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The Development of the Body Image in the First Three Years of Life

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Abstract

The earliest developmental line of body image, which is commonly regarded as a key construct within psychoanalytic developmental psychology, cannot be simply traced either from observable infant data nor from psychoanalytic reconstruction. This article proposes a new approach, based on the maturational progression of the neurobiological substrata that underly the intrapsychic functioning that contributes to body image self experience. Thus, in the first part of the article, four parameters each on the psychobiological level and on the level of behavioral development are postulated as providing cues for gaining

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knowledge about body image development. By means of data comparison across the eight parameters it becomes possible to discern several phases of the earliest body image development. Such a model of phases in body image development is proposed and outlined in the second part of the article. Postnatally, the author assumes five ontogenetic phases of body image constitution, an Extension-*phase, the* Cohesion-*phase, the* Comparation-*phase, the* Expansion-*phase, and the* Introspection-*phase. The earliest developmental line of body image development is described as progressing from a centeredness on autonomic regulatory processes through establishment and widening of body image boundaries to cognitive differentiation of the inner space of the body image.*

Introduction: History, Presentation of the Problem, and a New Approach

Body image as a central problem in psychoanalytic developmental psychology is traceable to the Freudian conception of the ego's origin. With the introduction of psychological structure theory, the body ego receives a metapsychological place in his conception of the ego's foundations, since in 1923 Freud derived the origin of the ego from proprioception and the experience of pain, these making up the core of the ego experience (1923). What is less well known is that Freud had already spoken much earlier, in *The Interpretation of Dreams* (1900, pp. 59–62), of an overall bodily feeling *(Gemeingefühl)* as the basis of the ego. This is an overall bodily feeling that, arising from the body interior in the form of enteroceptive cues, stimulates the dream ego, and thus contributes to the creation of the dream.

With Schilder's work there took place an extension and systematization of Freud's concept of the body ego, and for this reason Schilder must be regarded alongside Freud as the actual founder of research into the body image. Likewise, Schilder (1923) attempted to explain various neuropsychological disturbances in accordance with Head's (1920) neurological concept of the *postural scheme*. As a psychoanalyst, however, Schilder came increasingly to see the neurosis–psychological relevance of the body image and its psychodynamic phenomena. In 1935 he presented the sum of his neurophysiological and psychoanalytic insights in a monograph entitled *The Image and Appearance of the Human Body*. Important as Schilder's contribution has remained up to the present, there has been an abundance of psychoanalysts who have worked with the problem of the body image: Glover (1924, 1930), Bernfeld (1925), Federn (1926), Hoffer (1950), Anna Freud (1953), Greenacre (1953, 1958), Jacobson (1954, 1964), Spitz (1959), Mahler (1968), Lichtenberg (1975, 1978), and Kestenberg (1971, 1978), to name only the most important contributors. Together they have seen to it that body image has remained a key concept in the psychoanalytic picture of the earliest development. Winnicott (1972) spoke of the body as the starting point of the sense of self. Sandler (1994) described the body image as the basis of self representation. Yorke (1985) propounded his idea that the body image has within the psyche the important function of bridging, with the help of phantasy, the body–soul dichotomy that presents itself to the subject.

Today, psychoanalysts are increasingly interested in the body image, taking up the question of the relationship between psychoanalysis and the body; all the more so since the field is always under suspicion of excluding the body entirely (Bittner, 1986, 1992; Thomä, 1992). Müller-Braunschweig (1980, 1989, 1992) investigated how the body image was changing in psychoanalytic therapy, describing how, in the course of an analysis, a "psychosomatic subsystem" in the inner structure of the body image becomes affectively integratable into psychic events. In addition, he emphasized in 1989 the possibility of integrating the body image through averbal therapeutic processes. In a 1992 work he attributed a distanced body life in some patients to undifferentiated and body-bound affects that are threatening to them. This experience is connected to negative object representations associated with the respective parts of the body. In 1992, Thomä formulated the following concerning the body

TABLE 1
Levels of Body Image Perceptual Constituents

Neurophysiological Level

- Proprioception and movement sensing.
- Postural synergisms (Vestibular, Cerebellar, pons).
- Morphosynthesis (multimodal neocortical fields).

Affective Level

- Tension-relaxation.
- Vegetative arousal.
- Muscular expressive feedback.

Interactive Level

- Interpersonal signalling.
- Interactional system.
- Contextual unit.

image: "There is no disturbance of the sense of self without a disturbance of the object relation" (p. 127).

Similarly Kutter (1980, 1989a,b) sees the structural functions of the body image as the fundamental psychic activity, and calls the dynamics that develop around the disturbed body image in schizophrenics and somatoform patients the "basal conflict" *(Basiskonflikt)*. The fundamental role of the body image and its disorders can be seen with special clarity in psychoses, psychosomatoses, in group processes, and in medical psychology; for example, in the wake of organ transplants, and in numerous ways also in childhood and youth disorders, such as eating disorders. A developmental psychological theory of the origin of the body image is essential for the clinical understanding of these disorders. Up to now, however, there has been no set theory available, either in psychoanalysis or in academic developmental psychology. And in empirical psychology

TABLE 2
The Parameter Model Approach to Body Image Development

Psychobiological Parameters

- Neuromotor development: spontaneous motor behavior, 0-24 months.
- Biocyclicity and state-organization, 0-15 months.
- Cerebral somatotopic, multimodal, affective capacities, 0-36 months.
- Memory development: capacity for engram formation, 24 GW-36 months.

Socioemotional Parameters

- Self-recognition in the mirror, 0-24 months.
- Development of body related interactional systems, 0-36 months.
- Ontogenesis of primary affective expressions, 0-24 months.
- Development of representational capacities, 0-36 months.

as well, up to now there has been no research on the development of the body image for the years between birth and 3, although something is known about its later cognitive development, especially in late childhood, puberty, and adolescence (Hartmann and Schilder, 1927; Schilder and Wechsler, 1934; Gellert, 1962, 1975; Poek and Orgass, 1964; Daurat-Hmeljak, Stambak, and Bergès, 1966; Daurat-Hmeljak and Grebot, 1969; Fisher, 1986, 1990; Boeger, 1995).

Since it is no longer possible to practice developmental psychology without reference to the latest research on infants, I too shall base my presentation on recent findings. Kohut's demand in 1959 for purely empathic or introspective insight as the central way of gaining knowledge has hardly been touched upon, since nomothetic statements can only give rough guidelines where the elucidation of individual cases is concerned.

Even so, I shall have to ask readers to confront even neurophysiological facts concerning the brain and psychobiological peculiarities of the infant's earliest existence, with the hope that our knowledge about the earliest mental life will thus be enriched in important ways on the basis of its *preconditions.* Astonishingly, many of the findings cited here are traceable to the work of research psychoanalysts.

My own approach is based on eight parameters that provide essential definitions for the developmental psychology of the body image: neuromotor development, the maturation of the central nervous system, the differentiation of neonatal behavioral states, findings concerned with the memory capacities of early childhood as *psychobiological* preconditions. *Developmental psychological* findings, then, which are concerned with the developmental stages of the infant's ability to recognize himself in a mirror, with body-related systems of mother–child interaction, with earliest affect development, and with knowledge regarding imaginative capacities and the development of representational capacities. I work from a model in which, as is the case with those of Freud, Schilder, and many others, proprioception is given a decisive place in the ontogenesis of a body-related sense of self. The decisive premise is that experientially, movement and perception are a unity where sense of self is concerned. The goal of this work is a model of the body image's normal development, the chronological sequence of whose developmental phases will be sketched in the second half of this paper.

Spontaneous Motor Functions in the Neuromotor Maturation Process

In older, nonpsychoanalytic developmental psychology, for example in Wallon (1931), Zazzo (1948), or Merleau-Ponty (1960), but also in the psychoanalytic contributions of Bernfeld (1925), Hartmann (1939), Hoffer (1950), and others, it is assumed that the genesis of the body image is tied to the development of motor functions. Likewise, Piaget (1936, 1937) and

Wallon (1931) hold with the view of many older developmental psychologists that the development of the gross motor functions, and particularly of the fine motor functions, is tied to the process of myelination of peripheral nerve pathways, or at least that its formation depends on this. When we go back to the influence of the "maturation theory" school of developmental psychology according to Gesell (1952), we find the maturation laws of motor function development set forth: His second law of growth-direction postulates a maturation of motor function capabilities in both cephalocaudal and proximodistal directions. These conceptions were held, for the most part tacitly, by psychologists as well as physicians.

Developmental psychologists such as Piaget appealed to the neurologists, and the developmental neurologists for their part to the developmental psychologists, with the idea that Schwann's sheath grows postnatally toward the periphery over available nerve pathways, and thus makes the fine motor functions possible. But data supporting this conception have never been available. Recent studies on myelination (Gilles, Shankle, and Dooling, 1983; Brody, Kinney, Kloman, and Gilles, 1987; Konner, 1991; Mezei, 1993; Webster, 1993; Benes, 1994), however, show this inherited conception to be untenable for the peripheral nervous system, because myelination is immediately linked to prenatal neurogenesis of nerve fibers and correlates directly with growth in thickness of the axons (Webster, 1993). In other words, the myelin sheath wraps the axon much like a rolled-up rug, a process that takes place directly during axonal outgrow. Therefore, a myelin sheath is generally present in peripheral nerve tracts at birth. If there exists any general trend of development at all, it is in the other direction: from the periphery to the center of the nervous system as a whole.

On the other hand, myelination must be considered a valid criterion for the maturation of the central nervous system (Flechsig, 1901; Konner, 1991). Neuroanatomic data can give an answer, why body image development proceeds in a direction from head to toes (Hoffer, 1949): Responsible for this sequential order is the myelination of the corticospinal tracts of the ventral and dorsal horns within the spinal cord. As distinct from intraspinal pathways, those tracts necessary for voluntary movement performance start their myelination cycle beginning in the cervical segment perinatally, and continue until, at around 24 months, the sacral segment is reached (Rorke and Riggs, 1969). Crucial for the development of the fine motor function (e.g., the pincer grasp) is the myelination of neural junctions through spinal interneurons between the ventral horn and the peripheral motor pathways (Kuypers, 1962). In the same way, myelination between the prefrontal cortex and limbic system is essential for affect regulation (Goldman-Rakic, 1981; Benes, 1994). Even before Piaget, the archaic newborn reflexes were seen as the starting point of motor-function development; controlled movements were assumed to develop from these. This can also be seen to be untenable in the light of current findings: In utero, complex patterns of spontaneous movement sequences are already present (Birnholz, Stephens, and Faria, 1978), and, if one takes into account the complex self-acted position changes that take place, one is led to think of intentionality in its preliminary stages (cf. Trevarthen, 1980). The phototropic phenomenon described by Wolff (1959) and by Bower, Broughton, and Moore (1970), which refer to Darwin's (1877) work, are quite possibly not, therefore, the first expressions of intentionality.

In this respect there exists a continuity (Humphrey, 1964; Piontelli, 1992) from prenatal development onward, from fetal movements, through the gross motor functions, fine motor functions, and on up to play, which in this view allocates another role to the reflexes of newborns: They may serve as "guiding frames" *(Richtschienen)* for the acquisition of the extrauterine motor experience necessary for the building of the engrams, which are then gradually integrated into the established level of directed voluntary movement. So the findings of Twitchell (1970) and Conolly (1981), who studied in depth

TABLE 3
Comparative Data Survey on the Development of Gross Motor Skills

	Shirley 1931	*Bayley 1935*	*McGraw 1943*	*Brunet & Lezine 1951*
Axial roll-over	28	27	37	32
Prone creeping	44	-	28	-
Crawling on all four	-	38	50	62
Sitting up	31	30	32	-
Knee standing	-	-	-	-
Free standing	41	51	62	41
First steps	45	44	55	62
Free walking	64	54	85	-

Numbers indicate weeks: mean of respective sample

(continued)

the fine motor function of grasping, show a parallel existence of reflex and voluntary grasping over a period of several weeks.

What interests us more as regards the development of the body image is the question of what influence this limited (compared, that is, to that of an adult) motor function has on the infant's sense of self. Doesn't the infant's lack of motor control over his body and environment present him with a constant source of trial-and-error opportunities for practice? This, in any case, was the answer given by Bernfeld as early as 1925, in connection with Preyer's (1882) observations of his own children. From the perspective of the present day, however, an

TABLE 3 *(continued)*
Comparative Data Survey on the Development of Gross Motor Skills

	Bühler & Hetzer 1953	*Schmidt -Kolmer 1958*	*Illingworth 1960*	*Gesell & Armatruda 1964*
Axial roll-over	28	23	28	24
Prone creeping	-	28	40	-
Crawling on all fours	39	32	44	40
Sitting up	47	32	40	44
Knee standing	-	-	-	-
Free standing	47	39	36	40
First steps	69	47	56	65
Free walking	-	58	-	78

Numbers indicate weeks: Median of respective sample

(continued)

explanation of the "taking over of the body by the ego" (Bernfeld, 1925) cannot be made so easily, since in McGraw's (1946) studies, at the latest, it is clear what an enormously complex procedure neuromotor development represents in its individual stages. Making reference to Touwen (1976), I would like nevertheless to differentiate two rough stages, namely arbitrary directedness and volitional directedness.

Arbitrary directedness represents a weakened form of voluntary directedness, in which body parts can be moved in the intended direction already, but in which a final precision and

Table 3 *(continued)*
Comparative Data Survey on the Development of Gross Motor Skills

	Pikler 1972	*Touwen 1976*	*Dargassies 1982*
Axial roll-over	29	20	-
Prone creeping	39	28	-
Crawling on all four	44	-	-
Sitting up	44	48	32
Knee standing	45	45	-
Free standing	49	56	36
First steps	66	68	-
Free walking	72	-	56

Numbers indicate weeks: mean of respective sample

sureness of performance is still lacking. This is the case in infants between the third and ninth months of life. The volitional stage in movement execution is established between the ninth and the fifteenth months. In this period the infant acquires the two central skills of precise grasping and independent, upright walking. After the eighteenth month, neuromotor development as such is a less crucial factor in the development of the body image, because of a then somewhat developed representational capacity. What is then more important is how motor skills are brought into play, expanded, and refined; for example in interaction and play, or through imitation, and the influence that this has on the representation of the body in its specific content.

The Maturation of the Somatotopic, Multimodal, and Affective Processing Capacities of the Central Nervous System

The neocortical fields of the lobus parietalis, especially in the right hemisphere, constitute the most important organic substratum of the body image function (Butters, Barton, and Brody, 1970; Ley, 1979; Andersen, Essick, and Siegel, 1985). These association fields are employed multimodally; i.e., their sensory input stems from a variety of sensory modalities. The multimodality as such is based on a crossmodal blending of various sensory channels, probably for the most part subcortically mediated: in the structures of the colliculus superior or the lemniscus medialis, this crossmodal capacity exists already at birth (Stein and Meredith, 1990), while the multimodal fields of the neocortex begin to mature late (Yakovlev and Lecours, 1967).

Still, for the body image function, it is essentially the primary motor and somatosensory fields that directly process bodily experience. In the human neocortex, nine somatotopic organizations are known at present; regions, that is, in which the form of the body is reproduced in the morphology as neuronal maps; this is a distinctly greater number than in other mammals. Somatotopic organization forms are to be found even subcortically (e.g., in the thalamus) and in the medulla spinalis, though in much more primitive form. Little is known, or has been researched, regarding those neocortical fields in which affective processes produce expressive movements. Vegetative-enteroceptive-visceral organ perceptions, affective ego states, moods, etc., are represented, namely, in the gyrus cinguli or the limbic cortex on the base regions between the two hemispheres. The inhibition and delay functions, as well as control of memory regulation, are tied to the lobus frontalis. There

TABLE 4
Overview on Studies of Myelination in the Central and Peripheral Nervous System

Author of study	*Peripheral nervous system*	*Central nervous system*	*Developmental relevance*
von Virchow, 1854, 1858		+	
Flechsig, 1901		+	+
Flechsig, 1920		+	+
Keene & Hewer, 1931		+	
Langworthy, 1933	+	+	+
Davison & Dobbing, 1966		+	+
Yakovlev & Lecours, 1967		+	+
Rorke & Riggs, 1969		+	
Huttenlocher, 1970	+	+	
Davison, 1974	+	+	
Kirschner & Caspar, 1977	+	+	+
Norton, 1977			+
Raine, 1977	+	+	+
Rogart & Ritchie, 1977	+	+	
Braun et al., 1980		+	+
Gilles et al., 1983			
Brody et al., 1987		+	+
Mezei, 1993	+		+
Webster, 1993	+		+
Benes, 1994		+	+

TABLE 5A
Overview on the Differentiated Growth of the Neocortical Layers in Different Cerebral Regions

Area	5th GM	8th GM	Birth	3 Mo's	6 Mo's	15 Mo's	24 Mo's
FAγ	800 µm	700 µm	1400 µm	1800 µm	1900 µm	2500 µm	2700 µm
FE	500 µm	900 µm	1600 µm	1800 µm	2000 µm	2300 µm	2100 µm
FCB_m	600 µm	900 µm	1600 µm	1800 µm	1900 µm	2100 µm	2000 µm
PC	800 µm	1000 µm	1900 µm	1900 µm	2000 µm	2100 µm	1800 µm
PF	900 µm	1000 µm	1200 µm	2000 µm	2300 µm	2700 µm	2500 µm
TA	800 µm	800 µm	2000 µm	2200 µm	2300 µm	2500 µm	2400 µm
TC	1200 µm	1000 µm	1700 µm	2000 µm	2300 µm	2600 µm	1900 µm
OC	1200 µm	500 µm	1400 µm	1500 µm	2000 µm	2100 µm	2200 µm
OA	700 µm	900 µm	1400 µm	2100 µm	2000 µm	2700 µm	2400 µm
LA	800 µm	700 µm	2400 µm	2100 µm	2000 µm	2300 µm	2500 µm
LC	1000 µm	800 µm	2500 µm	2000 µm	2100 µm	3000 µm	3000 µm

Source of data: Rabinowicz, 1986.

are indications of a hemispheric specialization in the emotion-specific activities of the neocortex, so that in EEG of the orbitofrontal cortex on the left side, the positive affect qualities associated with approach are found, while in the right hemisphere, the negative-aversive reactions are associated with withdrawal (Davidson and Fox, 1989; Davidson, 1992; Dawson, 1994). In the centroparietal unimodal areas 5, 7, 19, a "morphosynthesis" of the body image takes place: They provide the subject with the impression of the body as a spatial entity *(Raumgestalt)* (Gurfinkel and Levick, 1991; Kalaska, 1991; Paillard, 1991; Stein, 1991).

