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Self/other organization in human psychological development

KENNETH J. AITKEN[a] AND COLWYN TREVARTHEN[b]
[a]*Hospital for Sick Children, Edinburgh, Scotland; and* [b]*The University of Edinburgh, Edinburgh, Scotland, and Centre for Advanced Study, The Norwegian Academy of Science and Letters, Oslo, Norway*

Abstract
Evidence from the evolution of human cultural behavior and learning, embryology and genetics of the brain, and the behavior of human infants indicates that the critical and uniquely human motives for cooperative imagination and joint interest in objects and tasks are determined by expression of genes and epigenetic neural systems elaboration long before birth, along with essential peripheral organs of perception and motor expression that will serve in communication by rhythmic facial, vocal, gestural, and body movement signals. These cerebral motives continue to exercise their influence on neural development and behavior throughout life, transforming the behaviors of the developing individual through a succession of phases to which other individuals and cultural institutions are constrained to adapt. We discuss the theory of innate intersubjectivity and relate it to the hypothesis of an Innate Motive Formation that emerges in brain development as regulator of morphogenesis in neural systems, and that continues to function, postnatally, as generator of motives and emotions by which human contacts and relationships are regulated. We suggest that differentiates of the primary motive formation in the embryo brain later serve to generate intelligent exploration of the objective environment, and the emergence of an additional dialogic mechanism that represents the self-subject as a partner for an other-subject, intersubjectively. Intersubjective communication in infancy leads, through systematic age-related transformations of the brain and behavior, to preverbal mimetic negotiation of cooperative awareness and joint task performance. Finally we discuss, in relation to this theory, interpretations of faulty communication and development at different stages of the life cycle that result from maternal postnatal depression, autism, premature birth, and schizophrenia.

In Mexico, before the wheel was invented, gangs of slaves had to carry giant stones through the jungle and up the mountains, while their children pulled their toys on tiny rollers. The slaves made the toys, but for centuries failed to make the connection.

Peter Brook, *The Empty Space*, 1968

Perhaps it made practical sense in mountainous Mexico not to use wheels. Maybe the culture could not think how wheels could help. In psychology and psychopathology connections and functions are persistently overlooked because accepted methods of research or evaluation do not address them. When functional links are overlooked, analytical assumptions are made that lead to different conclusions from the same data. In a recent paper, Morris (1996) discusses assessments that purport to measure "attention," "memory," and "executive functioning," and demonstrates the variety of overlapping conclusions that are drawn depending on which tests are employed.

The cognitive approach to developmental psychopathology focuses on one facet of developmental processes in the mind, seeing just the functions of individual intelligence. How a Piagetian child gets to know the world and solves epistemological problems privately and logically is important, but to adopt this individualist focus to an extent that excludes recognition of interpersonal functions is, in our opinion, not to notice the rollers which make the developmental system move forward. Hu-

Address correspondence and reprint requests to: Dept. of Clinical Psychology, Hospital for Sick Children, Edinburgh, Scotland.

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man cognitive developments, and their pathologies, are regulated, from birth, by highly specific motives in the child's brain for engaging with motives in other brains (Trevarthen, 1980a). Emotions constitute an innate system of matching and sympathetic regulatory states by which functions of attending, purpose, and learning may be coordinated between subjects (Trevarthen, 1980b, 1984a, 1993a).

Wittgenstein (1953), in his "Private Language Argument," offered an escape from the spectre of perpetual solipsism—from the belief, or illusion, that all knowledge is knowledge of the self alone, that the Self is the only object of real knowledge. He proposed that, for a philosopher to consider the question of the existence of his own mind (or any other mind), he had, necessarily, to have acquired a language, which in turn required life in a social world. This makes meaningless the question of whether thinking is inherently social or a private mental phenomenon (Hacker, 1982). Wittgenstein's highly significant conversion from logical positivism and his theory of language came after a retirement from philosophy of about 10 years, during which he became a teacher of young children, gained an interest in psychology and Freud's theory, and made contacts with the Vienna Circle. As a school teacher, "his attention was drawn to the informal language of everyday life, to the fact that language is primarily a medium of communication . . . to the way language is learned and more generally to the whole process of enculturation" (Sluga, 1996).

The Russian developmentalist Vygotsky, whose work and ideas continue to influence English-speaking clinicians and researchers (Wertsch, 1985), enunciated a principle of "extracortical organization of complex mental functions," and he emphasized the role of the social context in developmental process: "What children can do with the assistance of others might be in some sense even more indicative of their mental development than what they can do alone" (Vygotsky, 1978).

Vygotsky saw this cultural process as essentially linguistically mediated, as do many of the neo-Vygotskians. He was not implying, or expecting, a critical role for the social environment in the preverbal (infant) stage, the one which concerns us here.

Recent years have seen a resurgence of interest in the concept of the "self" and its consciousness, emotional forces, and defenses, an issue explored by psychoanalytic theorists at the turn of the century, and reintroduced into the United States by immigrant scholars and clinicians from Europe around the Second World War. How "self-regulation" is achieved continues to be the main question in clinical developmental theory, animated by new interest in the problem of the relationship between "mental" (psychological) and "physical" (cerebral) aspects of the self and their interaction in development (e.g., Bolton & Hill, 1996; Damasio, 1994; Hochmann & Jeannerod, 1991; Levin, 1991; Popper & Eccles, 1977; Schore, 1994; Sperry, 1983). It is clear from these books, leaving aside the discussions among notional mentalists of cognitive science, that no consensus has been reached as to what phenomena are the most fundamental; disagreement between the monists and dualists is still with us.

Infant Self-With-Other: Innate Intersubjectivity and Companionship Theory

In this paper, we propose general principles for a model of *self/other organization* in psychological growth. We conceive human mental development as fundamentally a process of innately *intersubjective* interactions. We believe it is evident that a newborn infant is organized as a psychological subject at birth—one who is seeking to enter into regulated engagements with subjective processes in other human beings. In some respects, we take up Wittgenstein's philosophical case in our argument for the ontological primacy of interpersonal (social) life. We concur with Vygotsky's emphasis on the importance of the social/cultural environment for mental growth. However, we view this process as beginning in early, prelinguistic experiences of companionship and protoconversation actively motivated from the infant, as well as from adult company. We see self-conscious cognitive processing of experience emerging within, or associated with, the infant's biologically founded social-interactive capacities. The infant's self is organized to develop in

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interaction with others, as well as in self-contained endeavor and experience. Subjective and intersubjective processes are mutually regulating, and, in early infancy, before manipulative investigation of objects is under efficient volitional control, the regulations of communication with a caregiver who offers affectionate, emotionally available company appear to dominate in the discovery and learning of reality.

We would stress, furthermore, that neonatal involvement in interactions with the mother or other partner are not solely concerned with control of physiological "arousal" or "tension" in a nonpsychological being (i.e., with "caregiving" and "carereceiving" in the hospital sense). With respect to further development, attention to both cognitive (individualist) and intersubjective (communitarian) aspects is necessary in the formulation of an adequate theory of the emergence of human mental functions, which are innately motivated to sustain a process of cultural learning with trusted others, in *companionship.* Attachment Theory does not adequately address this process.

We see human intersubjectivity and learning in companionship to be firmly grounded in the developmental neurobiology of the infant and have recently reviewed evidence from research on human brain embryology, the neurobiology of motivation, and the large literature on mother–child communication and its psychopathologies in support of the hypothesis that a coherent mechanism of motives, an Intrinsic Motive Formation (IMF), is ready at birth to engage with the expressed emotions of adult companions in a mutual guidance of infant brain development and sociocultural learning (Trevarthen & Aitken, 1994). The IMF of the individual, which we view as the biological substrate for social behavior, generates what Bråten (1987, 1997), in a formal model of the intersubjective system, has called a "virtual other," or organismically provided need for a partner. This need is manifested in a set of expectations concerning the actions of others, especially specific features of their expressive and emotional behavior (see Figure 1).

A biologically grounded, but flexible, motive formation would be the only possible way that such an ontogentic strategy could function, over evolutionary time, as an innate regulator of a communicative, care-stimulating experience for a human child. The child must be prepared to deal successfully with a wide range of potential culturally regulated caregiving environments. The biological (genetic) basis to any such mechanism could only evolve very slowly, while the situations for which the mechanism would be expected to equip the infant would be capable of great variety and rapid change. Indeed, recent centuries have seen dramatic transformations in how infancy is viewed and in how infants are catered for (Hardyment, 1984). In such a flexible or dynamic control system, experience may result in accommodation of the motives and their virtual representation of "others" in response to unusual environmental circumstances. However, inevitable limits to any biologically determined regulation designed for sympathetic human response will be a factor in the success or failure of care for infants. For example, it must constrain the artificial environments that can be successfully employed in medical care of neonates (Als, 1995).

