Toward a Logic of Organization in Psychobiological Development

The theme of clinical implications of biologic response styles can be discussed on at least three levels: 1) the nature of the biological substrate; 2) the establishment of a response style through interaction of biological predisposition and early experience; and 3) the contribution this initial interaction process makes to *later* adaptive resourcefulness. The processes that relate one of these levels to another become of central interest to explore. Appropriate discussion of relationships between these levels should extend from considerations of finest detail to broadest perspectives. In this endeavor, one is immediately confronted by complexity, the complexity of the situation in nature. This is a confrontation that is leading investigators to propose the usefulness now of a methodology of description (1) and of conceptualizations based on an organizational perspective (2).

As the matter of individual differences is addressed, sources of complexity are obvious in the uniqueness of the individual's endowment, environment, and trajectory of developmental experience. Inseparable from this is the appreciation now that developmental process presents not a single pathway but a route of many alternative pathways. We seek understanding that will include the interplay of domains of continuity, of change, and of transformation. How we think about complexity in our investigations of living systems is becoming a critical factor in the design of new research. This brief paper is intended to suggest a way of thinking about relationships between biological organization and psychological organization at the human level.

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The biological substrate that will be considered in this paper is that of the 24-hour organization of states of the newborn along the sleep–awake continuum. Newborns show wide individual differences in this organization and consequently in the organization of the bidirectional interactive process between the newborn and the caregiving environment. The nature of this early interactive process and the way it bears on infants' organization of adaptive behavior—their behavioral styles—and in turn, on their psychological organization, will be drawn upon to suggest that we can begin to formulate principles that govern this organizing process, leading to our topic of a *logic of organization* in psychobiological development.

The data that have suggested our perspective have emerged from two areas of investigation. The first is that of continuous around-the-clock, noninvasive bassinet-monitoring of infants, their states, and interactions with caregivers over the first few months of life (that is, the origins of an interactive infant–caregiver system); the second area is that of a 25-year follow-up of subjects, selected before birth on the basis of maternal personality as it was assessed during prenatal clinic visits. Interaction between subject and family was then observed and studied in great detail over the first six years of a subject's life. It was the effort to compare behavioral exchange over time in one infant–caregiver system with that in another that led to a first formulation of a logic of organization, the proposal of a sequence of seven issues over the first three years of life, around which, behaviors related to the achievement of successive adaptive coordinations between infant and caregiver could be organized epigenetically (3, 4). (See Table 1.)

In the 25-year follow-up, this sequence of interactional issues of adaptation, along with evaluations of affect and other descriptive

Table 1. Adaptive Issues Negotiated in Interaction between Infant and Caretaker

Issue	Title	Span of Months	Prominent Infant Behaviors That Become Coordinated with Maternal Activities
I	Initial Regulation	Months 1–3	Basic infant activities concerned with biological processes related to feeding, sleeping, elimination, postural maintenance, etc., including stimulus needs for quieting and arousal
II	Reciprocal Exchange	Months 4–6	Smiling behavior that extends to full motor and vocal involvement in sequences of affectively spontaneous back-and-forth exchanges, activities of spoon-feeding, dressing, etc., become reciprocally coordinated
III	Initiative	Months 7–9	Activities initiated by infant to secure a reciprocal social exchange with mother or to selectively manipulate environment
IV	Focalization	Months 10–13	Activities by which infant determines the availability of mother on the infant's specific initiative. Tends to focalize need-meeting demands on the mother
V	Self-assertion	Months 14–20	Activities in which infant widens the determination of his or her own behavior, often in the face of maternal opposition
VI	Recognition	Months 18–36	Activities (including language) that express perceptions of infant's own state, intentions, and thought content
VII	Reversal (Continuity or conservation of self as active organizer)	Months 18–36	Activities rupturing and restoring coordination on an intentional level. (Intended and directed aggressive behavior in equilibrium with directed initiations aimed at facilitating restoration of interactional concordance.)

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variables related to coherence or its lack in the infant–caregiver system, now form the design of the outcome analysis. Follow-up data collection has just been completed on these families and the subjects after 25 or more years from the onset of the study. In this, we are exploring the extent to which the *course* over the *first two years* of life by which infants construct their individual configurations or repertoires of adaptive strategies may be the best statement of the "rules" for the way that each individual constructs the later organization of adaptive behavior, that is, the rules that form the logic of organization or *grammar of assembly*. In other words, we are following a sequence in adaptive organization that proposes that behavioral links connect an initial biological marker, in the form of features of sleep–awake state organization, with interactive strategies characterizing the infant–caregiving system in its moves to accomplish harmonious regulation of infant states. As recurrent and desired states first become expectancies, then goals, goal organization of infant behavior to effect the re-experiencing of such states becomes central to the infant's adaptive coordination with the caregiving system. This early repertoire of strategies is then drawn upon to organize characteristics of the individual's later adaptive behavior. (This relationship was first suggested by the high correlation of ratings for negotiation of Issue I with ratings for negotiation of subsequent Issues III, IV, V, and VIII in the 1954 longitudinal study sample) (5).