TABLE 5B
Overview on the Differentiated Growth of the Neocortical Layers in Different Cerebral Regions: Nomenclature and Function

Area	*von Economo*	*Brodmann*	*Function*
Precentral	FAγ	4	Primary motor area
Orbitofrontal	FE	10	Tertiary limbic association area
Frontal	FCB_m	44	Motoric speech area of Broca
Parietal	PC	1	Somatosensory projection area
Parietal	PF	40	Cognitive body surface mapping, only on the right hemisphere
Temporal	TA	22	Deep anterior receptive speech area
Temporal	TC	41	Auditory projection area
Occipital	OC	17	Primary visual projection area
Occipital	OA	19	Secondary visual association area
Limbic	LA	24	Limbic association area
Limbic	LC	23	Limbic projection area

There are lateral and nonlateral functions of the body image: The primary projection fields of motor and somatosensory functions stretch across both sides of the brain equally, while orientation toward one's own body and networking of space experience are localized more to the right. In the parietal and temporal fields there are mixed spatial–visual and socioemotional memory traces derived from socioemotional scenes tied to bodily experience. Purely cognitive functions of the body image, such as body naming, the body touch picture, and cognitive space orientation are the most strongly lateralized and are

TABLE 6
Synoptic Presentation of the Neocortical Neuronal Substrata Employed in the Different Niveaus of Body Image Functioning

Area [a b]	*Function*	*Modality*	*Experience*
6aβ = FB	supplementary motor projection area	kinesthetic vestibular motor	complex motor movement outlines
3, 2, 1 = PC, PD	primary somatosensory projection area	proprioceptive	skin and muscular body perception
5 = PE_m	kinesthetic and somatosensory association area	proprioceptive-kinesthetic vestibulary synergies	vestibular and joint position sensing; body-space mapping
7 = PE_p, $PE\gamma$	kinesthetic-visuomotor coordination	proprioceptive vestibular optic	skin-muscle-visus, positions; body-space mapping
19 = OA	secondary visual association area	optic unimodal associations	visual flow perception, visual body ideation, images from social body experiences
21 = TE_1	temporal auditory association area	multimodal acoustic associations	affective-scenical body experience, memories to socio-emotional contexts

[a] Numbers after Brodmann.

[b] Letters after von Economo.

[c] Letters indicate position of thalamic nuclei.

[d] Numbers indicate position of neocortical area as [a].

[e] Niveaus of body image functions according to Lemche, 1993.

[f] Refers to the right or minor hemisphere; in the left or dominant hemisphere there are located at the respective region (Wernicke's area) language and symbol understanding functions in action competencies, whose lesion subsequently cause the following disorders: acalculia, agraphia, alexia, aphasia.

References: Goldstein & Gelb, 1918; Gelb & Goldstein, 1920; Hochheimer, 1920; Gerstmann, 1924, 1930, 1940; Foerster, 1931, 1936; Hoff & Pötzl, 1937; Penfield, 1958, 1975; Kleist, 1959; Semmes, Weinstein, Ghent, & Teuber, 1962; Eccles, 1977; Creutzfeldt, 1983; Millner, 1965; Poek, 1989; Paillard, 1991; Berthoz, 1991; Kalaska, 1991; Roll, Roll, & Velay, 1991; Stein, 1991.

(continued)

TABLE 6 *(continued)*
Synoptic Presentation of the Neocortical Neuronal Substrata Employed in the Different Niveaus of Body Image Functioning

Area [a b]	*Afferences* [c]	*Efferences* [d]	*Niveaus* [e]	*Disorders*
6aβ = FB	VL, VPL, VA	23 Cerebellum	body ego	
3, 2, 1 = PC, PD	VPM, VPL, VL	5, 7, 19	body ego	
5 = PE_m	VPM, VPL	1, 2, 3, 6 Cerebellum	body ego	apraxia, astereognosis, anosognosia
7 = PE_p, PEγ	VPM, VPL	1, 2, 3, 5, 6, 19, 22, 23 Cerebellum	body ego	apraxia, astereognosis, anosognosia
19 = OA	LP, PL, pulvinar	24, 38, 46, Hippocampus	body image	loss of recognition of face and body parts, "psychic blindness"
21 = TE_l	MD, auditory	12, 24, 38, Hippocampus Amygdalae	body image	hallucinations, dissociative states negativism, amnesia, amusia

(continued)

found on the right lower parietal lobe (areas 39 and 40), directly opposite passive speech functions *(Wernicke)* on the left side. Finally, the body related social introjections in the form of stored social experiences are the contribution of the right temporal lobe areas (for more details on brain mechanisms of body image, see chapter 4, Lemche [1997]).

What information about the earliest development of the body image can one gain from findings in the field of brain research? One may, with the help of certain neuroanatomic data concerning maturation of the brain, come to some conclusions as to which functions of the body image were actualized at earlier or later times in its development. Among others, cortical layer thickness, density of neurons, and myelination are important criteria of functional maturity. Interestingly, it is in fact the case that the cerebral cortex, during the infantile growth

TABLE 6 *(continued)*
Synoptic Presentation of the Neocortical Neuronal Substrata Employed in the Different Niveaus of Body Image Functioning

Area [a b]	*Function*	*Modality*	*Experience*
22 = TA	temporobasal tertiary association area	multimodal complex sensory linkages	affective-scenical body experience, memories to socio-emotional contexts
20 = TE_2	temporobasal tertiary association area	multimodal complex sensory linkages	socio-emotional contexts; understanding, interpretation, déja-vu.
23 = LC_2	limbic projection area	enteroceptive visceral autonomic	visceral organ perception and autonomic balance
24 = LA	limbic association area	enteroceptive	body experience in affective ego states and moods
38 = TG	temporal pole , transition to fasciculus uncinatus		autonomic rhythms olfactory sensing
39 = PG [f]	somatosensory association area	proprioceptive optic	proprioceptive-cognitive body touch image
40 = PF [f]	somatosensory association area	proprioceptive optic	cognitive body orienting "right-left" etc.

(continued)

spurt, grows the fastest in those places where experiences take place in the greatest number. In other words, increase in the layer thickness and myelination is most advanced where the functional demands upon the cortex are the greatest. In this respect, data on myelination taken from various regions of the cortex allow us to conclude which area of the body image is to a greater or lesser extent involved in which month of life. Advances in the last ten years in the field of neurobiology have been able to place this information at our disposal, opening this research path.

TABLE 6 *(continued)*
Synoptic Presentation of the Neocortical Neuronal Substrata Employed in the Different Niveaus of Body Image Functioning

Area [a b]	*Afferences* [c]	*Efferences* [d]	*Niveaus* [e]	*Disorders*
22 = TA	MD, auditory thalamic und vagus afferences	21, 24, 28, Hippocampus Amygdalae	body image	memory disturbances, emotion disturbance, "Klüver-Bucy Syndrome"
20 = TE_2	MD	19, 21, 22, Hippocampus Amygdalae	body image	memory disturbances, emotion disturbance, confusion, exitation, screaming
23 = LC_2	AM, AD, AV	6ab, 7, 11, 19, 22, 46	body self	depressive demotivation, desinterest, negativism, unrest
24 = LA	AM, AD, AV	6, 7, 12, 22	body self	restlessness, confusion, exitation, screaming
38 = TG	19, 20, 21, 22, 23, 24	20, 21, 22, 23, 24 Hippocampus Amygdalae	body self	memory disturbances, emotion disturbances
39 = PG [f]	LP, pulvinar	1, 2, 3, 5, 7, 19 Cerebellum	cognitive body image	spatial agnosia, prosopagnosia
40 = PF [f]	LP, pulvinar	1, 2, 3, 5, 7, 19 Cerebellum	cognitive body image	disturbances of gestalt perception, space relation, location

Early studies of myelination in the cerebral cortex (Flechsig, 1901) demonstrate that at the time of birth, myelination has begun in the following fields of the brain: the motor and somatosensory fields of the central area; the fields connected with sense of smell and autonomic balance; and the representation fields connected with affective and motor expressive reactions in the basal area of the interhemispheric gap (fissura longitudinalis cerebri). In the first months, the primary sensory fields begin to myelinate, especially the representations for the face and sense of hearing, and some secondary fields in the immediately surrounding area. In the fourth month of life, myelination begins in the tertiary association fields of the parietal, temporal, and frontal lobes. The myelination cycle lasts for different lengths of time in the various areas: While in the primary projection areas, sense perception is concluded within the first year of life, it proves to be extremely protracted in the association fields, lasting there into the fifth decade of life, from which it may be assumed that it preserves the multimodal memory content. It is known today that the brain's plasticity over the entire span of life is enormous, and that experiences permanently alter the brain in its micromorphology!

Another, more important indication concerning the development of the brain is found in measuring the thickness of the cortical layer. During postnatal growth, there is a demonstrably narrow correlation between layer thickness and sensory impact. Astonishingly, Rabinowicz's (1986) data demonstrate again that the greatest thickness in the limbic projection regions, where information concerning autonomic balance, affective ego states, expressions, and enteroceptive information concerning visceral body life come in. At 3 months, it is the somatosensory, auditory, and visual areas in particular that catch up. At 6 months, regions of speech perception follow, while the frontal regions and the active speech centers lag. A fairly comparable layer thickness is reached only between 15 and 24 months.

However global these trends may be, the most important thing that they show is that in the earliest months of life, the perceptions of affective–autonomic body life and motoric and somatosensory domains of experience are obviously decisive, while the distance-bound senses (vision, audition) follow only in the course of the first year. Multimodal association areas that bear the representational and morphosynthetic aspects of the body image are the last to grow. In these also, the complex scene-contents of social life are preserved in memory engrams.

TABLE 7
Synoptic Presentation of the Subcortical Neuronal Substrata Employed in the Different Niveaus of Body Image Functioning

Structure	*Function*	*Modality*
Spinal motor functioning	reflex arcs	motor
Spinal sensory functioning	reflex arcs	motor
Cranial nerves	e.g. facial sensorimotor function	motor and all other modalities
Vestibular centers in mesencephalon	vestibular system	vestibular
Lemniscus lateralis	vestibular system	vestibular
Lemniscus medialis	somatosensory system	proprioceptive
Thalamic nuclei	distribution and coordination of the neocortical input	multimodal
Inferior cerebellar peduncle, inside	vestibular and somatosensory system	vestibular and proprioceptive
Inferior cerebellar peduncle, outside	motor system	motor
Colliculus superior	crossmodal sensorimotor integration	multimodal
Bundle of Vicq d'Azyr [d]	tractus mamillothalamicus, integration emotion-memory	affective, mnemonic
Somatosensory pathways	somatosensory system	entero- und proprioceptive

[a] GM = Month of gestation.

[b] PNM = Postnatal month.

[c] GW = Week of gestation.

[d] Regarding the other essential intralimbic pathways, the stria terminalis, the medial forebrain bundle, the tractus amygdalohypothalamicus, as well as Broca's diagonal ligament, no maturation data are available at the moment.

(continued)

TABLE 7 *(continued)*
Synoptic Presentation of the Subcortical Neuronal Substrata Employed in the Different Niveaus of Body Image Functioning

Structure	*Systemic connection*	*Myelination cycle* [a b]	*Embryogen. differentiation* [c]
Spinal motor functioning	medulla spinalis	4 GM - 2 PNM	4 GW
Spinal sensory functioning	medulla spinalis	6 GM - 7 PNM	4 GW
Cranial nerves	medulla oblongata	6 GM - 2 PNM	5 GW
Vestibular centers in mesencephalon	thalamus, cerebellum	6 GM - 9 GM	8 GW
Lemniscus lateralis	thalamus	5 GM - 9 GM	8 GW
Lemniscus medialis	thalamus	6 GM - 14 PNM	8 GW
Thalamic nuclei	neocortex	8 GM - 8 PNM	7 - 14 GW
Inferior cerebellar peduncle, inside	nucleus vestibularis and other pontine nuclei	6 GM - 9 GM	7 GW
Inferior cerebellar peduncle, outside	nucleus olivaris	8 GM - 5 PNM	13 GW
Colliculus superior	thalamus	8 GM - 4 PNM	8 GW
Bundle of Vicq d'Azyr [d]	limbic system, thalamus	9 GM - 36 PNM	6 GW
Somatosensory pathways	thalamus	9 GM - 14 PNM	-

(continued)

TABLE 7 *(continued)*
Synoptic Presentation of the Subcortical Neuronal Substrata Employed in the Different Niveaus of Body Image Functioning

Structure	*Function*	*Modality*
Nucleus globus pallidus	output organ of the basal ganglia	motor and affective
Striatum (nucleus caudatus and putamen)	basal ganglia: motivation, tonication, expression vs inhibition	extrapyramidal system
Tractus corticospinalis	pyramidal system	motor
Fornix	limbic feedback loop	affective mnemonic
Gyrus cinguli	limbic cortex area representing affective and enteroceptive cues	enteroceptive-autonomic, affective
Commissures	hemisphere connections	
Intracortical neuropil of the associative regions	white matter consisting of axons between neocortex and the deep cerebral nuclei	
Corticospinal fibers	extrapyramidal system	motor
Corticopontine fibers	extrapyramidal system	motor
Hypothalamus; hippocampus	autonomic control; memory regulation	
Amygdalae	basic libidinous and aggressive affect generation	affective
Corpora mamillaria, septum, induseum griseum	modulation of STM, modulation of attentional shifting	

(continued)

TABLE 7 *(continued)*
Synoptic Presentation of the Subcortical Neuronal Substrata Employed in the Different Niveaus of Body Image Functioning

Structure	*Systemic connection*	*Myelination cycle* [a b]	*Embryogen. differen-tiation* [c]
Nucleus globus pallidus		7 GM - 24 PNM	6 GW
Striatum (nucleus caudatus and putamen)		2 PNM - 24 PNM and longer until 10th year of life	6-7 GW
Tractus corticospinalis	effector musculature	birth - 24 PNM	-
Fornix	limbic cystem	3 PNM - 24 PNM	8 GW
Gyrus cinguli	limbic system	2 PNM - 10 PNM	4-5 GW
Commissures		3 PNM - 120 PNM	-
Intracortical neuropil of the associative regions		3 PNM - 6000 PNM	4 GW
Corticospinal fibers	effector musculature	birth - 8 PNM	-
Corticopontine fibers	effector musculature	birth - 14 PNM	-
Hypothalamus, hippocampus	limbic system	birth - 8 PNM	9 GW 8 GW
Amygdalae	limbic system	birth - 72 PNM	5 GW
Corpora mamillaria, septum, induseum griseum	limbic system	4 PNM - 36 PNM	7-8 GW 9 GW

The Memory and Psychic Engram Formation Functions

In the last fifteen years, biologically oriented memory research has been able to make essential progress that allows it to expand the findings of developmental psychology in fundamental ways. Though Lashley, in his classic article of 1950, had denied the possibility of indicating a specific location of memory function, the situation today has turned around completely: In the meantime, there is a wide reaching consensus that the allocortical hippocampus serves as the essential binding member mediating the storage of memory contents in the associative areas of the cortex (Rawlins, 1985; Lahmann and Lahmann, 1986). Schacter and Moscovitch (1994) assume a modality-specific layout of memory contents in the secondary sensory fields, while source data (i.e., place and time) are stored in prefrontal areas responsible for bringing together the engram contents of various modalities. In this synergy, the dorsolateral frontal cortex has an inhibitory and delaying function that likewise goes hand in hand with the controlling function on the limbic system in affect regulation that is executed by orbitofrontal areas 10 and 12. Every memory trace has an affect-content that is influenced through pathways between the frontal cortex on the one hand and the amygdala and other limbic structures on the other.

In contrast to long-term storage in interplay between the hippocampus and the various cortex areas, the short-term working memory seems to depend on limbic structures consisting of the corpora mamillaria, fornix, and anterior and mediodorsal thalamic nuclei, which exercise a complex feedback function and influence the autonomic nervous system by way of the hypothalamus, rendering affects autonomically sensible (Mishkin and Appenzeller, 1987). In the hippocampus, whose granular cells hold on to neuronal excitement in certain regions (in the cornu ammonis), there takes place a holistic gestaltlike or scene-contextual processing of the contents to store (Miller, 1991) before these are passed on to the associative cortex areas.

For our purposes, the finding that the maturity of the hippocampus is well-advanced in the last trimester of pregnancy is of essential significance; from the neurogenetic perspective the hippocampus is fully mature at 15 months and myelination to a great extent concluded (Kretschmann, Kamradt, Krauthausen, Sauer, and Wingert, 1986). Increase in memory capacity with respect to retention time seems to occur on the basis of the maturation of the dorsolateral cortex and the cerebellum; the reasons for this are as yet unresearched (Diamond, 1990). It is possible to prove the function of the hippocampus through its electrophysiological activities in the form of theta frequencies in EEG (Schacter, 1977). Certain nuclei not yet fully located in the pons–medula area give a nonrhythmical impulse to the septum, which generates a theta rhythm with a ground frequency of 2 to 4 cps. These rhythmic impulses obviously exercise a processorlike pacemaker function on the hippocampus in the processing of sensory impressions. The activation of memory contents is electrophysiologically measurable in dream work as well; for example, as theta activities in the form of "sawtooth" waves in EEG sleep; they indicate the visualization of dream imaginings in the secondary visual occipital area 19. Memory processing through the hippocampus proceeds in two directions, in the form of (1): storage = encoding and (2): recall = ecphory. As I will report in the next section, storage of memory contents appears probable, at least from the last trimester on, taking into account the activities of the hippocampus at this time.