The usefulness of a dialogical model of intelligence and its motives in the developing interpersonal mind of the child will be illustrated by its brief application to several types of developmental psychopathology. To understand these, and the program or strategy of the developmental process itself, it is necessary to have a conception of regulation in the organism and its constituent organs, with their behaviors and functions.

Self/Other Organization in the Genesis of Communicating Minds

The concept of self-organization, or autopoesis, guides our understanding of universals and commonalities in ontogeny of organisms. Classically, it is concerned with the regulation of organic form, growth, and behavior as characteristics of species and individuals. But it does not require that attention be restricted to regulations within the individual subject or species, or between either of these and a physical or nonpsychological environment. In social species of organism, relations to other or-

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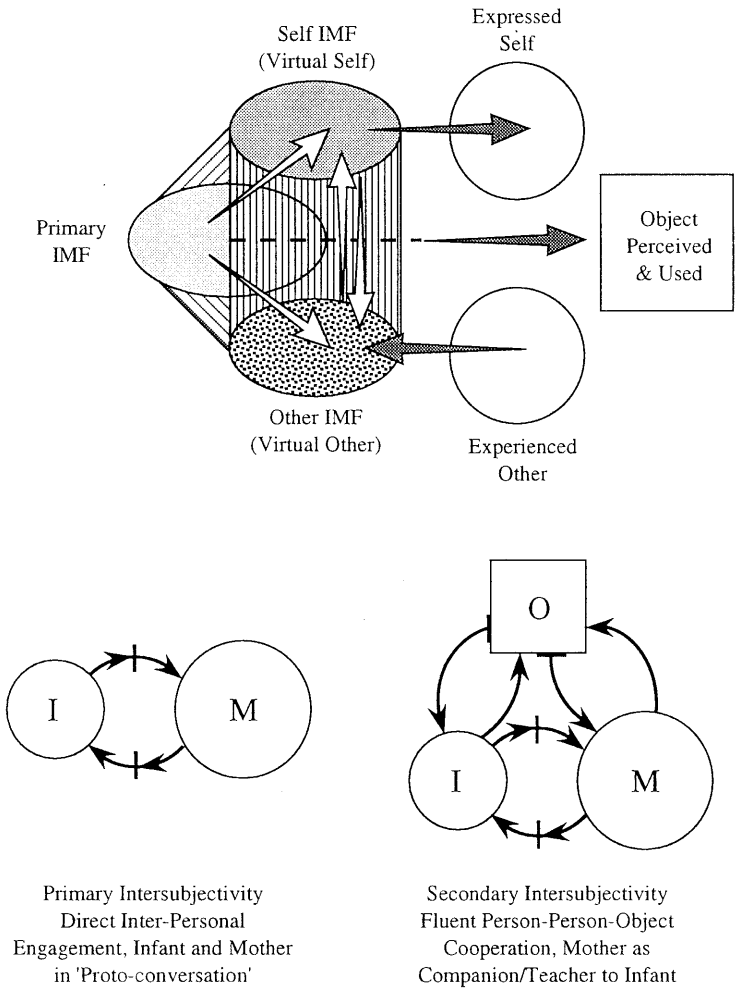


Figure 1. It is hypothesized that intersubjective communication, or "dialogic closure" (Theory of the Virtual Other; Braten 1987, 1997), depends upon a dual motive system in each communicating subject. This generates, besides perceptuomotor adaptation of the individual to objects and situations in the environment, a representation (Self IFM, or virtual self) of the expressive subject's body, in dynamic emotional relation or sympathy with respect to a cerebral representation (Other IMF or virtual other) of the experienced other subject's expressive body. In development of cooperative awareness, all three IMF devisions must be coordinated by mutual attunement in dynamic emotional narrative envelopes (Stern, 1985, 1993). Thus an infant becomes capable, before the development of symbolic, linguistic communication, of joint interest in objects and joint task performance, in the person–person–object fluency of Secondary Intersubjectivity (Trevarthen & Hubley, 1978).

ganisms, conspecific or not, become part of the regulation of development and life.

Reproductive ontogeny has evolved elaborate relationships between immature animals and their parents, with, in the reptiles, birds, and mammals, an initial embryo period in egg or womb adapted to self-elaboration of body and brain in a protected milieu provided by a nest or the parents own body. This isolation of the organism from responsibility for behavioral regulation of nutrition and organic self-maintenance in interaction with an inanimate environment postpones the responsibility of the central nervous system for directing and guiding behavior. In mammals, the embryo is succeeded by a fetal stage in which new fore-

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brain mechanisms are elaborated that will serve after birth in cognitive mastery of a highly complex conception of a social and physical world. In the midfetal period the already formed special sense organs of hands, eyes, nostrils, and mouth are sealed by fusion and thickening of the integument. Presumably this serves to cut down unwanted input while neural projections, with their newly generated electrical transmissions, are sorting themselves out in the brain, setting essential constraints on subsequent stimulus-driven selective removals of components (Trevarthen, 1985).

It is now recognized that the principle selective pressure for evolution of larger brains in the line leading to humans comes from the advantages of social intelligence, in which the young acquire skill in adjusting to roles in a highly structured group (Donald, 1991). Cultural learning, the cumulative passing on of artificial knowledge, techniques, and beliefs from generation to generation puts wholly new demands on intersubjective representations (Bruner, 1996). No human group can function without intuitive mimetic acceptance by the young of intentions and interests displayed by their elders. Thus, in human psychological development, intersubjective processes and "narratives of cooperative awareness" are an inextricable part of self-organization by education (Trevarthen, 1988, 1992).

In preparation for this epigenesis of culture, the human embryo and fetal brain displays elaborate formation of *intrinsic regulatory mechanisms* that are connected, on the one hand, with the most complex (facial, vocal, and gestural) expressive organs among the primates, and, on the other hand, with the most elaborate reciprocal connections between motivating structures of the core and limbus of the brain and the expanding neocortical system in which postnatal experience will be elaborated (O'Rahilly & Müller, 1994; Trevarthen, 1980b; Trevarthen & Aitken, 1994). The neocortex is laid down in the late embryo, as a "proto-map" of rudimentary cell columns, but its dendritic arbors and billions of synapses mature postnatally, and this process is regulated, at every step, by the brain core intrinsic motivating systems (Rakic, 1991; Trevarthen & Aitken, 1994). The process of regulated cortical differentiation continues after birth, by sympathetic communication with the social environment, in intimate affective exchanges with more mature persons and their more experienced brains (Trevarthen, 1990).

Despite the overwhelming evidence as to intrinsic adaptations for intersubjective activity, from developmental biology, neurobiology, ethology, and human prehistory, most of the models that have been advanced to explain human psychological development, and its errors, neglect this necessary communicative self–other dimension. They fail to perceive the fundamental advantage of a form of development that is human in this way, and they miss regular and predictable events and phases in the pattern of infant development.

Piaget's genetic epistemology charted the unfolding regulation of cognitive schemes in an individual observer/actor (Piaget, 1953). His model was epigenetic, accepting the role of intrinsic regulation as well as environmental construction, but the principle agent of change was the individual child's motor activity operating on objective experience. Application of a similar epigenetic model to intersubjective psychology of the infant leads to enquiry about the initial state of the infant's motives and awareness in interaction with those other subjects who approach the child and offer sympathetic engagement. In attachment theory this initial state of the infant, with its adaptations to companionship and cultural learning, is, as we have suggested, not well comprehended. According to the current formulation of this theory, the infant is born with need for maternal care in regulating endogenous physiological tension, but no specific need for organizing psychological structures and processes in cooperation with a human companion (Sroufe, 1996).

Principles of Prefunctional Patterning: Primary Genetic Organizers

In his last book, Gregory Bateson (1979) describes how he set questions for artists and psychiatrists to illustrate the distinction between organizing form and the collection of component elements. He talks of "the pattern

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which connects." By getting students to describe, first, how they know that a crab is a living thing and, second, how they knew that a conch shell had been part of a living system, he drew them quickly to realize the importance of higher order similarities in developmental processes—such as radial symmetry and nonlinear patterns of expansion. "In truth, the right way to think about the pattern which connects is to think of it as *primarily* . . . a dance of interacting parts and only secondarily pegged down by various sorts of physical limits and by those limits which organisms characteristically impose" (Bateson, 1979, p. 22).

