Biocultural approaches to the Emotions

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1 Emotions: You can feel the difference

Carol M. Worthman

> That cry – that was Hector's mother I heard!
> My heart's pounding, leaping up in my throat,
> the knees beneath me paralyzed – Oh I know it . . .
> something terrible's coming down on Priam's children.
> (Hector's wife Andromache hears wailing at his death: *Iliad* 22:529–532)

> And I with the same grief, I died and met my fate.
> . . . nor did some hateful illness strike me,. . .
> No, it was longing for *you*, my shining Odysseus –
> . . .that tore away my life that had been sweet.
> (the shade of Odysseus' mother Anticleia: *Odyssey* 11:225–232)

The place of emotion in human experience is presently under careful reconsideration, a long-overdue process which the present analysis aims to advance. As the ancients just quoted clearly expressed and anyone today might recognize through introspection, emotion is both visceral and central to intelligent knowing and acting, contrary to Enlightenment distinctions between feeling and thinking. Furthermore, through the thoroughly embodied aspects of emotion, acutely related above by Andromache, life's vicissitudes wield biological as well as cognitive force that acts on physical as well as mental well-being. Emotion is therefore a matter of life and death, as Anticleia reported, for it mediates not only responses to but also short- and long-term effects of deprivation, neglect, or trauma and loss. Mounting evidence suggests that the kinds and life-long differential distribution of experiences meted out by societies shape the architecture and physiology of cognition, including that of emotional response and state regulation; thus, intra- and inter-cultural variation in emotion has biological concomitants that result in differences in survival and health.

This chapter concerns these aspects of emotion, currently neglected in anthropological discourse. Here, I discuss the ''difference'' that emotions make in the lives of persons, emphasizing their role in cognition and in physical well-being. I also present data that question the isometry between contexts with cultural emotional valence and actual emotional impact on indi-

process	detection, attention learning, memory integration
drive	motivation organization, prioritization recruitment
signal (to self, others)	communication relational representation

Figure 1.1. What emotions are/do

viduals: shared culture does not necessitate shared experience. Competing anthropological accounts of emotion have been concerned with what emotions are (Lutz 1988; Lutz and Abu-Lughod 1990), but asking what they do may take us further by requiring a dynamic explanation (Figure 1.1). Cognitive accounts focus on the signaling dimension of emotions as communicative, relational, representational, involved in situating persons and essential for negotiating and decoding everyday relations (Lazarus 1991; Russell 1991; Zajonc *et al.* 1989; Zajonc 1991). In psychodynamic views, emotions generate drive by being motivational and organizational: they prioritize, and recruit or mobilize action and experience (Levy 1973; Nuckolls 1995; Spiro 1982; Whiting and Whiting 1975a). Social practice-oriented descriptions emphasize contextual determinants of affect and view lived emotion as a product of culture (Goldschmidt 1975; Lutz 1988; Lutz and Abu-Lughod 1990; Markus and Kitayama 1994). But emotions also have information-processing features; they guide knowledge of the world by altering what we notice, influencing rate and content of learning, and evoking recall. Emotions rapidly recruit memories and schemes, and integrate them in cognition and action. These functions are essential to intelligent being-in-the-world.

Much less well studied is the role of emotions in embodiment, namely, as transducers between physical states and experience, as both mediators and dynamic products of the interaction between person and context. The notion of embodiment excites growing attention among anthropologists and social theorists (Csordas 1994), but its weak conceptualization in relation to actual material phenomena (i.e., the body itself) limits its utility for understanding on-the-ground variation in function and well-being. A different view of embodiment will be proposed through notions of *dual embodiment*, which integrates developmental and processual perspectives on emotion; *local biology*, which points to intrinsic nature of biological variation; and *develop-*

mental indeterminacy, the probabilistic relationship of biology and culture to ontogeny, given the biocultural interaction operating throughout development. The present chapter will explore these two dynamic and related roles of emotion, in information processing and embodiment, and apply them to two literatures implicating context-sensitive emotion processes in well-being and health. This exploration of emotion will, not incidentally, touch on the nature of culture and of the relationship of individual to culture, and the biocultural bases of human diversity and commonality.

Ethos and eidos: Feeling and thinking

Bateson's *Naven* (Bateson 1958) made a key contribution to anthropological understanding of the cultural ecology of human experience by seeking to characterize the everyday phenomenological landscapes that produce culturally scripted behavior. *Naven* involved an experience-near, individual-based account of culture that addressed structural-functionalist anthropology's neglect of motivated action and cultural phenomenology, and of the relationship of individuals and culture. Bateson's analysis of Iatmul culture draws a fundamental distinction between *ethos*, or the affective-emotional landscape characterizing members of a culture, and *eidos*, the cognitive-propositional landscape characterizing working cultural logic of members of a culture (pp. 2, 32–33, 220).[1] He links the individual to culture, the existential to the structural, by defining ethos and eidos as involving the ''standardized,'' or shared, affective and cognitive modes of individuals.

Bateson, along with Benedict, Mead, and others, effectively launched psychological anthropology as a comparative phenomenological study of cultural worlds. Nevertheless, anthropology's Batesonian legacy institutionalizes two conceptual impediments to the understanding of emotion in particular, and of culture in general. The first impediment is the distinction between thinking and feeling, reflected in the ethos–eidos dichotomy; the second is the elision of ontogeny in the notion of ''standardization,'' or shared culture. The present chapter seeks to show why these impediments are significant, and how their circumvention or resolution will advance conceptualization of emotion and of culture. The remainder of this section deals with the ethos–eidos issue; subsequent sections will deal with ontogeny and standardization.

