wimsatt 1984), and
2. the womb provides a relatively similar environment for all humans.

But although the neurobiological development of the fetus is genetically regulated, it also seems clear that the influence of the environment upon the development of cognitive and perceptual structures begins at some point in prenatal life (see Gottlieb 1976b and Barrett 1981 for reviews), and accelerates throughout the pre- and perinatal period. We now know that most of the activity of the sensory neural cells at every hierarchical level involves abstraction of invariant patterns in the ever-changing perceptual field, and projection of these (as *re*-cognition) upon events arising in the world (Hubel and Wiesel 1962; Gibson 1969; Barlow and Mollon 1982; Imbert 1985).

Moreover, a range of environmental factors are known to influence the development of children in the womb — mother's diet and fetal malnutrition, toxins in the environment, availability of oxygen, noise, mother's endocrinal and emotional states, mother's attitude toward pregnancy and birth, mother's movement, mother's smoking, alcohol and drug consumption, and other stressors have an effect upon the child's experience and neural development (see Verny 1982; Sontag 1941; Schell 1981; Klosovskii 1963; Joffe 1969; Stave 1978; Maurer and Maurer 1988:16-20; Chisholm 1983:135ff.; Dhopeshwarkar 1983; Streissguth et al. 1989; Winick 1976; Elkington 1985). In addition there are some suggestive data from animal studies that indicate that the extent of enrichment or impoverishment of the maternal environment may have a determinant effect upon the complexity of dendritic branching of the fetal cortex, thus indicating in physiological terms the possibility of "intrauterine education" (Diamond 1988:91), a possibility acknowledged and even institutionalized in some other cultures (e.g., Japan, see Nakae 1983; Mohave Indians, see Devereux 1964:267; and Ashanti, see Hogan 1968).

Fetuses may well become "sensitized" to the speech of their mothers and others while in the womb, and are quite capable of some types of associative learning by at least the fifth month of gestation (Busnel and Granier-Deferre 1983). It is also significant that areas of the left hemisphere of the cortex associated with language processing are observed to be larger than homotopical areas of the right hemisphere as early as the 29th week of gestation (Rosen and Galaburda 1985: 315), indicating that the neural substrate for the processing of speech and language may be present *in utero*.

Emotion

Part of early learning involves establishing an emotional set relative to objects in the world, and to the world of phenomena as a whole. Contrary to the views of theorists who consider "emotion" to be a strictly cortical-level, cognitive process (e.g., Maurer and Maurer 1988), stress-related affective and arousal states, mediated by discrete interconnections of hypothalamic, autonomic, adrenal medulla, brain stem reticular, limbic, and motor "fight and flight" systems, that develop early in prenatal life, may establish responses to recurrent stressful stimuli (see relevant discussion by Gellhorn 1968:144ff.; also McKinnon, Baum and Morokoff 198; Levenson 1988; Hofer 1974). In other words, subcortical and peripheral nervous system orientations toward the world of experience may be established prenatally even before cortical processes have matured, and this may eventually induce a biased orientation of cortical connections when they do mature. And it is now known that most, if not all of the basic human emotions are present and being expressed by the perinatal child just after birth (Campos et al. 1983). Indeed, studies of changes of heart rate, blood pressure and peripheral vasomotor tone suggest that the fetus and newborn are endowed with extremely reactive autonomic systems that respond to a wide range of stimuli in the environment (Rogers and Richmond 1978; Hofer 1974). A number of theorists have held that a bivalent approach-with-interest/withdrawal-with-disgust emotional response to objects is present from birth and provides the initial motivation for exploration of the physical and social world (Schneirla 1959; Izard 1977; Fox 1985).

Thus, a long-term, often generalized, stressful and emotional orientation may develop toward either specific aspects of experience, or experience generally (Chamberlain 1989). Among other causes, the emotional state of the mother during pregnancy may influence long-term emotional patterns in the child. Chisholm (1983:135ff.) has reviewed the cross-cultural data showing a correlation between the elevated blood pressure on the part of pregnant women, or women in labour, and the later high stress level (as indicated by irritability) on the part of their newborns (see also Barrett 1982:279). There is also reason to believe that, as in rats, early infant stress may result in higher physical stature in human males cross-culturally (Landauer and Whiting 1964). Of corollary interest is the suggestion that extraordinary stressing may be incorporated within childhood initiation ceremonies to bring about culturally required transformations in autonomic and endocrinal balance or "tuning" (Morinis 1985; Gellhorn and Kiely 1972; Lex 1979).

Awareness

It is methodologically difficult to obtain direct evidence of attention or "awareness" in prenatal life, but if one assumes a correlation between conjugate saccades (rapid scanning eye movements) and attention, this function is operating by at least the 28th week of gestation, and probably earlier. And if one assumes that some form of awareness is requisite for memory (operating by at least the 25th week), then this would push the beginning of awareness back even further (e.g., Ploye 1973). In any event, the child is exquisitely sensitive to its environment, and the range of visual, auditory, biochemical, emotional and somaesthetic stimuli arising in its cognized environment is remarkable (see Ploye 1973; Liley 1972; Schell 1981; Sontag 1941; Fries 1977).