For Bateson, the critical feature of living organisms was that they conformed to certain general principles of regularity that are constant across a variety of transformations. These principles, and variants in them, emerge early in ontogeny of the individual organism and set limits to its subsequent course through more elaborate stages.

Edelman's (1987) view of within-subject epigenesis of psychological processes applies the theory of selection at the level of competing neural components in the cerebral cortex, which is conceived abstractly as a nonlinear dynamic system. In this theory, only the most ecologically relevant responsive cell groups in the neocortical networks survive. Edelman's metaphor of Neural Darwinism has had widespread, if generally uncritical, influence, encouraging belief in the adaptability of human cognitive growth. It receives support from evidence that exuberantly overabundant components in the developing nervous system are subject to draconian selection, through synaptic pruning, apoptosis (selective cell death; Golstein, 1997), and several other mechanisms thought to permit an increase of functional specificity through selective reduction in numbers of redundant neurons and/or neural connections (Changeux, 1985).

Striking "plastic" responses to environmental factors occur in some developmental processes in neural systems. However, a postnatal selection theory offers no satisfactory explanation for robust panspecific features of human psychological function and brain organization, such as those that have an active part in the determination of social and cultural adaptation in all human groups, and which are displayed by infants from the first weeks, when the cortical selection process has scarcely begun. Nor does it offer an explanation for anatomical and behavioral features of both the body and the brain that are consistent throughout widely separate phylogenetic lines and that emerge in prenatal stages of brain development when the extracorporal environment has minimal selective power.

Classical comparative embryology, demonstrating homologous organs and developmental pathways in different phyla, has always been taken as providing fundamentally important evidence for Darwin's theory of evolution by natural selection to explain accumulation of adaptive programs in development of body form (de Beer, 1954). Modern genetics is discovering the mechanism for these conservative principles of organismic self-regulation. Aspects of human biology and behavior have features in common with organisms that have homologous symmetry of body form. These are encoded at a very general level in the genetic code. So-called "secondary" biological constraints on development have been redefined recently as critical or fundamental principles in determination of the range of possible organismic actions within any biological environment, canalizing the expression of adaptive genetic potentialities (Cziko, 1995; Kauffman, 1993, 1995). The epigenetic landscape of Waddington (1975) is structured by internal constraints on development imposed by the developing organism itself (see Figure 2).

Current research on CAT (comparative anchor tagging) sequences is identifying a wide range of homologous genes across mammalian species (Nadeau & Sankoff, 1997). Homeotic genes, for example, have preserved their structure and function in most of the segmented, cephalocaudally polarized, bilaterally symmetrical animal kingdom. Unchanged by most predictable and/or minor changes in environment, overall symmetry, body segmentation, and a coherent multimodal sensory capacity, integrated with a unified spontaneous rhythmic motricity, have become distinctive and consistent features of the animal king-

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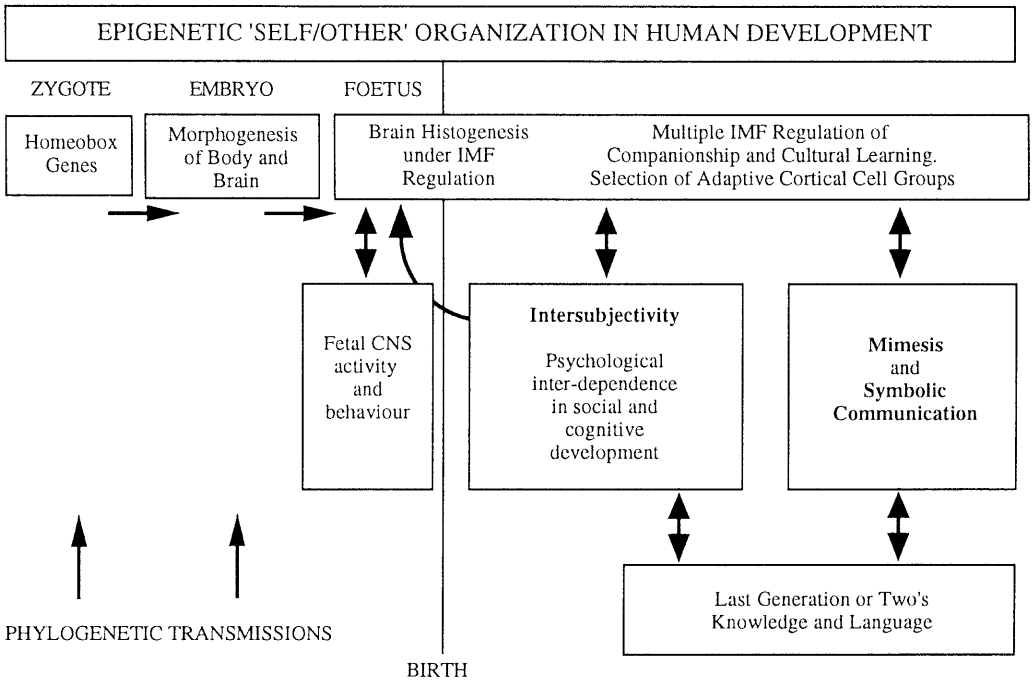


Figure 2. Factors important in the generation and transmission of cooperative cultural awareness by sympathetic regulation of motives in human brains.

dom. These features were selected for stability because they are adapted to solving persistent and varying problems in life and ontogeny. They specify a potential "behavior field" around the body into which acts are projected and within which layouts and goals are defined prospectively by perceptual systems, and retrospectively by memories.

Brain Epigenesis and Patterning of Motives in Whole-Brain Action, and Between Brains

"Prefunctional morphogenesis" refers to this early definition of features of an organism's pattern that are retained through later epigenetic elaborations as a fundamental framework. These general features do not themselves develop, while they contribute to the regulation of many features that come into being at later stages. Thus, the eye develops in utero as an outline optical receiver designed to make an image when there is no patterned field of light to see; fetal hands are grasping or gestural organs; the face of a fetus is an elaborate expressive organ. Anticipatory generative rules of psychological function, of its body-related form and its movement-related timing, by organized structures and processes in brain and body can be identified by considering those features that appear in the newborn infant in a form similar to their final adult condition. The anatomy of the infant's face and hands, and certain cyclic patterns of expression by which these organs display the field of contrasting emotions, the rhythmic hierarchy of motor impulses shown in infantile vocalizations and spontaneous body movements, corresponding to syllables, utterances, and phrases that are retained in the patterns of adult speech and music (Lynch et al., 1995; Pöppel, 1994; Ross, 1993; Trevarthen, 1984b, 1985, 1986; Trevarthen, Kokkinaki, & Fiamenghi, 1997) are examples of innate psychological features that act as developmental organizers and that enable infant and adult to meet as corresponding partners who can interact efficiently by exchanging complementary,

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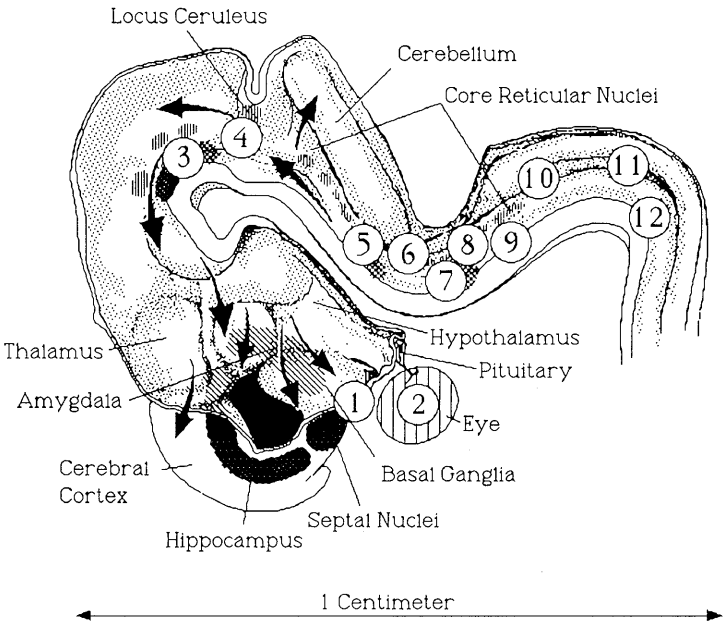


Figure 3. The reticular and limbic components of the IMF are organized as a core regulatory neural system in the embryo human brain. Integrated with humoral regulatory mechanisms, the IMF plays a crucial role in determining the primary organization of protomaps in the emerging cerebral neocortex, and the further patterning of cortical circuits in the fetal stage (O'Rahilly & Muller, 1994; Rakic, 1991; Trevarthen & Aitken, 1994). It surrounds and links up the developing sensory and motor structures of the special receptors of the head and their cranial nuclei (Figure 4). The IMF nuclei project to all developing sensory and motor fields in the embryo, continuing to exercise control over epigenetic events in later stages of brain development. The IRM and cranial motor and sensory systems are specialized for integrating cerebral systems of forebrain, midbrain, and hindbrain (including the cerebellum). They regulate visceral processes in coordination with states of behavioral activation and arousal of consciousness (Porges, 1997).

mutually imitative messages, in synchrony or in alternation (Trevarthen, 1986, 1993b, in press-b) (see Figures 3–5).