Bateson's heuristic distinction between culturally specific domains of ethos (emotional landscape) and eidos (knowledge structures, or ''minding'') both reflects and reinforces a Western view of emotion (feeling, affect) and rationality (knowledge, thought) as mutually exclusive. The division places emotion and (rational) cognition as separate, mutually exclusive elements in consciousness (Figure 1.2): a conscious state with more ''feeling'' will have little ''thinking,'' and vice versa. The dichotomy is reflected in the way each

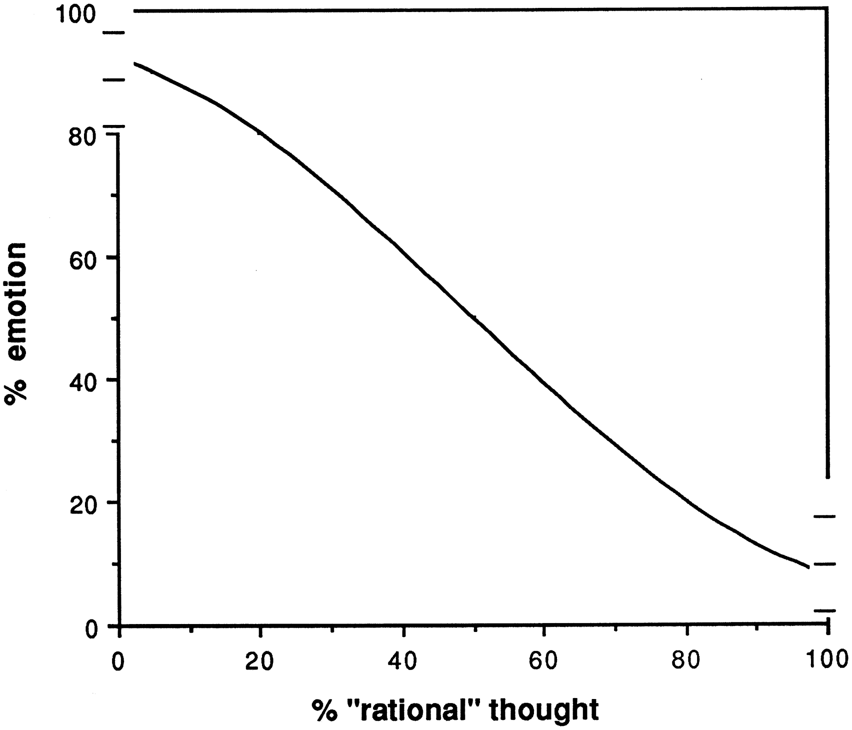

Figure 1.2. Classic Cartesian view of emotion and rational thought, in which the two are mutually exclusive. That is, the degree to which a person is thinking, or rational, varies inversely with the degree to which s/he is in an emotional state. The negative relationship holds true over the mid-range of degrees of emotionality or rationality, but at the extremes of either (very high emotionality or rationality), the opposite state is completely excluded.

has been studied: emotion is examined in terms of states or labels for states, while cognition is approached in terms of information processing. A simplified view of lateralized brain function – with the right hemisphere tuned to non-verbal, emotional, intuitive processes, the left to verbal, rational, and analytic thought – has entered popular culture because it reinforces this division, although the distinction is belied by intrahemispheric specialization and, especially, the functional interdependence of the two hemispheres (Fox 1991; Heller 1990; Silberman and Weingarten 1986). Emotion-thought distinctions are further reinforced by the notion that the two domains are localized in different brain regions: emotions have a ‘‘home,’’ characteristically located in the ancient interior basal structures of the brain, the limbic system. Extensive neural linkages between the limbic system and locations throughout the cerebral cortices are often overlooked or subject to interpretations skewed by views of limbic structures as primitive brain and the emotions as inimical to rational thought. Setting aside these important neurological details for the moment to pursue Cartesian logic in terms of the think–feel dichotomy, one can go on to characterize the distribution of experience-states by their feel–think composition on the level of the individual (Figure 1.3). We may then ask (as has frequently been asked; Abu-Lughod 1986; Heider 1991; Menon and Shweder 1994; Rosaldo 1984; Schieffelin 1985) whether and how culture shifts this distribution and exerts characteristic effects on experience and behavior apparent on the population level. Figure 1.3 represents the individual level, but if we take the leap to imagine that these curves represent population distributions in specific contexts, then the landscape, or social distribution of emotion states (analogous to Waddington's ''epigenetic developmental landscape'' [Waddington 1957]) across contexts describes ethos, while the landscape of mindful process in organization and representation of cultural knowledge describes eidos.

Alternatively, what if feeling and thought operate synergistically in much of experience and behavior? (Figure 1.4) Recent advances from cognitive neurobiology and neurology suggest that this is the case (Damasio 1994). Then, a positive relationship would obtain between emotion and conscious processing, with intensity in one enhancing intensity in the other, up to some cutoff. Actual slopes and shapes of the relationship would vary, both by domain and because of temperamental and experience-specific differences. Perhaps this synergy between emotion and thought is essential, that is, structurally integral to information processing (Figure 1.5). The vast majority of sensory information processing takes place preconsciously, which is also where parallel distributed processing occurs: what appears as consciousness from multiple and parallel inputs and throughputs is shaped by relative valences of processing networks. Consciousness rides on the crests of waves in a preconscious ocean: emotions can influence which wave will be ridden. Neurologically, emotions reside in the preconscious, for they center in the limbic system and thalamus, which are secondary and primary routes for incoming sensory information.

Emotions, then, are integral to cognition. First, they are crucial to preconscious processing, for they direct attention, mediate rapid shifts in states of arousal, and thereby shape what is consciously attended to and how closely (Heller 1990; LeDoux 1989; Oatley and Johnson-Laird 1987). Further, emotions participate in memory formation and retrieval, both unconscious and conscious. Emotion-processing areas, such as locations within the amygdala, store memories of emotion events that inform future emotional processing of experience (Aggleton 1992; Damasio 1994). The result is unconscious emo-