Learning and Birth

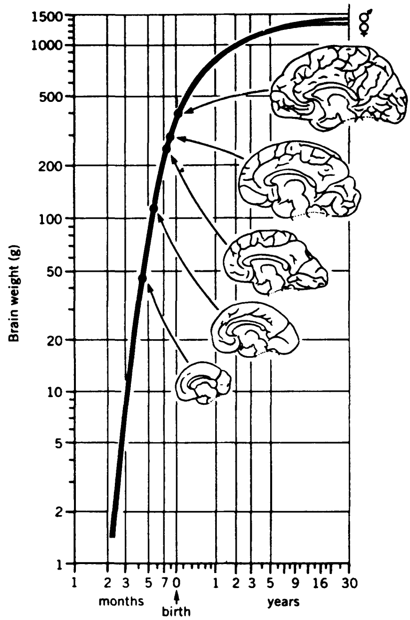
Unless interrupted by obstetrical intervention, birth is a tremendous event in the life of every person (Stave 1978). Recent evidence has shown that there is a naturally enhanced sympathoadrenal activity in the fetus/neonate, releasing adrenal catecholamines into the bloodstream during the birth process (Lagercrantz and Bistoletti 1973). The suspicion is that this enhanced excitation of the child's circulation, respiration and metabolism during birth helps the child to establish a normal somatic adaptation to its new circumstances, as well as to protect itself from potential hypoxia and hypercapnia during the actual birth (articles by Jones and by Silver and Edwards in Parvez and Parvez 1980). Moreover, conservative interpretations of strictly experimental research to the contrary (e.g., Maurer and Maurer 1988), there is ample clinical (Chamberlain 1983, 1989; Verny 1982, 1987; Janov 1972, 1983; Laing 1982; Cheek 1974; Grof 1976, 1979, 1985, 1988), pediatric (Brazelton and Als 1979; Brazelton, Koslowski and Tronick 1977; Sanders-Phillips, Strauss and Gutberlet 1988; Blackbill et al. 1974; Rose 1981), and ethnographic (Neumann 1963; Eliade 1958; Trevathan 1987; Laughlin 1985, 1989) data to indicate that just how the birth process occurs may leave a lasting positive or negative, and even a traumatic effect upon consciousness. A study by Niles Newton (1970) shows that there is a cross-cultural correlation between the psychological environment of birth and the ease and speed of birth. Easier labours seem to be associated with acceptance of birth as natural and non-frightening, and with a comfortable and supportive social environment. Newton tested this finding experimentally on mice and found the same association. Of course, cultural influences upon the birth process and the treatment of the neonate are found to vary enormously cross-culturally (Brazelton, Koslowski and Tronick 1977; Liedloff 1975; Trevathan 1987; Kay 1982; MacCormack 1982; Ford 1945, 1964; Eibl-Eibesfeldt 1983; Mead and Newton 1967), thus indicating an enormous range of possible birth experiences from the neonate's point of view.

Perception and Learning in the Perinatal Child

Interaction between the developing nervous system and the environment becomes even more important during postpartum development and with age. The growth of the brain is rapid and dramatic during the first months of infancy. The brain of the neonate at birth weighs roughly 300 to 350 grams and will reach 80 percent of its adult weight (1250-1500 grams) by the age of four years (Spreen et al. 1984:29).

Figure 3 illustrates the dramatic increase in the weight of the human brain during gestation and after birth, while Figure 4 provides a comparison between the rates of postpartum development of humans and chimpanzees.

Figure 3
The Growth Curve of the Weight of the Human Brain through Gestation and into Adult Life



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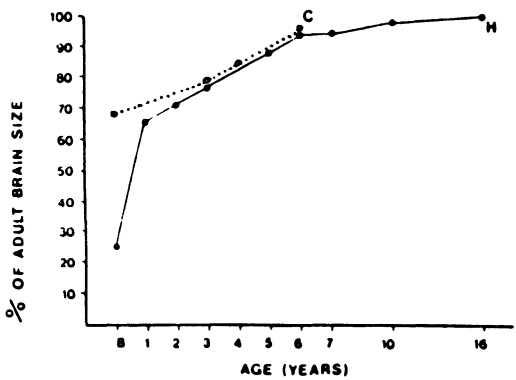
Virtually all of the neural cells that one will ever have in one's life are present by the seventh month of gestation.[6] Most of the dramatic brain development during the last trimester of prenatal life, and during early postnatal life involves the growth of interconnections between neural cells, selection and elimination among these connections (Oppenheim and Haverkamp 1986; Changeux 1985; Purves 1988; Bronson 1982), growth of glial (support) cells (Bronson 1982), and myelinization of certain classes of fibres (Yakovlev and Lecours 1967). It is only later in development that the growth of other somatic processes overtake that of the brain (see Figure 5).

The most intense phase of dendritic branching and synapse formation occurs after birth. Figure 6 gives yet another indication of the prolific development of the perinatal cortex.

A cautionary note is worth interjecting here: Much has been made in the past about the presumed greater plasticity of the infant brain compared with the adult brain (the so-called Kennard principle). The implication of this view has been that the organization of the infant brain is so immature and malleable that functions can be readily spared and taken up by alternative tissues if

Figure 4
Percentage of Adult Brain Size Plotted against Age in the Chimpanzee (C) and Human (H)



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damage is sustained. There is now a growing body of data to suggest that the opposite situation may be the case, that under certain circumstances the infant brain may be more susceptible to disruption than the adult brain (see Will and Eclancher 1984). Of related interest are data indicating that the neonatal and infant cortex is already thoroughly lateralized in its functions, even prior to language competence and fully developed handedness (Kinsbourne and Hiscock 1983). Table 2 presents a summary of some of what is known about perinatal development to the postpartum age of six months.

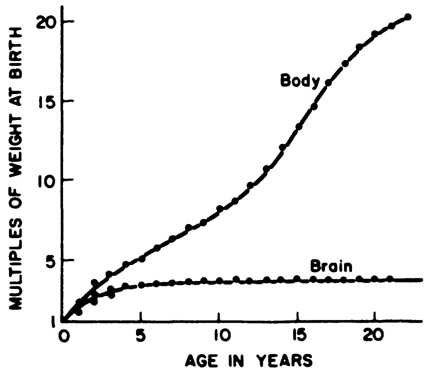
Table 2
A Rough Summary of the Landmarks of Neurophysiological and Psychological Development, with Sources of Data, during Human Perinatal Life by Month of Postpartum Age

Month	Week	What Is Known About Brain and Consciousness:
0	0	Birth is an intense experience of transformation (Stave 1978); bonding with mother before and just after birth (Sugarman 1977; Chamberlain 1983:17, Brazelton and Als 1979; Liedloff 1975; Ainsworth 1967; Ainsworth et al. 1972; Bowlby 1969; Eibl-Eibesfeldt 1983; Trevathan 1987); recognition of mother's voice demonstrated (Busnel and Granier-Deferre 1983; DeCasper and Fifer 1980); born with innate capacity for interpersonal communication (Trevarthen 1983b); foveal vision immature relative to peripheral vision (Banks and Salapatek 1983), but multimodal perceptual coordination in exploration of environment (Field 1987); able to discriminate and imitate facial expressions (Meltzoff and Moore 1983a; Field et al. 1982); facial expression of positive and aversive response to tastes (Steiner 1979); cerebral hemispheres anatomically asymmetrical (Witelson and Pallie 1973);