Brains control actions and assess the affordances of the environment by motor and sensory systems that "map" the body in neural systems (Trevarthen, 1980, 1985). This "somatotopy," which pervades sensory and motor fields and nuclei in all levels of the CNS and orders projections between them, is generated under the guidance of the regulator genes that also determine fundamental dimensions and complexity of the whole body. Activities and experiences are animated in sensory and motor regions from within the CNS by a unique system of motives that depends upon the coherence of the representation of the body-related behavior field in a consistent manner in all parts of the nerve net. Understanding the development of this essential organization representing an active body within a brain requires appreciation of different levels of description of the organism and its internal anatomy and function.

A number of theoretical models to explain neuropsychological conditions, and evidence accumulating on localization of cognitive processes in normal subjects, have argued for functional interactions between corticothalamocerebellar systems (Morecraft, Geula, & Mesulam, 1993). The advent of functional brain imaging methods, such a PET and fMRI, has provided strong support for the notion that multiple discrete interacting neural systems are a minimal level for a within-subject analysis of functions (Cabeza & Nyberg, 1997). Functional neuroimaging proves complex interactions between cortical systems

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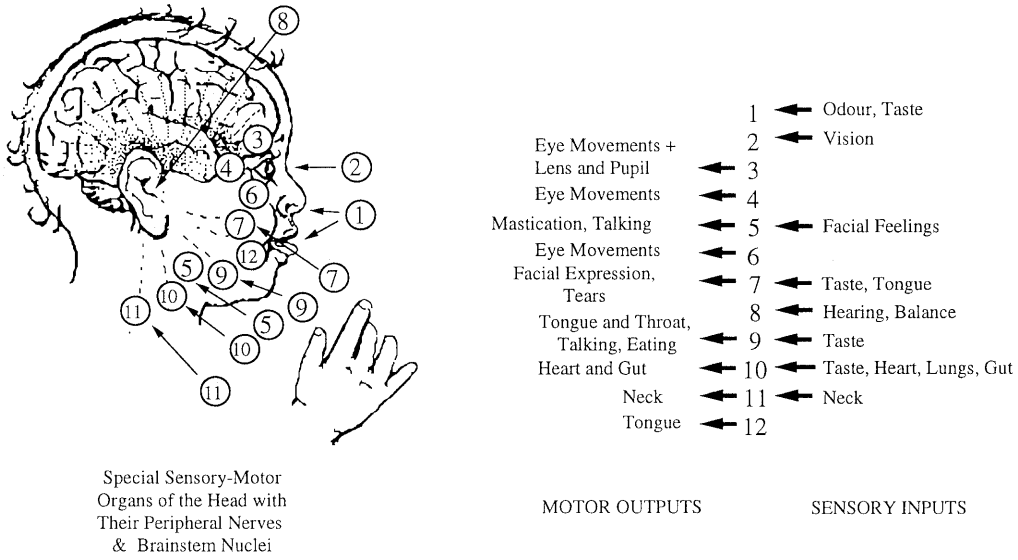


Figure 4. The nuclei in the brainstem that regulate the expressions of human communication transmit information about motive activity in the core of the brain. Core motivating mechanisms coordinate and synchronize expressions by the muscles of the head receptors and of the hands. Special visceral efferents of nuclei 5–11 are adapted in humans to regulate interpersonal attachments and communication of mental states (Porges, 1997).

during motor actions (Houk & Wise, 1995), and functional interrelationships between multiple brain areas occur during spontaneous activities such as conversational speech and verbal thinking (Ingvar, 1993).

Organizational principles that direct the ontogeny of the body and CNS into a coherent individual system, which has defined symmetry and forward progression, prescribe a single body-related spatiotemporal field of action and experience (Trevarthen, 1980b). The same principle of morphogenesis has given rise to a genetic regulation of sympathetic intersubjective expressions and responses. If the body-representing form of intelligence in the brain, in which all components must "talk" the same language of prospective movement, has the capacity to recognize homologous temporal–spatial patterns of organized body activity in another individual, to mirror organizing motive states or "motor images" (Jeannerod, 1994), this allows for the cooperative regulation of further developments in behavior (Trevarthen, 1980, in press-b; Trevarthen et al., 1997). We propose that such a process of genetically guided epigenesis has transformed the IMF of the brain core into a set of psychogenic principles for interpersonal conversation and cooperative awareness (Trevarthen, 1982; Trevarthen & Aitken, 1994) (see Figures 1, 5).

Mutual regulation by communicating parent and offspring of events that arise in the epigenetic landscape of the developing brain of the child leads to the advantages of transgenerational development not mediated by gene change. Social patterning of developments in brain and behavior occurs to some degree in many animal species, even primitive ones. But in the human case the process of intersubjective regulation in development is elaborated and has gained the capacity to create cumulative psychological adaptations of collective action that we perceive as cultures (see Figure 2).

Disorganization of Body, Brain, and Behaviors

Bateson's intuition of what regularity is in an organism, and how, when, and where it is expressed, in the body and in the brain and behavior, finds application in a clinical context in cases where the fundamental symmetry of

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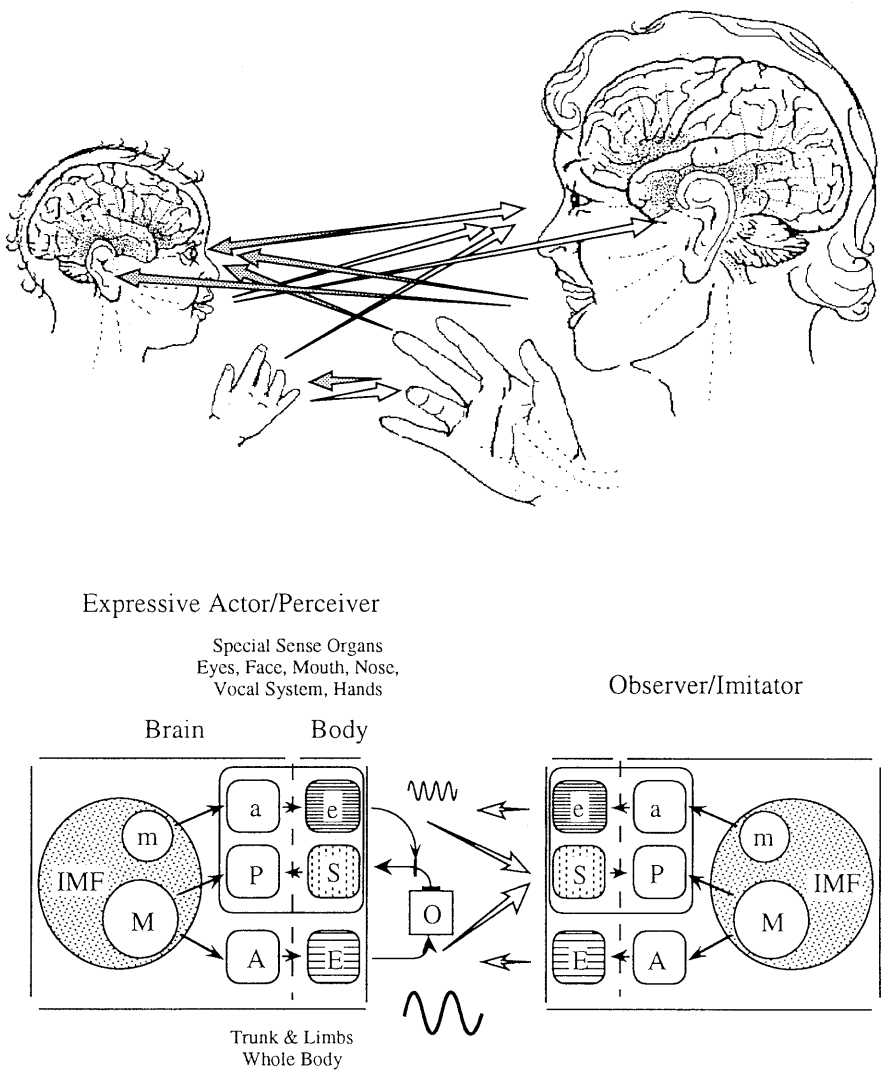


Figure 5. Expressive movements in face-to-face protoconversational communications between a mother and her infant soon after birth (i.e., in the stage of Primary Intersubjectivity; Trevarthen, 1979). The IMF in each subject (Trevarthen and Aitken, 1994) regulates the coordination (M) of motor images (A) and efferent activity (E) of the limbs and whole body, as well as motor adjustments (a+e) and experiences (P+S). In close conversations, the dynamic motive activity in a subject is expressed mainly by movements (e) of the face, eyes, vocal system, and hands, all activated (m) in motor nuclei (a) that are also dedicated to adjust the expressive individual's muscular modulation of focused activation (S) and perception (P) in the modalities of sight, hearing, and touch. Actions on objects (O) communicate praxic intentions. The proximal movements of the limbs and body have slower rhythms than the distal adjustments of special receptors and fine manipulation. This creates a natural hierarchy of rhythms, generated in the IMF, that serves as a temporal foundation for the utterances and phases of communicative interaction (Trevarthen, 1986, 1993b; Trevarthen, Kokkinaki & Fiamenghi, 1997).