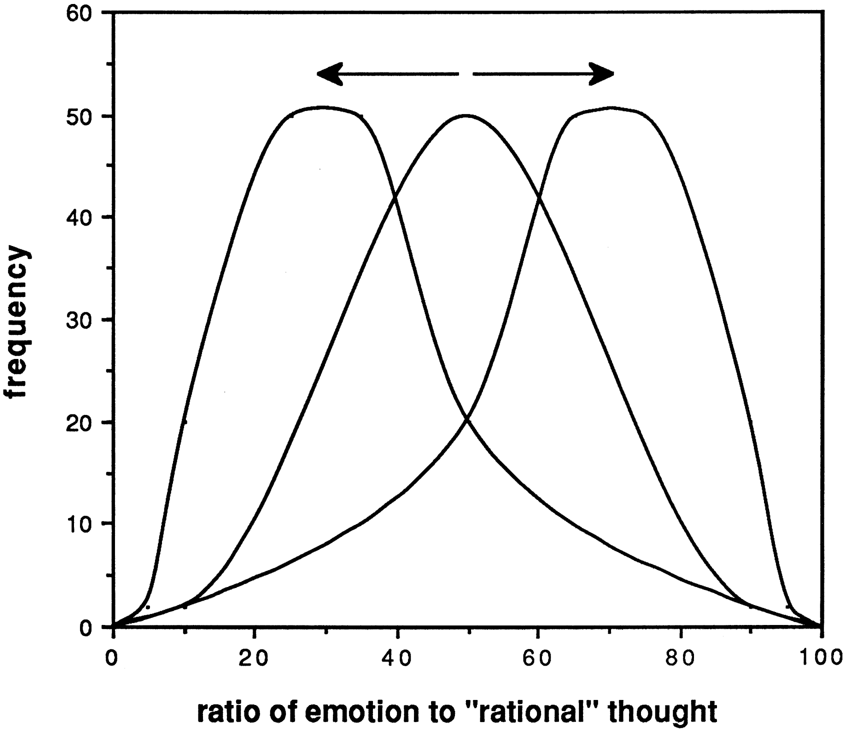

Figure 1.3. Schema extending Cartesian logic to individual temperament or disposition in terms of distribution of emotion/cognition ratios in mental states. The ratio of emotion to cognition or rationality is plotted by the frequency with which an individual is in that state. The arrows at the top indicate that the shapes of the curves, and hence their mode, may be evaluated on an individual basis in relation to cultural ideals, and thus form the basis of culture-specific attributions of temperament. Thus, in a Western view, the curve on the left might represent an ''impulsive'' person, while that on the right might represent a ''controlled'' person. Notions of culture and personality relate to the socialization practices and cultural demands on individual performance as bases for variation in these curves, or rather of population variation in their frequencies.

tional learning. Limbic structures, both amygdala and hippocampus, as well as hormones influenced by affective states, have been linked to modulation of memory and its conversion to long-term storage (de Wied *et al.* 1993; McEwen 1995; McGaugh 1989). Thus, emotion affects propositional learning: it influences what is remembered, inflects how it is remembered, and hence modulates the retrievable information base for future cognition. Addi-

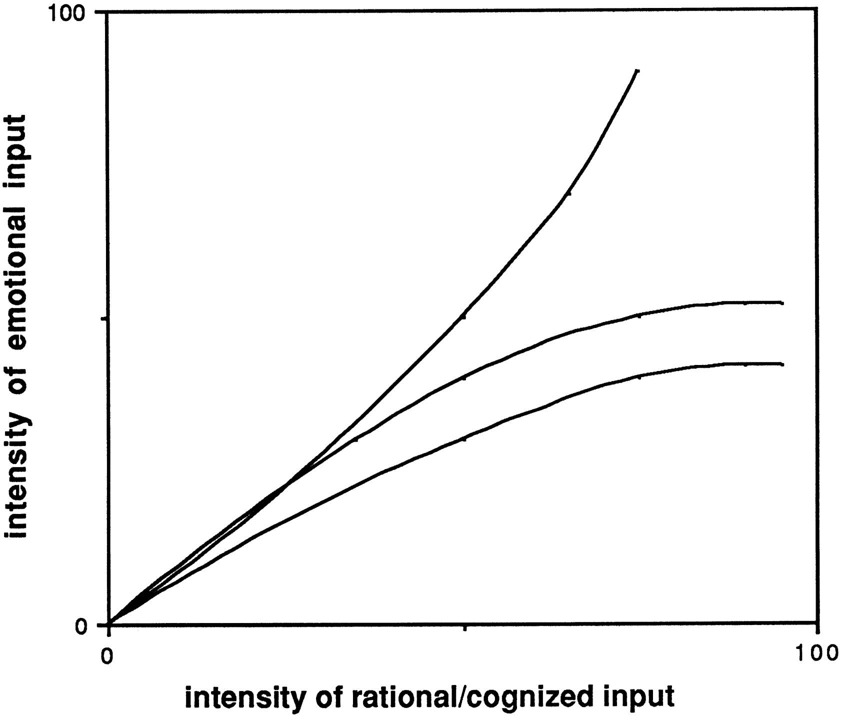

Figure 1.4. A model of emotion as intrinsic to thinking, or information processing, showing a synergistic relationship between intensity of emotional input and intensity of rational input in shaping ongoing information processing (rate and content). Because the numbers of factors under consideration may limit rate of information processing, and because emotion may assist in discounting alternatives (thus reducing computation size and increasing speed), the relationship of emotional and rational inputs to thought is nonlineal. The figure shows that steady emotional state may be required for sustained conscious computation, while very high emotional load may cut off sustained conscious consideration of alternatives or consequences. See also Damasio 1994: 173.

tionally, in their preconscious attention directing and prioritizing functions, emotions may also form a bridge to the unconscious (by definition, that which is and remains outside consciousness, including emotion memories), across which the unconscious ‘‘leaks’’ into thought or purposive action but eludes conscious scrutiny. Emotions may, like other perceptions, become conscious, and emotion experiences are then subject to the same conscious processes of experience, interpretation, schematization, and continuity maintenance as are