Table 2 (continued)

Month	Week	What Is Known About Brain and Consciousness:
		behavioural and electrophysiological asymmetries (Turkewitz and Creighton 1974; Molfese 1977); slight right-hand bias from birth in dextrals (Bates et al. 1986).
	1	Recognize and prefer mother's smell (McFarlane 1975).
	2	Recognize their mother's picking them up in the dark and silence (Widmer cited in Murray and Trevarthen 1985).
	3	Typical adult pattern of lateral asymmetry for speech and non-speech sounds present by 22 days, but possibly from birth (Entus 1977).
1	4	May be visually sensitive to kinetic flow-field information about impending collision with an object (Yonas and Granrud 1985).
	5	
	6	Evidence of ability to perceive spatial structure of visual objects (may be present from birth; Cook 1987); sensitivity to complex nuances of communicative and emotional states in mother by this age or earlier (Murray and Trevarthen 1985).
	7	
2	8	Evidence of phonetic discrimination (Busnel and Granier-Deferre 1983); evidence of bimanual haptic exploration of objects (Streri and Spelke 1988); great proliferation of cortical dendritic spines, many of which are later lost (Banks and Salapatek 1983:453).
	9	Emotional expression by facial expression, vocalization and gesture; intensely involved in interpersonal engagement (Trevarthen 1983b) involving "turn-taking" between mother and infant (Mayer and Tronick 1985).
	10	
	11	
3	12	
	13	Significant right-hand bias established, stronger for symbolic, as opposed to non-symbolic movements (Bates et al. 1986).
	14	
	15	
4	16	Visual stereopsis and equalized optokinetic responses adult-like (Held 1985); binocular summation of pupillary response (Birch and Held 1983); visual accommodation now more like adult (Haith 1980:122); knowledge produced by bimanual haptic exploration is transferred cross-modally to vision (Streri and Spelke 1988).
	17	
	18	Size of visual objects remains constant with varied distance (Day 1987).
	19	
5	20	Evidence of object permanence (Spelke and Kestenbaum 1986; Baillargeon, Spelke and Wasserman 1985).
	21	
	22	
	23	Pictorial depth information (Yonas and Granrud 1985)
6	24	

Figure 5
Growth of the Human Brain Compared to Overall Growth of the Body, Using Weight as a Measure



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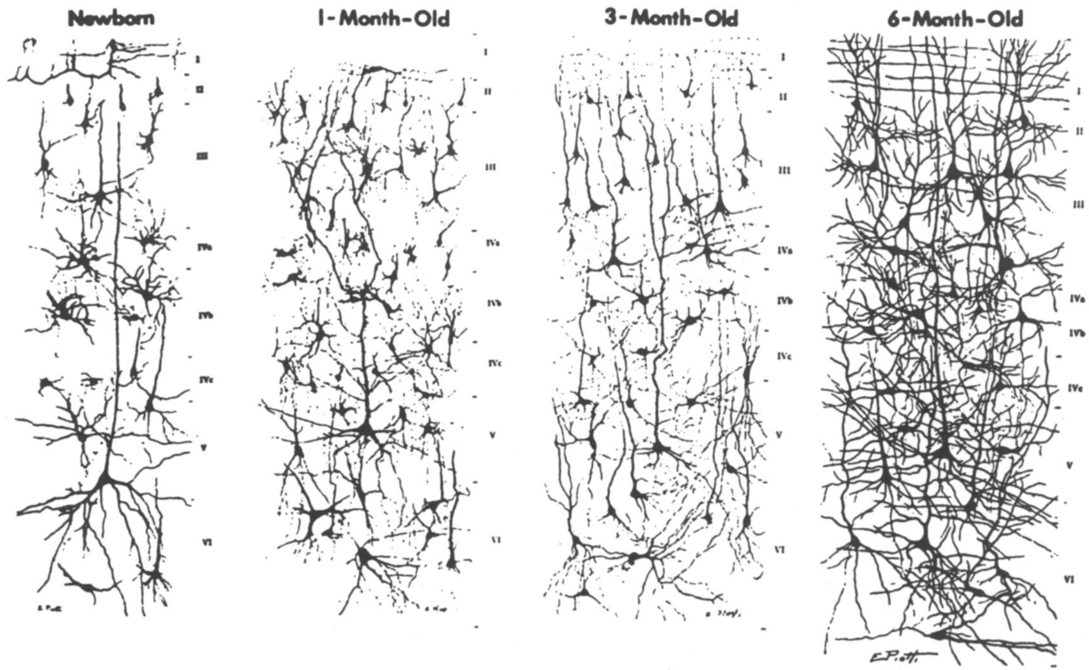
The Perinatal Sensorium

The perinatal sensory system is comprised of developing networks of interconnecting cells that have already begun to function in prenatal life as soon as they are in place. At no time is the sensory system producing a chaos of random sensations as was once believed (and at least tacitly implied by some current writers; see Maurer and Maurer 1988:51). Rather,

> In recent years, it has become abundantly clear that William James' . . . characterization of the world of the infant as a "blooming buzzing confusion" is simply wrong. There is evidence that the infant's world is structured and that far from being overwhelmed by a barrage of stimulation which only slowly comes to be sorted out, the infant from his earliest days is quite properly characterized as competent and organized. It is our contention that one of the major sources for this organization is the infant's limited sensory capacity. (Turkewitz and Kenny 1982:362)

This is a crucially important fact: most available evidence suggests that *there exists no stage of development, prenatal or perinatal, in which the cognized environment of the child is in chaos.* It is ordered from first to last (e.g., see Blakemore 1974 on the development of the visual system). Sensory organization emerges during development, mediating an ever ordered, yet ever more complex and more flexible field of perception. Furthermore, as the sensorium develops, particularly at the subcortical levels, well before higher cortical functions, the order inherent in primitive perception is ontogenetically the primary order in human experience. In other words, the primacy of the order of perception in consciousness holds not only for adult cognition

Figure 6
The Developing Perinatal Brain. Drawings of Cells in the Visual Cortex of Human Newborns, One-month-olds, Three-month-olds, and Six-month-olds. Roman numerals refer to cortical layers.



