Thoughts on the Relations Between Emotion and Cognition

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ABSTRACT: This paper argues that thought is a necessary condition of emotion. It therefore opposes the stance taken by Zajonc, which reflects two widespread misunderstandings about what is meant by cognitive processes in emotion: (a) that a cognitive appraisal of the significance of an encounter for one's well-being must occur in fixed stages through the information processing of initially meaningless inputs from the environment; and (b) that such an appraisal is necessarily deliberate, rational, and conscious. Some of the phylogenetic and ontogenetic implications of a cognitive theory of emotion are also discussed briefly.

Recent years have seen a major change in the way psychologists view emotion—the rediscovery that emotions are products of cognitive processes. The emotional response is elicited by an evaluative perception in lower animals, and in humans by a complex cognitive appraisal of the significance of events for one's well-being.

Although there are many other issues concerning the relations between emotion and cognition, my comments will focus on the role of thought in the emotional response. I will refer often to Zajonc's (1980) challenge to the assumption that cognition occurs prior to emotion. I use his views to illustrate widespread misunderstandings of what it means to speak of cognition as a causal antecedent of emotion; I also use his views as a point of departure for my argument that cognitive activity is necessary as well as sufficient condition of emotion.

Do Emotions Require Cognitive Mediation?

My own position on this question is a variant of a family of theories of emotion centered on the concept of cognitive appraisal. Campos and Sernberg (1981) state, for example, that "The recent history of the study of emotion has been dominated by approaches stressing cognitive factors. In theories of adult emotional response, cognitive appraisal now functions as the central construct" (p. 273). Its role is to mediate the relationship between the person and the environment. The appraisal process gives rise to a particular emotion with greater or lesser intensity depending on how the relationship is evaluated with respect to the person's well-being. Cognitive appraisal means that the way one interprets one's plight at any given moment is crucial to the emotional response.

Cognition and emotion are usually fused in nature (Folkman, Schaefer, & Lazarus, 1979), although they can be dissociated in certain unusual or abnormal states. For example, cognitive coping processes (cf. Lazarus, 1981) such as isolation and intellectualization (or detachment), which are aimed at regulating feelings, can create a dissociation between thoughts and feelings. Moreover, attack can occur without anger, and avoidance without fear. These latter conditions are also instances in which the usual link between thought and feeling has been loosened or broken. Yet such separations are less often a rule of living and more often a product of coping under special circumstances. The full experience of emotion (as opposed to shame rage, for example) normally includes three fused components: thoughts, action impulses, and somatic disturbances. When these components are dissociated we are left with something other than what we mean by a true emotional state. Our theories of emotion must reflect the normal fusion, and separating thoughts, action impulses, and somatic disturbances except under certain specifiable conditions (as was done in the old days of faculty psychology—which treated cognition, emotion, and motivation as independent entities) distorts rather than clarifies the structure of the mind (cf. Lazarus, Cooney, & Folkman, 1982).

One bit of fallout from the above analysis is the implication, often derived from statements of cognitive theory, that cognitive appraisal is a necessary
as well as sufficient condition of emotion. Such a position has been criticized trenchantly by Zajonc (1980). He writes that affect is erroneously regarded in contemporary psychological theory as postcognitive, occurring only after extensive cognitive operations have taken place, and that in actuality affective judgments are fairly independent of, and even precede, the perceptual and cognitive activities on which they are said to depend. Zajonc argues that not only can affect occur without extensive perceptual and cognitive encoding—and even before—but that affect and cognition are controlled by separate and partially independent neural systems (see also Tomkins, 1981). Zajonc thus seems to be saying two things contrary to what I have argued: first, that the proposed directionality in which cognition determines affect is wrong and that the actual direction is affect to cognition; and second, that cognition and affect should be regarded as relatively independent subsystems rather than as fused and highly interdependent.