The *organizational perspective* means the perspective of systems concepts, and all that 50 years of elaboration of these concepts imply in the application of the many principles common to the functioning of all living systems. Among these are principles of regulation, adaptation, integration, specificity, recognition, etc. Even the most familiar of these, such as regulation or adaptation, cannot be assumed to be fully understood yet in terms of the structure–function relationships on which they depend. Any logic of organization would touch on at least one or more of the following sets of principles:

1. Living systems display properties of self-regulation, self-activation, self-organization, or self-righting. These have profound

implications, for example at the level of the human infant, in the respect we accord the infant's initiation of action within a range of contexts.

2. The cybernetic model has been useful to our present understanding of many essential regulatory functions and mechanisms, such as those underlying the "construction" of neuronal models related to orienting and habituating processes, and the construction of goal-organized behavioral schema, the essential match–mismatch experiences related to the expectancy schemata that eventuate in perception or awareness.
3. Biorhythmicity and the principles of entrainment, phase-shifting, and phase-synchrony are fundamental to regulatory maintenance and temporal organization, both within the organism and between the organism and the environment. The biorhythmic model makes meaningful the concept of the recurrent situation in the process of adaptation (6), and the concept of coherence in the phase-synchrony of multiple subsystems—such as has been described and elaborated upon by Prechtl (7–9).
4. Related to the concept of coherence is the concept of *state*. State can be described as a configuration of the values of variables representing the component subsystems of an organism, which shows a profile that recurs, and which can be *recognized* when it recurs. State, then, represents the position in the complexity of organismic functioning that can be treated as a recognizable unity.
5. Whether along the sleep–awake continuum or whether representing an emotion such as anger, fear, surprise, joy, etc., the unity of state provides the *specificity* of a signal that is key to the interactive process between infant and caregiver.
6. The condition of coherence in infant state, then, is a basic and essential condition for the achievement and maintenance of *integration* both within the infant and between infant and caregiving environment. It depends on specificity in the governing of exchange between infant and caregiver which, at the same time, is basic to interactions involved in regulation, adaptation, communication, recognition, and so forth.

To put together the logic of organization suggested thus far by these principles, features of biorhythmicity that are basic to regulation of states on the sleep–awake continuum provide the daily (around-the-clock or 24-hour) conditions for regular *recurrence* of infant state sequences within *recurrent* caregiving contexts and, therefore, for *recurrent* infant signals within recurrent caregiving sequences. These relationships describe necessary elements in the organization of a 24-hour pattern in the interactive process that, in its recurrence, becomes shared by and familiar to both infant and caregiver. Such a commonly shared pattern can be considered the site for an experiential framework common to both infant and caregiver on which common meaning becomes established. The emergence of meaning can be assumed to depend also on processes of habituation and then orientation to details of variation in the sequence, following construction of the expectancy and operant schema of both infant and caregiver that lead to the establishment of the 24-hour pattern. It is essential to include a 24-hour, around-the-clock background of regulation, adaptation, and organization of interactive process in order to have an extensive enough mutual framework for recognition by caregiver of unique features of the individual infant, and by the infant of unique events in the caregiving context.

7. The idea of a background of habituation and familiarity of sequence and pattern against which variation and novelty can be experienced in the foreground of interaction provides the conditions of match–mismatch that lead to perception and awareness. Given the logic spelled out in the preceding paragraph, patterns of expectancy and awareness must include patterns of inner as well as outer events.
8. Finally, *disturbances* in newborn 24-hour sleep–awake state-sequencing can be considered to be in the realm of *biological markers*. Newborns range from those who show obviously well-organized, endogenously coherent, predictable, crisply differentiated state-sequencing to infants who are difficult to read, unpredictable, fragmented (for example, unable to sequence within a nap from REM to non-REM subphases without awak-

enings), slow to differentiate any day-and-night distribution of awakenings and naps, inconsistent state response to caregiving interventions, etc. From the outset, the caregiver infers the quality of the infant's inner experience from "reading" the infant's current position on the continuum of infant states. On the basis of such inferences of the infants inner experience, caregiving decisions and interventions will be organized to achieve and maintain as far as possible that which is the caregiver's expectancy for regulation in the system. Thus, a unique regulatory system is becoming established over the first weeks of life by virtue of the engagement of infant and caregiver in an adaptive interactive process of mutual modification. On the well-organized end of the spectrum, the well-organized infant can organize an inexperienced or poorly organized mother. On the opposite end of the spectrum, the most experienced mother can become confused and uncertain about ever achieving regulatory effectiveness; such infants lack the *coherence* of state organization we have referred to, and give few clues as to the quality of inner experience.