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(as Merleau-Ponty 1964, 1968 repeatedly emphasized), but for ontogenesis as well (see Laughlin 1985). Moreover, it is now clear that there is continuity in the development of cognitive functions operating upon sensory objects from at least birth onward (Bornstein and Sigman 1986).

Vision

The visual system of the infant, although it is the last to begin developing in the womb, is nonetheless fairly precocious at birth (Haith 1980). The infant soon after birth is found to have a fully functioning pupillary response over a wide range of light intensities, if somewhat nearsighted by adult standards. The infant can scan (with both eyes synchronized, but with immature convergence) the visual field in moderate illumination and in the dark, will fixate upon objects of interest (particularly the edges of things), inspect them avidly and follow their movements. Objects are cognized by the detection of invariant features, including movement (Burnham 1987). They have both foveal and peripheral vision, saccadic movements, and the internal visual pathways and cortical association areas requisite to learning. Haith (1980:119) suggests that "the newborn's visual activity can be understood in terms of a system that serves to keep visual cortical-firing rate at a high level." In other words, the newborn is already prepared to explore its environment, and detect, explore and model objects and relations found there. In fact, some researchers go so far as to suggest that object perception develops early and that the infant at, or near birth is perceiving the world out of a single mechanism, an already mature "object concept" (Streri and Spelke 1988) from which it explores the surfaces and movements of objects in its environment.

The infant appears to require several months before it is capable of fully binocular experience, extraction of information (Imbert 1985), and well coordinated selectivity and attention control (Braddick and Atkinson 1988). However, within a couple of months after birth at the latest, the infant is perceiving objects that extend behind other objects, and by five months can perceive them as continuing to exist when lost to view (Kellman and Spelke 1983; Baillargeon, Spelke and Wasserman 1985; Spelke and Kestenbaum 1986). From at least the time of birth, infants are thought to discriminate colours and sounds on the basis of perceptual categories mediated by innate neural structures maturing during gestation (Wilson 1987).

The Other Senses

The perinatal cognized environment is also rich in gustatory, auditory and tactile sensations, as well as somaesthetic sensations of intrinsically initiated movements (see Ganchrow, Steiner and Daher 1983; Steiner 1979; Barlow and Mollon 1982; Busnel and Granier-Deferre 1983). Of particular importance to anthropologists is the infant's interest in and ability to discriminate speech sounds in a manner similar to that of adults (Eimas and Corbit 1973; Cutting and Eimas 1975; Eimas 1985; Eimas, Miller and Jusczyk 1987; Jusczyk 1985; Aslin, Pisoni and Jusczyk 1983). The newborn's cerebral hemispheres are distinctly anatomically asymmetrical (Witelson and Pallie 1973), and Molfese (1978) has presented electrophysiological data showing that left hemisphere response to speech sounds is greater than for non-speech sounds. Newborns have been shown to prefer speech sounds to sounds made by non-human objects, and female voices to male voices (Eisenberg 1975), and to extract information about emotional expression from intonation (Trevarthen 1983a).

Abstract Perceptual/Cognitive Associations

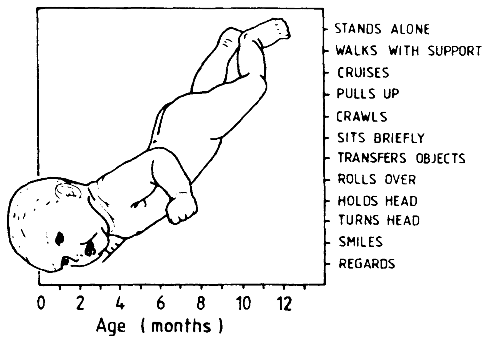
Although their functioning seems primitive, the infant between birth and about four months of age is nonetheless equipped with the perceptual and cognitive structures in place to apprehend substantial, physical objects, their unities, their boundaries, their constituent parts and their continuity during displacement (Spelke 1985, 1988a and 1988b). Some researchers have suggested that perhaps by late intrauterine life, by birth, or certainly by four months of age the child is equipped with innate higher perceptual and cognitive structures that anticipate a three-dimensional and temporal/causal world that becomes fulfilled and refined in actual perceptual experience as it arises in the sensory system (see Gibson 1969; Treiber and Wilcox 1980; Bower 1974; Bower and Wishart 1979; Meltzoff and Borton 1979; Antell and Keating 1983; Banks 1988; Spelke 1988b; Leslie 1988; Gottlieb 1976a). This fulfilment may include a fundamental evaluation of the object as being positive or negative, pleasurable or displeasurable (Lipsitt 1979; Steiner 1979).

Refined perceptual structures project redundancy upon the perceptual field. It is clear that neonates and infants are conscious of and learn from perceptual novelty in their environment (Rovee-Collier and Lipsitt 1982; Sameroff and Cavanaugh 1979). Individual differences in attention to novel, as opposed to previously seen objects, as well as other attention-related factors, have been found among infants, and these have been shown to be predictive of psychometric intelligence later in childhood (Fagan 1984a, 1984b; Fagan et al. 1986; Lewis, Jaskir and Enright 1986; Hollenbeck et al. 1986; Rose, Feldman and Wallace 1988; Colombo, Mitchell and Horowitz 1988). The intelligent neonate and infant seems to be curious about its world and especially about novelty, despite the well-known altriciality of its behaviour, i.e., its dependence on its caretakers (Zelazo 1979; Moss et al. 1988; Trevathan n.d.). Long-term memory increases dramatically during the first weeks after birth (Ungerer, Brody and Zelazo 1978).

Associations are not merely limited to single sensory modalities, for infants are quite capable of multimodal perceptual associations (Dodd 1979;

Spelke 1979; Kuhl and Meltzoff 1988) and synaesthesia ("seeing" sounds, "hearing" colours, etc.; Lewkowicz and Turkewitz 1980). This supramodality of perceptual categories and associations is just as one would expect if higher, more abstract perceptual structures are indeed in place by birth. Moreover, as the nervous system, even during prenatal life, is developing in intimate dialogue with the external environment, the question of a role of culture in influencing the development of these perceptual and cognitive structures is clearly indicated (see Bornstein 1985), despite the relative behavioural altriciality of the neonate and infant (see Figure 7).