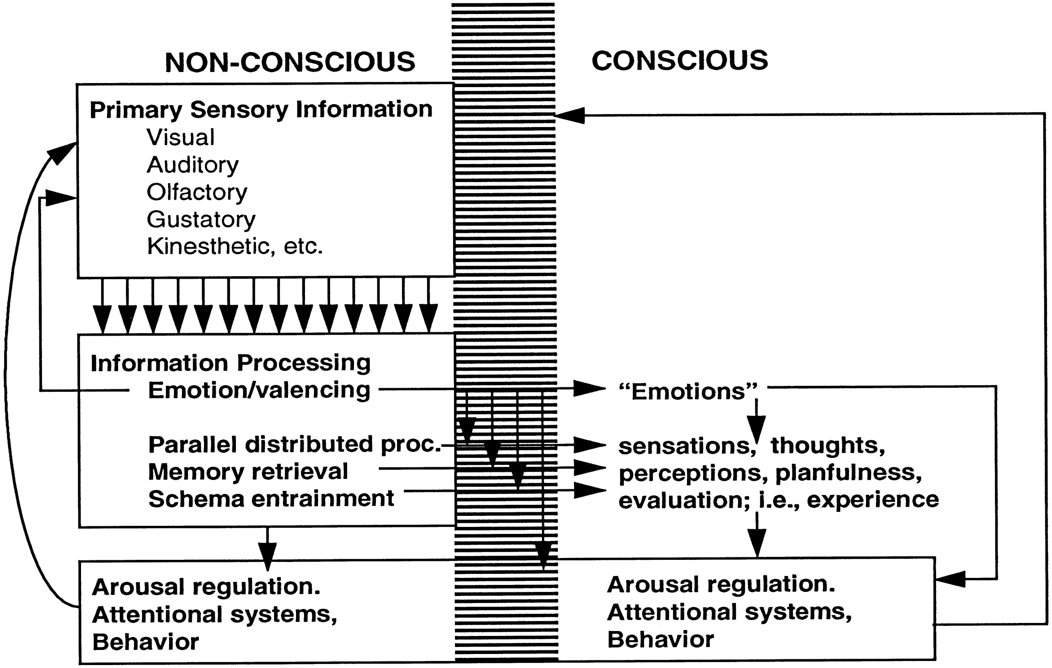

Figure 1.5. A model of relationships among central information processing modes, unconscious or preconscious, and conscious, along with of the role of emotion in trafficking among these modes and prioritizing within them. Notably, considerable peripheral information processing or selection has occurred prior to arrival at the CNS; much of regulatory emotional processing remains backgrounded, outside of consciousness but reflected in efferent outflows.
See also Leder 1990; Porges 1995.

other sensory perceptions or conscious thoughts (Lakoff 1987). Finally, emotions participate, often crucially and definitively, in meaning-making (Shore 1996).

A significant point pertaining to this reconceptualized role of emotion in cognition is the sheer multiplicity and volume of preconscious representations, in relation to what little becomes conscious. For instance, the visual system projects to multiple (likely more than eight) cortical areas that each delineate specific attributes and form representations that then collaborate and compete in composing what is consciously ‘‘seen’’ (Changeux 1985). Such parallel distributed processing of various aspects of sensory input in different neural nets greatly enhances the capacity for information extraction. At the same time, what becomes conscious is thus necessarily selective, often highly so: emotion shapes the selection and thereby forms a link in the dialectic between preconscious and conscious, as well as to the unconscious. In short, the input, storage, and processing capacities of the brain are large, consciousness is finite, and a very high functional premium is therefore placed on determining what to pay attention to and what to ignore or background. By attaching valence and weight to inputs and throughputs, emotion plays a key role in directing selective attention and prioritizing cognitive tasks (e.g., LeDoux 1990). It can also influence the apparent speed of cognition by focusing or diffusing attention and altering the intensity of directed cognition.

Moreover, cognitive-emotional lability acts as a medium for both coping and creativity. Selection from multiplicity can be a powerful means to generate flexible, condition-specific cognition to deal with a shifting, complex environment with competing, often conflicting, demands. If we reconsider the multiplicity of preconscious inputs we can, instead of seeing them as competing for conscious representation, view them as generators of diversity that act as grist for moment-to-moment selection in composing consciousness. Without this multiplicity and selection, experience and behavior would be pauperized. Likewise, we may say that the multiplicity of competing or conflicting sources of motivation and meaning are essential to human functioning over a lifetime in a complex, changeable sociable world. At the same time, temperament, or emotional disposition, can enhance experiential continuity in such a world.

In brief, emotions are intimately involved in information processing; they guide knowledge of the world by altering what we notice, enhancing learning, and evoking recall. Emotions also rapidly recruit memories and schemas, and integrate them in cognition and action. Finally, they provide bases for coping and creativity. These functions are essential to intelligent being-in-the-world: via emotions we do, indeed, ‘‘mind.’’

Ontogeny and the epidemiology of emotion

The second issue with Bateson’s approach, noted above, was that of ‘‘standardization,’’ or shared aspects of affect and behavior. This inherently developmental concept implicitly relies on culturally determined commonality of experience to mediate standardization. Bateson's analysis is avowedly synchronic for practical purposes of presentation (Bateson 1958: 3), but development is none the less bracketed at the same time as it is recognized as central. Despite a distinguished history of comparative research on human development by Mead, the Whitings, LeVine, and others, anthropology remains strongly adult-centered. Yet the study of emotion, in particular, would appear to call for a developmental approach, and again, psychological anthropology has a strong history of work in this area (e.g., Whiting and Whiting 1975b; LeVine 1974, 1990; Levy 1984). This analysis builds on and expands that tradition by suggesting that, rather than to search for either the innate universal or the culture-specific features of emotion, we would engage emotion or emotional experience much more comprehensively by examining the interaction of innate and contingent factors in the constitution of emotion. The burden of existing evidence suggests that emotion comprises shared and nonshared elements. Indeed, one human universal appears to be the capacity to generate complex emotional repertoires contingent on experience (Plomin *et al.* 1994). Only a developmental analysis will reveal the dynamics of dispositional and cultural factors which inform adult emotional life, and the pathways by which specific factors exert their effects. In other words, any clarification of the sources of commonalties such as shared affective modes, much less of the sources of cross-individual variation or of cross-cultural diversity in emotions, must ultimately involve development.

An adequate view of emotion would furthermore integrate corporeal and cognitive dimensions, and the relationship of these dimensions as emergent through ontogeny. As discussed in the previous section, most processing of sensory information, including emotional processing, occurs in the unconscious, and thus much emotional experience is literally embodied, outside the realm of consciousness, and indeed often irretrievable for conscious examination (Leder 1990; LeDoux 1994). Such a view implies a distinction between unconsciousness and cognition as one between unconscious and conscious aspects of information processing or thought. Yet both aspects are embodied (that is, they have a material basis), and pursuit of the implications of this point by integrating advances in neuroscience with study of emotional experience, expression, and behavior has yielded exciting insights into the nature of emotion and thought (Churchland 1989; Damasio 1994; Leder 1990; LeDoux 1986).