As far as research in developmental psychology is concerned, the earliest proofs of the simplest recognition memory can be dated from the thirty-sixth week of gestation. Newborns are capable of recognizing plain areas of bright color that they have already seen (Werner and Siqueland, 1978). Differentiated perception memory activities, such as the recognition of faces and objects, can be proven experimentally between the fifth and eighth month of life (Fagan, 1973; Maurer, 1985). I will not discuss here the fine points of perception and cognition development on which memory performance depends in enormously complicated ways. Essential for the development of the body image, however, is the retention of event sequences that may be measurable as "predictive" capabilities—the ability, that is, for anticipation, which comes into play after 3 months of age. At 9 months, memory capability makes a clear leap: Measurable retention of behavioral sequences is at this time possible over a period of twenty-four hours. Meltzoff and Moore (1994) have recently been able to show that already at the age of 9 months some children are capable of "deferred imitation"; the majority, however, only in the first half of the second year. These and other facts indicate the use of evocative recall from that time onwards. Between 11 and 13 months, the ability to imitate sequences of actions in all their complexity clearly increases (Mandler, 1990). Further milestones of memory development may be seen in the sixteenth and twenty-fifth months. At each of these times the learning capacity of children quadruples, but even so, these reach dimensions with values comparable to those of adults only in the second half of the third year.

As Rovee-Collier emphasizes (1990), long-term memory is tied to language, which leads cognitive psychologists to doubt that children have preverbal long-term memory. I hardly agree with this standpoint, but in any case, evidence of long-term memory may be proven experimentally only after the sixteenth month (Bauer and Mandler, 1989). Myers, Clifton, and Stanton (1987) could nevertheless show that in experimental situations memory contents of (experimental) events experienced at one year of age were available to 3-year-olds. One must therefore differentiate between the ability to store memory (encoding) and the ability to actively remember (ecphory, or retrieval). Dornes (1994) was therefore correct in pointing out the differences between free and conditioned evocation: Preverbal children need associational retrieval cues for ecphory. But is it not exactly the same in the psychoanalytic process, where associations first make access to repressed early-childhood memories possible?

As to the question of what one may gather from the findings here presented on the formation of memory engrams as preconditions for the development of a representation of the body, the following can be summarized: "Physiological correlates suggest that memory storage is already taking place in utero. At the time of birth a perception-memory exists in very global form that provides simple recognition. At 3 months the foundations are laid for anticipation of event sequences, made possible by the formation of perception–action–affect patterns (Lichtenberg, 1983). At 9 months, an infant can already imitate motor actions, and especially defer them; also there are indications of active retrieval—the beginnings of recall memory (Mandler, 1984). At 16 months the child can imitate complex motor actions with several components; with this age long-term storage is already experimentally measurable. Around 24 months the child becomes able, mainly through progress in symbolic–cognitive capacities, for an active use of previously experienced events from their lives (Nelson, 1984) in event representations.

TABLE 8
Overview of Research Findings for the Development of Memory Capacities from Different Cognitive Paradigms

Author-Study	*Time frame*	*Design*	*Paradigm*
Werner & Siqueland, 1978	36 GW	recognition of brightly colored planes	novelty preference: visual paired comparison
Rovee-Collier & Fagen, 1983; Rovee-Collier, 1990	2-6 months	movement of a mobile by foot triggered mechanism	response reward contingencies
Haith, Hazan, & Goodman, 1988	3 months	"prediction" of repetitive pattern of objects in serial order	learning paradigm: anticipation
Nelson & Gruendel, 1981	3 months		
Baillargeon, Spelke, & Wasserman, 1985	3 months -5 months	rotating screen, disappearing object	habituation: impossible event
Diamond, 1990	4 months -12 months	recognition of known, grasping for unknown toys, respectively	visual paired comparison and delayed non-matching to sample
Fagan, 1977	5 months -6months	recognition of a face from photography	novelty preference: visual paired comparison
Fagan, 1973	5 months -6 months	recognition of a face from photography	novelty preference: visual paired comparison
Baillargeon & Graber, 1988	5 months -8 months	rotating screen, disappearing object	habituation: impossible event

(continued)

TABLE 8 *(continued)*
Overview of Research Findings for the Development of Memory Capacities from Different Cognitive Paradigms

Author-Study	*Time frame*	*Findings*	*Explanation*
Werner & Siqueland, 1978	36 GW	primitive recognition memory present	
Rovee-Collier & Fagan, 1981; Rovee-Collier, 1990	2-6 months	retention-test: 2 months no retention, 3 months retention 6-8 days, 6 months retention 14 days	
Haith, Hazan, Goodman, 1988	3 months	anticipation of sequences positive	procedural capacities present
Nelson & Gruendel, 1981	3 months	evocation of event sequences in correct temporal order	procedural capacities present
Baillargeon, Spelke, Wasserman, 1987	3 months -5 months	infants 4-5 months look longer to impossible event	
Diamond, 1990	4 months -12 months	with 9 months delay time decuples	delay indicates increase of memory capacity
Fagan, 1977	5 months -6months	recogniton in a more differentiated form	
Fagan, 1973	5 months -6 months	recognition after 2 weeks delay	
Baillargeon & Graber, 1988	5 months -8 months	infants 5-6 months memorize features and dimensions of dissappeared object	

(continued)

TABLE 8 *(continued)*
Overview of Research Findings for the Development of Memory Capacities from Different Cognitive Paradigms

Author-Study	*Time frame*	*Design*	*Paradigm*
Diamond & Doar, 1989	6 months -12 months	understanding of reward	delayed response
Meltzoff, 1988a, 1990; Meltzoff & Moore, 1994	9 months	retention of model behavior without previous motor experience	deferred imitation
Rovee & Fagan, 1976	10 months	retention of conditioned reflex	reward contingency
Rovee-Collier, Sullivan, Enright, Lucas, & Fagan, 1980	10 months		deferred imitation
Diamond, 1985	5 months -12 months	understanding of reward on place other than previously seen	"A not B"-failure
Mandler, 1990	11 months	imitation of modeled 2-tailed action sequence	modeled imitation
Bauer & Mandler 1992; Mandler, 1990	13 months	imitation of modeled 3-tailed action sequence	modeled imitation
Meltzoff, 1988b	14 months	presentation of object manipulation in 6 variations	deferred imitation
Meltzoff, 1988c; 1990	14 months and 24 months	presentation of object manipulation in TV	deferred imitation
Bauer & Dow, 1994	16 months -20 months	imitation of coherent multitailed action sequences	modeled imitation
Myers, Clifton, Stanton, 1987	30 months		

(continued)

TABLE 8 *(continued)*
Overview of Research Findings for the Development of Memory Capacities from Different Cognitive Paradigms

Author-Study	*Time frame*	*Findings*	*Explanation*
Diamond & Doar, 1989	6 months -12 months	linear increase of retention time beyond 11 s	
Meltzoff, 1988a; 1990; Meltzoff & Moore, 1994	9 months	retention over 24 hrs in 20% of sample	earliest indication of complex imitation
Rovee & Fagan, 1976	10 months	retention over 24 hrs established	
Rovee-Collier, Sullivan, Enright, Lucas, & Fagan, 1980	10 months	evocation of memory after 27 days	
Diamond, 1985	5 months -12 months	linear increase of retention time beyond 10 s	delay indicates increase of memory capacity
Mandler, 1990	11 months	86% correct in new activities, 79% in familiar	
Bauer & Mandler, 1992; Mandler, 1990	13 months	75% correct in new activities, 15% in familiar	
Meltzoff, 1988b	14 months	retention of 3 or more sequences of modeled behavior over 1 week in 66%	
Meltzoff, 1988c; 1990	14 months and 24 months	no retention found over 24 hrs	real person necessary for deferred imitation
Bauer & Dow, 1994	16 months -20 months	20-month infants evoke 3-tailed sequences after 2-week intervall	distinct increase of long-term storage
Myers, Clifton, Stanton, 1987	30 months	partial ekphory of experimental situation, experienced as 2-10-month infant	reuptake of prelinguistic episodes partially possible

State Differentiation in EEG

At least in the first year of life, psychic organization is determined by the so-called neonatal behavior states. The cyclical state sequences are one factor neglected by the research of developmental psychology on infants, which is oriented mainly toward social perception: This research is to an extent one-sided, in that often only findings gained through the narrow window of the alert waking state are passed on, and these cannot do justice to the entire range of psychic existence. It is probable, however, that state development, because of its involvement in emotional development, exercises a considerable effect on the building of psychic structures, since it essentially provides the biological ground rhythm for mother–child interactions. In point of fact, as Lester, Hoffman, and Brazelton (1984) discovered, development and capacity for state regulation in newborns is the essential predictor for social–emotional and cognitive competence at 18 months.

The state correlates above all in EEG with a certain level of wakefulness (Prechtl, 1974). It is no surprise, therefore, that it is the state that determines in the first year whether a baby can receive information or react to stimulation. Brazelton (1986) differentiates the following six behavioral states: (1) Quiet sleep (delta EEG) offers the best protection from stimulation but develops completely only in the course of the first year, while up to that point only short regular episodes appear. (2) Active sleep (REM) at first takes up the greatest amount of time and presumably has significance for brain development through the processing of waking state experiences. In active sleep startle reactions appear and stimulation leads to waking up. (3) Drowsiness develops in the course of the first year with the diminishment of active sleep; stimulation leads to wakefulness or crying. (4) Quiet alertness makes possible the reception of social–environmental stimulation and the reaction to these. Overstimulation leads to a change of state. (5) Active wakefulness is accompanied by motor movement; the child is, however, to a certain extent receptive. Stimulation leads either to calming or crying. (6) The crying state has usually to do with pain, hunger, boredom, or dissatisfaction and demands the immediate attention of the parents. Possibly crying is biorhythmically based in the first months and therefore brings about regular appropriation *(Zuwendung)*. Brazelton and Cramer (1989) are of the opinion that crying helps the infant to regulate behavior conditions through tension discharge. Other important state researchers, such as Prechtl, Ashton, Wolff, Thoman, and Hopkins, among others, have not counted drowsiness or cyclical crying with the other behavioral states. When the infant has learned basal self-regulation of states, change of state for defense purposes is his first possibility to protect himself from over- and understimulation.

It was above all the investigations of Metcalf (a scholar of Spitz) and Dreyfus-Brisac (both in 1979) on EEG spontaneous activity, which produced data showing that during ontogenesis the states are subject to a process of differentiation. Table 9A shows the Basic Rest Activity Cycle (BRAC) appears in an early period, then the differentiation of quiet and active sleep comes about, and then, in the course of the first two years of life, how sleep-stage organization is differentiated and deepened while length of alertness lengthens and increases in quality, to the extent that in the third year it is comparable to the vigilance of an adult. It is therefore clear that states have biocyclical change at their foundation, anchored in chronobiological processes, but that in the course of the first month this changes over to a more self-guided regulation: Sander (1985, 1988) speaks of a "state-self" as the first psychological structure, which comes ahead even of the body self.

I would like to turn now to the processing of reality and experience of affect as based on state change. State change has essential psychic significance both with regard to the mother–child interaction and to the body experience that takes place in this integration. The cyclical sequence of states produces highly rhythmical sequences of bodily contact that structure social–emotional exchange on the macro level; for

TABLE 9
Ontogenesis of Some Biocycles and the Differentiation of the State-Organization

24 GW - 30 GW	*32 GW - 38 GW*	*Birth - 2 months*	*3 months - 7 months*
hippocampus-θ increasingly continous	differentiation QS-AS	cortical-subcortical synchronization	sleep spindles appear and develop until 7 months
Basic Rest-Activity Cycle governs intrauterine motility	onset of deep sleep-δ with 1 cps	"tracée alternant" pattern until 4 PNW	K-complexes appear as indicators of experience impact during sleep
surface-EEG with 28 GW	REM-dominance in active sleep with θ-proportion of 70%	sleep stage organization begins its differentiation	deep sleep organization onsetting with stage 2
increase of hemisphere-synchronicity with 31 GW	onset of respiratory cycle and of electrodermal reaction		continous deep sleep-δ

(continued)

example, in hunger satiation or touching–holding sequences. These sequences, with mutual affective–preverbal communications or affective/bodily contact/perceptual exchange processes on the microlevel are to be regarded as the foundation stones of psychic representation (Brazelton, Koslowski, and Main, 1974; Beebe and Stern, 1977; Beebe, Gerstman et al., 1982; Stern, 1987, 1988, 1989a, 1992; Beebe and Lachmann, 1988, 1992, 1994).

At first, then, it is the biocyclical organization of infantile states in the first months that forms the mutual regulation of the mother–child interaction as a biological system (Sander, 1980, 1983). Then the child's infantile state organization is influenced more by the systemic conditions of the mother–child interaction (Stern, 1971, 1974a,b, 1984; Stern, Hofer, Haft, and Dore, 1985). And so Sander (1988) could

TABLE 9 *(continued)*
Ontogenesis of Some Biocycles and the Differentiation of the State-Organization

9 months - 15 months	*17 months - 23 months*	*26 months - 36 months*
onsetting differentiation of QS into stages 3 to 4	further increase of sleep depth within EEG	total proportion REM declines from 30% to 20%
emergence of the drowsiness state with 4 cps high voltage	increase of hemisphere symmetry	replacement of hypnagogic θ by adultomorphous patterns of falling asleep
hypnagogic hypersynchrony indicates cortical layer differentiation, memory functions	variability of the wake-EEG power	adult distribution of sleep stages with stage 1 as sleep onset
disappearance of the central humps at 8 months	sleep spindle proportion decreases from 76% to 10%	within wake-EEG tendency towards β: spikes of 6-14 cps right hemispherically posterior temporal

References: Dement & Kleitman, 1957; Wolff, 1959, 1965, 1966, 1967, 1969, 1985, 1987; Hellbrügge, Lange, Rutenfranz, & Stehr 1964; Roffwarg, Muzio, & Dement, 1966; Parmelee, Schulte, Akiyama, Wenner, Schultz, & Stern, 1968; Petre-Quadens, Hardy, & DeLee, 1969; Sterman & Hoppenbrouwers, 1971; Ashton, 1973; Parmelee, 1974; Prechtl, 1974; Thoman, 1975; Dumermuth, 1976; Dreyfus-Brisac, 1979; Metcalf, 1979; Niebeling, 1980; Eisert, 1981; Dittríchova, Bricháchek, Paul, & Trautermannová, 1982; Anders, Keener, Bowe, & Shoaff, 1983; Paret, 1983; VanVliet, Martin, Nijhuis, & Prechtl, 1985; Brazelton, 1986; Hopkins & Palthe, 1986; Berg & Berg, 1987; Davis & Thoman, 1987; Jones, 1994.

(continued)

show that when the infant's sleep rhythm increasingly becomes one of day-night, it is the result more of social than of physical influences. The connection between change of state and the experience of interaction within an object relation must be understood, in accordance with post-Mahlerian symbiosis research, as not only a purely psychic process; rather, it is entirely characterized by biological processes of exchange (Hofer and Shair, 1982; Hofer, 1990).

TABLE 9 *continued)*
Ontogenesis of Some Biocycles and the Differentiation of the State-Organization

24 GW - 30 GW	*32 GW - 38 GW*	*Birth - 2 months*	*3 months 7 months*
	emergence of a wake-state with an occipital β		precusors of α-blockade with 3 months occipitally
	increasing quiet sleep proportion		protodreaming as precursors of dream work: so-called saw-tooth waves indicate functional pathways pons-geniculatum laterale-area 19 for visual dreaming
	increase of hemisphere synchronicity from 50% to 100%		integration of CNS indicated through drowsiness-hypersynchrony
			increase of dominant frequency in wake-EEG almost to α

(continued)

Of central significance for the acquisition of self-regulation is the exchange of expressions of facial and vocal affect in the waking state, as well as the possibility of object manipulation and spatial exploration. The child makes this experience both alone and through a joint direction of attention through gaze (Murray and Trevarthen, 1985). This results in the development of rhythmical state regulation and affect interaction structures that are the foundation of the later processes of affect attunement found in the second half of the first year: tuning, state sharing, state transformation (Stern, 1983, 1984, 1985). These *emotional* states, as they once existed in the specific

TABLE 9 *(continued)*
Ontogenesis of Some Biocycles and the Differentiation of the State-Organization

9 months -15 months	*17 months - 23 months*	*26 months - 36 months*
decrease of the REM-proportion to 35%	appearance of an occipital α-rhythm of 11cps	lateral α-balance, but more continously and consistently in minor hemisphere
resolution of neonatal behavioral states to adultomorphous patterns; shortening of single REM-period	amplitude of the SWS-δ exceeding 200 μV	
full unfolding of SWS-high voltage until 12 months	unfolding of adult sleep stages after Dement & Kleitman, 1957	
"pre-dreams" with pavor nocturnus, indication of dream scenes with talking	first verbal dreaming reports appear in toddler	

organizations of the primary interaction systems are the basis of later deep inner sense of self (Schwaber, 1981; Sander, 1987).

After the first year, the psychobiological foundation of the states diminishes in significance, since the boundaries between behavior conditions, formerly well-defined, become of less significance, and during the extended waking episodes intrapsychic structuring on the symbolic level is already so advanced that it is this, and no longer just the biological fundament that can take over self-regulation in dependence on object relations. The relevance of states for the development of the body image is manifold. At first the motor function activity of the fetus and infant are linked to the state. The biocyclical recurrence of bodily needs—oral needs in gastric motility cycles for example (Friedman and Fisher, 1967)—or other biorhythms, are responsible for the fluctuation of libidinal tensions within the body image (Schilder, 1935). In the first year of life are internalized, within the states and in the biorhythms biologically bound to them, emotional experiences that in later life guarantee basal structures for the entirety of psychic existence (Federn, 1926). To these belong, on the one hand, the active body experiences acquired while awake, and on the other those experienced passively in half-sleeping states and tending toward a sense of safety (Sandler, 1960).