Figure 7
The development of behaviour lags behind the competence of perception and cognition. The stages of behavioural development are depicted for the human infant. The orientation of the baby on this graph indicates its cranial-caudal progression.



Source: Lowrey 1973. Reprinted with permission.

The Social Cognized Environment of the Perinatal Child

The preparedness of the neonatal perceptual/cognitive system for learning is not limited to physical objects and relations in the environment. The infant is inherently and actively social in its activities, and participates fully in socially related learning (Papousek and Papousek 1982). A major mechanism of social learning for the infant is, of course, imitation. This is learning about social interaction by doing, and the structures for inculcating perceived gestures and facial expressions may prove to be present at birth (Meltzoff and Moore 1983a, 1983b). As Meltzoff and Moore (1985:140) note, imitation is ubiquitous to human learning cross-culturally. Research on this capacity of neonates is just beginning, and conclusions should be treated as tentative (Over 1987).

However tentative, the research results thus far (see Meltzoff 1985) do support the notion that the newborn human being is neurocognitively active and prepared to recognize significant social events in the environment. In phenomenological terms, not only is the primacy of perception the rule for neonates in ordering the physical cognized environment (à la Maurice Merleau-Ponty 1964), it is also the rule in ordering the social cognized environment (à la Alfred Schutz and Thomas Luckmann 1973). That is, not only is the world of physical objects "already there" to the neonatal perception at, or before birth, so too is the world of socially significant objects and interactions – objects that include speech sounds, interactive gestures, emotional expressions and faces, and especially the face, gestures, emotional expressions, smell, physical touch, breasts and voice of its mother (Field 1985; Murray and Trevarthen 1985; Butterworth and Grover 1988). Furthermore, these socially relevant objects receive characteristic bivalent emotional responses by the infant (Schneirla 1959; Lipsitt 1979; Bowlby 1969, 1972), indicating an innate proclivity to seek out social bonding and interaction, and avoid separation, isolation and potentially dangerous strangers. Failure or serious perturbation of the infant's social bonding can and does produce profound and potentially long-term effects upon personality organization, affective orientation and patterns of adaptation (various references in Murray and Trevarthen 1985:192; also Ali and Lowry 1981).

The inborn proclivity for social interaction is, as we have seen, reflected in the infant's preparation to explore and produce speech sounds. It was until recently thought that older infants passively receive language enculturation and that their early babbling is meaningless and bears no relation to the later development of "real" speech. This view has currently been reversed (at least in developmental psycholinguistics). The best recent evidence indicates that infant vocalization and babbling are constituted by both genetically endowed and culturally labile features, and that they are a consequence of both an active intent on the part of the infant to communicate on the one hand, and the willingness of adults to interpret their vocalizations and behaviour as meaningful and to engage in dialogue with them on the other hand (Waterson and Snow 1978; Bullowa 1979; Murray and Trevarthen 1986). Oller et al. (1976) have shown that some of the phonetic content of babbling exhibits similar preferences to that found in later child speech, depending upon the language spoken. De Boysson-Bardies, Sagart and Durand (1984) partially confirm this finding by showing that adult speakers of different languages can accurately distinguish the recorded babbling of infants raised in their particular language group by recognizing certain metaphonological characteristics.

Furthermore, the form and content of adult babytalk has been shown to be determined by cultural attitudes and relations operating elsewhere in the culture (Blount 1972, 1977:301; Goldman 1987), and to involve simplification and reduction of form (Ferguson 1977; Papousek, Papousek and Bornstein 1985). The data on many societies show that the mother is not the sole linguistic influence on the infant, influence coming frequently from an extended group of siblings and other kin (Blount 1977:299).

The Challenge of Pre- and Perinatal Psychology to Ethnology

Summarizing from the wealth of data now being accumulated about early human neurocognitive development, the pre- and perinatal child appears to be an active, growing, self-regulating, exploring and learning organism that is: (1) capable of seeking out, examining and learning about physical objects, (2) capable of constructing memories about life in the womb, about birth and about events occurring in postnatal life, (3) genetically predisposed to be interested in faces and speech sounds, (4) inherently social in its synchronized interactions and communications with caregivers, (5) inherently inclined to imitate expressions and gestures perceived, (6) capable of constructing supramodal models of physical and social objects, (7) probably (although as yet hard to be sure) engrossed much of the time in a symbolically rich dream-state cognized environment,[7] and (8) cognitively and perceptually precocious relative to its behavioural altriciality. None of this should be surprising to those who understand that much of what has made the evolution of the human brain so distinctive has been the emergence of precisely those areas of neural tissue subserving the construction of a cognized environment (see Sarnat and Netsky 1974; Jerison 1973; Laughlin and d'Aquili 1974).

The Obvious Question, and the Problems in Answering It

The obvious question that all of this raises for ethnology is: Does enculturation — i.e., the learning of new and traditional skills and ideas by individuals during the course of life (Herskovits 1948:37-45) — begin earlier in life than was previously thought? Does enculturation begin in fact during pre- and perinatal life? Does culture actually begin to be inculcated while the child is still in the womb, and does the inculcation process accelerate during the first months after birth? This question is difficult, if not impossible to answer by reference solely to ethnology, for it is precisely the pre- and perinatal period of life in which traditional ethnological theory has had little interest, and for which ethnography has produced little direct data.

There are several theoretical and methodological problems that hamper the production of ethnological theory and ethnographic data about early enculturation. The first and most obvious problem is that most ethnographers have been, and still are males, and males are usually excluded from direct participation in female-only activities and concerns. For example, most cultures forbid the presence of males during birth (Ford 1945; Trevathan 1987:35ff.), yet as Trevathan (1987) and Jordan (1978) have noted, accurate information about birth practices requires detailed direct observation.