If we assume the principle just described, we can assume that the inner experience of the infant is getting organized or remaining disorganized in the interactive process, by which the regulation of states is being sought for within the first months of life. This very early point is the site for a first integration of cognitive schema related to behavioral events, and emotional schema related to state events. The adaptive process could be said to integrate a biological disposition (the endogenously organized state-sequencing of the infant) with an organization of caregiving proclivities and a particular initial organization of consciousness in the infant. By organization of consciousness here is meant the way the infant's awareness of his or her own state gets established as the organization of regulatory interactions become established with the caregiver system.

The organizational perspective proposes that it is the system, then, that, by virtue of its idiosyncratic solutions to the various adaptive tasks required of each partner to achieve an enduring

harmony of coordination, carries a major burden of continuity. This implies that there is a certain logic of adaptive strategies that work in a particular system and can be employed at different levels of differentiation. For example, awake states differentiate quickly postnatally into the range of emotional states and their expressions, such as the repertoire of recognizable emotions that have been identified by Izard (10). States of alertness and attentive focus become associated with surprise and then pleasure, as social reciprocation becomes established in the second three months of life. The infant's operant production of affects is becoming associated with similar pleasurable emotional states during this time, which are becoming experienced as the infant's capacity to elicit a positive social response. It is at this early point, given a competent system and the organization of inner experience we have been describing, that desired states can become goals for the infant's operant behavioral schema. The idea of a logic of organization or grammar of assembly for a given *system* would propose that such schema become organized within the same basic rules for regulation that have governed the system from the outset. This process is clearly bidirectional and makes it imperative that we understand that the notion of psychobiologic *response* styles represents only one direction in a bidirectional process. Over time the patterning of such bidirectional transaction becomes established within a given system as a recurrent, habituated repertoire of coordinations and adaptive strategies that serve to maintain regulation in the system and so become characteristic of that particular system. In turn, these interactional skills and adapted strategies will be drawn upon by the new, developing individual over the *later* course of development in adapting them to the *construction* of one's own world of perception and adaptation—that is, one's later ecologic niche.

As a way of summarizing the observations drawn from our two principal areas of investigation and as a way of integrating the ideas briefly touched upon above, a sequence of five propositions can be stated. (This sequence of five propositions was first presented at the 13th Margaret S. Mahler Symposium in Philadelphia, May 1982.) The general idea is that each will characterize

the experiences of the healthy infant within a healthy caregiving system. This is an epigenetic series, with the accomplishment of subsequent steps based on the organization of the infant–caregiving system made possible by the preceding steps. The logical implications of each proposition depend on how one understands the mechanisms involved in the way the biological substrate functions in a healthy infant within a healthy caregiving context. The way each system functions in regard to each proposition sets a bias on that system in subsequent operations depending on that function, that is, introduces a *rule* for, or logic of, organization in that system. Each of the propositions will then be elaborated and illustrated briefly. They have served us as conceptual milestones—in attempting to unravel the intricate relations that elements at the biological level weave with those at the psychological level, and that may bear on the earliest determinants in development of a sense of self, and the role the sense of self can then assume in the later construction of adaptive behavior.