The Development of Self-Recognition in the Mirror Test

The relevance of self-recognition in a mirror arises from the fact that it is an objectively observable capacity making possible direct conclusions concerning the intrapsychic genesis of the body image, independent of the intrapsychic events that may lead to this development. A comparative synopsis taken from a number of controlled and uncontrolled studies indicates that there are clear developmental stages, reaching from a simple to a complex process of becoming aware of one's own body representation. Connections with the development of the motor function in visuomotor control and to the development of affect are here obvious, too. Asendorpf and Baudonnière (1993) were able to demonstrate that the capacity for self-recognition in a mirror goes along with the development of prosocial–empathic tendencies, and in this way lends support to the older psychoanalytic paradigm of a parallel relationship in the development of self representation and representation of the object (Jacobson, 1954, 1964).

A more precise examination of the results of many studies shows authentic self-recognition to be a relatively late acquisition of psychic development, which goes through several stages. Brooks-Gunn and Lewis (1984) distinguish three major steps in self-recognition: (1) a contingency relatedness analogous to visuomotor control, with an accompanying by observation of own movement execution. (2) a feature relatedness as a perception both of an entire gestalt and attention to its outer characteristics in form of body parts. (3) the "categorical self" as a form of self-recognition, which goes along with shame, embarrassment, and other painful affects of self-consciousness. There remains only the addition of (4) verbal self-reference as a symbol-bound step, which may be observed only after 2 years of age and goes with the beginning of identity formation.

The objective standard of self-recognition is the Amsterdam–Gallup mirror test, which was developed by the then doctoral psychology-student Amsterdam and the primate researcher Gallup independent of each other in the late sixties. Incidentally, some primates, such as chimpanzees and orangutans, reach a self-recognition stage, while others, such as gorillas, do not (Povinelli and Preuss, 1995)—a fact that suggests just what a highly developed capacity is here entailed. In the developmental psychology version, the test situation is constructed in such a way that the unclothed child is given a red spot next to his nose, outside his field of vision. When, after the rouge spot in the mirror has been pointed out to him by his mother, the child touches his face or shows other signs of a self-recognition response, this is considered proof of an established self-recognition capacity. This capacity makes its appearance between 17 and 25 months at the earliest and requires that a protorepresentation of the child's own body already be developed.

There appears at first, in the earliest stage of the development up to about 3 months, a tendency to show interest in novelties seen in the mirror, so that as a rule, the father or mother in the mirror are more interesting than the child is to himself. At 3 to 4 months the child begins to explore the mirror by touch, something he would also do with other objects. In the course of the next months, the child's attention to his own image increases; it is fixed upon and attentively studied. Eye contact, the production of action-image contingencies, and orientation behavior are the center of his interest (Papousek and Papousek, 1974). Social smiling cannot be brought about by the child himself, but only secondarily by the parents (Darwin, 1877; Papousek and Papousek, 1974). At 5 months he demonstrates exalted joy in the achievement of movements, a phenomenon called "success-feeling" (Wallon, 1931). Mahler and McDevitt (1982) observed that the infant is first and foremost studying body parts and member movements: This seems to be corresponding to visuomotor control, which would occur anyway, without the child's consciousness of its mirror character. After the third month of life tactile explorations of his own body parts or those in the mirror image begin, along with movement studies. It has been suggested that in the "playmate behavior," which expresses itself at 8 months in laughing and happy gurgling, the child does not really recognize himself, but rather "thinks" there is another child in the mirror (Amsterdam, 1972) and so tries to make contact with him.

At 8 months there appears a fear of the mirror image (Priel, 1985) as well which, in analogy to fear of strangers, is expressed as confusion, searching, distress, and withdrawal from the mirror. If a parent is present, the child compares the two mirror images (Darwin, 1877). The beginning of a naturalist mirror-interest begins at 10 months; children begin to look behind the mirror, kiss the image, or hit the mirror (Lewis and Brooks-Gunn, 1979). Somewhat later, at 12 months, children begin systematically to touch their own mirror image or that of objects that are in the mirror (Lewis and Brooks-Gunn, 1979). The expression of joyous amusement and jubilation has also been observed (Dickie and Strader, 1974; Wallon, 1931). In the same period after the first year, the child compares his body parts in the mirror with those of the parents, as he does often systematically in any regular interaction, or he turns entirely away from the mirror. This tendency to retreat continues in the next weeks and 90 percent of all children show indications of withdrawal at 14 months. At 15 months, children gradually seem to understand the reflecting character of the mirror:

TABLE 10

Comparative Data Survey of the Development of the Capacity for Self-Recognition in the Mirror and for Self-Referentiation

Months	*Capacity for recognition*	*Behavioral responses*
1	negative	Novelty preference
2	negative	Attention
3	negative	Tactile exploration of mirror 12,5%
4	negative	Mirror image being fixated and studied
5	negative	Exaltated joy from performed movement sequence
6	negative	Body parts and movement of extremities are being studied
7	negative	Observation of mirror image
8	negative	"Playmate behavior"
9	vague awareness	Study of movements
10	partially	Mirror image anxiety
11		Grasping towards mirror
12	"Self-permanence"	Seeking behavior, averting
13		Action intentionality
14	Withdrawal 90 %	Head banging towards object
15		
16		More complex movement studies
17	Indication towards chest	Imitation
18	positive	Self-admiration, bashfulness

References: Darwin, 1872; Preyer, 1882; Freud, 1920g; Wallon, 1931; Gesell & Thompson, 1934; Zazzo, 1948; Dixon, 1957; Boulanger-Balleyguier, 1964; Amsterdam, 1972; Stone & Church, 1968; Dickie & Strader, 1974; Papousek & Papousek, 1974; Amsterdam & Greenberg, 1977; Modaressi & Kenny, 1977; Schulman & Kaplowitz, 1977; Bertenthal & Fischer, 1978; Lewis & Brooks-Gunn, 1979; Amsterdam & Levitt, 1980; Mahler & McDevitt, 1982; Gouin-Décarie, Pouliot, & Poulin-Dubois, 1983; Brooks-Gunn & Lewis, 1984; Kernberg, 1984; Priel, 1985; Lewis, 1986; Bischof-Köhler, 1989; Lewis, Sullivan, Stanger, & Weiss, 1989; Lewis, 1992; Asendorpf & Baudonnière, 1993.

(continued)

TABLE 10 *(continued)*
Comparative Data Survey of the Development of the Capacity for Self-Recognition in the Mirror and for Self-Referentiation

Months	*Affective expression*	*Relational aspects*
1	Interest	More interest towards mirror than towards familiar person
2	Interest	
3		
4	Attention	
5	"Function pleasure"	
6		
7		Search for the eyes of the mother
8	Laughing, cooing	Comparative contemplation of paternal mirror image
9	Sobering	
10	Confusion, consternation	
11	Jubilation	
12		"Reciprocal discrimination" within interaction
13		Identification of bodily parts in other persons
14	Astonishment	
15		
16		
17		
18	Shame, pride	

(continued)

They turn toward other people when they see them in the mirror. Understanding the mirror mechanism leads to astonishment and a sobering in the expression of affect (Modarressi and Kenny, 1977; Lewis and Brooks-Gunn, 1979) or to silliness, shyness, or embarrassment (Dixon, 1957; Amsterdam, 1972).

At about 16 months, types of behavior such as pointing to the chest, complex self-imitation, but also disinterest, and a vacillation between self-admiration and shame may be typically

TABLE 10 *(continued)*
Comparative Data Survey of the Development of the Capacity for Self-Recognition in the Mirror and for Self-Referentiation

Months	*Capacity for recognition*	*Behavioral responses*
19	Response towards rouge-spot in 16% / 52% of subjects	Posing
20		Increasing complexity of behavioral responses
21		
22		
23		
24	Rouge-spot responses in 65% of subjects	Own face is getting into focus of infant's interest
25		Spelling of others' names
26		
27		
28		
29		
30		Insensibility towards mirror images
31		
32		
33		
34	Self-recognition in photographs	
35	"moi proprioceptif"	
36		

(continued)

observed. Already in 1882, Preyer described this form of self consciousness as "I-ness" *(Ichheit)*. Edelman (1989) distinguished between a primary sense consciousness and the secondary reflexive consciousness that is now present. Characteristic for authentic self-recognition is the wavering between the poles of embarrassment and shame, on the one hand, and self-admiring behavior and pride on the other (Schulman and Kaplowitz, 1977; Brooks-Gunn and Lewis, 1984). By 17 months, in 50 percent of all children, self-recognition in the mirror is accompanied by self-touching; this percentage increases up to the twenty-fourth month, when 65 percent react

TABLE 10 *(continued)*
Comparative Data Survey of the Development of the Capacity for Self-Recognition in the Mirror and for Self-Referentiation

Months	*Affective expression*	*Relational aspects*
19	No interest towards mirror	
20		Prosocial behavioral signs
21		
22		
23		
24	Embarrassment	
25		
26		
27		
28		
29		
30		
31		
32		
33		
34		
35		
36		Spelling of own name

to the rouge spot (Amsterdam, 1972). The calming of affect expression leads to even more complex movement studies and imitative actions, which occasionally take the form of posing. Possibly it is the experimental situation that is responsible for the expressions of shame and embarrassment manifested by most children, since they find themselves exposed in an unpleasant way to the social eye. With the capacity for self-recognition, the child's interest in his own mirror image decreases markedly; perhaps the earlier exalted expressions of affect were yet the result of an illusion that the image was that of another person.

In the third year of life, the child increasingly becomes capable of recognizing himself and his body in static pictures like photographs, and later in films. In this phase, a more exact study of the face becomes the focus of the child's attention (Zazzo, 1948). Self-reference and naming are very complex processes that demand semantic reference (deixis) to a fairly developed bodily self representation. In contrast to the mere recognition of his own bodily exterior in the mirror or in photographs, the act of naming is dependent on the existence of a psychosocial identity that has already reached the level of a mental sense of self. The use of the word *I,* or precursors of naming, such as "little boy," "girlie," or "baby,"or other such names, occurs before reaching this step at about 22 months. Wallon (1931) assumes that at about 35 to 36 months, there takes place a connection of the spheres of movement that he calls the proprioceptive self with the exteroceptive images, and only then is self-reference possible.

Systems of Body-Related Mother–Child Interaction

In no sphere of early childhood development do qualitative transformations take place as fast as within the matrix of the mother–child interaction. Rapid change in physical growth, the differentiation of central nervous system capacity, and socioemotional competence bring about a constant change in the mother–child interaction system. The "proximal zone of development" of which Vygotski (1934) spoke has the meaning that within an interaction system, it is the mother–child interaction which at this time takes place at the highest possible level. "Parental intuition" (Papousek, Papousek, and Bornstein, 1985) adjusts itself as it were to the required level. And parents simply don't like regressions in this course of progress, since for them competence on the part of the child makes for less work, with the result that, almost involuntarily, they require that competence be at the highest level achieved up to that time.

As has been mentioned already, Sander was the first to speak of the mother–child interaction in terms of a biological system—he was one of very few psychoanalytic researchers and theoreticians who carried out systematic long-term observational studies of early childhood interaction, which were unfortunately published only in incomplete form, with the result that it is only now that his achievements are gradually coming to be recognized appropriately (Nahum, 1994). His observations of the mutual regulation process between infant and mother have been unsurpassed to this day (Sander, 1964). In the following formulations of interaction systems concerning body-related and affective exchanges I often rely, certainly, on his observations, but I employ an entirely different frame of reference when it comes to the duration and description of the interaction system.

In the intrauterine situation, a mutual influence of state regulations in human beings and in animals and an impact of the physiological level in the neurohumoral area have been described a number of times. The activities of the fetus are determined, for example, by the depth of the maternal sleep (Sterman, 1967). Of course, real bodily interactions, for example, hitting against the maternal abdominal wall, are fairly limited, not counting those during the "storm of activity" period of the eighteenth to the twentieth week. Brazelton and Cramer (1989) have correctly pointed out that during pregnancy it is above all the phantasmatic dimension of conscious and unconscious expectations, the attribution of roles for the child, and past experiences of the parents, which exercise an enormous influence upon the attachment relations that develop after the child is born.

The adaptation–interaction system from birth to the age of $2^1/_2$ months: This is the mode of interaction in the mother–child system that deals with adaptation to the outside world. The neonate must adjust his breathing, digestion, temperature regulation, etc., to the outside world, and the mother helps him in reaching the physiological homeostasis necessary to survival

(Sander, 1964; Greenspan, 1981). The interaction is determined by biocyclically expressed needs, which involve the maternal adjustment to the twenty-four-hour rhythm of the newborn in order to take care of him. In this respect a joint regulation of physiological needs of the neonate is established, based above all upon the closest bodily contact and vestibular stimulation, but entailing only the barest amount of face-to-face engagement, during feeding.

The appropriation–(Zuwendung) interaction system from 3 to 7 months is aimed at bringing about sufficient reciprocity in affective exchange, based upon face-to-face engagement with positive displays of affect (interest, joy, smiling). If the mutual socioemotional stimulation is sufficient, there arises a "consistent contingency" (Papousek and Papousek, 1975) in the exchange, which leads, through reciprocity of affective responses, to joy and pleasure on both sides. It is important here that a recurring fitting of affect be reached, a "matching" that forms the basis of a later process of attunement that will accompany the child in his exploration of space and objects. Since the child can carry out few directed motor actions at this point, the modulation of bodily position takes place within a relationship based upon close bodily contact. The child then practices his own activities within this relationship of bodily contact, bracing himself with his legs against the body of the mother, pushing himself away from her with his arms, or reaching for things that interest him, while still being held.

The referencing interaction system from 9 to 15 months builds a facial–affective signal system between mother and child as a way of reporting back while independent exploration increases. Patterns of turning toward and away, approaching and retreating from the mother in a relatively narrow space characterize this period between the crawling and running stages. The phenomenon of social reassurance over spatial distance through the use of facial affect displays is understood as "social referencing" (Klinnert, Campos, Sorce, Emde, and Svejda, 1983; Klinnert, Emde, Butterfield, and Campos, 1986), and described as "checking back" by Mahler, Pine, and Bergman (1975). During his explorations, the child will "tap on" the mind of the mother (Grossmann, 1994), who signals to him by facial cues, for example, whether a threat of danger exists. But since the child does not always pick up the maternal confirmation, this mode requires her continuous attention and emotional availability (Emde, 1980b; Biringen and Robinson, 1991; Biringen, Robinson, and Emde, 1994), and she must in certain circumstances step in and set boundaries. This exclusivity of the object relation in favor of the mother may explain the appearance of the fear of strangers at that time, since the incursion of others into this system must be avoided.

The proxemic interaction system from 17 to 24 months regulates the position of two bodies to each other in space. *Proxemics* (a term taken from nonverbal communication research; Hall, 1963) is the regulation of adequate closeness and distance within the object relation. In distinction to the referencing mode, this interaction system is already based upon linguistic and linguistic-gestural (Ekman and Friesen, 1969; "emblems") communication. In this phase, the child practices, through complex imitation, social body gestures, using them for his own bodily self-assertion and definition (Spitz, 1953, 1959). The child's running away within a wide spatial range, and his return, sometimes seeking bodily contact, sometimes avoiding it, has been documented by Mahler and La Perrière (1965) with the name "rapprochement," and the emotional crisis here is characterized by the overcoming of the partial object relation through introduction of ambitendent–ambivalent behavior. "Preoccupation with bodily functions" (Sander, 1964) and the emotional specifics that accompany this, such as defiance and negativity, have been so elegantly formulated upon in the older psychoanalysis (Freud, 1908; Abraham, 1924).