Building his argument, Zajonc cites a stanza of poetry from e. e. cummings (1973):

since feeling is first who pays any attention to the syntax of things will never wholly kiss you. (p. 160)

He also cites Wundt's (1907) concept of affective primacy, and Bartlett (1932), Ittelson (1973), Os- good (1962), and Fremack (1976) as having adopted the view that feelings come first. He states, for example:

In fact, it is entirely possible that the very first stage of the organism's reaction to stimuli and the very first elements in retrieval are affective. It is further possible that we can like something or be afraid of it before we know precisely what it is and perhaps even without knowing what it is. (p. 154)

The most serious mistake in Zajonc's analysis lies in his approach to cognition, which is characteristic of much of present-day cognitive psychology. In this approach information and meaning stem from the conception of mind as an analogue to a computer (Shannon & Weaver, 1962), a view illustrated also by the work of Newell and Simon (1961) and Weiner (1960). This conception has been rebutted by Dreyfus (1972), Polanyi (1958, 1966), and others, although the rebuttal has not affected the mainstream of cognitive psychology. The mainstream stance is that meanings for decision and action are built up from essentially meaningless stimulus display elements or bits and that systematic scanning of this display generates information. Thus, human cognition, like the operations of a computer, proceeds by serially receiving, registering, encoding, storing for the short- or long-run, and retrieving meaningless bits—a transformation to meaning that is called "information processing." Meanings and their associated emotions, or hot cognitions as Abelson (1963) referred to them, are built through such processing. As Erdelyi (1974) and others (e.g., Neisser, 1967) have suggested, however, emotion can influence the process at any of its stages. With this in mind, it is not surprising that Zajonc might be troubled by the implication that emotion lies at the end of a tortuous cognitive chain of information processing and therefore find it necessary to suggest an independent system making possible rapid, nonreflexive emotional reactions.

As many have argued (Folkman et al., 1978; Wrubel, Benner, & Lazarus, 1981), humans are meaning-oriented, meaning-creating creatures who constantly evaluate events from the perspective of their well-being and react emotionally to some of these evaluations. Zajonc is therefore correct in asserting that meanings are immediately inherent in emotionally laden transactions without lengthy or sequential processing, but for the wrong reasons. In my view, the concept of meaning defined by the traditional information processing approach subscribed to by Zajonc has a perfectly reasonable—and better—alternative.

We do not always have to await revelation from information processing to unravel the emotional code. As was argued in the New Look movement in perception, personal factors such as beliefs, expectations, and motives or commitments influence attention and appraisal at the very outset of any encounter. Concern with individual differences leads inevitably to concern with personal meanings and to the factors that shape such meanings. We actively select and shape experience and in some degree mold it to our own requirements (see also Rychlak, 1981). Information processing as an exclusive model of cognition is insufficiently concerned with the person as a source of meaning.

The history of debate about the phenomenon of subcensure is instructive (see Eriksen, 1956, 1960, 1962; Lazarus, 1956; Lazarus & McCleary, 1951). In a controversy experiment, McCleary and I showed that by associating a set of nonsense syllables to the threat of a painful electric shock, subjects would later react with a galvanic skin response selectively to the shock-associated syllables, even when they had misperceived and misreported them. We referred to this phenomenon as "autonomic discrimination without awareness," or "sub-
ception," arguing that subjects somehow sensed the threat without consciously recognizing the syllables.

The debate sparked by this interpretation touched on many complex issues, but it mainly centered on a claim by Bricker and Chapainis (1953) and Eriksen (1956, 1960, 1962) that even though the subjects had misreported what had been flashed on the screen, they probably had registered perceptually some of the structural elements of the syllables and, in effect, reacted automatically (emotionally) to "partial cues" of threat.

My response (Lazarus, 1956) was that it was reasonable to assume that perceptions are often global or spherical rather than built sequentially from structural elements and that emotionally relevant meanings (connotations) could be triggered by inputs whose full-blown denotations had not yet been achieved. An anecdotal example might be that when people misperceive the word cigarette, they do not necessarily report a structural equivalent such as pencil, but a meaning equivalent such as smoke (cf. Werner, 1948). All this accords nicely with Zajonc's insistence that emotional or affective meaning comes early, even before one knows what the object or event is. However, I reject the assumption that this early presence means that it is detached from or independent of cognitive appraisal.

If one accepts the principle that meaning lies at the end of a seriatim cognitive processing, then accommodating the fact that we can react emotionally instantly, that is, at the onset of a transaction, forces us to abandon the idea that emotion and cognition are necessarily connected causally and to adopt the position that emotion and cognition are separate psychological systems. This is exactly what Zajonc does.

However, we do not have to have complete information to react emotionally to meaning. We can react to incomplete information, which in fact we do in most ordinary transactions. The meaning derived from incomplete information can, of course, be vague; we need to allow for this type of meaning as well as for clearly articulated and thoroughly processed meaning.