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the organism is disturbed. Lateralized differences in development of the nervous system can be associated with developmental psychopathology (Geschwind & Galaburda, 1985; Tucker, 1992; Tucker & Williamson, 1984). In the unilateral neurodevelopmental conditions known as *hemifacial microsomia* and *progressive facial hemiatrophy*, in which development of one side of the face is distorted, associated genetic factors and behavioral features have been identified (Dupont, Catala, Hasboun, Semah, & Baulac, 1997; Johnson & Bronsky, 1995; Naora et al., 1994).

Human behavioral phenotypes are being related to underlying neurobiological mechanisms as well as to physical formation of the body. The notion that a disorder of behavior or psychology may be consistently associated with a clinical condition that has previously been defined by diagnostic features in the body and in the genetic material is gaining widespread acceptance (O'Brien & Yule, 1995; Turk & Sales, 1996). Genetic bases have been demonstrated for broad range of neurological disorders (Martin, 1993; Rowland, 1992) and neuropsychiatric conditions (Ross, McInnis, Margolis, & Shi–Hua, 1993). Predisposing biological (developmental) risk factors are now well accepted in psychiatry (Rutter & Caesar, 1991). In the Fragile-X syndrome, for example, behavior is now known to be more condition-specific than features of facial and sexual anatomy that had previously been taken as diagnostic (Crowe & Hay, 1990; Dykens, Hodapp, & Leckman, 1994; Hagerman & McKenzie, 1992; Reiss & Freund, 1992; Turk, 1993).

It is clear that particular regulatory factors have widespread expression affecting early developments in many locations of the body and brain, in parallel. Many neurodevelopmental and psychiatric disorders prove to be associated with migration abnormalities affecting an extensive array locations in the fetal brain (Barth, 1992). This has been demonstrated in certain forms of epilepsy (Brodtkorb, Nilsen, Smelvik, & Rinck, 1992), in Asperger's syndrome (Berthier, Starkstein, & Leiguarda, 1990; Berthier, 1994), and in some autistic disorders (Courchesne, 1995). Brain imaging confirms the simultaneous involvement of widely separate structures (Chugani, Phelps, & Mazziotta, 1987; Lee et al., 1994). It seems certain that coordinated motive systems of the brain stem are affected at an early stage, giving rise to complex functional impairments, sometimes much later, both at the level of the detected brain metabolism and in spontaneous behavior.

In the mature brain, evidence for functional integration between spatially distant brain systems can be seen in the damping of functional capacity in one region by abnormal activity generated in a distant region—for example, noxious interference from the temporal cortex interferes with prefrontal function (Hermann & Seidenberg, 1995). In developmental dyslexia there is a lack of concerted action affecting a set of cortical regions implicated in phonological processing (Paulesu et al., 1996). Complex distributed functional activation in cortex and subcortex has been demonstrated during schizophrenic hallucinations (Silbersweig et al., 1995), and on provocation of obsessional states in obsessive–compulsive disorder (Schwartz, 1997). Interhemispheric interference from a damaged left hemisphere suppressing receptive language function in the cortex of the right hemisphere must involve subcortical components. Such interference appears to explain differences seen between the linguistic capacities of patients with left hemisphere lesions who have become totally aphasic, and left hemispherectomy or commissurotomy patients who retain some right hemisphere receptive language (Levy, 1990). A damaged left hemisphere prevents full expression of the language-receptive potentialities of the right hemisphere.

The neural systems involved in many activities appear to alter with practice as complex interconnected systems, sometimes after only brief exposure to a particular situation. For example, it has been demonstrated that playing the computer game "Tetris" results, in naive subjects, in increases of metabolic activity in the right inferior frontal and right superior temporal gyrus, and the cerebellum, and that regular practice results in reductions in these effects (Haier, Siegel, MacLachlan, Soderling, Lottenberg, & Buchsbaum, 1992).

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Raichle and colleagues (1994) reported practice effects on brain metabolism of the verb-generate task. In novel trials various areas became active which included left prefrontal cortex, left anterior cingulate gyrus, left posterior temporal cortex, and right lateral cerebellum. With practice, these areas normalized their activity, and other areas which were previously inactive became active, including the sylvian-insular cortex bilaterally, and the left medial peristriate cortex. The authors concluded, "These results indicate that normal subjects change areas of the brain used during tasks performance following less that 15 minutes of practice. One critical factor in determining the circuitry used appears to be the degree to which a task is learned or automatic" (Raichle et al., 1994).

Cycles of Epigenetic Change and Transitional Phases: Variations in Motives and Their Asymmetry

The interaction of brain systems and their dynamic organization produces periodic age-related crises or transitions which are associated with advances in psychological capacities or motives (Dawson & Fischer, 1994). These transitional events are also critical for pathology and expression of abnormalities in epigenesis (van de Rijt–Plooij & Plooij, 1993). Predictable development of psychological processes in stages confirms the neurodevelopmental hypothesis concerning self/other organization by a succession of age-related differentiations in neural nets. The sequence of the Piagetian stages in acquisition of pragmatic, problem-solving cognitive skills can be related to fluctuations in the proliferation of corticocortical connections that are indicated by changes in the power of scalp-recorded electroencepahlic activity (Thatcher, 1994). Waves of myelination reveal a clear timetable in the stuctural elaboration of the cytoarchitectonics of the central nervous system (Bayer, Altman, Russo, & Zhang, 1993). In the infant period, van de Rijt–Plooij and Plooij (1993) have demonstrated transitions in the development of sleep patterns, immune function, and behavior. There is thus abundant neurobiological and psychobiological evidence in support of the hypothesis of a systematic phasic elaboration of intrinsic motivating process in development that affect cognitive and intersubjective functions, and thus cooperative learning (Trevarthen, 1982).

The Psychobiological Dyad in Infancy and Its Developmental Transformations

The social environment into which the infant is born is the most important and, in many ways, the most demanding to which it will have to adapt and adjust. It should, therefore, be unsurprizing that a baby is born with interactive behaviors, rich expectations of its social environment, and cognitive capacities which enable it to immediately make sense of basic potentialities of the human world, which approaches with clear manifestations of interest and affection.

Infants, indeed, do possess considerable psychological individuality at birth, preparations for which are evident in the coordinated behaviors and spontaneous activity cycles of fetuses in the last trimester. Newborns can display coordinated motor actions that are directed to external goals and monitored by perception of goal affordances; they also exhibit imitative mirroring of motive symptoms in other individuals, and sensitive recognition of affective states in others to which they make matching or complementary responses. The motive capacities necessary to generate and regulate such activities require a significant degree of prefunctional intercoordination in the brain and body.

Understanding the self-organization of the developing infant requires an understanding of influences arizing from prenatal and postnatal elaboration of the internal neural systems of the infant, social interaction between the infant and its caregivers, and changes in the psychological awareness and responses of the caregivers through interaction with the infant. There is abundant evidence now that neonatal brains are embarking on changes in organization that are highly responsive to stimulation from caregivers. The effects of this experience, while demonstrating the adaptive plasticity of the newborn brain, also give proof of highly elaborate and highly selective

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systems in the infant for engaging with the processes that motivate expressive behaviors on caretaking individuals (Trevarthen, 1980a, 1990, 1996).