The remainder of this chapter, then, will proceed to: (1) delineate a scheme that, via development, links the individual to the social-cultural level of analysis, and (2) specify and elaborate this model through the analysis of two well-studied issues, reactivity and well-being, and anger/hostility and life expectancy. These cases are selected not only because they demonstrate biosocial interrelationships in emotional development and function, but also because they remove the discussion from the realm of abstraction. They provide a phenomenological basis for sociocultural analysis through recognition of the truly embodied nature of emotional experiences created by aversive or inequitable conditions in socially constructed human ecologies. Through embodiment, social conditions become translated into physical outcomes that include impairment, suffering, and death. Conversely, such cases also demonstrate the importance of culture, of social conditions, and the experience of those conditions, for construction of meaningful lives and human well-being. That the effect of social conditions on outcomes is probabilistic rather than definitive, also reflects on the relationship of culture to individual.

Dual embodiment and the biocultural bases of local biology

Contemporary culture theory increasingly employs the notion of embodiment, a concept initially advanced by Merleau-Ponty (1962) to indicate the situated-projective relationship of subject to object in perception, and by Bourdieu (1977: 1243) to denote the ‘‘socially informed body.’’ Conceptions of embodiment address the persistent conceptual gaps between mind and body, individual and society in both social and cognitive theory. For this reason, and because such gaps have widened with recent ascendance of social determinism in social theory, a more experience-near (Wikan 1991), phenomenological, or embodied approach to relations of individual to society or culture has become increasingly popular (Csordas 1994). As a concept, ‘‘embodiment’’ is applied ‘‘not to argue that the human body is an important object of anthropological study, but that a paradigm of embodiment can be elaborated for the study of culture and the self’’ (Csordas 1990: 53). On the one hand, culture or cultural ecology influences the form and function of the body and is said to be ‘‘inscribed’’ – or embodied – in persons (Figure 1.6) (Braidotti 1994; Broch-Due and Rudie 1993). Examples include simple physical transformations through circumcision or tattooing, and complex modifications such as conditioning (Weinberger 1995) or socially mediated acquisition of culture-specific language skills (Ochs and Schieffelin 1984) that entail permanent modifications in language ability (Changeux 1985). Through this usage of embodiment, culture can be shown to be more than skin deep, to organize corporeal function beyond the level of knowledge or thought. Indeed, some have used the notion of embodiment to extend cultural domination to the body, displace the notion of an innate or separate biological domain, and present the body as an artifact of culture (Butler 1993).

On the other hand, stringent cultural determinism scarcely accounts for human variation, invention and originality, deviance, or dissidence. Culture affects the probability that an individual encounters specific experiences at

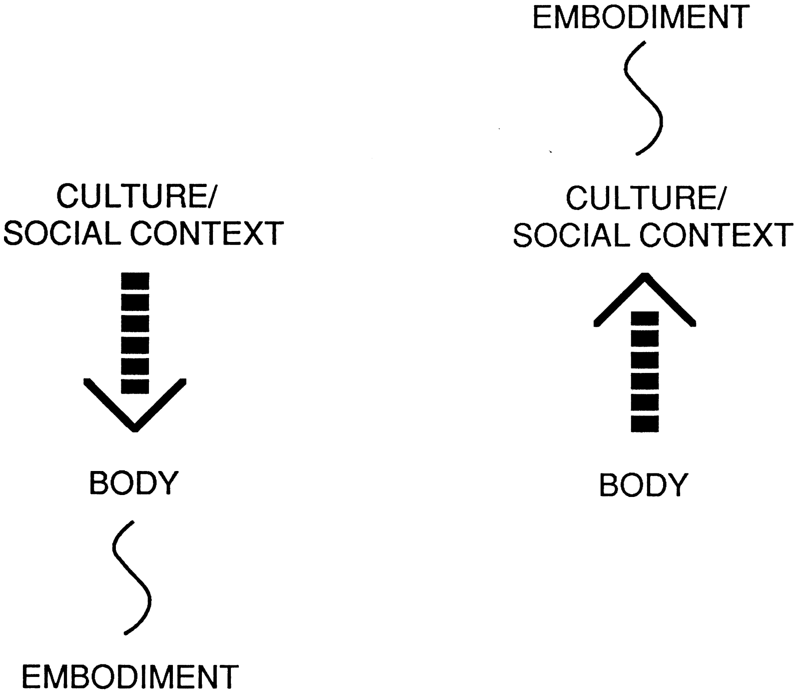

Figure 1.6. Dual embodiment schema

specific times. Within this probabilistic frame, the individual level of experience is determined by historical, idiosyncratic-local constitutional, and stochastic factors that generate very different individual experiences or life histories. For this reason, in Figure 1.6, although the arrow between culture and the body is direct insofar as culture does affect physical ontogeny and function, the arrow between the body and embodiment is wavy, or indeterminate and probabilistic, with respect to specific ways in which individuals are shaped by culture. Embodiment depends on developmental processes, and recent advances in many areas of developmental biology underscore the reliance of ontogenetic processes, by design, on environmental inputs to shape the course of development, from the molecular level upward (reviewed in Worthman 1992, 1993). This feature of organismic design establishes ontogeny as a co-construction of organism and its specific contexts, inputs, and experiences; hence, all biology is ‘‘local’’ and ontogeny is to some degree indeterminate, contingent on proximal interactions of individual and environment. Thus, a universal design feature can generate local biology, developmental indeterminacy, and variation (shaped in divergent or convergent ways). Moreover, developmentally emergent individual differences in motivation, perception, behavior, and physical attributes result in differing individual–environment interactions: individuals choose and influence their contexts, are differentially viewed and treated by others, and vary in perception of and responses to their phenomenological worlds. Thus, physical form and function, as well as affect, cognition, and behavior, dynamically co-emerge in the process of development: all these are components of embodiment as they constitute the individual as a set of conditions, dynamics, and actions-in-the-world.