Zajonc actually appears ambivalent about the cognitive involvement in emotion, as displayed in the many qualifying phrases he uses in speaking of affect or feeling. In the abstract of his article, for example, he writes that "affective judgments may be fairly independent of perceptual and cognitive operations commonly assumed to be the basis of these affective judgments. . . . Affective reactions can occur without extensive perceptual and cognitive encoding" (p. 151, emphasis added), and he refers to "affective judgments" (p. 157), implying that cognitive judgment is indeed involved in emotion.

Addressing some of Zajonc's statements from my perspective highlights the difference in our views. For example, he writes, "in fact, it is entirely possible that the very first stage of the organism's reaction to stimuli and the very first elements of retrieval are affective" (p. 154). This is acceptable if one adds that this is so only because evaluation or cognitive appraisal also begins at the start. In this connection it is noteworthy that earlier on the same page, Zajonc states, "in nearly all cases, however, feeling is not free of thought, nor is thought free of feelings." With this I agree wholeheartedly. Later Zajonc writes that for most human decisions it is very difficult to demonstrate that there have actually been any prior cognitive processes whatsoever. One might argue that these are cases in which one alternative so overwhelmingly dominates all the others that only a minimum of cognitive participation is required and that is why the cognitive involvement preceding such decisions is so hard to detect. (p. 155, second emphasis added)

Where, then, are we left with respect to the question of whether cognitive mediation is a necessary condition for emotion? By and large cognitive appraisal (of meaning or significance) underlies and is an integral feature of all emotional states. Are there any exceptions? I think not, and I underscore qualifications by Zajonc such as "minimum cognitive participation" to reflect that emotion or feeling is never totally independent of cognition, even when the emotional response is instantaneous and nonreflective, as emphasized in Arnold's (1960) use of the term appraisal. This is the real import of the expression "hot cognition." The thought and feelings are simultaneous. The only doubts I have are in the arena of phylogenetically based triggers or releasers of fear in humans such as those postulated by Hebb (1946). Perhaps humans are "instinctually" wired to react with fear to spiders, snakes, or strangeness. However, many of these tendencies (such as the sucking reflex) seem to disappear or at least go underground with an ontogenetic shift to higher mental processes, just as they seem to disappear or go underground with the phylogenetic accretions of the neocortex that only suppress or regulate but do not banish lower functions.

For all intents and purposes, therefore, meaning (in the sense of significance for well-being), whether
primitive or advanced, is always an essential component of such reactions. Such meaning exists not merely in the environmental display, but inheres in the cognitive structures and commitments developed over a lifetime that determine the personal and hence emotional significance of any person-environment encounter.

Some Widespread Confusions About Cognition

In his discussion of cognitive activity in emotion, Zajonc errs in his understanding of cognitive appraisal, displaying a confusion that is widespread and had been dealt with much earlier in my original treatment of appraisal (Lazarus, 1966). The cognitive activity in appraisal does not imply anything about deliberate reflection, rationality, or awareness. Nevertheless, Zajonc (1980) writes:

The rabbit cannot stop to contemplate the length of the snake's fangs or the geometry of its markings. If the rabbit is to escape, the action must be undertaken long before the completion of even a simple process—before, in fact, the rabbit has fully established and verified that a nearby movement might reveal a snake in all its coiled glory. The decision to run must be made on the basis of minimal cognitive engagement. (p. 156, emphasis added)

This would obviously have to be correct. It must be remembered, however, that as a result of its neural inheritance and experience the rabbit already has cognitive schemata that signify danger instantly at the sound of a slight rustle in the grass or the sight of a dimly perceived shape. Although the schemata required in human social affairs are apt to be far more complex and symbolic, the appraisal of danger does not have to be deliberate.