The deictic interaction system from 25 to 36 months differentiates a bodily and mental sense of self (cf. Lichtenberg, 1975, 1978). In this mode, the interaction turns on the gaining of

TABLE 11
Development of Interaction Systems

Intrauterine	*Birth - 3 months*	*3 months - 9 months*
Modi of interaction ==============>	**Adaptation interaction**	**Appropriation interaction**
Neuroendocrine, immunological and metabolic influences	Holding, rocking, calming, "soothing"	Mutual socio-emotional stimulation
In utero there is relatively few direct interactions	Close body contact; interaction is being dominated through biocyclicity of the neonate	Face-to-face engagement and reciprocity; "Consistent contingency" (Papousek & Papousek, 1979)
Of particular importance is the phantasmatic dimension on the parental side	Mutual regulation of the basic physiological needs	Arousal games, affective responsivity
Mutual influencing in state regulation	Coping with aftereffects of birth	Reaching of mutual joy: "matching," fitting together
Onset of unfolding of foetal perceptual capacities	Mutual acquaintance	Preferential 1 to 1 relationship (Sander, 1985)
	preferential responsivity for mother	Modulation of infantile bodily positioning within a relationship of close body contact
Developmental goals =============>	Organization of a psychobiological mother-infant system and mutual regulation	Foundation of the attachment organization (Beebe & Lachmann, 1994)
	Homeostasis	Synchronization

(continued)

common semantic references, the deixis, with respect to the body and the world. The new level of symbolic communication

TABLE 11 *(continued)*
Development of Interaction Systems

9 months - 16 months	*16 Mo - 25 months*	*25 months - 36 months*
Referencing interaction	**Proxemic interaction**	**Deictic interaction**
Supporting of locomotion	Turning away-approximation, negativism, obstinacy, ambitendent body contact	Establishment of the speech-based interactional system with a referential character
Interactional motor games, e.g. "persecution games"	Introduction of a speech-based interactional system	"Mobilizing" of the interactional system in a sagittal plane (Kestenberg et al., 1971): Running away - coming back
Systematic comparison of body parts	Complex imitation of social body gestures; mutual understanding through nonverbal signals	Body parts and genitals receive names
Initiation of exploration and manipulation in an"experimental manner"	Establishment of self assertion within the interactional system (A.Freud, 1965, Spitz, 1957)	Gone-there-games (Freud, 1920g); symbolic and pretense games express anxiety of losing body parts
"Monotropy" (Bowlby, 1959); availability of mother in case of need indicates exclusive object relation	"Preoccupation with physical functions" (Sander, 1962)	Differentiation of linguistic communication by inclusion of inner states
"Social Referencing" (Klinnert et al., 1984) consistent attention and feedback of mother	Some onset of damming up and modulation of the destructive aspects of affective expressiveness	Replacement of bodily bridging objects through transitional objects, for projection purposes
Focalization of infantile needs towards mother	Initiative for spatial differentiation	Foundation of the psychosocial ego-identity
More independent organization of self-regulation	Maintainance of a regulatory harmony	Differentiation of a bodily and a mental sense of self

References: Piaget, 1936, 1937, 1945; Spitz, 1957; Bowlby, 1959; Sander, 1964, 1977, 1985; Freud, A., 1965; Sander & Julia, 1966; Kestenberg, Marcus, Robbins, Berlowe, & Buelte, 1971; Clarke-Stewart, 1973; Escalona, 1973; Brazelton, Koslowski, & Main, 1974; Condon & Sander, 1974; Lewis & Lee-Painter, 1974; Stern, 1974a, b; Brazelton, Tronick, Als, & Wise, 1975; Papousek & Papousek, 1975, 1979, 1992; Bell, 1977; Trevarthen, 1977; Beebe, Stern, Jaffe, 1979; Brazelton & Als, 1979; Tronick, Als, & Brazelton, 1980; Greenspan, 1981; Campos, Barrett, Lamb, Goldsmith, & Stenberg, 1983; Klinnert, Sorce, Emde, Stenberg, & Gaensbauer, 1984; Lester, Hoffman, & Brazelton, 1984; Thompson & Lamb, 1984; Als, 1986; Cramer & Stern, 1988; Brazelton & Cramer, 1989; Campos, Campos, Barrett, 1989; Gorski through the vocal channel brings about an opening up of spatial proximity. Kestenberg, Marcus, Robbins, Berlowe, and Buelte (1971) speak of the "mobilization" of the motor interaction system in a sagittal plane. What this means is that the child runs far out in advance of the mother or remains far behind, only then to catch up with her. Everyone is familiar with this picture; the mother waits and calls to the small child. Muscular tone is held at high tension: The child is striving for bodily motor mastery and performance, taking joy in running fast and other ways of proving his motor skill to himself. In this mode, body-related references are also made to bodily parts (also the genitals), bodily products, bodily conditions, etc.

Ontogenetic Sequence of the Appearance of Primary Affect Expressions

On the basis of newer research it is possible to assume that facial displays of affect (Ekman and Friesen, 1969) in the earliest years of life have an essentially greater function with respect to intradyadic signal-giving than is later the case, and that they exert a special influence upon the earliest sense of self. Up to around the twenty-fourth month of life there seems to exist a direct link between facial display and the particular emotion felt (Rinn, 1984). The direct link, i.e., without social filter, between facial expression of affect and affective body-life corresponds to the assertion described by Spitz (1965a), Mahler (1968), and Parens (1993) that in earliest childhood, affect is a total organismic reaction. Empirical affect research was able to prove that certain specific neuronal autonomic excitement patterns go along with the facial display of affect, differentiating and amplifying the subjective contents here brought to expression (Tomkins, 1980; Ekman, Levenson, and Friesen, 1983; Levenson, Ekman, and Friesen, 1990).

In preverbal childhood, this organismic totality of the affective experience is of special significance for the continuity of the sense of self and the experience of the body, in which the experiences arising from interaction accompany and integrate. Not for nothing did Emde (1983) emphasize the purely experiential nature of the affective core of the self: "Because of its biological organization our affective core guarantees continuity of our experience all through our development, despite the many ways we change; it guarantees in addition that we can understand other human beings" (Emde, 1983, p. 165). From around 24 months onwards, the small child becomes able to voluntarily form facial affect expressions (Rinn, 1984) and hence to separate display from subjective experiencing. Later, in the course of the oedipal development at around 4 years of age, the child begins to be better able to assess the social desirability of affect expression, and as a result introjects in equal measure cultural rules of expression (Cole, 1985; Saarni, 1995, personal communication) and parentally mediated laws and proscriptions concerning the expression of emotion. Further development in later years then leads, largely mediated through cognitive knowledge about certain social standards and demands upon behavior, to the formation of the superego and the "moral self" (Emde, Biringen, Clyman, and Oppenheim, 1991). Nevertheless, the affective attunement of the first years is not based upon symbolic–cognitive performance, but rather upon the repeated rhythmical sequences of matching between interaction partners.

Stern (1985) introduces the important distinction between categorical affects and vitality affects, here termed *discrete* affects and *organismic* affects. These names are meant to express that there are two different levels, tied to each other but demonstrating different degrees of differentiation, that must be brought to bear in considering the development of affects. Discrete affective displays have primarily a communicative aspect within the mother–infant dyad, while complex emotions emerge from the organismic dimension (which are termed *state affects* by Moser and von Zeppelin, 1996). In emotion research, there are two great theoretical directions that are in conflict with each other: The theory of discrete affects, or differential theory, assumes inborn facial configurations. The theory of affect differentiation claims that affects are produced by and emerge from primitive protoaffect conditions through integration and differentiation (cf. Sroufe, 1982, 1996). Up until now, neither of the two theories was able fully to win the field; the truth probably lies in the connection between the two, in the sense that there are differentiation processes to be found at the organismic level, while more or less whole configurations may be found in the face (Izard, Fantauzzo, Castle, Haynes, Rayas, and Putnam, 1995).

The current state of research is complicated but may be outlined as follows: There exist "six, at most seven" primary expressions (Krause, 1983), which manifest themselves in the course of the first year (Scherer, 1992); incomplete precursory configurations of affect displays can be observed even a few days after birth (Camras, 1992). All in all, it seems that the expression of affect is subject to a developmental sequence (Scherer, 1992) stamped by the requirements of the interactions of the mother–child dyad. Certain expressions, such as distress–pain and startle reactions, are present immediately after birth, because they are important for the survival of the neonate (adaptation mode of interaction). Some positive expressions of affect, such as joy (exogenic smiling) and interest are relevant in the initiation of a relationship between mother and infant, when it becomes a question of positive mutual stimulation, that is, from about the third month onward (appropriation mode of interaction). A number of more negative expressions of affect, such as fear, anger, sadness, later disgust, seem to be connected with the development of locomotion, when dangers threaten the crawling infant and he gets reassurance from the mother (referencing mode of interaction).

The unending debate as to when authentic anger, sadness, or fear appear can better be resolved if the organismic level is brought into consideration. This is where the differentiations, outcroppings, and deepenings seem to occur, whose appearance is important in deciding the question of "authenticity."

Already in 1872 Darwin, to whom so many affect researchers refer, described the prestages of the organismic anger reaction in the first month of life up to the full outbreak of rage in a temper tantrum at 6 months, or the development of the startle reaction into the state of fear. In summary, it may be formulated that the development of affects cannot be reduced to the discrete displays, but must include rather the autonomic reactions, as they have an impact on bodily experiencing.

Beyond the first year of life there develop the nonfacial affects of "painful self-consciousness" (Amsterdam and Levitt, 1980), which I designate as *body-related social affects,* since they appear in the social framework at the time when the social eye is cast upon the toddler's body. Here we have embarrassment, shyness, timidity, the affects of the shame group, for which a biological basis (Kagan, Reznick, and Snidman, 1988) has also been postulated, but whose expression is determined as well by social standards such as behavioral ideals, already important as cognitive contents even at 2 years of age, and can only be differentiated, if at all, through subtle nuances in naming. Around the 2-year boundary there have been descriptions of the appearance of the feeling of guilt, which as an expressive phenomenon is not so very distinguishable from the shame affects, but is determined rather more through cognitive contents such as right and wrong in the sense of social norms and moral claims. While facially communicated affects of the first year have their effect more through the experiential immediacy of autonomic reactions on bodily experience shame and guilt affects, though they may be more deeply imbedded cognitively, are of special relevance for the molding of the body image. This is something that is to be observed again and again in psychic disturbances: norms, ideals, and guilt about body zones, bodily feelings, and processes. It is to be assumed that it is in the course of the third year that the internalization of interpersonal affect regulation begins. Through symbolic–cognitive forming over of the interactions, the preverbal world of experience is

TABLE 12
Ontogenetic Sequence of Primary Affective Expressions

Age in mo's	*Facial configuration*	*Antecedents*	*Organismic plane*	*Social expression*
1	Distress-Pain	Startle reaction	Unpleasure	Crying
2	Interest	Precursors of all facial configurations present	Orienting reaction, turning towards	
3	Joy	Exogenic smiling		
4		Rage precursors	Pleasure	Active Laughing
5	Anger	Crying with tears	Rage	
6	Sadness	Spitting		
7	Fear			
8			Anxiety (respiration, heart rate)	
9	Disgust			
10				Pride, Mastery
11				
12				Anxiety
13				Embarrassment
14				Shyness
15				Admiration, Elation
16				Contempt
17				Jealousy
18				Shame
19				
20				
21				
22				
23				
24				
25				
26				Guilt

References: Darwin, 1872, 1877; Bridges, 1932; Ekman, 1978; Izard, 1978; Oster, 1978; Hiatt, Campos, & Emde, 1979; Izard & Buechler, 1979; Emde, 1980a; Tomkins, 1980; Malatesta & Haviland, 1982; Izard, Hembree, Dougherty, & Spizziri, 1983; Krause, 1983; Lewis & Michalson, 1983; Klinnert, Sorce, Emde, Stenberg, & Gaensbauer, 1984; Malatesta & Haviland, 1986; Izard, Hembree, & Huebner, 1987; Malatesta, Culver, Tesman, & Shepard, 1989; Camras, Malatesta, & Izard, 1991; Camras, 1992; Scherer, 1992; Asendorpf & Baudonnière, 1993; Lewis, 1993; Sroufe, 1996.

partially integrated into a symbolic mode of mental functioning. As Lichtenberg (1988, 1989a,b) describes in his conception of different motivational systems, there develop around every bodily state of need basic experiences, which flow into the basic structure of the body image as model scenes.

Imagination and Symbolic-Cognitive Representational Capacity

Development of body representation in the socioemotional area is an extremely complex process that goes through several stages and is dependent upon the development of memory and anticipation capacities, imagination capacity, and the introduction of symbolization. Intrauterine body regulations, developed at first with chronobiological–biorhythmical support, take on a psychic quality when the state self as basal self-regulatory capability is reached. The imagination is tied to the function of secondary visual association area 19 (Goldenberg, 1987; Kosslyn, 1987) and therefore its ontogenesis is dependent upon *seeing* capacity. The development of the capacity to imagine has as its neurophysiological starting point the formation of a myelinated functional connection between certain pontine nuclei through the corpus geniculatum laterale with the secondary visual area of the occipital region in the third month of life. The ontogenesis of the capacity for imagination, which is not inborn, is indispensable to the development of the body image, since it enables—independent of reflexlike automatic body positioning—first the ideation of movements, the position of the body in space, and as a result, finally, the objectivization both of space and the ideation of the infant's own body as well. In my opinion, this ability is a necessary preliminary stage to symbolic activities that ultimately depend upon linguistic coding (Paivio, 1969, 1971, 1991), even if later only a part of the symbols are tied to speech.

Immediately after birth, what we have here, in addition to the establishment of fundamental self-regulating capacities in interaction with the mother—the state changes mentioned above—is above all the establishment of a continuing dialogue in periods of waking. Even in the feeding situation, it is not always so easy to maintain this relation of reciprocal regulation: The mother must perhaps alter her own bodily regulation in order to be able to give herself and the infant the relaxation without which he would be unable to drink. In any case, great importance must be attached to such interruptions and resumptions of reciprocal regulatory efforts, these derailments and reestablishments of the body–affect dialogue (Spitz, 1961, 1963, 1964, 1965b), since it is through them that the experience of producing positive feelings about his own bodily regulation in the relationship are conveyed to the infant. Since they appear to him simply as bodily sensations, they can be considered at the semiotic level as an iconic sign relationship, according to Peirce's classification (Peirce, 1902; von Uexküll, 1994). In this early phase, therefore, in the state of attentive alertness, pleasant experiences are as a rule tied to object relatedness because of a novelty preference. These "pleasurable experiences" contribute certainly to the infant's further engagement in face-to-face interactions, out of which he can develop interaction structures and imaginary structures. It must be emphasized, of course, that it is equally important that the infant not only can gather experiences in the system of reciprocal regulation, but that the relationship, by guaranteeing fundamental care activities, makes it possible for him to acquire self-regulatory capacities. This, however, is an aspect that only more clearly emerges some months later.

How is it that imaginative structures can come from interaction structures? Before the development of imaginative structures, as a consequence of the maturation of the perceptual systems through the storage of movement contingencies colored by affect experiences, there arise perception–affect–action patterns that form the basis for interaction structures. In this way, already at 3 to 5 months, expectancies emerge (Sander, 1964; Stern and Gibbon, 1979; Beebe and Lachmann, 1994), implicit action expectations within the interaction system, which give rise, through the linking of time, space, affect, and organismic arousal, to categorical prototypes for the representation of self and interaction. Here the capacity for discrimination, which has increased in this period, takes on a special role, since it makes possible the infant's sorting and differentiation of experienced reality. In a special way, this capacity is related to the perception of affect displays toward the other but also to the perception of movements. (It has been proved that infants can distinguish between biologically and nonbiologically generated movements; Bertenthal and Profitt, 1984.) At this time, the attainment of matching and its interactive, rhythmical repetition is of fundamental communicative importance (Beebe and Lachmann, 1994), because the infant learns not only to expect and share reciprocal joy and organismic–autonomous excitement, but also because through this the ground rules of communication are conveyed. The subjective–affective experience of sufficient dependability in positively colored reciprocity of affectively cathected bodily interaction experiences forms the basis for a later attachment quality at the age of 12 months or later (Beebe and Lachmann, 1994; Crittenden, 1995). If on the other hand the expectations of the child are hurt, this sets off negative affect reactions. These processes, which take place on a microanalytic level, show that the infant is capable of *anticipation activities* based upon the abstracted and generalized experiences arising from the sum of past interaction expectations. On the basis of sorting capacity, certain interaction scenarios, such as nursing, bathing, body care, cleaning, and playing, can be differentiated as model scenes (Lichtenberg, 1989b). The possibility of anticipation is the basis of imagination (Lemche, 1995). Viewed from a semiotic perspective, the child is at the level of indexicalic use of signs, since here an abstraction of accumulated experience is brought into play, an abstraction, however, which still contains at its core immediate bodily sensations (von Uexküll, 1994).

TABLE 13
Ontogenetic Constitution of Psychic Structures
and Representational Capacities

Intrauterine	*Birth - 2 months*	*3 months - 7 months*
Representational capacity		
Precursors of self-regulation and mutual regulation	State coordination still determinated chronobiologically	Distance perception and linkage of time, space, affect and arousal
Onset of chronobiological triggering of bodily regulatory processes in the last trimester	Emergence of a "State-Self" (Sander, 1985) as a basic self-regulatory capacity	Perception of movement contingencies
Onset of the myelination cycle of the Limbic Cortex area 23	Interruption and reuptake of regulatory structures within interaction	Discrimination of similarity vs. dissimilarity
Storage of engrams plausible through hippocampal activity	Beginnings and derailments of face-to-face communication	Formation of perceptual categories and prototypes (Nelson, 1981, 1984, 1988); RIGs (Stern, 1985)
Self-produced position changes made possible by vestibulary processing capacities	Alert wakefulness; novelty preference; other relatedness	Formation of expectancies within interaction structures

Bodily regulatory structures — Interaction structures

=======================================>
Perception-action-affect patterns

Imaginative capacity
=======================>

(continued)

TABLE 13B *(continued)*
Ontogenetic Constitution of Psychic Structures and Representational Capacities

9 months - 15 months	*16 months - 23 months*	*26 months - 35 months*
Representational capacity		
Establishment of attachment relationships; Social Referencing	Onset of symbol use	Beginnings of a "Theory of Mind"
Imitation of 2-3-tailed action sequences, procedural memory capacities	Linking of symbols and pluritailed action sequences	Deixis of inner states
Affective attunement, state sharing, and mutual state transformations	Onset of the transitional object	Use of proper names, onsetting verbal self-referentiation
Anticipation capacities due to increased memory capacities: interaction expectations indicate phantasmatic functioning	Creation of imaginary situations during play	Onsetting object constancy
Total bodily imitation indicates imagination capacities	Object dependent, signal-based action regulation	Onsetting intrapsychic cognitive-emotional action regulation

Presymbolic-imaginary structures

Symbolic structures

Imaginative capacity
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Verbal coding
============================>

References: Piaget, 1963, 1966; Nelson & Gruendel, 1981; Nelson, 1986, 1988; Mandler, 1983, 1984; Bretherton & Bates, 1984; Sander, 1985; Stern, 1985, 1987, 1989, 1992, 1994; Bertenthal & Campos, 1987; Beebe & Lachmann, 1988, 1992, 1994; Crittenden, 1989, 1990; Piñol-Douriez, 1989; Meltzoff, 1990; Perner, 1991; Mayes & Cohen, 1992; Krist & Wilkening, 1993; Beebe, 1994.