Individuals are themselves social actors who, as members of a culture, participate in its instantiation and continual re-creation, for culture is not an entity disassociable from individual behaviors. Culture depends on practice for reproduction, or re-production. Thus, embodiment exerts phenomenological force and represents a force on, as well as a force in, culture. As culture shapes persons, those persons shape culture. This phenomenon represents the dual, or reciprocal, nature of embodiment (the right side of Figure 1.6): culture is also embodied in the sense that it is represented, re-created and modulated by its individual members, and fundamentally reflects the corporeal domain. Moreover, although the stream of social existence may transcend individuals, it must be actualized through individuals who thereby embody it. In this way, culture may be seen to be accountable, through ontogeny, to individuals through its probabilistic impact on the future affect, cognition, and behavior of those individuals: dual embodiment is the central dynamic in cultural epidemiology.

The notion of dual embodiment may be especially useful for understanding emotion. Emotions are particularly thorny for anthropologists because they require integration of individual and cultural levels of explanation, but they are interesting for just that reason. Emotions involve relational-evaluative stances of individual to situation. Moreover, they effect a crucial link in embodiment of the experiential self by entraining physical states with both individual experience and behavior. Relationships between physical and emotional states have been extensively investigated in psychology, psychiatry, and neurobiology, with a focus on physical concomitants or causes of emotional states (Figure 1.7, top panel). For instance, the study of depression and other mood disorders has focused heavily on identification of the biological factors within persons that cause depressive affect and psychobehavioral dysfunction (Schildkraut 1978; Siever and Davis 1985), with some consideration of reinforcement or feedback from emotional to biological function, largely in terms of how disorder becomes progressive (Gold *et al.* 1988). In other words, risk for becoming depressed is thought to have a genetic-biological

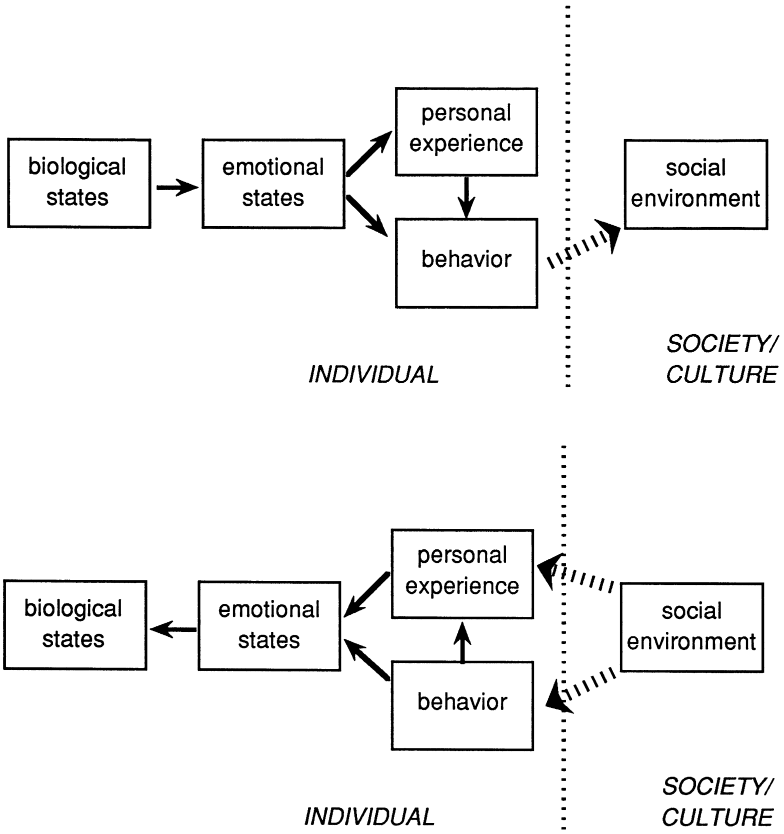

Figure 1.7. Two prevalent, and potentially complementary, models of relationships among biology, experience, and affect in etiology of affective disorders such as depression.

basis, but the biology of being depressed is associated with neuroendocrine and other physiologic states that may be as much the product as the cause of the condition.

The reverse set of linkages, from social experience to physical states via affective experience (Figure 1.7, bottom panel), has been less systematically explored. In the case of depression and other major affective disorders, associations of prevalence and onset with stressful life events have been repeatedly reported (Gold *et al.* 1988). Psychobiological interplay in emotions has been extensively explored under the conceptual umbrella of ''stress.'' Perceived (psychosocial) stress is linked to extensive acute physiological changes (Sapolsky 1992) on even such ''fundamental'' levels as gastrointestinal activity and immune function, and patterns of stress influence long-term developmental and functional outcomes, including health, survivorship, and physical size. Again, in the case of affective disorder, biological risk factors are viewed not as direct causes of disorder, but as predisposing factors which interact with situational risk factors (Costello and Angold 1995). Informed by this interactive model of affective pathogenesis, clinical treatment has largely aimed to ameliorate individual biology and palliate symptoms, while epidemiologic and public health approaches also aim to uncover social-situational risk factors and to buffer or remove potentially damaging conditions. The approaches are synergistic, but differ profoundly in level of intervention and, thus, political implication: the one targets individual change to alter vulnerability to risk (Kramer 1993), while the other involves social change to alter exposure to risk (Breggin 1994). The goal of the present analysis is to demonstrate how a developmental biocultural approach to emotion yields insights which bear directly on such practical issues of human well-being, but space does not permit pursuit of implications of these insights.

The following two sections apply a biocultural, dual embodiment model through analysis of two substantial literatures concerning individual variation in affect.

Lifespan interactions of temperament and well-being

The complex social world of a long-lived species like humans has its vicissitudes, and everyone must endure their share of loss as well as enjoy a measure of gain. Yet the proverbial cup can be seen as half full or half empty, and events that are disturbing or exciting to one person can be overlooked by or seem uninteresting to another. The individual's interpretation of events, rather than the objective facts themselves, is what constitutes lived experience, the phenomenological world of feeling and knowledge, and the sources of motivation and behavior. If interpretation is key, then understanding the bases of interpretation is crucial. Here, ‘‘interpretation’’ has a dually embodied sense as involving not only psychobehavioral but also biological impact of experiences on individuals; moreover, individually characteristic patterns of biobehavioral impact arise developmentally (that is, through time) out of dynamics between the individual and the environment. Neither properties of the environment nor features of the individual are sufficient to explain individual variation in well-being; the interaction between these determines much of that variation. As Jemerin and Boyce put it, in an analytic review of childhood stress and illness: ‘‘individual tendencies in physiologic responses may be seen as the biological analog of behavioral coping, and may thus reflect the operation of meaning at the physiologic level’’ (Jemerin and Boyce 1990: 1413). They conclude that ‘‘it may not be possible to understand the individual meaning of an event for a child without careful observation of both behavior and physiology'' (Jemerin and Boyce 1990: 1473). Recent research in behavioral pediatrics and child psychiatry establishes this point most vividly with the observations that stressors themselves account for merely 10 percent of variance in illness outcomes, that a stable subgroup comprising 15–20 percent of children experiences a significantly disproportionate amount of mental and physical morbidity and absorbs over half the medical service use, and that another substantial subgroup of children exposed to environmental risk does not experience poor outcomes (Barr *et al.* 1994; Boyce and Jemerin 1990; Liang *et al.* 1995). Individual and situational factors that exacerbate vulnerability or enhance resilience are currently under intense investigation; findings underscore the centrality of *person-environment* interaction (e.g., Granger *et al.* 1994b, 1996).