Zajonc, like many others, also seems to erroneously equate cognition with rationality. He writes, for example:

Unlike judgments of objective stimulus properties, affective reactions that often accompany these judgments cannot always be voluntarily controlled. Most often, these experiences occur whether one wants them to or not. One might be able to control the expression of emotion but not the experience of it itself. It is for this very reason that law, science, sports, education, and other institutions of society keep devising ever-new means of making judgments "objective." We wish some decisions to be more independent of these virtually inescapable reactions. (p. 156)

Such a statement implies that cognition is rational whereas feeling is irrational and primitive, a view that goes back to classical Greek times and that was also emphasized by the Catholic Church during the Middle Ages. Even today most psychologists treat emotions as primitive, midbrain phenomena, whereas reason is seen to reflect human phylogenetic superiority and as vulnerable to being overwhelmed by the primitivizing effects of passion (see Averill, 1974). One of the most influential of the cognitive behavior therapists, Ellis (1962), has argued in accord with this centuries-old tradition that faulty belief premises underlie psychopathology, creating distressing emotional states when the person reacts to situations on the basis of such premises. The treatment is designed to help the person give up the faulty beliefs so that he or she can operate more effectively and with less misery. However, in my view even positively toned, healthy emotions such as joy, peacefulness, love, and certainly many human commitments which sustain morale, resist on shared or private illusions (Lazarus, in press) and depend on beliefs whose accuracy is often irrelevant to the elicitation of the emotion. The point is that cognition cannot be equated with rationality. The cognitive appraisals that shape our emotional reactions can distort reality as well as reflect it realistically.

Finally, cognitive appraisal does not necessarily imply awareness of the factors in any encounter on which it rests. In this connection Zajonc writes about two different forms of unconscious processes:

"One emerges where behavior, such as that occurring in discrimination among stimuli, is entirely under the influence of affective factors without the participation of cognitive processes" (p. 172). In this he includes perceptual defense and subliminal perceptions. The other form of unconscious process is "implicated in highly overlearned, and thus automatized, sequences of information processing; this form includes cognitive acts but has collapsed them into large molar chunks that may conceal their original component links" (p. 172). Zajonc assumes that the former type of unconscious process involves no cognitive activity (as in Freud's "primary-process" thinking); the latter is a primitive, automatized process without significant cognitive activity or reality testing. I would certainly agree that a person need not be aware of his or her cognitive appraisals and may utilize primitive logic, but I would argue against the idea that some appraisals (Zajonc refers to preferences) are non-cognitive.

Some Further Issues About How Emotion Is Generated

There are a number of phylogenetic and ontogenetic implications of this cognitive emphasis. For

example, the causal route to the start of the affective system is absent or not considered, and the evaluative dimension of an emotion is considered as a complex system of subcategories that is not clear. A revised version could be summed up as follows: Since our concept of emotion is based on the affective system, an emotion is considered as a complex system of subcategories that is not clear. A revised version could be summed up as follows: Since our concept of emotion is based on the affective system, an emotion is considered as a complex system of subcategories that is not clear.
example, those who are less sanguine than I about the causal role of cognition in emotion often point to the startle response, since cognition is obviously absent or negligible in this reaction. I do not consider startle an emotion. Emotion results from an evaluative perception of a relationship (actual, imagined, or anticipated) between a person (or animal) and the environment. Startle is best regarded as a primitive neural reflex process. It signals that something has happened, and although it could precipitate a "true" emotional response, it is in itself merely a physiological response to an unanticipated change in stimulation, perhaps analogous to an eye blink in response to a sudden burst of light.

On the other hand, I am also convinced that some emotions depend more on cognitive activity, particularly of the symbolic sort, than others. For example, cognitive activity is apt to be more modest with respect to symbolic representation in fright than in anxiety. As Averill and I (Lazarus & Averill, 1972) have argued, anxiety always involves symbolic threats (probably to the self), is anticipatory, and occurs under conditions of ambiguity, whereas fright is immediate, concrete, and concerns survival-related dangers.

From this standpoint, then, in comparatively simple creatures there should be little symbolic representation in the appraisal process, although no living creature could survive unless it were able to distinguish harmful from nonharmful events. Perhaps the concept of releaser (i.e., a physical pattern that matches a neural array and sets off an emotional escape or attack reaction) is now considered simplistic. However, the basic idea seems sound that in more primitive creatures there is greater dependence on rigid, built-in processes, whereas in higher creatures such as humans there is much more variability and dependence on learning and symbolic processes.

Probably all mammals meet the minimal cognitive requirements of emotion if one permits the concept of appraisal to include the type of process described by ethologists in which a fairly rigid, built-in response to stimulus arrays differentiates danger from no-danger. An evaluative perception, hence appraisal, can operate at all levels of complexity, from the most primitive and inborn to the most symbolic and experience-based. If this is reasonable, then it is also possible to say that cognitive appraisal is always involved in emotion, even in creatures phylogenetically far more primitive than humans.