In the development of representational structures, there are fundamental analogies between face-to-face engagement and body-related interaction; the mechanisms of abstraction are the same, but a number of motor experiences can only be made alone. While in face-to-face interaction the child's affect expression is oriented to the affect display of the mother object, while in motor learning he must accompany his own movements with visual control. Through this there arise complex blendings of sensory data, among them the visual and the kinesthetic modalities. The anticipation arising from generalized expectations nevertheless takes place here on a purely presymbolic level. Between 9 and 15 months the establishment of presymbolic–imaginary structures with increasing anticipation activities is indicated by an increase in the complexity of whole-body imitation. This means that motor acts of parents or siblings can also be imitated by following movements, and visual control of the performance is no longer necessary. At the same time, there is a sharp increase in the length of time during which a behavior can be held in memory before it is imitated by the child.

Speech acquisition leads, through linguistic coding of presymbolic-imagined experience contents, to the substitution of perception–affect–action patterns with symbolic structures. This representation stage of compressed and generalized experience sequences is reached between 17 and 23 months. Symbolic signs lead intrapsychically to an integration of the immediate body-bound experiential world and finally to mental psychic structures. This is clear in the interactional space as well, when it comes to the replacement of bodily bridge objects with symbolic transitional objects, since this raises the object relation as well to a new level. The introduction of language—not only spoken language, but also nonverbal emblems—brings about in the bodily realm as well an object-dependent, signal-based regulation of action: Child and mother communicate with gestures long before the toddler's word repertoire would be sufficient for this. This already corresponds to the semiotic level of the symbolical employment of signs in reference to a third something; that is, to a common meaning. The negotiation of meanings between mother and child brings about symbolic reference capabilities in the interaction. Between the ages of 23 and 25 months, the child becomes capable, not only of outlining his action with a word, but also of referring to his internal emotional condition during the action, when he is able to put together several verbal symbols. This shared demarcation of symbolic signs and the struggle to understand causal meaning sequences takes the child, in the words of Lichtenberg (1983), into the second perceptual–cognitive–affective mode: Only representation through a symbolic self makes possible a normal mental experience of the self. In his opinion, this "holistic self" is reached at the age of 24 months. It accords in this respect with the findings of a number of developmental psychologists, who have been able to observe the beginning of verbal self-reference at this time. Imagination is therefore the reproduction of reality as taken from perception. Introduction of symbolic concepts makes possible the cognitive replacement (Stern, 1994, p. 10) of this perception. In the course of the third year of life, the play of symbols develops in a social context, especially with other children (Deleau, 1993). Into this context come, in the form of scenes, unconscious motives, and the communicative exchange becomes the essential form of representation of body-related imagination in the play situation.

Stages of Ontogenetic Transitions

In developmental psychology, considerations of certain problems often have meaning only when their results furnish evidence of demonstrable stages that are characteristic of the process of development in question. When, as with the material here presented, a maturation of certain neurophysiological substrata is presumed, one must take these changes into consideration. There is probably no other period in human life in which psychic development is so closely interconnected with the development of the brain, as here in this earliest period. For this reason it is hardly possible not to consider this development if one is to make well-grounded statements about the period.

The starting point for the stage-model taken as a basis here is the research findings of Emde, Gaensbauer, and Harmon (1976). On the basis of EEG measurement and the appearance of affect expressions in the first year of life, they distinguish two phases of rapid change in the central nervous system, which they call "biobehavioral shifts." Wolff (1987) considers these profound and wide-reaching changes to be so important and decisive that he speaks in terms of a transformation in the relation between brain and behavior. Between "biobehavioral shifts" there are plateau phases in which changes based upon underlying maturation processes are not so fundamental, and within which the continuing accumulation of experience seems to be of great significance. Emde and Harmon expanded their concept (1984) with a description of discontinuities and continuities in the process of development. This concept has been confirmed and expanded upon by other authors, particularly for the period of the first 18 months.

In the course of development, underlying maturation determinants, as measured by at first quite sharply determinable neurobiological changes, become increasingly less sharp, since CNS development is dependent upon the influence of lived experience: There are complex interactions at play here, which are just beginning to be researched. Then between 18 and 36 months, psychic development has already become so multilayered and independent of maturation processes that in investigations, great discontinuities only can be discerned resulting from expansion of cognitive competence or other developmental performances (cf. mirror studies).

As far as intrauterine development is concerned, an expansion of the method of Emde, Harmon, and Gaensbauer based upon fetal EEG data (Dreyfus-Brisac, 1979), and neonatological research (Prechtl, 1981; Van Vliet, Martin, Nijhuis, and Prechtl, 1985) has made it possible to discern two biobehavioral shifts, in the twenty-fourth and the thirty-first weeks of gestation respectively. Developmental neurologists describe EEG patterns from the last trimester as being so regular that the age of the fetus can be derived from measurement of EEG. It is only between the twenty-first and the twenty-fourth week of pregnancy that the first discontinuous electrophysiological signals can even be registered from the cortex surface, and these take on a continuous character from the twenty-fourth week on. In brain development there begins at this time the formation of the gyri and separation of the hemispheres, which accompanies the sprouting of dendrites, and can be closely correlated with synaptogenesis (Als, 1986). As of the thirty-second week, differentiations in the EEG can be observed, namely the incipient development of deep sleep and coordination of the theta parts corresponding to REM phases with the fetal breathing rhythm that begins at this time, along with other biorhythms. One can place a further biobehavioral shift in the last two weeks before birth, when a state of focused alertness appears. It is not clear whether the appearance of this state is connected with the onset of differentiated laminary growth of the neocortex.

At 2½ months, the most important development is the maturation of the intracortical connections of some perception systems. In this earliest period, the central nervous system is dependent for its differentiation upon extensive sensory stimulation from the outside world. Greenough (1987) speaks of maturation processes that are "experience expectant" during this "sensitive" period, and in later periods maturation is even more dependent on experience. Sensory impact is demonstrable in many and various physiological correlates as of this two-and-a-half month shift. The essential result is a subsequent social reciprocity; for example, with the exogenic smile that was

TABLE 14
Temporal Stages of Ontogenetic Transitions

Biobehavioral shift Discontinuous development	*Plateau-phase* Continuous development	
24 GW	25 - 29 GW	Weeks of gestation
30 GW - 32 GW	32 - 38 GW	
38 GW - 40 GW	40 GW - 10 PNW	
10 PNW - 12 PNW	3 -7 months	Postnatal months
7 - 8 months	8 - 15 months	
15 -16 months	17 - 23 months	
24 - 25 months	26 - 34 months	
35 - 36 months		

References: Preyer, 1885; Uzgiris, 1972; Emde, Gaensbauer, & Harmon, 1976; Kagan, Kearshley, & Zelazo, 1978; McCall, Eichhorn, & Hogarty, 1979; Trevarthen, 1979; Lecours, 1982; Mounoud, 1982; Emde & Harmon, 1984; Kagan, 1981, 1984; Prechtl, 1981, 1985; Klinnert, Sorce, Emde, Stenberg, & Gaensbauer, 1984; Prechtl, 1985; Thompson & Lamb, 1984; VanVliet, Martin, Nijhuis, & Prechtl, 1985; Wolff, 1985.

before endogenic. The child is more capable of turning toward the outer world, and this can be seen in his tendency toward object manipulation.

At 7 to 9 months as well, profound and extensive changes in the CNS take place: These are evident above all in new forms of EEG activity, in the incipient myelination of the frontal lobe and the cerebellum, etc. Along with these changes, principal manifestations are a sharp increase in memory capacity, coordinative motor skills, the first stage of object permanence, a deepening of emotional expression including the deepened social relations already noted, along with a simultaneous increase in caution. At 15 to 17 months, the layer-thickness of the active speech fields catch up, so that overall there is in the neocortex a more or less even distribution of layer growth. In the EEG the alpha pattern develops. Still, it is not until the 23- to 25-month biobehavioral shift that the child develops increased vigilance values with beta band EEG that begin to compare with those for adults, since such desynchronous EEG patterns are based on neuronal network linkages such as can only come into being on the basis of an advanced dendritic arborization. During this biobehavioral shift there takes place a reorganization of the states in favor of sleep stages along an adult distribution with short REM periods.

Decisive Role of Proprioception in the Constitution of the Body Image

Before I introduce the processes contained in developmental phases of the body image, some explanations may be necessary concerning the origin of the terms used. Recently von Uexküll noted again what a central position proprioception, i.e., muscular self-perception, occupies in the creation and maintenance of bodily self-perception. He describes bodily self-perception in terms of a process in which a previously unconscious monologue comes into awareness: "Sense, feeling, and perception of one's own body must then be conceived of as a sort of dialogue between parts of a social-self through this [inner - E. L.] monologue" (von Uexküll, 1994, p. 80).

In the approaches to development of the body image presented up to now in the field of psychoanalytical developmental psychology (Lemche, 1993) there are various approaches as to which sources of experience actually feed a body-related sense of self. Among these may be discerned two major lines of thought: those approaches that take *proprioception* as their starting point, and those that instead take *enteroception,* i.e., the perception of visceral tension, as their point of departure. There are a number of proprioception theorists. Freud (1923) emphasized the role of the sense of touch and the sensation of pain in the genesis of the body ego, including the corresponding brain structures. Schilder (1935) emphasized the role of bodily position and place reactions, on the psychodynamics of conscious and unconscious affect organization and on sensorimotor development. Kestenberg (1971, 1978) emphasized the role of movement perception for bodily sense of self in the context of the mother–child interaction. One can distinguish in the above approaches body image models that place a concept of enteroception at the center of their considerations: This is the approach of Federn (1926), Spitz (1945), Mahler (1968) and Greenacre (1953, 1955, 1958). These authors trace the origin of the body image back to a perception of tension, a tension that is shifted at the beginning of psychic development from an original state inside the body to the outside, where it undergoes a more differentiated boundary modality.

In the model here proposed we are dealing with an activity-proprioception model of the body image ontogenesis, one corresponding to the tradition in body image research that centers on the experience of touch. The basis for the nomenclature here is the consideration of just what movement sequences proprioception experiences are to be derived from. Essential to this approach is the insight that it is not so much passive experiences that are most decisive for body experience, but rather that perceptions originating in the infant's own motor activity dominate the structure of internalized bodily experiential qualities, finally appearing in psychic processes as well, in imagined and symbolized form (Schilder, 1935), when the small child leaves the preverbal stage. Proprioceptive movement perceptions are mediated in the peripheral nervous system by gamma motor neurons (Kestenberg, 1978), which in coaction with alpha motor neurons are responsible for carrying out movements. In the sense of von Weizsäcker's (1950) concept of the gestalt-circle *(Gestaltkreis)* that sees movement and perception as an experiential unity, the model presented here is based on the idea that proprioceptive movement sensations arise from motor activity; specifically from the sensation of touch and the experiential qualities conveyed through the various systems of interaction within the mother–child dyad. One may assume that the experienced contingency between proprioception and exteroception represents the basis of a body-related sensing of self (Bahrick and Watson, 1985). The nomenclature of the developmental phases of the body image described here takes into account this experiential unity to the extent that the terms *cohesion-fragmentation* and *expansion-contraction* are derived from the work of Schilder (1935), who was the first to describe these fundamental experiential dimensions of the body image.

In considering the ontogenesis of proprioception it is essential to know that neuromuscular linking of gamma end-plates reaches its final form in the twenty-fourth gestational week (Barker, 1974). Another starting point of this theoretical model is the spontaneous motor function whose origin can be traced back to the basic rest–activity cycle (BRAC) first described by Sterman and Hoppenbrouwers (1971), the cycle that is also the biorhythmic starting point for movement development (Dreyfus-Brisac, 1979), though of course fetal movements take place earlier in pregnancy. In recent years, research on infants has contributed a number of results that lend support to the importance of being held and rocked for the child's thriving and well-being. There now exists an abundant research literature that is able to demonstrate that earliest development is largely centered upon the sensation of contact (overview in Barnard and Brazelton, 1990), which gives it decisive developmental stimulus. Bodily contact has a significant effect upon the development of the CNS and the endocrinum; for this reason newborns placed in incubators are at a disadvantage. The quality of the touching interaction is a main factor in the later development of attachments-relationships, and it is notable that the parents derive their attitude toward touching from their own history of body-related relationships (Main, 1990).

Proprioceptive sensation has a decisive place also, as Freud (1923) makes clear in his formulation, "*dem Getast zweierlei Empfindungen*" (two impressions in the sense of touch), because the connection to the love-object or to one's own body is differentiated in the experience—bodily self-sensation is always *in relation,* and interaction and the object relation are decisive for development. The basal self-object needs discovered by Kohut (1971) have their place here as well, because they relate to the experience of the other that involves warmth, acceptance, being picked up, being held, protected, and accepted unconditionally by the parents (Basch, 1982, 1983, 1990), experiences that are conveyed in the preverbal period predominantly in a physical and proprioceptive manner. But as important as touch sensation and kinesthetic experience are in the dyad of early infancy, they do not constitute the entirety of the experiential world integrated in the body image. The openings in the body, for example, are also experienced proprioceptively, because they are found under the body's surface, and therefore within the proprioceptive sphere. Schilder (1935) sees the eyes, nose, lungs, ears, mouth, skin, hands, urethra, vagina, and anus as the areas most important for the body image, in that they bring the body into contact with the outside world (Schilder, 1935, p. 140). Paradoxically, the boundaries of the body are experienced more clearly at its openings. In the same way, Bick (1968) and Anzieu (1970, 1985) see the skin as an opening of the body: The skin is an open organ, even though it is the visible boundary of the body. Even so, the body image is no "skin-ego" since every body possesses, subject certainly to culture and pathology, an imaginary spatial boundary that has direct bearing upon body experience (Horowitz, 1968). In research on nonverbal communication, interpersonal distance is described as the decisive boundary in dealing with other people. A decisive subjective determinant is here constituted by unconscious phantasies from the earliest object relations, which have an effect, through individual dynamics, upon the body image, but which elude to a great extent any beginnings of an effort toward normal development. The unveiling of these qualities is the task of individual psychoanalysis.

The Rotation versus Disruption Phase

When, as was the case in the previous section, the names of developmental phases are derived from movement quality of spontaneous motor activity, it is appropriate to make some remarks about fetal movement during this period. Characteristic for the rotation plateau phase are turning and writhing movements of the trunk and head as well as the members. Since musculature is not yet limited in this period by flexor tone, the fetus can move with relative freedom within the amniotic fluid. Movements have at this point a gentle and circular character, as has been described in several studies (Humphrey, 1964; Birnholz, Stephens, and Faria, 1978; DeVries, Visser, and Prechtl, 1985). The phase between the twenty-fourth and thirtieth week of gestation, in which movement activity (as in the 15th week and between the 32nd and 37th weeks also) is especially intense (Birnholz et al., 1978, p. 538), representing the most active movement phase of the entire pregnancy. In order to make the contrast clear, I will go back once again into the early period of pregnancy.

The movement activities of the fetus begin early in the pregnancy: Already in the 8th week of pregnancy movements may be discerned in ultrasound pictures (Reinold, 1972). Nevertheless, they have a fully different quality from those described above: They are characterized by their abrupt quality and are made up of twitching of the trunk and head, of writhing with a spastic quality, and of jerky, stagnating movements of the members. Stimulations of the fetus show that between the eleventh and fifteenth weeks of gestation it has at its disposal the full inventory of reflexes; these reflexes—grasping, among others—are based nevertheless on spinal reflex arcs, whose neuronal connections are being closed during this period (Humphrey, 1969). Accordingly, reflexes in this period can be triggered by skin contact. The transition from spinal to cerebrally controlled movement occurs in the second trimester of pregnancy. At twenty-four weeks, the proprioceptive sensation receptors of the sensory paths, as well as the neuromuscular end-plates of the efferent-motor alpha and gamma innervation have reached full neurogenetic development. The myelination cycle of these efferent and afferent pathways has taken place already in the fourth or fifth month; furthermore, information from cranial nerve VIII, the nervus vestibulocochlearis, is now available to the fetus, giving it sensations of balance and position (Yakovlev and Lecours, 1967). Such sensations contribute to the vestibulocerebellar mode of experience as one important ego precursor (Frick, 1982; Levin, 1991). Opening and movement of the eyes occur between the sixteenth and twentieth weeks of gestation.

Observations of the fetus's activities show that it makes use of all neuronal possibilities: Characteristic patterns of movement consist of periodical sequences, and rest periods are characterized by lying down and changing place and position (Reinold, 1972; Reinold and Kucera, 1975; Nijhuis, Martin, and Prechtl, 1985; Piontelli, 1992). In a neurologically healthy fetus one may observe circular or arclike arm and leg movement sequences, which are supported by the vermis cerebelli and perhaps for this reason demonstrate this gentle mode. Without these rowing motions, the fetus sinks in the amniotic fluid and touches the bottom of the amniotic sac. This happens, for example, when the fetus, as the result of a loud noise, experiences a startle reaction and stops moving. There are descriptions as well of how, in the rest period, the fetus positions itself in a resting position at the bottom of the sac, while in periods of activity it takes a more upright position (Piontelli, 1992).

The neurogenetic shaping of the hippocampus formation has already reached completion at this point. The myelination cycle of the hippocampus, which extends into the twenty-fourth month of life, has already begun. The beginning of myelination does not mean that the hippocampus is not yet mature but rather the contrary; that it is already functionally active. The incipient theta activity in EEG, at first discontinuous, is further physiologically based evidence that already at this time long-term storage of memory contents is in process. One can nevertheless assume that this storage encompasses only most general and undifferentiated experiences.

With the beginning of the last trimester, the motor activities of the fetus are tied to the basic rest–activity cycle (Sterman and Hoppenbrouwers, 1971) and are rapidly increasing in complexity. Thumb-sucking had made its appearance earlier in the pregnancy, and hand–mouth movements remain the most frequent of all, both before and after birth (Prechtl and Hopkins, 1986). In the phase of rotation versus disruption, the neuron migration phase of the origin of the CNS is very near completion, and dendrites are just beginning to be formed. The slow onset of synaptogenesis is another reason to believe that experiences are processed and stored. Although there can be no proof that the experiences of the last trimester actually influence the representation of the body, all the necessary conditions are here at hand. It is clear here that there now exist self-initiated performances of movements whose character is well beyond being reflectory.