Developmental psychologists have investigated the nature and implications of individual differences in emotional valence and interpretive stance toward the world, known as temperament (Lewis 1989; Thomas and Chess 1977). Temperament is viewed as dispositional or innate, that is, seen very early, though etiology is not necessarily genetic. Yet the lived manifestations and consequences of temperament are increasingly understood as the product of person–environment interactions (e.g., Gunnar *et al.* 1992). Accordingly, investigators have sought to distinguish very early patterns in behavioral and concomitant physiological responses to stimuli or stress, and to test their predictiveness of both later reactions to experience and formation of social relationships (Calkins and Fox 1992; Fox 1991; Goldsmith *et al.* 1987; Gunnar *et al.* in press; Kagan and Snidman 1991; see also reviews in Fox 1994).

Temperament likely comprises multiple domains (physiological, affective, and behavioral). Relations across these domains, and of specific vectors within them, can be complex and non-linear. Thus, empirical and conceptual work on temperament is rapidly evolving through synergistic interactions of new data with emerging models, and investigators are clearly aware that current formulations are heuristic simplifications. It is impressive that, despite all these caveats, individual differences in responsiveness to experience, operationalized in terms of ‘‘reactivity,'' have emerged in relation to variation in outcome. Using physiologic (heart rate change, vagal tone, cortisol release) and behavioral (crying, facial expression, movement, social engagability) measures of reactivity, arousal, or responsivity to social or situational novelty (Gunnar *et al.* 1989; Kagan and Snidman 1991; Tennes 1982), maternal separation (Gunnar *et al.* 1992; Kagan and Snidman 1991; Tennes 1982), or physical stress such as inoculation or heelstick (Ramsay and Lewis 1994; Worobey and Lewis 1989), investigators have repeatedly found that some infants and children respond more vigorously to unfamiliarity, uncertainty, frustration, or pain than do others. Further, they report significant, though by no means universal, temporal continuity in individual biobehavioral styles of coping with or responding to experience (Gunnar *et al.* 1989; Gunnar *et al.* in press; Snidman *et al.* 1995).

Kagan and colleagues have intensively studied a minority (15–20 percent) of infants and children who exhibit a biobehavioral pattern of dealing with stress or stimulus termed ‘‘reactive-inhibited.’’ Relative to their peers, physiologically ‘‘reactive’’ and behaviorally ‘‘inhibited’’ infants are more easily excited, difficult to soothe, and less readily habituated, while shy or withdrawn children exhibit longer latency to play with unfamiliar objects, slowness to engage with adult strangers, and lassitude or crying during maternal separation (Kagan *et al.* 1987). Physiologic responses to these challenges include high, relatively invariant heart rates, low vagal tone, and exaggerated cortisol response without habituation through repeated experience (Fox 1989; Jemerin and Boyce 1990; Kagan 1992; Kagan *et al.* 1987; Lewis 1992). In reactive-inhibited individuals, familiarity with challenging stimuli may result in behavioral habituation in the absence of physiologic habituation; indeed, physiologic responses may escalate with repeated exposure (Granger *et al.* 1994a; Lewis and Ramsay 1995). Ontogenetic pathways to dissociation of physiologic and behavioral concomitants of experience remain unclear (Gunnar *et al.* 1989; Lewis and Ramsay 1995), but are of high interest from a dual embodiment perspective.

Work by Suomi and colleagues on developmental effects of rearing conditions in rhesus monkeys has provided a rich basis for insight and comparison in this area. In striking parallel to Kagan and colleagues’ observations among children, they report that around 20 percent of rhesus exhibit exaggerated responses to situational novelty or brief social separations, characterized by high cortisol and noradrenaline turnover, high and more stable heart rates, and behavioral inhibition (Suomi 1991). Patterns of reactivity show high individual stability over time (Higley *et al.* 1992; Suomi 1991). Their findings suggest that long-term effects exerted by early social experiences vary depending on individual constitution or temperament. Specifically, social, behavioral, and biological outcomes of high-reactive infants are more affected by rearing conditions than those of low-reactive infants: high-reactive rhesus reared by very nurturant foster mothers were behaviorally precocious and showed most rapid adjustment and high social dominance when transferred to large peer groups, whereas those fostered by ‘‘average’’ mothers were socially avoidant and attained low dominance status, and low-reactive monkeys assumed intermediate status irrespective of rearing condition (Suomi 1991).

As a possible substrate for such differences in reactivity, these investigators have identified individual differences in neuroendocrine activity (serotonin

[5-HIAA] and noradrenaline [MHPG] turnover) with significant biparental heritable components (Higley *et al.* 1993). Studies of free-ranging rhesus on Cayo Santiago have shown that a cerebrospinal fluid (CSF) marker of brain serotonin turnover, 5-HIAA, in adolescent macaque males correlated positively with levels of affiliative sociality and time of emigration from the natal troop (Mehlman *et al.* 1995) and negatively with rates of risk-taking, escalated aggression, and wounding (Mehlman *et al.* 1994). Such studies further demonstrated that early physiologic or behavioral responses to social stress or capture predicted antibody titers following immunization (Laudenslager *et al.* 1993). Finally, rearing conditions (peer *vs.* mother) exerted enduring effects on cortisol patterns and neuroendocrine activity (monoamine and noradrenaline turnover) both routinely and during social isolation: peer-reared monkeys exhibited greater physiologic responses to social stress (separation) than did maternal-reared peers (Higley *et al.* 1992).