1. Infants' initial inner experiences consolidate around the experience of their own recurrent states.
2. The second proposition is that the infant's own states, where coherent, recurrent, desired, or essential to key regulatory coordinations that become established with the caregiver, become the primary target or *goals* for behavior.
3. The third proposition, then, is that infant competence in initiating and organizing self-regulatory behaviors to achieve desired states as goals represents a *system's* competence (to be elaborated) in facilitating goal realization, as well as in providing conditions for the infant's initiation of goal-organized behavior. Such system competence ensures a sense of agency in the infant. The emergence of infant-as-agent must be *granted by the system*, because it means a reorganization of the system to admit the newcomer. If the system is such that it can permit the entrance of a new agent within it, it provides the conditions that establish not only the capacity for self-awareness, but conditions that ensure the use of such inner awareness by the infant as a frame of reference in organizing his or her own adaptive behavior (that is, being in a position that permits appreciation of which behaviors lead to which states). The valence of this inner experience under these conditions of self-initiated goal realization will be felt as the infant's "own."
4. The fourth proposition follows: Each infant–caregiver system constructs its own unique configuration of regulatory constraint on the infant's access to awareness of his or her own states, inner experience, and on initiatives to organize self-regulatory behavior. These configurations then become a repertoire of enduring coordinations or adaptive strategies between the interacting participants, representing patterns unique to, and characteristic of, each infant–caregiver system. These strategies set the conditions in the system by which infants can re-experience a *knowing* of, or recognition of themselves (see Issue VI, Table 1). Construction of experiences in which one recognizes oneself in terms of re-experiencing familiar states is the vehicle by which a sense of continuity of self is conveyed. The experience of self-recognition constitutes a parameter that biases the infant's later construction of an ecologic niche in which these same strategies can be employed so as to promise a familiar continuity of predictable self-regulation and self-recognition.
5. Finally—continuing differentiation of the individual's competence, as agent, to reconstruct the array of familiar states under widening and changing contextual circumstances is an ongoing life-span process biased by the organizing logic of initial experience, which confirms continuity by re-creation of individual uniqueness; a repeated process, which ultimately describes that individual's life-span trajectory. The process of aging requires continuing differentiation in the re-creative process, including modification in the framework of self-awareness as alterations of various functions reflect the aging process. Differentiation and continuity proceed in a close and paradoxical connection with competence of regulatory coordination in the system. The better the system achieves coordination, the better differentiation proceeds and, paradoxically, the stronger the experience of continuity.

Proposition 1 proposes a capacity for inner experience that exists at the outset of postnatal life—as an initial level in the organization of consciousness. This initial root of the sense of self does not await the organization of a body image, or depend on production of affects, or on visual or tactile experience, or the double-tactile experience that, through touch, begins the differentiation of self and other. The ego begins as a *state* ego rather than a body ego.

The data relevant to proposition 1 are essentially those relevant to our earlier formulation of the negotiation, between 0–3 months, of a first issue of infant–caregiver adaptation, the achievement of the mutual modification necessary to effect basic regulation (see Table 1, Issue 1). We have organized our around-the-clock data over the first two months of life from the perspective of biorhythmicity, entrainment, and phase-synchronization. This allows central emphasis, in this earliest period of organization, to be given to the matter of *recurrence* of events, to the timing and temporal patterning that makes *expectancy* and *match or mismatch* a repeated daily experience of specificity for both infant and caregiver. The *regulation* of infant–caregiver interaction involves phase-shifting of naps, nap length, awakenings, and awake length, with the achievement of "fitting together" or adaptation becoming a matter of phase-synchronization or concurrence of states of *readiness* in both infant and caregiver. Such concurrence originates endogenously and in relative synchrony in each, and sets the stage for the experience of *meeting*, as identified by Buber (11). Such meeting, as recurrence goes on, is experienced differently than an encounter would be that was a result of elicitation by one partner of a response by the other partner. Meeting is, in our view, the essential systems groundwork for the emergence of a capacity to trust, but must be comprehended as a systems condition at the outset of life and a foundation for the higher-frequency, interactional tuning or resonance that is so important in later months of the first and second year (12). Such a perspective makes it clear that a constructionist view of development must also include a systems view of "construction." A "narcissistic" solution to initial regulation might be predicted if meeting is replaced by the adaptive necessity for the infant at this early time to have to take

premature responsibility for his or her own regulation, to have, too unilaterally organize attention and initiative.

The powerful significance of the 24-hour sleep–awake and interactional-monitoring data lies in the evidence it provides of the unexpectedly *early* point at which organization is jelling in the *healthy* infant–caregiver system. It is between the fourth and sixth day of postnatal life that the distribution of naps, awakenings, and first- and second-longest sleep episodes become differentiated as to their day or night location. By 10 days of life, the majority of the longest sleep period per 24 hours is occurring within the night 12 hours (13). The rearing conditions for these healthy newborns allow the pattern of the infant's initiative in self-regulatory behavior (i.e., the timing and sequence of states on the sleep–awake continuum) to become the logic around which caregiving is organized. At least by 7 days of life, under these conditions, the recurrent sequence of caregiving over an awake period has become an habituated pattern of events in time and space, an expectable background, so that an apparently insignificant violation in the foreground can evoke a striking surprise reaction in the infant, with arousal and increased latency in time taken to return to sleep (14). In the second week of life, under these same conditions, it can be demonstrated that the infant's transition from drowsy states to sleep depends upon recurrent experience with a complex habituated caregiving pattern of cues that provide essential entraining inputs.