A corollary of the above is that the child's capacity to experience particular emotional reactions depends on the development of an understanding of the social context and its significance. Complex and more symbolically based emotional reactions, such as indignation and guilt, probably emerge later in ontogenesis than more simple types of emotion such as anger and fear, although even anger and fear in humans can have highly complex and symbolic social and psychological determinants. The capacity for emotional richness seems similar in the very young child and the more primitive mammal. However, the capacities diverge as the human child acquires symbolic modes of thought and knowledge; the child's cognitive processes and social circumstances extend its capacity for emotional richness far beyond that of other mammals. By implication, particular emotions will enter into the child's repertoire only after the child has come to master their particular cognitive prerequisites.

From a cognitive perspective, we can also ask whether it is possible to speak meaningfully about universals in the generation of an emotional state. Across species the basic neurochemical makeup of animals is quite similar, especially if we take as our starting point MacLean's (1949, 1975) reptilian and mammalian brain, two of three systems of the "trine" brain that also includes the human cerebral cortex. These similarities provide a neural template that makes emotion in all species similar in some fundamental ways.

Of even greater interest to those who emphasize a social and cognitive perspective are the similarities and variations within the human species in the processes underlying the elicitation of an emotion. Here too, although people share some biological and social agendas, social and personal meanings vary and take on great importance. As Hochschild (1979) points out, every society has "feeling rules"—prescriptions and proscriptions about how people should feel and act in diverse social contexts. The society, then, provides a kind of template (see also Kemper, 1978) of human relationships and meanings on which the appraisal of the significance of an encounter for one's well-being depends. These shape not only impression management but how we actually feel. Further, within a species and within a society, commitment patterns and beliefs vary from individual to individual and group to group. Therefore, whatever their origins, there are both common and distinct agendas that shape appraisals of the significance of a particular transaction with the environment for the well-being of any given individual.

If, as I do, one regards emotion as a result of an anticipated, experienced, or imagined outcome of
an adaptationally relevant transaction between organism and environment, cognitive processes are always crucial in the elicitation of an emotion. This idea has long been resisted by those disciplines most concerned with emotion as a feature of biological adaptation, perhaps because the concept of appraisal appears to emphasize individual differences and thereby requires complex, even individualized, rules about the determinants of appraisal. However, the search for such rules about how emotion is shaped by cognition in no way threatens the basic premises of the evolutionary-adaptational perspective that has long dominated the biological and social sciences. There is nothing in this perspective that requires reduction of all emotion to the lowest common denominator of comparatively simple animals and reptilian or mammalian brain structures. When such reduction occurs, it is at the expense of recognizing and investigating the primary role of cognition in emotion. It is about time we began to formulate rules about how cognitive processes generate, influence, and shape the emotional response in every species that reacts with emotion, in every social group sharing values, commitments, and beliefs, and in every individual member of the human species.

REFERENCES
MacLean, P. D. Psychosomatic disease and the "visceral brain": Recent developments bearing on the Pavlov theory of emotion. Psychosomatic Medicine, 1940, 11, 338-335.
EMOTION

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ABSTRACT

We review recent trends and methodological issues in assessing and testing theories of emotion, and we review evidence that form follows function in the affect system. Physical limitations constrain behavioral expressions and incline behavioral predispositions toward a bipolar organization, but these limiting conditions appear to lose their power at the level of underlying mechanisms, where a bivalent approach may provide a more comprehensive account of the affect system.

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INTRODUCTION

Recent research on emotions is almost as vast and diverse as emotional life itself. A literature search limited to the term "emotion" using PsychInfo re-

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turned 5064 citations over the past five years, and a comparable search using Medline returned 3542. A Handbook of Emotions appeared (Lewis & Haviland 1993) with a second edition already in preparation, journals are now devoted almost exclusively to the topic (e.g. Cognition and Emotion, Motivation and Emotion), and numerous textbooks on the topic have surfaced. The swell of interest in emotion continues to ascribe a large role to deliberation and civil discourse. Humans have walked the surface of the earth for about 2,000,000 years, and for all but the last 2000–3000 years humans have been hunter-gatherers. We nevertheless tend to see our distant past "through a reverse telescope that compresses it: a short time as hunter-gatherers, a long time as 'civilized' people" (Ackerman 1990, p. 129). We begin by reviewing recent developments in the study of human emotions. We then consider the general features of an affect system, archaic in some respects, that can be conceived as underlying emotion.