The notion that, at the beginning of human development, the minimum level of psychobiological organization is the parent–infant dyad had an important place in Freud's theory of human emotional development. Winnicott, the British pediatrician and psychoanalyst, who clarified the importance of the mother's emotional support from "primary maternal preoccupation" with her newborn infant, made the following famous statement, in a footnote to his paper on "The theory of the parent–infant relationship" (Winnicott, 1960/1990): "I once said: 'There is no such thing as an infant,' meaning, of course, that whenever one finds an infant one finds maternal care, and without maternal care there would be no infant."

In the same paper, Winnicott quoted Freud, who said, when speaking of the infant, that, "an organization which was slave to the pleasure-principle and neglected the reality of the external world could not maintain itself alive for the shortest time, so that it could not have any existence at all." This organization is possible in an infant, "provided one includes with it the care it receives from the mother."

Winnicott proposes that the infant passes from absolute dependence, "only in a position to gain profit or to suffer disturbance," towards independence, "accomplished through the accumulation of memories of care, the projection of personal needs and the introjection of care details, with the development of confidence in the environment." Mahler likewise supported Freud's view of this early phase as a symbiosis, or rather complete emotional fusion of the infant with the mother (Mahler, Pine, & Bergman, 1975). Both Winnicott and Mahler presented observations in support of their claim that the emotional regulations of the infant progress from a condition of total dependence towards autonomy. Klein (1963) elaborated this theory with descriptions of transitions driving the infant through a "depressive position" to a "paranoid schizoid position." Like Freud, she based her account of the infant's psychic experience on clinical work with pathological states in adults. This bias in inferences about infancy from psychoanalytic experience has been corrected by the observations of infants' capacities for communication in normal circumstances of maternal and infant well-being (Trevarthen, Murray, & Hubley, 1981; Stern, 1985).

Bowlby (1958) formulated his Attachment Theory on the basis of evidence from research of Harlow and his colleagues on the effects of maternal deprivation in rhesus monkeys, in which it was shown that body-contact support, as well as physiological sustenance, is essential for the psychological well-being of the newborn primate (Harlow & Harlow, 1965, Higley & Suomi, 1986). It was clear from this work that early contact played a critical role in the later emergence of appropriate social behavior and that marked disruption to such early contact with a responsive holding mother could result in extremely aberrant behavior. This evidence has been elaborated by subsequent studies of the effects on neurochemisty and brain growth of maternal stimulation, or its absence, in early interactions (Hofer, 1990; Kraemer, 1992; Schanberg & Field, 1987; Schore, 1994). Klaus and Kennell demonstrated the importance of early contact for the parent in the close relationship with a newborn, and stressed the dyadic nature of this process (Klaus & Kennell, 1982). It should be noted that exaggerated application of the idea of a biologically driven bonding, conceived as essential to normal development of the mother–child relationship, may have negative consequences in practice and orientation of caregivers to their role (Sluckin, Herbert, & Sluckin, 1983).

For a time the debate concerning how the human neonate should be conceived became trapped in the distinction between the extreme altricial versus neotenous models of maturation (i.e., models claiming that the young infant is either largely independent, or is totally dependent on its caregiver; Gibson & Petersen, 1991). Western medicine adopted the view that the newborn was extremely neotenous and wholly dependent on external maintenance (maternal or technical). Discovery of more and more perceptual, volitional, and learning capacities in newborns, including the

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prematurely born, has promoted the idea that the human neonate, while physiologically dependent on caregivers for nutrition, thermal homeostasis, and hygiene, is biologically prepared for interaction and semiautonomous psychological activity (Lecanuet et al., 1995; Trevarthen, in press-b). There is evidence from studies of twins in utero that prenatal development and the prenatal environment are significant in differentiation of temperamental characteristics that persist into childhood (Piontelli, 1992). It is vital that the infant's requirements for nutrition, thermal homeostasis, and hygiene are taken care of, but the budding interpersonal or psychosocial needs, which will drive the development of the cultural learning process, also seek to be met.

In our research on parent–infant interaction (Aitken, 1991a; Trevarthen, 1979; Trevarthen & Hubley, 1978; Trevarthen, Murray, & Hubley, 1981), we have traced, from premature infancy, the development of mutual emotional regulations in an intersubjective system with innately formulated needs (see Figure 6I). This development culminates, at the end of infancy, in emergence of a cooperative self-awareness that initiates cultural learning before mastery of language (Hubley & Trevarthen, 1979; Trevarthen, 1988, 1992). Tests of the effects of perturbation in mother–infant interactions confirmed that the 2-month-old infant is equipped with a well-organized system of emotions that serve as regulators of the attentions and feelings of the mother (Murray & Trevarthen, 1985, 1986). Developmental affective attunement of the infant in interaction, supported by complementary sympathetic motives of the person or persons who take the role of an affectionate parent or other consistent companion, is now recognized as a cardinal principle in developmental psychology, following the work of psychologists who have made detailed studies of communication in early infancy (Bateson, 1979; Beebe et al., 1985; Fogel, 1977; Papousek & Papousek, 1977, 1987; Stern, 1985; Stern et al., 1985; Tronick et al., 1978). Particularly important is research demonstrating the imitative capacities of the newborn, and their need for sympathetic expressive and imitative reciprocity in a partner (Heimann, 1989; Heimann et al., 1989; Heimann & Schaller, 1985; Kugiumutzakis, 1985, 1993, 1997; Maratos, 1982; Meltzoff, 1985; Meltzoff & Moore, 1977).

The inborn state of dynamic receptivity for self/other interactions is, in good circumstances, validated and elaborated by actual experience. It is constituted as a regulator of the social epigenesis of the infant's mind. The IMF model can be usefully employed in the analysis of developmental psychopathologies, in which cerebral components in one or other of the interactants, or in both, fail to generate effective motives. Disorders in it may originate either in the infant's brain, or in the brain and behavior of the adult caregiver, and may emerge at any stage in the developmental process, since intrinsic regulations for brain maturation may have their effect on the course of psychological growth, and on intersubjective communication, at any stage of the life cycle.

We will briefly elaborate on four such anomalous situations: postnatal depression and its effects on the infants developing expectations of other, autism and its effective removal of the virtual other, prematurity and its effects on infant expectation, and schizophrenia and the gradual disappearance of the individuals ability to use virtual expectation in prediction of social reaction.

Postnatal depression

There is increasing recognition of the immediate interpersonal effects of maternal postnatal depression on an infant's motives and emotions (see Figure 6II). These effects may be seen in the failure of protoconversational exchanges in the period of Primary Intersubjectivity (Trevarthen, 1979). They also have an impact on later phases of a child's development (Kaslow, Deering, & Racusin, 1994; Murray & Cooper, 1996). Maternal perceptions of infant vulnerability are changed by depression (Bendall, Field, Yando, Lang, & Martinez, 1994). Several groups of researchers have implicated postnatal depression with problems in early interaction (Field, 1992; Field et al., 1988; Murray, Stanley, Hooper, King, & Fiori–Cowley, 1996) and these may lead to disorders of cognitive motivation and

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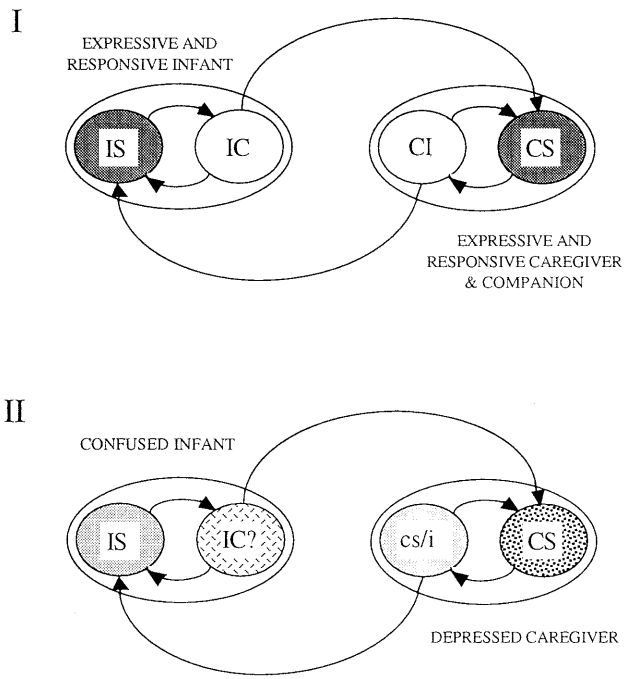


Figure 6. I. In interaction between a normal infant and a happy and receptive caregiving companion, the dual IMF systems of the two subjects are mutually supportive in rhythmic, sympathetic engagements which demonstrate synchrony and turn-taking of utterances and clear flexible emotionally toned phrasing, with affect attunement. IS = Infant's Expressed Self; IC = Infant's Experience Caregiver; CI = Caregiver's Experienced Infant; CS = Caregiver's Expressed Self. II. In postnatal depression, the caregiver's internal model of self CS is distorted, and the caregiver's experience of the infant (cs/i) is both indistinct from the self and distorted. Consequently, the infant's experience does not fit well the natural model of Virtual Caregiver and is confused (IC?). This will weaken the IS.

learning (Murray, 1992; Murray & Cooper, 1996; Murray, Kempton, Woolgar, & Hooper, 1993). Children of mothers who had an episode of PND show propensities to develop behavior difficulties and affective disorders at preschool and primary school ages (Field, Estroff, Yando, Del–Valle, & Malphurs, 1996; Hammen, 1991).