The logic of the second proposition, that desired states become goals in organizing operant interpersonal behavioral schema, becomes apparent particularly around the delight and joy experienced during the second three months of life, as caregiver and infant interact to maximize the resonance of exuberant states, introduced first by the appearance of the smiling response, and later culminating in the elaborated social exchanges of the three- to six-month period. It is instructive in the experimental situation to see the infants' efforts and, we propose, state of delight on succeeding to restore the exchange (15), at the point in the experimental design when the mothers begin carrying out instructions to be nonresponsive. We can also infer the infants' inner experi-

ence of collapse and dejection as we see them finally abandon their efforts to realize their goal as the mothers persist in nonresponse. *Predominant* failure to so regulate one's own state of delight, as an archaic experience in the first year of life, can be proposed as a trigger for self-esteem collapse in later situations of failure, or as underlying later childhood depression. On the other hand, the delight of social exchange, as well as the fine-tuning of the reciprocal interpersonal behaviors that elicit it, become the criteria to be matched or the goal to be experienced in organizing schemata of later interpersonal adaptation—that is, the emotion of delight remains the marker for the experience of an interpersonal agreement, togetherness—or meeting.

The idea that re-creation of a particular state can be the goal motivating the organization of operant schema is evidenced in later life in the complex behavioral strategies involved in alcohol and drug use. The reverse, namely, an inability to be aware of, or *to be guided by*, an awareness of one's own inner state characterizes anorexia nervosa and certain types of obesity. ALEXITHYMIA

That the infant, in the first months of life, is in a prerepresentational level does not preclude awareness of inner experience. One of the consequences of prerepresentational experience would be that *direct change of own state* would be *the goal of schema organization, not some cognitive substitute or representation of it.* This would have important implications if it became characteristic of regulation in a particular infant–caregiver system (that is, that competence in one's own direct state regulation could be experienced as a consequence of self-initiated behavior). When conditions are such in the caregiving system as to facilitate such competence, the system as a whole could be called competent.

In regard to the third proposition, an important property lies in the respect accorded by the caregiving system for the infant's initiative in organizing self-regulatory behavior. One of the predictive hypotheses of our initial longitudinal study* was that our

*This study, carried out between 1954–1962, was designed and directed by Eleanor Pavenstedt, M.D., Chairman of the Department of Child Psychiatry at Boston University Medical School. It was supported by USPHS grants M898 and #3321, and the Scottish Rite Foundation.

findings for maturity of child personality at six years of age would correlate with the ratings of the extent to which the infant is regarded from the outset by caregivers as an "individual in one's own right." Continuity in this aspect of organization of regulatory exchanges in the *system* must precede continuity in this aspect of self-regulatory organization in the individual. The experience of awareness of being the agent to initiate action that then leads to the re-experiencing of a desired state would depend upon the extent to which agency is granted by the ambience of the caregiving system. This ambience begins with correct attribution of the infant's inner experience (derived from the reading of infant states)—validation of the infant's entitlement to organize his or her behavior to re-experience positive states and void negative ones.

There is, almost from the outset, an attribution of intentionality given the infant's self-regulatory activities by the caregiver and, in the latter part of the first year and second year, important regulatory exchange between them becomes governed by inferences as to intention on the part of each as intentionality progresses to the forefront of awareness. Here, there is opportunity for misreading as well as validation and meeting. In the second year, this can set powerful biases on the way the infant comes to regard and be guided by his or her own perceptions of inner states and experiences.

It is here that the paradox can be appreciated between the control of one's own state by the "other," and the experience of "meeting" as a consequence of synchronous or similar states of readiness in the interacting partners. This paradox has nowhere been more beautifully expressed than by Winnicott's description of the predicament of the toddler in which "it is joy to be hidden but disaster not to be found" (16).

CONCLUSION

The organizational perspective on developmental process suggests that the apparently paradoxical relationship between complexity

and unity resolves if one begins with the idea of state as a biological mechanism of recurrent organizational coherence at the level of the organism. This level of recurrence exists within a context of a recurrent, interactive, adaptive process by which regulation of exchange between infant and caregiving surround is governed. This is a configuration that establishes, then, a system of a next order of complexity. The way a number of fundamental biologic principles operate in a given system provides the rules for, or logic of, interactive organization in that system. At the human level, the link between biological and psychological levels is proposed to begin with the way the infant's experience of inner awareness emerges from organization of state in the interactive regulative exchange with the caregiving environment. The organization of state governs the quality of inner awareness. The regulatory conditions prevailing in the system then govern the way such inner awareness operates reciprocally in organizing the behavior of the infant and, in turn, the system. The set of propositions provides entree to consideration of the relationship that awareness of one's own state bears to the early ontogeny of the sense of self in personality organization, and, from the systems point of view, its role in the organization of later adaptive behavior.

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