Methodological Developments in the Study of Emotion

The study of emotion has been aided in recent years by the development of standardized stimulus materials and procedures for eliciting emotions, and this continued to be an active area of inquiry in recent years (e.g. see Davidson & Cacioppo 1992, Gerrards-Hesse et al 1994). New developments were seen in stimulus sets consisting of pictures (Lang et al 1995), films (Gross & Levenson 1995, Philippot 1993, Westermann et al 1996), sounds (Bradley et al 1994), words (Bradley et al 1997), and stories, imagery, or social interactions (Westermann et al 1996, Gerrards-Hesse et al 1994).

The measurement of emotions also remained a bustling research area. The interplay among social, cognitive, and biological processes in emotion is becoming increasingly tractable, and emotional phenomena are now fruitfully studied drawing upon theories and methodologies that require collaboration among social, cognitive, developmental, clinical, and neuroscientists. For instance, methods for stereogoeometric functional brain imaging and complementary methods for mapping the temporal dynamics of neural processing have become a reality over the past two decades. Positron emission tomography (PET) (e.g. Drevets & Raichle 1995, George et al 1995, Lane et al 1997, Paradiso et al 1997) and functional magnetic resonance imaging (fMRI) (e.g. Grodd et al 1995, Maddock & Buonocore 1997, Lang et al 1998) offer considerable promise in studies of affective processes (cf Fox & Woldorff 1994, Kutas & Federmeier 1998, Sarter et al 1996).

As Kutas & Federmeier note, the temporal resolution of the fMRI is still limited by the fact that the blood flow response typically lags the actual electrical signal by one to two seconds and does not track activity on a millisecond-by-millisecond basis. The temporal resolution of PET is similarly limited. In
In the past five years, and a comparable search using A Handbook of Emotions appeared (Lewis & Haviland-Jones, 2000). New editions already in preparation, journals are now devoted to the topic (e.g., Cognition and Emotion, Motivation and Emotion, and Personality). In the textbooks on the topic have surfaced. The swell of interest in the field has led to numerous studies and reviews. We tend to see our distant past as through a reverse mirror: a short time as hunter-gatherers, a long time as man (Swan, 1990, p. 129). We begin by reviewing recent advances in human emotions. We then consider the general issues, archaic in some respects, that can be conceived as operations in the Study of Emotion

been aided in recent years by the development of new methods and procedures for eliciting emotions, and this area of inquiry in recent years (e.g., see Davidson & Harman, 2004). New developments were seen in pictures (Lang et al., 1995), films (Gross & Levenson, 1996), sounds (Bradley et al., 1994), and stories, imagery, or social interactions (Eisenberg et al., 1994).

Notions also remained a bustling research area. The nature, and biological processes in emotion are still under study and methodologies that require collaboration with developmental, clinical, and neuroscientists. For instance, functional brain imaging and computer modeling the temporal dynamics of neural processing in the past two decades. Positron emission tomography (PET, Raichle, 1995, George et al., 1995, Lane et al., 1997), functional magnetic resonance imaging (fMRI) (e.g., & Buonocore, 1997, Lang et al., 1998) offer considerable promise (cf. Fox & Woldorf, 1994, Kutter et al., 1996).

Note, the temporal resolution of the fMRI is still low but flow response typically lags the actual events and does not track activity on a millisecond temporal resolution of PET is similarly limited. In studies in which higher temporal resolution is required, fMRI or PET studies can be complemented by other measures. Indeed, advances in tracking phasic aspects of emotion were seen in (a) event-related brain potential paradigms (Cacioppo et al., 1994, Crits et al., 1995, Gardner & Cacioppo, 1998); (b) startle probe methods (Davis, 1997, Lang, 1995); (c) continuous self-report measures (Stayman & Aaker, 1993); (d) retrospective verbal protocols (Cacioppo et al., 1997), Davidson et al., 1997, Hurlburt, 1997); (e) nonverbal pictorial assessment techniques (Bradley & Lang, 1994); (f) facial electromyography (Tassinary & Cacioppo, 1992, Wittlief & Vrana, 1995); and (g) observational methods of infants (Emde et al., 1993) and interactants (Carroll & Russell, 1997, Gottman, 1993).