Dawson and coworkers have shown a reduction of frontal EEG activity in infants while they are interacting with their postnatally depressed mothers (Dawson, Klinger, Panagiotides, Speiker, & Frey, 1992; Dawson, Grofer Klinger, Panagiotides, Hill, & Speiker, 1992). It is conceivable that there may be a direct effect on brain development of the anomalous affective environment (Schore, 1994).

In our conceptual framework, the interactional difficulties seen in dyads where the mother is postnatally depressed are viewed as resulting from distortion to the mothers internal view of her own motives, as well as to her awareness of the infant virtual other. There is consequently a mismatch between the infant's motive expectations and actual maternal behavior, especially in the emotional signals of her motive dynamics. A depressed mother cannot mobilize her feelings and is especially taxed by the sensitive requirements and immediate emotional reactions of an infant. Thus the infant becomes a factor in her depression (Murray, Stanley, Hooper, King, & Fiori–Cowley, 1996).

Autism

Autism can be presented as a paradigm case of a biological disturbance of affective contact (Frith, 1991; Hobson, 1993; Kanner, 1943;

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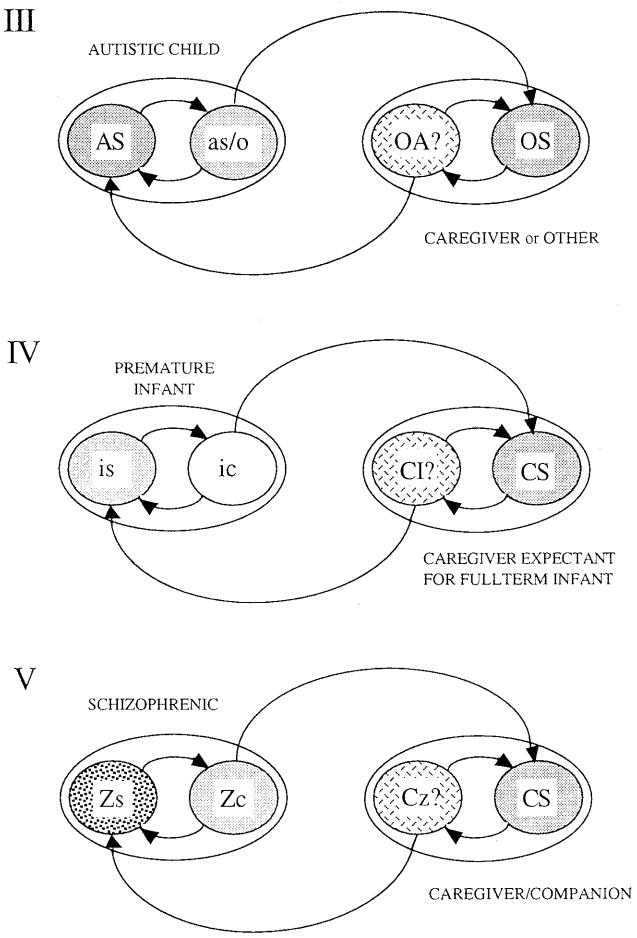


Figure 7. III. An autistic child has a poor differentiation of both the internal model of the self (AS) and the representation of an other as a partner in communication and cooperation. The experience of the other (as/o) is confounded with the self-experience. The autistic child's behavior confuses the partner who develops a distorted model of the child's motives (OA?), which may affect the other's Expressed Self (OS). IV. A premature infant has an immature representation of self (is) and other (io), and is responsive only to some components of the caregiver's affectionate communications and caregiving. The CI is distorted (CI?), and this may lead to a loss of sense of security and weaken the CS. V. A schizophrenic individual has a distorted representation of both self (Zs) and other (Zo), with confused narrative engagement with experience and other person's minds and behavior. As with autism, this produces distortion of the caregiver/companion's experience of the affected individual (Cz?), with a risk of weakening of his or her Expressed Self (CS).

Trevarthen, Aitken, Papoudi, & Robarts, 1996) (see Figure 7III). There is clearly a neurobiological basis to autism (Bailey, Phillips, & Rutter, 1996). We have evidence that this is the case, from neuropathology (Bauman & Kemper, 1994), from imaging of CNS structure and activity (Aitken, 1991b), and from neurochemistry (Barthelemy et al., 1988). Notwithstanding the ongoing controversy over the extent to which autism may arise from a single genetic cause—a gene for autism (Gillberg & Coleman, 1992, 1996; Rutter, Bailey, Bolton, & Le Couteur, 1994)—there is increasing confidence that early neuroembryological abnormalities of brain development are at the origin of the disability that appears later in development (Courchesne, 1997; Rodier, Ingram, Tisdale, Nelson, & Romano, 1996).

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Enthusiasm for the explanatory power of a Model of Mind account of autism, which claimed that autistic children could not metacognitively represent other persons mental states of belief, knowing, desiring, intending, etc., generated a spate of cognitive hypotheses (Baron–Cohen, 1995; Baron–Cohen, Tager–Flusberg, & Cohen, 1993). There are reasons for scepticism as to the explanatory and practical utility of such an explanatory framework for autism (Frith & Happé, 1994), a condition which appears to stem from a number of more general and widespread functional disturbances that collectively interfere with conscious awareness, voluntary planning of activity, interaction with other persons, and thinking about self and other (Trevarthen, Aitken, Papoudi, & Robarts, 1997).

Model of Mind deficits are not confined to autism; they are found in other conditions, including Down syndrome (Zelazo, Burack, Benedetto, & Frye, 1996) and semantic–pragmatic language problems (Shields, Varley, Broks, & Simpson, 1996). Furthermore, mentalizing difficulties are not the only kind of cognitive disorder in autism, and they appear in association with other problems in other disorders as well. They correlate with lowered levels of performance in tests of "executive function" (Zelazo, Burack, Benedetto, & Frye, 1996), and with reduced receptive language ability (Happé, 1995). Executive function deficits are themselves, while characteristic of the autistic child, also seen across a broad range of other clinical disorders such as Attention Deficit Hyperactivity disorder (Pennington & Ozonoff, 1996), temporal lobe epilepsy (Hermann & Seidenberg, 1995), pituitary tumors (Peace, Orme, Thompson, Padayatty, Ellis, & Belchetz, 1997), schizophrenia (Liddle & Morris, 1991), and in the survivors of acute lymphoblastic leukemia (Cieselski, Harris, Hart, & Pabst, 1997).

Although it is not likely that criteria for a secure diagnosis will be found in the 1st year of infancy, there is increasing evidence for early abnormalities in social development of autistic children from retrospective interviews, from analyses of family videotape material (Osterling & Dawson, 1994), and from prospective screening (Baron–Cohen et al., 1996). Interactional abnormalities may antedate identifiable cognitive–social processing difficulties that are heavily dependent on language.

In line with the IMF model of intersubjective function to explain normal interactive development, we propose that autism should be viewed as a condition in which the affected individual, lacking effective motive representations for the virtual other, interprets the actions of other persons as if they are not clearly distinct from those of the autistic individual himself or herself. In circumstances where the actions of the other correspond to the motives attributed by the autistic child, this can prove an adequate frame for successful interaction; however, there will be many situations where such expectations will result in collapse of all satisfying mutuality, and the partner will give up. We think that development of this effective absence in the child of a virtual other in companion space (Bråten, 1987) would be likely to be preceded by early interactional difficulties, which would, however, not become clearly manifest before the stage in development known as secondary intersubjectivity, typically beginning at around 9 months of age. At this age there are large transformations in both behavioral evidence of motives for joint awareness, self-presentation, and cooperative task performance, as well as in neurobiological evidence for significant developments in the brain, especially in the frontal lobes (Dawson, 1994; Trevarthen et al., 1996).