In sum, studies of rhesus suggest that: (1) individual reactivity can be a product of genetic inheritance or of early experience alike, (2) long-term effects of early experience may be exhibited only under particular conditions, such as specific types of social deprivation or uncertainty; and (3) effects of early experience depend on individual temperament through the interaction of individual reactivity with specific contexts or experiences. Such ‘‘embodied’’ styles of relating with the world influence not only behavior patterns and social relations across the lifespan, but also physiologic determinants of health and longevity. The subsequent section will deal with risk for chronic disease, but here one should note that perceived negative stress and life events have been associated with decreased or suppressed immune function, and thus with risk for infectious disease. In a study serendipitously spanning the Loma Prieto earthquake, children with high versus low pre-earthquake immunologic reactivity to kindergarten entry subsequently showed insignificant post-earthquake increases in illness when earthquake impact on parents was low, but illness rates declined sharply in low-reactive and increased markedly in high-reactive children if parent impact was high (Boyce *et al.* 1993). Consequently, variation in child reactivity to mild, normative stress (school entry) emerged as a predictor of illness rates dependent on social conditions (parent distress) following a major stress or stressor. In the many parts of the world where pathogen load and child mortality are high, differential vulnerability to major normative (e.g., weaning) or non-normative (warfare, displacement) stress may attain even greater import for health and survival.

This brief survey of the substantial developmental literature on temperament brings several points to bear on emotion and dual embodiment, and we can begin to discern how divergent biosocial life histories can be constructed through interactions of constitutional and conditional variables. First, individual differences in biobehavioral affective styles of relating to experience (reactivity) create variation in the effects of any given experience. Temperamental variation furthermore comprises degree of reactivity to specific aspects of experience, such as frustration, social loss, or physical discomfort. Reactivity includes threshold to react, duration of reaction or time to restabilization, and ability to habituate to repeated stimulation (Lewis 1989, 1992). Hence, degree of individual variation in impact of an experience, including type, magnitude, threshold, duration, and contingency (habituation) of response, depends in part on specific characteristics of the experience. Second, cultural practices influence the timing, type, and frequency of specific experiences. For instance, maternal workload may allow infants continuous contact over the first two years of life (e.g., Ache; Hurtado *et al.* 1992), or may require early and prolonged maternal separation. Additionally, social variables such as status or role differentiation may create systematic intracultural variation in experience. For example, the timing and abruptness of weaning for Samoan infants may depend on maternal status and number of alternate caregivers (Ochs and Schieffelin 1984). Moreover, the content of alternate caregiving is known to influence infant separation distress (Gunnar *et al.* 1992). Third, culture merely influences the probability of exposure to a given experience or set of experiences; actual individual experience is conditioned by historical, proximate, and stochastic factors. However common their circumstances (e.g., twins) no two individuals will ever have the same set of specific experiences, in type, sequence, or frequency. This leads to developmental indeterminacy with respect to effects of cultural factors such as caregiving and socialization practices. Anthropologists have been slow to appreciate the ontogenetic and cultural opportunities and constraints this situation represents. Fourth, temperament–environment interaction modulates individual phenomenology of even shared experiences. Experiences may be common, culturally marked as normative rather than traumatic (e.g., weaning, brief maternal absences, school entry), but their impact on individuals varies. Predictability of or degree of control over experience may vary not only among cultures but within them along class/status or other social ecologies (Anderson and Armstead 1995). The degree to which maternal versus paternal status affects regulation and predictability of early child experience has scarcely been explored. Fifth, feed-forward ontogenetic processes shaped by person–environment interactions set up future trajectories of actual and lived experience that further interact with the evolving social niche the individual comes to inhabit through both attainment and ascription. Early variation in styles of relating to the world, however attained, sets up different relationships with others, which elicits different treatment by them, which further influences experience and the impact of experience, with implications for future psychosocial and biological outcomes (Gunnar *et al.* 1995, 1997). Variation in situational factors (such as maternal nurturance or household composition) influences the trajectory of this cascade and means that long-term effects of early constitutional affective differences are not a foregone conclusion, but contingent on sociocultural and even stochastic variables.

To conclude this section, the developmental literature on temperament directly supports the central role of emotion in being-in-the-world, for variation in affective responsiveness influences how information is perceived, evaluated, and acted upon, in both the present and the future. It demonstrates the role of biological variation in psychobehavioral variation, and identifies the intersection of person and context as a major determinant of variable outcomes. The next section probes more explicitly how the converse also obtains, that is, how experience conditions the psychophysiology of emotion and behavior regulation, with consequences for psychosocial and physical well-being. In particular, it details evidence concerning the role of emotions as mediators of biological effects of social experience, and traces the dual embodiment of social structural conditions for adversity or inequity.

Hardship, hostility, and health

The example of ‘‘hostility’’ represents a second well-studied exemplar of the influence of social conditions on emotion development, person *vs.* environment interaction in constructions of the life course, and the consequences of these for health (see McCall 1994 for a powerful account). Research in the United States has traced linkages among negative affect, negative experiences, temperament or reactivity, and long-term health outcomes. Specifically, associations of hostility to shortened life expectancy have been persuasively though not definitively documented, and developmental bases for this relationship are emerging (reviewed in Smith 1992; Williams 1994). Hostility has been defined as ‘‘a set of negative attitudes, beliefs, and appraisals concerning others [and] . . . connotes a view of others as frequent and likely sources of mistreatment, frustration, and provocation’’ (Smith 1992: 139). It involves various emotional (anger, irritation, resentment, contempt), cognitive (cynicism, hostile attributions), and behavioral (aggression, antagonism, uncooperativeness) components. Hostility has been related to increased sympathetic activation and cardiovascular reactivity reflected by elevated blood pressure and heart rate under specific social conditions, which conditions are salient interpersonal rather than non-social stressors (Smith 1992). Notably, these associations are more commonly identified for men than for women. Hostility thus appears to increase risk for coronary disease directly, as well as indirectly through its associations with increased risk-taking and health risk behaviors (smoking, caffeine consumption, obesity) (Scherwitz *et al.* 1991).