A second problem is that although anthropologists claim to be interested in enculturation, ethnographers on the whole have paid little attention to infancy, much less prenatal life (see Bullowa, Fidelholtz and Kessler 1975; Newman 1972:51, Schreiber 1977 on this matter). Interest in infancy is now increasing in anthropology, but is still more the stock-in-trade of the cross-cultural psychologist than the ethnographer.

A third problem – and perhaps the most intractable due to its largely unconscious roots – is that anthropological thinking, uncritically reflecting its origins in the pre-scientific cognized environment of Euroamerican culture, tends to presume that a human being only begins to attain personality or consciousness at some time (days, weeks, months) after birth (LeVine 1982:245; Bullowa 1979:31). Entire texts can be written in general and even psychological anthropology with little or no reference to either the cultural forces that may shape the pre- and perinatal cognized environment, or the pre- and perinatal influences upon the later psychology of the individual as culture-bearer. As a result, until quite recently, anthropologists have had little to say about the quasi-scientific and ritualistic procedures and training still utilized in "modern" obstetrics (see Davis-Floyd 1987, 1990 on this issue).

A fourth problem is that ethnographic research is typically of short duration (usually between 12 and 36 months) and it is impossible in such a short time to carry out long-term causal studies. There exist virtually no longitudinal cross-cultural studies covering the entire life-course from conception to adulthood. And, as LeVine (1982:245) correctly notes, simultaneous studies of cultural influences upon the child and of adult characteristics can be misleading because cultures change, often rapidly. The cultural influences that formed the adult may have been different than those now operating on the child.

A fifth problem is that anthropology has traditionally conceived of the very young child as a passive recipient of culture. Until recently, there has been little awareness exhibited in the ethnographic literature of the pre- and perinatal child as a cognitively and perceptually competent, autonomous, self-regulating, adapting and experiencing human being exerting some control over interactions with its physical and social environment (see Konner 1981; Curran 1984:9).

A sixth problem is that the literature exhibits little sensitivity to the world as it may be experienced from the fetal/neonatal/infant point of view. Descriptions of pregnancy, birth, the puerperium, infant caregiving and child-rearing are generally from the outside-in, so to speak, and rarely consider the experience of the child. Of course, part of the problem is methodological. It is hard to interview a fetus or an infant, at least when one is limited to the language-based and interactional methodologies typical of traditional ethnographic fieldwork.

A seventh problem lies in the established theoretical biases of ethnographers interested in childhood and childrearing. The two theoretical perspectives responsible for initiating and interpreting most of the ethnographic research on childhood are Freudian psychoanalysis, which has influenced ethnology from the early twenties (Whiting and Child 1953; LeVine 1980), and Piagetian genetic epistemology, which began to have an influence on cross-cultural work in the seventies (Dasen 1977; Dasen and Heron 1981). Neither of these two perspectives is particularly sensitive to the importance of pre- and perinatal enculturation. The Freudian perspective (in keeping with the predominant attitude in Euroamerican culture) conceives of personality as beginning sometime after birth (see Laing 1982 on this issue), and therefore has oriented research away from pre- and perinatal development and toward the more obvious institutionalized childrearing practices directed at the older child. Such research has been more concerned with the influence of traits like weaning practices, toilet training, handling of the Oedipal conflict, and the like on later personality structure.

Piagetian theory is concerned more with the universal organization of cognition and less with its content, its affective associations and its applications to environmental contingencies which may well be culturally influenced. Moreover, Piagetian methodology does not recognize the critical significance of the precocity of infant perception/cognition relative to sensorimotor competence. For instance, Piagetian theory holds that the object concept is constructed well after birth as a consequence of the process of sensorimotor interaction with physical objects (see Butterworth and Grover 1988 on this point). Moreover, Piagetian methods require the testing of competence via fairly advanced motor responses, and thus little cross-cultural research has been carried out, under the Piagetian banner, of relevance to the influence of prenatal, natal and neonatal variables upon later cognitive and psychological development.

Current Strengths and Future Directions

Despite these serious theoretical and methodological obstacles, ethnology has produced a significant literature pertaining to the cultural ethos and social factors that impinge upon the experience and conditioning of pre- and perinatal human beings (see Laughlin 1989 for a list of relevant reviews). Reading the ethnographic literature leaves one with the impression of the innumerable ways that a culture may influence the course and experience of very young children (for example, see Whiting and Edwards 1988 on the treatment of "lap children" in different cultures).

Culture influences who may court and reproduce, who may conceive and bear children and how often, who will be socially recognized as parents and caretakers, and to what social groups the child will belong. Custom dictates appropriate nutrition during and after pregnancy, the style of parturition practised, when feeding begins and how often it is allowed, which child will live and which will die, the value of multiple births, what work pregnant women may and may not do, how socially and communicatively competent the fetus/neonate is considered to be, and when the child is considered a human being and a member of the society. The ethnographic literature has documented the extent to which tradition may determine where a birth occurs, special herbs and massage administered during childbirth, who will attend the birth and who will be forbidden to do so, the proper posture(s) for parturition, the proper duration of the birthing, and the duration of and treatment of mother and infant during the puerperium. Culture will determine the intensity and nature of mother-infant attachment, the nature and duration of mother-infant separation, and the range of environmental stimulations to which the infant is exposed. Any and all of these factors may have their effect upon the experience, learning and later psychological development of the child.

Ethnographic research oriented toward pre- and perinatal enculturation should continue and be intensified in this vein — especially by female ethnographers — for not only is its importance now clearly indicated by research into the perceptual/cognitive competence of the very young child, it also will further help to place the findings of the experimental disciplines (e.g., cross-cultural psychology, pre- and perinatal psychology, developmental neuropsychology, developmental social psychobiology, etc.) within a naturalistic frame of reference. While there does seem to be a hiatus in the development of ethnological theory capable of explaining early enculturation and of guiding more refined research on this issue, research can nonetheless be profitably continued so as to provide the naturalistic context for the burgeoning experimental work of the sort reviewed above — indeed, a naturalistic context such as is called for by some of the experimental researchers themselves (see Joffe 1969:307-8; Gottlieb and Krasnegor 1985).