It has been predicted that younger infants who are destined to develop autism will be likely to show diagnostic problems with certain emerging psychological functions important in social development, such as discrimination of the eyes and eye-to-eye contact at around 4 months and joint referencing at about 9 months, believed to be building blocks of a model of mind intelligence. Our view, based on understanding of developments in the first 2 years (Trevarthen, Murray, & Hubley, 1981), is that the autistic infant has a latent disorder of intersubjectivity and narrative organization of thinking that becomes critical around the middle of the 2nd year, following mastery of joint awareness

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and cooperative task performance at around 1 year. There are cases in which children that become autistic are abnormal in their attention and responsiveness in early infancy, but this appears to be an indication of a broader neurological disorder, and such signs will not be diagnostic; they will also appear in other developmental abnormalities on the continuum of empathy disorders (Gillberg, 1991) and evident also in conditions leading to mental handicap, such as Rett syndrome (Witt–Engerstöm, 1990).

Autistic persons can be guided in their learning of tasks and the development of desirable habits, or dissuaded from undesirable habits, by reinforcement schedules in an intensive program (Lovaas, 1987). Such methods appear to operate by bringing the results of action within the range of the person's motives for his or her own activity in a regulated environment. It is of interest that other therapeutic approaches which have been developed successfully for working with autistic children (e.g., the "Option" approach; Kaufman, 1981) emphasize the adoption of attitudes in parents or teachers that will facilitate mutual understanding through the use of attention focused intensely on the child and exaggerated imitation—an approach which effectively brings the behavior of others into a closer approximation of the autistic child's view of a virtual other as self (Nadel & Peze, 1993). There is some research evidence to support the claim that imitative responding can facilitate joint attention and other desirable aspects of communicative development (Dawson & Galpert, 1990). A similar theoretical explanation can be put forward to explain the beneficial effects of improvizational music therapy, and other forms of nonverbal facilitation, in developing cooperative expressive engagements with an autistic child (Robarts, 1997; von Tetzchner & Jensen, 1996).

Prematurity

Distorted patterns of behavior typical of premature babies vary with the quality or intuitive skill of interaction between the infant and his or her caregiver (Aitken, 1991a; Huppi et al., 1996) (see Figure 7IV). Premature infants benefit from improved affective contact with caregivers and with musically structured stimulation of human expression (Als, 1995; Buehler, Als, Duffy, McAnulty, & Liederman, 1995; Standley & Moore, 1995). Numerous features of their constitution and behavior may contribute to the developmental problems of prematurely born infants, including increased gaze avoidance, relative physical fragility (Guthkelch, 1971), the intensely arousing nature of premature infants' cries (Frodi, Lamb, Leavitt, Donovan, Neff, & Sherry, 1978; Frodi, 1981), and perceived differences in their physical attractiveness (Corter, Trehub, Boukydis, Ford, Celhoffer, & Minde, 1978; Miller & Ottinger, 1986).

The rudimentary interactive capacity of the premature infant, coupled with the mismatch of infant and adult behavioral repertoire and responsivity, leads to breakdown of attunement or reciprocal expressive behavior. Although the preterm infant is capable, when carefully facilitated, of sustained and mutually gratifying interaction with the caregiver, many aspects to normal parent–infant interaction meet with active rejection, avoidance, or distress (Field, 1977). Difficulties parents have in complementing a premature infant's needs can lead to extreme interactional problems, including physical abuse of the infant (Hunter, Kilstrom, Kraybill, & Loda, 1978).

The interactions of premature infants and their caregivers are stressed by the mismatch of expectations on both sides of the dyad. The infant can be presumed to possess, already formed, a set of expectations which attend a predictable and reliable contingent responsivity from the immediate nurturant environment. These needs can be answered artificially, at least in part, by reactive pulsed waterbeds, lambswool nesting depressions that comfortably support the curled body of the infant, etc. (Als, 1995; Harrison et al., 1996). The parent/caregiver has a set of expectations for an infant who will demonstrate more active dynamic interest in qualities of caregiver behavior and responses than is shown by the typical premature baby, and tolerance for a wider range of caregiver behaviors and responses.

Interventions which focus on encouraging

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a repertoire of parental behavior that is more appropriate with respect to the limitations of the infant's apparent virtual other, accentuating those aspects of adult behavior to which premature infants appear selectively responsive, have been demonstrated to produce significant improvements in early interaction, with benefits to the mother's emotional state and the infant's well-being and maturation (Aitken, 1991a; Als, 1995).

Schizophrenia

Many psychological models have been proposed to explain schizophrenia (see Figure 7V). Discussion of a number of the more recent attempts is to be found in the paper by Gray and colleagues in *Behavioral and Brain Sciences* and the subsequent commentaries and replies (Gray, Feldon, Rawlins, Hemsley, & Smith, 1991, 1993).

Significant developments have been made in research on the schizophrenic individual's ability to analyze his or her own cognitions, on the disordered nature of these cognitions, and on language produced to describe them (Cahill & Frith, 1996; Frith, 1992; McKay, McKenna, & Laws, 1996). This type of analysis is one attempt to address the difficulty that the schizophrenic has, as an individual, in attempting to come to terms with his consciousness. He or she is portrayed as having a disturbed "cognitive homunculus." An alternative thesis would propose that the schizophrenic suffers a progressive loss of the ability to respond intuitively to the purposeful acts of both self and others. The neuropsychology of affective disorders that also present as disorders, not of separate processes or "modules" in intelligence or cognition but of the coherence of planning, forethought, and executive responsibility, indicates that dynamic and narrative mental processes are central to both individual purposeful consciousness and dynamic social relating (Damasio, 1994). Schizophrenia certainly disturbs both personal narrative-generating processes and the sharing of organized affective dynamics with others.

The core difficulty in schizophrenia has been analyzed as a loss of the ability to draw correct social inferences concerning actions (Frith, 1992). This is compared to the deficit is seen in autism, but in this case the condition becomes manifest at a significantly later stage, usually in late adolescence or early adult life, after a period of relatively normal earlier social development. There is some evidence, however, for abnormalities of social interaction in young children who go on to develop schizophrenia in early adult life (Walker, Grimes, Davis, & Smith, 1993). According to this "aberrant social processing" view, the gradual disappearance of the individuals ability to interpret social action and reaction lead to progressively more bizarre and unusual conclusions concerning the nature of and motivation for the behavior of both self and others.

It is becoming clear from a number of lines of complementary evidence that schizophrenia, like autism, originates in a neurodevelopmental disorder (Akbarian, Bunney et al., 1993; Akbarian, Vinuela, Kim, Potkin, Bunney, & Jones, 1993; Harrison, 1997; Weinberger, 1987). It is significant that the disorder commonly manifests itself in adolescence, at a time when brain mechanisms are undergoing a set of transformations comparable in magnitude, if different in cognitive and representational level, to those that occur in the infant and toddler period, when autism makes itself apparent.

If we apply the conceptual framework of an IMF, and its other-representing mirror formation, to this problem, schizophrenia can be viewed as the gradual disruption of both the individual's internal (narrative) model of the thinking self, and also of engagement with the virtual other critical in driving expectations and prediction with respect to the behavior of actual others. The schizophrenic individual has lost the dynamic internal frame of reference against which actions of both self and other are measured; in consequence, cooperative awareness is impaired.

Conclusions

If we regard human psychological development as the epigenesis of a system that has gained reproducable self-regulated stability in

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evolution as a complex nonlinear dynamic system, we cannot ignore the essential role of motives for psychological interaction between human individuals. The dependence of the child on cooperative understanding and cultural learning is part of human genetic inheritance. It is a persisting need in the child's brain and is motivated by a powerful appetite for human company and affectively regulated interaction. This need must have its origin in development and integration of extensive systems of brain structures, receptors, and bodily effectors that are formed before birth.

It is in the nature of these prenatally, prefunctionally formulated motive formations that they will persist to have effects reaching right through the life cycle. We propose that it is possible to clarify the workings of these ontogenetic events by seeking to define how motive processes that were evolved originally so that the individual animal could direct its behavior in intelligent relation to the outside reality, and learn to be more intelligent about it, became divided and transformed to represent and direct behaviors of the individual's self in relation to the motives expressed in the behaviors of others who are similarly motivated individuals.

We believe that the order of psychological developments in an infant and young child confirm that these developments are guided by regulatory mechanisms in the brain that formulate a behavior field for the individual acting practically in relation to the objective world, and socially related fields of subjective expression for a self and one or more others. This theory may be useful in analysis of the epigenesis of normal human behavior and of pathologies of behavior that arise at different times in development.

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