The Reversion versus Insituation Phase

After the biobehavioral shift of the thirty-first week of gestation, characterized by increasing hemispheric synchronization in the EEG (Dreyfus-Brisac, 1979), a period of greater developmental continuity seems to be reached. In this plateau phase, the experiential situation that arises for the fetus is changed compared to that in the rotational phase since, owing to its increased size, there is less space in utero, and this necessarily limits movement. Free movement of members is hardly possible any longer, and the surfaces of the fetus's body touch the inner wall of the amniotic sac in many places.

The most common movement sequences ascribed to the fetus at this stage are principally the turning of its head along with twisting of the trunk, kicking on the abdominal wall, light locomotive movements with the arms and legs, and hand–mouth contact such as thumb-sucking. Although the members must to a great extent remain in a bent position, the fetus makes these movements with great energy: In the eight weeks before birth, it can only turn and change position with great effort. All the more surprising, then, that it can still do this! As observations of its movement behavior demonstrate, it takes great pains to reposition itself by turning on its bodily axis. Such spatial actions of turning around can take from one to two minutes, as for example when it changes from head-up to head-down position and vice versa. This motor activity can be seen, in its astounding complexity, as a precursor of intentionality.

As has been described in the previous section, BRAC is established, and from this are differentiated REM precursors with theta rhythms. But it would be presumptuous to say that the fetus is a dreaming being (Schindler, 1986), as has often been claimed, even if certain physiological correlates for this are available. At this time there is no dreaming; this is only a physiological possibility after the third postnatal month at the earliest. If one interprets EEG data with respect to activity, one could assume that what is involved here are, at best, "twilight" states, which put the fetus to a great extent into a hazy existence. And even these statements are mere speculation, for we know nothing about the sensation world of the fetus and can only gain fairly certain information about its activities. At any rate, what is measurable is the fact that in this period differentiated waking and sleeping develops out of the basic rest–activity cycle. The changes of state at this time are chronobiologically controlled, but the influence arising from the mother's state has been documented several times (Brazelton, 1986): Whether the mother is sleeping, resting, or active has relevance for the fetus's sleeping, resting, and activity.

Regarding the perception capacity of the fetus, it is probable that it can perceive differences between bright and dark, and noises from outside may be perceivable in dampened form in utero, since the amniotic sac may be susceptible to vibrations. Certainly the mother's voice can be heard clearly. Startle reactions, as mentioned, appear early in the pregnancy. These are related primarily to acoustic perceptions, because the maturity of the necessary sensory paths are here well advanced, in distinction to those of other exteroceptive channels. Although in growth the minor hemisphere is in general about two weeks ahead of the dominant one, as of this time the speech perception regions on the left side (Heschl's gyrus) have clearly increased in size morphologically. This fact is certainly to be seen in its relevance to the possibility for acoustic perception, specifically to the maternal voice (DeCasper and Fifer, 1980). The first psychological evidence of existing memory capacity comes from preterms after thirty-six weeks of gestation: They are capable of recognizing large, bright, areas of color. These experimental data convey a clear impression of the undifferentiatedness of memory storage in this plateau phase.

Movement activity of the fetus diminishes significantly shortly before birth due to spatial impairment, so that in the biobehavioral shift of the last two weeks of pregnancy, hardly any more movements can be registered (Birnholz et al., 1978). The French neurologist Amiel-Tison (1968) was able to show that the high point of flexor tone is found in this period. This condition, not actively influenceable by the fetus, results in its arms and legs being pulled in very close to the trunk. The biological ground for this is presumably that it makes passage through the birth canal easier. The state of increased tonicity holds for some time after birth and plainly limits the free execution of movements.

The Extension versus Flexion Phase

The name of this plateau phase is also derived from the quality of the movement sequences that most often appear. At around the time of birth, neuromuscular flexor tone in the prenatal biobehavioral shift reaches its high point. The members, which as a result are bent in periods of rest, can only with effort be moved outward by the neonate for some time after birth. Quantitative analyses carried out independently by several research teams have shown that the most frequently occurring movement patterns in the neonatal stage are undirected extending, stretching, waving and kicking movements such as can be characterized as extension (Dowd and Tronick, 1983; Prechtl and Hopkins, 1986). So these can as yet hardly be used for the manipulation of objects. The long held opinion, according to which there are side-specific preferences for postural positioning, could not be confirmed (Cioni, Ferrari, and Prechtl, 1989).

A biobehavioral shift occurs during the last two weeks before a birth that takes place on schedule; this is parallel with the onset of the growth spurt of the brain: It prepares the central nervous system for extrauterine experience. This contradicts the widely held conception of maturation processes as independent biological activities; the central nervous system development at this time is tied indispensably to incoming sensory perceptual experience. The fact of so-called experience dependence for neuronal growth has been known now for more than twenty years, and it is clear that the nervous system would atrophy and die away without sufficient stimulation from the outside world. The more salient and positive the stimulation during the period of experience expectancy, the more differentiated the neuronal networks that come into being at this time (Greenough, 1987). In the first months after birth these concern especially the primary sensory fields. These findings, which are gradually gaining acceptance, accord wonderfully with the psychoanalytic concept of the good enough mother (Winnicott, 1965). There is speculation about whether the increased REM phases during the first month of life serve as hallucinations to bring about autostimulation of the CNS, but there are no indications that hallucinatory processes occur in these phases with corresponding EEG correlates.

In the first minutes after birth the newborn is already awake and ready for contact, which is important for the first encounter between the mother and infant (Kennell and Klaus, 1984). In this early interaction, sensations of smell seem to be of special significance. On the other hand, the hypothesis that the first contact is one that will determine the nature of the attachment relationship by an imprintinglike mechanism similar to bonding is clearly unsubstantiated.

Mother and child need the two-and-a-half months after birth to recover from the birth and the pregnancy. The infantile organism has the task of adjusting to essential physiological–regulatory processes in the outer world. This cannot take place without the closest bodily contact with the mother, which results in a connection between their respective biological processes (Hofer, 1990). I will limit myself to the processes of exchange relevant to the experience, not wishing to discuss the fine points of the endocrinum here. The interaction is centered preponderantly upon physiological processes; accordingly it "forces" the mother to react to the child in accordance with the chronobiological processes of the child. He or she has first affective experiences through hunger-stilling sequences and the stimulation of being held and rocked. Autonomic perceptions, somatic regulations, and enteroceptive and affective–organismic cues are presumably the main determining factors of experience, if one looks at those neocortical areas that are growing the fastest during this period; namely areas 23 and 24 of the limbic cortex.

A more exact analysis of the perception capacities and behavioral repertoire of the child also shows clearly that these are adjusted to close bodily contact and the adaptation–interaction mode (Stern, 1977). You may recall that the states, at first chronobiologcially controlled, change rapidly in the first months through the mediation of interactional regulation; on the other hand, the availability of sufficient homeostatic equilibration makes it possible for the child to bring about self-regulatory experiences through state change (Sander, 1980, 1985), and interaction should allow him to build those first psychic structures in this period.

Affect experiences that the infant is able to make in the newborn phase are an important part of his earliest experience. Along with that precursor of fear, the startle reaction, which continuously recurs during sleep, and fleeting indications of a smile expression, it is above all organismic distress that organizes the contact to the mother necessary for the infant's survival. There are at least four distinguishable types of cries: pain, hunger, boredom, and discomfort, which carry corresponding negative affect qualities, and at the same time force the parents to make efforts to remove them. The parents learn in this phase to differentiate between the different types of cries. In the infant's face as well, the expression of distress-pain is the decisive discrete affect category for conveying discomfort and pain. Though already, as Camras (1992) shows using video analyses of her own children, there are in the period immediately following birth configurations of all discrete affects, their full expression and therefore also probably their subjective experience at this time are not yet so relevant, since a deepened autonomic reaction is not yet so differentiated and pronounced. Since discomfort and pain dominate now, the affect qualities tied to parental body regulations are made up of soothing, gratification, or tonic stimulation.

The sense of self in the newborn is especially dependent upon positive integration and loving attention from outside, and it is only now through these that there comes about a tentative development of perception–somatic regulation–affect patterns into limited self-regulatory capacities. Psychic existence is characterized by changes between discomfort, excitement, feeding, and holding contact, which still are combined with little expanded periods of alertness. From here, basal somatic experience may turn on stimulation from the sensations of tension and relaxation, digestion and breathing, and vestibular sensations of holding and rocking.

The Cohesion versus Fragmentation Phase

The name of this plateau phase is derived from the motor experience that comes about for the infant's sense of self when, as a result of increasing directedness in the performances of movements, he can experience that his body holds together as a motor–affective unity. This experience of bodily wholeness is the result of a transfer of movement intents that takes place with increasing success as, spurred perhaps by curiosity and interest, he explores his objective surroundings, feels the body of his mother in exchanges, or playfully touches his own body parts. The sensations that arise from this contribute, for example, to his experiencing his feet as belonging to his body, far away though they may be. The gradual success he has in carrying out movements results in his experiencing his body as a unified place of physical centeredness and affect processes, but is dependent on sufficient matching with the maternal other. Loss of this matching leads to excessive negative affect experiences, to the sensation that the unity is breaking up, and thus to the fragmentation of the body image.

Touwen (1976) calls the phase of reduced intentionality of neuromotor development in this period arbitrary: The infant can clearly express his movement intentions, but fully voluntary carrying out of movements has not yet been reached. The reflectory placing and positioning automatisms, in interplay with the apparatus vestibularis, cerebellum, thalamus, and globus pallidus, appear and facilitate the supportive motor processes so important as the basis for voluntary motor functions and for locomotion. Through practice, the infant can thus experience that his body can be used successfully in the fulfilling of wishes; for example, in the exploration of his environment. Successful movement of his members with visual control, increasingly successful object manipulation, and attempts at locomotion convey to the infant a body-related self-sensation of the body image as a unified entity. It is evident that the "mirroring" attunement qualities that accompany the activities of the infant are related in manifold manner to social–reciprocal, motor, and playful–explorative activities.

The biobehavioral shift at 2½ months brings precipitate changes in the maturation of the primary sensation systems, in the differentiated specialization of cerebral neurons and the growth of their axons and dendrites. The experiential impact leads to significant neocortical layer growth in the anterior limbic cortex, the central region, in the occipital pole and the anterior temporal speech center; that is, to the projection regions of the primary sense information (visceral regulation, somatosensorics, motorics, vision, and hearing).

In the development of states as well, the influence of the enlarged perception capability is expressed by the rapid increase of periods of alertness. This leads reciprocally to greater attentiveness and a new turn toward social contact. The biobehavioral shift that has taken place brings with it capacities for dream-imagination, filled out from this time on with perceptual content. Accordingly, protodreams (i.e., indications of dream behavior) can also be observed. By this time forerunners of the alpha blockade give measurable evidence that visual sense impressions are now coming into the visual cortex leading to its laminar differentiation.

As a result of increased periods of alertness, facial affect display configurations appear now in face-to-face interactions with the mother (exogenity of smiling), apparently with rather positive affect expressions. These consist especially of displays of joy and interest. Voice contours that stimulate the child in a greeting manner are also culturally universal (Papousek, Papousek, and Bornstein, 1985; Papousek, 1994). The first interaction structures are created through the highly rhythmic combination of vocal stimulation and affective–facial stimulation that brings about a positively exciting sensation quality in the infant (Beebe and Lachmann, 1994). The combination of attention, joyful affect qualities, and social contact, which stimulates excitement, brings about interactional structures that the child wants to repeat. The whole-body joyful affective quality, together with rhythmically exciting stimulation, are a novelty for the infant: They determine his body-related sense of self in this period. Exchange of positive affect expressions leads in the end toward a shared attentiveness between the other and the child as they jointly look in the same direction and regulate body positioning after this interaction (Fogel, Nwokah, Hsu, Dedo, and Walker, 1993). In this way, development of intentionality in the infant is also tied to mutual exchange of affect. If the positive affects that animate the exchange are disappointed, the infant reacts with negative affects, precursors, as it were, of anger reactions.

The interaction system in the appropriation–interaction mode strives to bring about matching on both sides: Long-term studies would seem to indicate that when both sides positively stimulate each other, a later secure attachment organization is more probable, since the emotional relationship is then stable enough to include negative affect qualities and bear stressful events as well. In the period between 3 and 7 months, the most important developmental goal is the creation of a repeating synchronization in the exchange of affect signals. At the end of the first year, when an affective behavior control system based upon facial cues between mother and child accompany the latter's widening explorations of his surroundings, this matching becomes all the more important. In the course of the cohesion phase, mutuality of exchange in the interactions at the physical behavior level increases. This has the effect that around the middle of the first year, body contact, which up to this point had been initiated for the most part by the parents, is now increasingly initiated by the child. As you can imagine, a growing capacity for motor control plays a role here. The close spatial–bodily relationship is gradually expanded through the child's prewalking locomotion (i.e., creeping and crawling), which is still done within reach of his mother.

Visual accompaniment to the infant's movement sequences in the mirror image corresponds to the contingency relatedness between vision and movement that exists outside the mirror situation as well, for example in his practicing of grasping movements. Visuomotor control and the experience of contingency between inner proprioception and outer, exteroceptive movement perception is of great importance for the cohesion of the body image in the first few months of life. It gives rise as well to affectively positive integration in the carrying out of movements, which expresses itself in exalted joy when this is done successfully, yet without the infant being capable of mirror self-recognition. Movement must here be accompanied by outer perception, since, because the cross-modal engrams are just coming into being, the child has as yet no capacity to imagine movements.

This is connected, of course, with the first use of memory storage for this sort of movement engram. All the same, the infant is becoming gradually capable of retaining and recognizing simple models of behavior over a period of twenty-four hours. The prerequisite for these imitative abilities, lengthening of retention time in short-term memory, takes place in the second quarter of the first year. The discriminative capacity necessary to make out ever finer features necessary for face recognition is increasingly present in the first 6 months; this is also the result, though not exclusively, of the development of visual capacity to adult sharpness.

Representational capacity at this time is based primarily on the linking of recurring distinctive features, perceived in interaction, to event categories. Event categories formed for the interactive experience of the object relationship, as well as in self-regulatory experiences, create the basis for later representation of the body and of the self. Generalization of such event categories brings about prototypical interaction structures in mutual regulation and self-regulation on the basis of their affective experiential content. Affective experiential contents influence expectations for interaction sequences that are always new, and that build, with the increase of memory capacity, the capacity for anticipation.

Kohut assumed the narcissistic quality of self from the beginning as a given since, as distinct from the "otherness of the other," the limbs and their movements are always at the body's disposal (Kohut, 1968, p. 192). On the basis of our studies we have to modify this view somewhat, since it has become clear that early development does not take the form once assumed and that the achievement of volition is a long and difficult process taken on with great effort by the child. Infantile grandiosity thus may be rather an attempt of restitution from an initial insufficience. Concerning this issue, Köhler (1995) emphasizes correctly that the nucleus of the self is only consolidated as of the seventh to the ninth month; this accords with the results presented here to the extent that it is from this time on that the polarity between cohesion and fragmentation is overcome.

The Comparation versus Affination Phase

The name of this plateau phase comes from the typical behavior of reciprocal touching between the mother's and infant's bodies first described by Piaget in 1945, which makes its appearance with great frequency in this phase. In the comparation phase this has to do with the infant's comparison of his body with another's. As the result of a simultaneous creation of awareness of otherness, a tendency toward approach with this other—the other body and the other person—is brought about. In the course of infantile development, of course, touching and holding the parental bodies has become commonplace; still, in the comparation phase these take on the systematic and repetitive quality of checking. A short episode:

> Emily, 13 months old, looks on as her mother takes a shower. She grasps her mother by the pubic hair, then grasps her own hair. She grasps her mother's breast, then looks down at her own breast. According to the report of her mother, she also observes closely the activities of her

naked father in the bathroom, but shows no affective reaction to the sight of his penis, nor any other indications of an awareness of gender differences as such.

It seems here to be rather a matter of establishing a parallel between respective body features, along with familiarity and approach to the other.

The biobehavioral shift that takes place between 7 and 9 months is characterized by the rapid progress of dendritic arborization, especially of the Golgi-II type neurons in certain layers of the cortex, which leads finally to a clearly measurable increase in memory capacity: The cognitive possibilities of postponing imitation thus promoted, whose beginning in this age group Meltzoff and Moore (1994) were first able to demonstrate, are a clear proof of a developed increased memory capacity. The neocortex takes over in wide areas the master control of formerly subcortical functions, among others, motor functions, affectivity, and cross-modal integrative functions, since it is only now that substantial prerequisites for the dense neuronal interlinking of neocortical structures gradually become available.

This also affects in a special way the actions of delaying and postponing memory contents. While short-term memory is guaranteed above all by the mesodiencephalic structures of the limbic system mentioned above, long-term memory is dependent on the networking capability of the tertiary associative fields. Development of object permanence in Piaget's (1937) sense, i.e., the overcoming of the A-not-B error—an object is sought only in the place where it has disappeared—gradually manifests itself during this period. The abstractive structural capacity of sustaining one's bodily existence independently of the movement of proprioception is based on the expanded memory capabilities now available.

In the further differentiation of neonatal states, there appears now in the comparation phase at about 9 months a drowsiness state, a condition of sleepiness within the province of alertness. In EEG this sleepiness correlates with frequencies in the theta-range, and it seems that the decrease of REM in the waking state goes together with the increase of this twilight condition. It is unclear what connection, if any, exists between this condition and the activity of memory. At any rate it is at this time that the neonatal state organization begins to disperse, giving way, toward the end of the third year, to an adult pattern of waking and sleeping.