However, because of the unique difficulties in acquiring information about the "emics" of pre- and perinatal experience, and the non-institutionalized subtleties of infant-caretaker interactions, more sophisticated methods should be used to augment the more standard participant observation techniques. For one thing, fieldworkers may wish to utilize modern photographic, cinematographic and video technologies to record and analyze infant-caregiver interactions. Some ethnographers have already done so, and use photographs in their reports to good effect (see Sorenson 1976; Mead and MacGregor 1951).[8] Ethnographers may want to consider the use of synchronized dual video recordings of infant and caregiver (Trevarthen 1983a; Meltzoff and Moore 1983a) in order to study spontaneous rhythmicity in synchronized interactions.

Pre- and perinatal ethnographers would be well advised to become sensitized to the range of testing procedures used to assess perceptual/cognitive and behavioural competence in the fields reviewed above (see Prechtl 1982 for a review). Some of these tests have been developed to evaluate the health of newborns, and have the dual advantage of being both cross-culturally applicable and in keeping with the level of neurophysiological maturity being studied (e.g., for the Cambridge Neonatal Assessment Scale see Brazelton et al. 1977; Freedman 1979:141ff.; for the Apgar measures of neonatal health see Apgar 1953, 1962; see also Gottlieb and Krasnegor 1985 for other techniques). In addition, tests have been developed to measure handedness (for the Edinburgh Handedness Inventory see Oldfield 1971) and perceptual novelty (see Fagan 1974, 1984b; Bornstein and Sigman 1986; Colombo, Mitchell and Horowitz 1988 for a variety of techniques).

But ethnology cannot simply borrow theory and methods from pre- and perinatal psychology and its sister experimental disciplines. On the one hand, these disciplines find themselves in theoretical disarray (see Mounoud 1988; Butterworth and Grover 1988). On the other hand, it seems likely that ethnographers may have to develop their own tests and techniques appropriate to the constraints of the field situation, to the naturalistic context that has been ethnology's greatest contribution to social science, and to the new questions being asked of the ethnographic data. For instance, as ethnology comes to develop theories of culture and psychology more applicable to pre- and perinatal life, the hypotheses they generate may require more of ethnographic methodology than can currently be supplied by participant observation, unaided by methods geared to circumvent the profound difficulties in researching the nature of infant development and adaptation. Traditional ethnographic methods are terribly reliant upon behavioural and linguistic competence for the production of data, but the pre- and perinatal human being, while being perceptually and cognitively precocious is neither behaviourally, nor linguistically competent.

Conclusion: The Roots of Enculturation

There is now ample evidence to suggest that the roots of enculturation are to be found in the adaptational dialogue between the developing pre- and perinatal brain and its physical and social environment. If this proves to be the case, then traditional ethnological theory and methods are inadequate to carry out the kind of research necessary to test non-trivial hypotheses about very early enculturation in a cross-cultural setting. Ethnology must therefore augment its traditional stock of methods with those adequate to the task of "interviewing'' the pre-linguistic, pre-behaviourally competent human being.

The research payoffs for closer and more informed attention to the pre- and perinatal period of enculturation could be remarkable. To offer several examples: armed with requisite procedures, we should quickly be able to generate a cross-cultural data base on the development of phoneme discrimination among neonates and infants. This would allow us to take early enculturation more into account in our understanding of first language acquisition. By careful study of neonate-caregiver interaction, we can better determine whether or not there exists an innate critical period just after birth for establishing mother-infant bonding. Realizing as we do that most enculturation is informal, we could also discover to what extent the neonate and infant initiate aspects of their own enculturation – that is, how sensitive a particular culture is to the initiatives of the neonate and infant to learn, and in which domains. Moreover, we could come to better understand to what extent individual personality differences in a society may be explained by reference to differences in neonatal temperament.

In order to reap these rewards, ethnology must become theoretically more sensitive to the influences of culture upon the development of early cognition and the pre- and perinatal cognized environment. I have suggested that the influence of society upon early enculturation may at least involve the following factors:

1. the production of experiences that lead to something like Grof's ''condensed experiential systems'' (or COEX systems; Grof 1985, 1988) which are very early memory structures configured upon affective-imaginal associations and which form seed-like cores upon which later neurocognitive development coalesces;
2. conditioning orientation toward culturally salient objects in the operational environment for scanning and intentional association – that is, what sights, sounds, textures, tastes, etc. are available to the child's perception, and to which set of these is the child's attention directed by caregivers;
3. conditioning relative to rhythmic stimuli, perceptual recurrence, and temporal structuring of events (e.g., see Ayres 1973 on the relationship between infant carrying style and type of musical rhythm in cultures);
4. establishing a fundamental affective/arousal/response orientation toward novelty in the operational environment – that is, an emotional orientation (formed initially, say, during the birthing experience) lying somewhere along a continuum from positive through neutral to negative toward novel objects and events, as well as strangers, and change and transformation generally;
5. a range of patterns of mother-infant and caretaker-infant bonding and a

fundamental orientation toward gender that is later manifested in gender-related social roles, interactions and cosmological gender attributions (see Laughlin 1985);

6. the institutional control of a range of pre- and perinatal operational environments extending along the enrichment/impoverishment dimension (M.C. Diamond 1988; Renner and Rosenzweig 1987) – i.e., is the infant sequestered in a hut during the first weeks of life, or is it covered by mother's clothing while outside, or perhaps carried in a cradleboard in full view of everything the mother sees?

Whatever form the cultural influences operating upon pre- and perinatal learning eventually prove to take, the roots of enculturation will undoubtedly turn out to be as subtle as they are consequential to the later development of the person. These influences will be far more subtle than the kind of institutional traits that have heretofore preoccupied some psychological anthropologists. Thus, ethnology must cultivate a theoretical sensitivity and a repertoire of field methods equal to both the importance and the subtlety of the causal processes involved in shaping the pre- and perinatal cognized environment and the later development of the child.

Notes

1. This paper was presented at the annual meeting, Canadian Anthropological Society, Ottawa, Ontario, Canada, in May, 1989. The author wishes to thank Dr. Robin Fox and Ms. Judy Young-Laughlin for their editorial suggestions. Address inquiries to the author, Department of Sociology and Anthropology, Carleton University, Ottawa, Ontario, Canada K1S 5B6.
2. It used to be thought that these neural structures did not begin to function until their axons were coated with myelin (a fatty sheath that is wrapped around some axons as a kind of insulation; e.g., Langworthy 1933). It is now known that myelin has the effect of modifying the speed of transmission of signals in cells that are already functioning (Larroche 1966:273; Bekoff and Fox 1972; Yakovlev and Lecour 1967). Myelinization usually proceeds from the most archaic parts of the nervous system through the most recent, thus reflecting in ontogenesis the stages of evolution of the nervous system in phylogenesis (Larroche 1966).
3. I am interpreting these data from a biogenetic structural point of view. Biogenetic structuralism is an interdisciplinary approach to the study of cross-culturally invariant regularities of behaviour, symbolism, consciousness and cognition that combines evolutionary biology and the neurosciences with phenomenology and the social sciences (Laughlin and d'Aquili 1974; d'Aquili, Laughlin and McManus 1979; Rubinstein, Laughlin and McManus 1984; Laughlin, McManus and d'Aquili 1990). In many of our writings we call the substrate of consciousness (at whatever stage of development) an individual's *conscious network* and the world of lived experience constituted by the conscious network an individual's *cognized environment* (Laughlin, McManus and d'Aquili 1990). We have argued in numerous writings that conscious network and the cognized environment develop in interaction between initial, genetically predisposed models (termed *neurognostic models*, or simply *neurognosis*) of the world and the *operational environment*. Much of the evidence for pre- and perinatal cognitive/perceptual competence stands as evidence for the existence and importance of neurognosis.

Our notion of cognized environment is similar in many respects to the phenomenological concept of the "lifeworld" (Schutz and Luckman 1973; Husserl 1970), and differs only in that our concept implies a world of experience produced by neurobiological networks of the brain. We originally borrowed the terms "cognized" and "operational environments" from Rappaport (1968), but have substantially altered their meaning within biogenetic structural theory (see d'Aquili, Laughlin and McManus 1979:12ff.; Laughlin and Brady 1978:6ff.; Rubinstein, Laughlin and McManus 1984:21ff.; and Laughlin, McManus and d'Aquili 1990:chap. 3). For one thing, Rappaport does not imply as we do a neurocognitive substrate to the cognized environment. For another thing, Rappaport equates the operational environment with that described by science, whereas we treat scientific descriptions as cognized environments.

4. A bias that has long hampered our understanding of pre- and perinatal consciousness and cognitive competence is that neural structures must in some sense be complete in their development before they are able to function. This view has increasingly come into question (see Gottlieb 1976b; Klosovskii 1963; Klopf 1982:6) as theorists realize that nerve cells are not some sort of organic microchips that remain static until they are "wired-up" to networks, but rather are living, functioning organisms in their own right. A more realistic view is that the body of a pre- and perinatal child is comprised of hundreds of trillions of cells of many thousands of types and of every conceivable description. The child is in fact a community of cells; a community of discrete organisms that are, themselves, made up of various parts like membranes, mitochondria, organelles, and nuclei (Varela 1979; Laughlin, McManus and d'Aquili 1990). The nervous system is an organ or sub-community within the greater community of cells. Each of the nervous system's 1012 neurons is a goal-seeking unit that becomes more and more involved in a hierarchy of nested networks (Powers 1973; Klopf 1982:13; Varela 1979; Glassman and Wimsatt 1984). The nervous system is the organ of the body that specializes in the purposeful regulation of vital functions, tracking events in the world of phenomenal experience that it, itself, constitutes, and which organizes the myriad systems of the body into adaptively appropriate entrainments. Most importantly for our current purposes, the nervous system constructs a cognized environment within the context of which discrete events are cognitively evaluated (Granit 1977). Furthermore, the immature nervous system during the early months of prenatal life "comprises a roughed-in structure whose levels and subsystems are poised for coding of certain categories. The subsystems are neither wholly flexible nor wholly predestined players in a ballistic ontogenesis" (Glassman and Wimsatt (1984). The vast majority of cells comprising neural models are those that communicate only with other cells within close proximity ("local circuits"; see Uttley 1966; Rakic 1976).
5. Although, as Aslin (1985:157) notes, it is difficult to establish "the relative contribution of genetic and experiential factors to the ontogeny of individual members" of our species, it seems probable that consciousness and learning begin at some point in early gestation and develop rapidly and in tandem with the genetic factors controlling ontogenesis throughout the prenatal and perinatal period (Gottlieb 1983:5). Given the confines of our present knowledge, it is pointless to try to establish the exact stage at which the prenatal child is conscious, for different investigators have different conceptions of what constitutes "consciousness" and thus much intersubjective disagreement.

Furthermore, the data pertaining to when various functions arise in the course of prenatal development are often spotty or inconclusive. Anthropologists should be wary of considering any point of initial development of a function as fixed, for the tendency has been for the age of emergence of any particular function to be pushed back to earlier stages as new and more sensitive techniques of observation and experimentation are acquired. Also, it would be well to keep in mind three other factors when evaluating these data: (1) the almost inevitable ethnocentricity of these studies, the subjects are usually Euroamerican in origin; (2) many subjects have undergone hospital births and obstetrical procedures; (3) the experimental research upon which conclusions are based frequently do not reflect the "real life," naturalistic situations so valued by ethnology (see also Murray and Trevarthen 1985:180; Edgerton 1974).

6. It is interesting that neurogenesis is prolonged in the hippocampus and continues well after birth. This may be related to delayed development of behavioural and memory functions of that area (Altman 1970; Altman, Brunner and Bayer 1973).
7. It is, of course, very difficult to know what a sleeping baby is experiencing. We know that the baby's brain is very active during sleep, and that it is in REM sleep most of the time. My suspicion has been for a long time that the younger the child (fetus/newborn), the more archetypal the dream symbolism is likely to be, and the older the child (from later infancy on), the more memories of events in the external operational environment will influence dream symbolism. There exist very little data on the matter so far.
8. E.R. Sorenson has also produced a film entitled *Growing Up as a Fore* (National Research Film Collection, Smithsonian Institution, Washington, D.C.) which covers infancy and childhood among a New Guinea people.

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