At this stage of motor development, the volitional directedness of grasping movements is being fully established, and the child undertakes his first free steps—*cum grano salis*—which mean independent locomotion, and bring about thereby a new quality in socioemotional relationships. Achievement of volitional intentionality of the motor function is based, among other things, upon the advanced functioning of the cerebellum, for example for the control of balance, and upon completion of the myelination cycle in the lower segments of the tractus corticospinalis, for a transmission of the high-frequency firing of pyramidal motoneurons. After mastery of locomotion, widened memory capacities make possible complex gestural, entire-body imitation capacities without visuomotor control; these abilities indicate that a body-related imaginative capacity already exists.

Some researchers are of the opinion that the capacity for locomotion makes it necessary that various affective patterns of expression attain great significance; namely, fear, anger, sadness, and disgust (Bertenthal, Campos, and Barrett, 1984; Campos, Bertenthal, and Kermoian, 1992), since these have life-maintaining functions for the small child in his exploration activities. Long before these empirical proofs of fear and caution in high places, Karl Abraham spoke, in 1916, of "locomotory fear," in connection with learning to walk, and Winnicott (1971) of the "fear of breakdown." Even though it may not be correct to directly link locomotive development with, for example, the pronounced appearance of the affect of fear, the functionality of negative discrete affect qualities in the increasing spatial distance between mother and child is clear. In this connection the referential–interaction mode can be seen: In explorations over spatial distances the toddler checks whether his mother is facially signaling permission, or danger, or threat. Interestingly, such archaic images can turn up in psychoanalysis as well. Peto reports on "terrifying eyes as superego forerunners" (Peto, 1969). As frontal area 8 starts maturing, control of facial affect expressions takes place over corticolimbic pathways (Benes, 1994), with the systemic inclusion of the respecting nuclei of the amygdalae and the globus pallidus that are responsible for the generation of affect. Affective integration of locomotive function patterns of approach and withdrawal are negotiated in play through the creation, with great excitement, of motoric persecutory or "chasing games." The child plays with spatial separation, challenging the parents to follow him as he crawls or runs away, and then quickly disappears; for example, behind the doorjamb with a yell.

Parallel to the onset of the one-word phase in speech acquisition, the child begins to imitate social gestures and expressive movements with and without semantic content—for example throwing kisses—which likewise are employed toward the end of the comparation phase in bodily signal exchanges, allowing the child spatial separation within this interaction scene while at the same time maintaining a connection on the "secure" basis. Bowlby (1969) spoke in this connection of "monotropy" toward the mother, in that the relationship to the mother in this phase of beginning locomotive separation takes on an even more exclusive character. In the mirror test, the child develops, after the jubilation phase, a mirror-image fear analogous to stranger distress; it is not surprising that in this phase observations of his own and the parental bodily features are the focus of the child's attention. The affective reactions of sobering, confusion, and turning away may be interpreted as apprehensive doubt, but the child does not fully recognize himself as a person.

Procedural memory capacities are closely connected with the development of presymbolic imaginary structures at the level of representation. The child can use his anticipation capability to reach a more independent form of self-regulation. After his first use of words, the child probably begins gradually, after the first year, to use a few object names for things. This leads to a gradual introduction of the use of symbols for basal categorization. Nevertheless, use of single words in connection with body gestures (waving, greeting, pointing, etc.) is typical for the comparation phase. Within the framework of imaginary interaction structures, bodily bridge objects—so named in 1971 by Kestenberg as "intermediate objects"—take on significance because they represent an imaginary connection between the child and the mother in body-care interactions. For example, since the child still considers fecal material to be part of his own body, he doesn't like it when his mother throws a diaper in the trash, and therefore brings it back to the mother as a gift.

In the body image, the skin–body boundary becomes relevant: The differentiation of same-different receives its first experiential content here. It would seem that it is this recognition of differentness and of body boundaries that elicits a deepened tendency to turn toward the person in the primary relationship to bring about a closeness. The new quality of this phase consists of the wish to be separated physically, yet still to maintain proximity through the experience of intersubjectivity (Trevarthen, 1979).

The Expansion versus Contraction Phase

The name of this plateau phase—in the sense of expansion and contraction of the body image—refers to the expanded motor function possibilities and the experience of boundary expansion that accompanies these. In the comparation phase awareness of the skin–body boundary was at issue. In the expansion phase, with the introduction of an ambivalent distance to the mother figure, the gaining of greater space makes necessary a negotiation of an adequate distancing within the framework of the interaction. An expansion of the body image comes about in the child's striving for efficacy and mastery (White, 1959), while the failure of such excursions and the return to the mother is accompanied by a deflation of this heightened body experience. In this respect, emotional states such as high-spiritedness and feeling low play an essential role in the inner experience of the body image. Still, the child is occupied in this period with the cognitive grasping of disappearing and returning, separation and reunion, the difference between "gone" and "there," and its affective implications.

The child practices these spatial constellations in various motor games, and is especially pleased when his parents make themselves or objects disappear and then reappear, and his affective involvement in such actions is considerable. This concerns as well his ability to perceive his own bodily configuration in the mirror, as was observed already by Freud (1920) in the fort-da ("gone-there") game of his grandson, who made himself, as well as a wooden spool in the known "spool game," appear and disappear in the mirror, with the repeated words, "gone-there." Such gone–there games in numerous variations excite the attention of the child and concern the object as well as the self when it disappears and then reappears (Gopnick, 1984). When one observes the rapid coming into play of symbolic games at this time, one finds this thematic once again, in connection either with the whole body or parts of it. After complete volitional directedness in motor-function development has been acquired, the child naturally tests his new abilities and makes use of them, which maneuvers the parents in the situation between looking on permissively and running up to protect the child. This motor function pleasure (*motorische Funktionslust;* Bühler, 1918), the striving for efficacy, and the drive toward speed correspond emotionally with the experience of elation, while falling, getting lost, and motor function failure are experienced with feeling low. These affective states are admittedly more signs of dependency relatedness than emotional independence, which leads Kernberg (1990) to speak of the "affect of elation in relationship with mother."

At around 16 months the laminary growth of the neocortical fields in all brain regions has become more regular, an index that the tertiary association fields (multimodal memory) of the neocortex is becoming entirely functional (Rabinowicz, 1986). At the same time myelination of the association pathways in the intracortical neuropil begins; the functional lateralization of the hemispheres finds expression in increase in volume of the corpus callosum (Innocenti, 1983; Trevarthen, 1984). These wide-reaching changes in brain development lead to a new quality of multimodal integration in all experiential areas, which are reflected in the substitute of symbols for the real, phantasy play, and the beginning of creation of imaginary situations (Dunn, 1988). That the functional lateralization of the cortex is becoming increasingly more pronounced has implications for speech, space-mapping, motor function preferences, and emotions. Recent research suggests, however, that the cognitive implications connected with the lateralization processes are considerably more complex than was formerly assumed (Thatcher, 1994), and research in this area has only just begun. Long-term memory at 16 months can be demonstrated (Bauer and Mandler, 1989), and the capacity for imitation already includes action sequences with several components and complex, entire-body actions that can be copied without visuomotor control.

Most children can now recognize themselves in the mirror and display self-indication, later on with verbal self-referencing; this is the stage of self-recognition itself. Since the small child can locate the red spot on his own face in the Amsterdam–Gallup mirror test as of this time, it is to be concluded that a developed protorepresentation of the body is at hand. In the ontogenesis of the affects, there now appear "body-related social affects": Their expression has nothing to do with facial configurations, but rather consists of types of conduct involving the whole body, for example twisting himself or snuggling against the mother's leg in embarrassment. Body-related social affects are embarrassment, shyness, timidity, shame. Their manifestation in different children can take extremely different forms, so that one is reminded sometimes of Freud's ordering shame within the contrastive pairing of voyeurism-exhibitionism (Freud, 1905). Lewis (1992) points out that such self-conscious affects as shame imply that social ideal standards have already been internalized. If social attention is brought to bear on the self or the body, self-evaluation brings about a sensation of adequacy or inadequacy.

The proxemic interaction mode describes position regulation between two bodies in space that takes place in the expansion phase. The patter of running away-exploration-return-bodily contact is frequently carried out in an ambitendent way, however, constituting what Mahler and LaPerrière (1965) called the crisis of rapprochement. At about 16 months there appear again and again situations in which the explorative interests of the child or other of his wishes contradict those of the mother and the social necessities that she represents. The developing power struggle that thus recurs in the conflict between the intentions of the two makes necessary a new definition of the optimal distance in the object relation. In the course of the expansion of the bodily boundary from the skin to the grasping space there gradually appears a new invisible personal space as the border of the body image. In the process of speech acquisition there occurs a transition from one to several word sentences, which make easier the verbal mastery of spatial separation and other conflict situations (Hédervari, 1995). Hand in hand with the introduction of the use of symbols—*alquid stat pro aliqua re*—children begin, in peer situations, to make for themselves intimate play spaces, away from the parents, in which imaginary situations can be enacted. The gradual divorce of phantasy from reality manifests itself in the replacement of intermediate objects with the beginning of a search for a transitional object. Small children at this age form word combinations mostly out of two words as they name their activities: "I go, I do, etc." In this way, processes are described in the here-and-now, including the child's own activity. Because it is now possible to tell stories in a core vocabulary, the first verbal dream reports now appear.

Introspection versus Pretense Phase

The name of this plateau phase is derived not from movement but relates rather to the symbolic–cognitive level of body representation. With the third year of life comes the beginning of introspection, with the possibility of self-referentiality and the ability, from inner motives, to refer to drives *(Antriebe)* and sensations in a linguistic–symbolic manner. In the introspection phase, the small child acquires the possibility to refer directly to his inner experience within the outer boundaries of the body image. There is a decisive clinical difference between the body images of patients who have experienced early preoedipal disturbances and those with neurotic personality organization: In the case of early disorders the experiential inner structure within body boundaries is missing. The capacities for introspection and empathy (Kohut, 1959) are two sides of the same coin. The development of empathy has been researched in cognitive terms under the name "Theory of Mind" as the process of development that enables children to imagine what may be going on in the heads of other people. The opposite of introspection in the body image is pretense, which manifests itself in the as-if games of small children. In these pretense games the goal is the simulation of an imagined situation as the outer staging of inner life, without deictic reference to corresponding intrapsychic states.

The biobehavioral shift between 23 and 25 months becomes clear essentially through a measurable growth of cognitive competence, a manifold increase of memory capabilities, and rapid progress in the process of acquiring speech (Kagan, 1981). The changes in the CNS can be traced above all back to the increasing progress of dendritic arborization, which continues with great rapidity into the fifth year of life. The signals of the small and dense neuronal nets, which are being formed as a result of this, give rise to a measurable increase of the level of alertness, with beta spikes at first in the lobus temporalis. The proportion of REM is reduced from a third to less than a fourth; at the same time adultomorphic patterns of falling asleep set in. The thickness of the neocortical neuropil in the frontal, parietal, and limbic association areas has in the meantime become greater than in the primary sense fields. A functional hemispheric lateralization enhanced by speech becomes clearly visible now, and in the dominant hemisphere the development of layers of the other associative regions is overtaken by that of the speech fields. This is of course connected with the cognitive leap that takes place in this phase from the introduction of logical-syntagmatic connections in two- to three-word sentences to several-word sentences with the first sentence structure. As a result, the introduction of the temporal axis (past-present-future) remniscences of past events can be actively used by the child as an episodic memory capacity (Nelson, 1984). The decisive cognitive difference is found in the first use of rules that represents the developmental–historical prerequisite for the narrative sense of self attainable, according to Stern's description, at 36 months (Stern, 1989b). The actual time that the leap takes place varies enormously intraindividually, however.

But what has all of this to do with the body image? These are all developments that would seem to have nothing to do with the bodily sense of self. Now I would like to show how these new symbolic–cognitive qualities indeed have relevance for the development of the body image. For with the expansion of two-word to several-word sentences, the child begins not only to communicate his own activities but also for the first time to refer to his inner conditions: wanting, liking, loving, being afraid, etc. That is, the child communicates inner events through the employment of a variety of "state words" (Bretherton and Beeghly, 1982; Brown and Dunn, 1991). The perception of these inner states is the prerequisite for being able, after the third year, to differentiate one's own wishes from what goes on in the mind of others (Perner, 1991).

In interaction with the mother, the small child acquires the capacity to refer significantly and symbolically to something noticed by both; that is, to relate to a third *something*—therefore the name deictic interaction mode. This is the introduction of symbols. What is new here is a triangular communication structure with the level of a symbolic sign quality (Peirce, 1902). The semantic communication forms over the nonverbal-dyadic communication structure (iconic and indexical level of signs) between mother and child. Certain experiences from the nonverbal period are carried over into the level of symbolic representation, others remain in the realm of the nonverbal, are repressed, and sink into the unconscious. This process is marked by a change in the sense of self, in which the small child no longer feels himself to be a baby, separating himself off in his identity from the "baby phase." If the child regresses, the parents say, "You're not a baby anymore!" The attainment of this not-a-baby-anymore identity seems to accompany verbal self-referentiality and the use of the reflexive pronoun.

Mirror experiments show that the child is especially occupied with his own face. He can recognize himself in photographs, and later in films. Naming and capacity for self-referentiality entail the reference to one's own person as psychosocial entity. In like manner, the perception of *gender difference* attains an affective relevance in the introspection phase, since sexual identity is an important factor in the development of social identity. An anecdotal example from a lake beach in Berlin, which may serve to underline this: "A little girl around $2^1/_2$ years old, who is there with her father, gets attracted by two naked infants, one male and one female, arousing each other in a crying contest. She wants to look at the two babies. When she sees the male baby, she points to him and calls out with great emphasis, 'The baby has a Willy!' " The little girl, who has only just left behind her own babyhood, had tied that state with femininity, while being a grown-up was connected, like the father, with having a penis. This phenomenon of becoming affectively aware of gender difference was called the early genital phase by Galenson and Roiphe (1971, 1974), because it comes ahead of the actual oedipal situation. In the introspection phase of body image development, face and genitals are integrated, according to Greenacre (1953), into the body image. In this golden age of pretense play (Dunn, 1988), inner themes are acted out outwardly: In as-if games in the third year, carried out in intimate playrooms away from the parents, these have characteristically to do with loss of body parts, fears of disintegration, the threat of loss of functions. Later these are replaced by the father–mother–child games of the oedipal phase. A decisive step on the level of representational development of the body image is the replacement of bodily bridge objects, which up to this point have maintained the imaginary connection to the mother, with the choice and magical animation of a transitional object as symbolic connection in intermediary space.

Hand in hand with the lateralization of linguistic–cognitive functions comes the employment of symbolic-cognitive spatial orientation and bodily orientation in the mirror hemisphere. Beginning in the introspection phase, the foundations are laid for spatial orientation in the child's own body: under/over, behind/in front of. Cognitive experiments show that spatial orientation in one's own body, tied to touching experiences, is connected with the employment use of lateral areas 39 and 40 of the right hemisphere.

In the introspection phase a certain dislinking between facial affect displays and inner emotions is achieved through the onsetting interiorization of social display rules having to do with the desirability of showing certain feelings (Cole, 1985). The internalization of previously interpersonal affect regulation is formed over by cognitive symbols, so that the affects receive an intrapsychic content and are no longer experienced in a "total" body manner. This development leads, especially because of cognitive knowledge about certain demands on behavior, to the formation of the superego and the "moral self" in later years (Emde, Biringen et al., 1991). Unlike cognitive behavioral standards that bring about shaming and are based on ideal qualities (Kagan, 1981), these newly appearing feelings of guilt are based on generally valid moral norms, which will play a role from this time on. Hédervari (1995) could show, in the context of long-term studies, that between 23 and 36 months, quality of expression is subject to a process of neutralizing the negative affects while holding onto positive emotional coloring. This empirical evidence of the primacy of positive-to-neutral emotional qualities could be a confirmation of what ego psychologists have comprehended as a necessary process of neutralization of drives (Hartmann, 1939; A. Freud, 1952; Emde, 1992). Interestingly, it could also be demonstrated that self-recognition in the mirror and the sensation of the self-conscious affect of embarrassment corresponds to a parallel appearance of prosocial–empathic tendencies in peer relationships (Zahn-Waxler and Radke-Yarrow, 1982; Asendorpf and Baudonnière, 1993).

An inner conception of the body with a conception of the organs develops nevertheless only in middle to late childhood. "Filling out" of the body image with experiential substance requires a successful oedipal development, as experiences with various groups of patients show. Early disorder patients regularly remain at one stage in their body image development, in which the periphery represents the quintessence of their unconscious body image, because the inner region is too threatening to their perception and must therefore be denied. Correspondingly, the symbolic forming over of the inner structure of the body image (Hägglund and Piha, 1980) does not take place, and this deficit leads to their choosing the body surface as a transitional object within the framework of a pathological development (Hirsch, 1994).

Closing Remarks and Prospects

Up till now there has been a gap in our knowledge concerning the earliest development of bodily self-perception: While there are numerous psychoanalytic theories, these are not very specific and have for the most part a speculative character. Kohut himself did not consider himself to be in a position to report findings about the earliest developmental lines of the nuclear self (Kohut, 1977), a task to which Stern (1985) devoted himself in an outstanding manner.

In the twenty years since then, neurophysiological research has made extremely rapid progress, producing an overwhelming salience of data whose integration makes possible scientifically based statements on the earliest development of the body image—from the first movements in utero to the differentiation of the mental self in the third year.

The approach outlined here assumes a unity of movement and perception and sheds light on the development of the body image from the perspective of proprioception of motor activity, and therefore emphasizes healthy aggression more than the libidinal side.

The proposals here are normative in the sense that they relate to normal development and do not as yet allow for statements concerning the etiology of certain disorders. We know that numerous psychic disorders and psychosomatoses are accompanied by sometimes severe disorders to the body image and the bodily experience of the self, the mechanisms of whose origin have not been hitherto explainable. It remains to be hoped that psychoanalysis can make use of the many findings in infant research to shed light on the body image disorders in severe psychic illnesses.

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