Laboratory studies can afford impressive control over relevant variables, an important feature when dissecting phenomena as complex and multiply determined as the emotions. The ecological and external validity of laboratory paradigms and measures can sometimes be uncertain, however. Advances in electronics and statistics have improved the feasibility and methodological sophistication of both ecological momentary assessments (e.g., Diener & Lucas, 1998, Larsen, 1996, Suls et al., 1998) and ambulatory monitoring of affective states (e.g., Guyll & Contrada, 1998, Kamarck et al., 1998). These assessments introduce their own set of statistical (of Schwartz & Stone, 1998) and methodological problems (e.g., Litt et al., 1998) but are noteworthy developments as they should make it possible to identify which laboratory findings generalize to the real world and to improve laboratory models of human emotions. Two additional developments that are needed are: (a) programmatic studies of emotion that test specific conceptual hypotheses based on both the internal validity of the laboratory and the external and ecological validity of field sampling methods and ambulatory assessments; and (b) greater use of experimental manipulations (e.g., an intervention program) in conjunction with field sampling methods and ambulatory assessments.

There has been no shortage of debate over methods and measures, either. Over the past couple years alone, discussions appeared on topics in a wide range: (a) import of linguistic analyses of emotion (e.g., Wierzbicka, 1995; cf. Forsyth & Eifert, 1996); (b) the role and limits of self-reports in studies of emotion (Lazarus, 1995, Reisenzein, 1995, Schwarz & Strack, 1998) and moods (Baggozzi, 1993, Green et al., 1993, Watson & Clark, 1997); (c) the unculturability of emotion judgments (Ekman, 1994, Rosenberg & Ekman, 1995, Russell, 1994); (d) the methodological nuances in research on cerebral asymmetries in emotion (Davidson, 1993, Hagemann et al., 1998, Reid et al., 1998); and (e) the nature and existence of basic emotions (Ekman, 1992, Izard, 1992, Ortony & Turner, 1990, Panksepp, 1992).

Individual differences in emotional disposition (Davidson, 1994, Depue, 1996, Gray, 1994, Rosenthal, 1995, Tangney et al., 1995), intensity (e.g., Keltner, 1995), and so forth are important for understanding the nature and dynamics of emotion. We will return to this issue later in the chapter.
& Ekman 1996), and reactivity (e.g. Cacioppo et al. 1992, Gilboa & Rev. 1994, Larsen et al. 1996) continued to be popular areas of theory and research. Explanations of the origins of the individual differences in emotion turned in part to studies of socioemotional development, work that now tends across the life span from infancy (e.g. Izard & Ackerman 1997, Nisbett de Haan 1997, Walker-Andrews 1997) through adolescence (Flannery & 1994) to old age (Carstensen et al. 1997, Schulz & Heckhausen 1997). Reports of the genetic determinants of emotion (e.g. McGuire 1993, Plomin et al. 1993) and the universality of emotional expressions (e.g. Averill et al. 1991, Ekman & Keltner 1997, Izard 1994) were counterbalanced by studies of cultural determinants (Mesquita et al. 1997, Russell 1994). As this work attests, emotion is a short label for a very broad category of experiential, behavioral, sociodevelopmental, and biological phenomena.

The Relation Between Emotion and Cognition

An assumption by rationalists dating back to the ancient Greeks has been that higher forms of human existence—mentation, rationality, foresight, and decision making—can be hijacked by the pirates of emotion. In accordance with the classic assumption that emotion wreaks havoc on human rationality, emphasis for years in psychology has been on cognition and rationality, and ways of diminishing the influence of subjectivity and emotion in decision making and behavior. Research with chimpanzees (Pan troglodytes) supported the notion that symbolic representations (e.g. Arabic numerals) evolve in part to lessen the primal grip of appetitive or aversive stimuli (e.g. sand on decision making and behavior (Boysen et al. 1996). However, emotions much more than primitive reflexes. The notion that emotions are a disrupt force in rational thought and adaptive action was shown to be a gross oversimplification (e.g. Bernston et al. 1993). Although the obstacles of a civilized world still occasionally call forth blind rages, emotions are increasingly recognized for the constructive role they play in higher forms of human experience.

Consider the neurological case of Eliot reported by Damasio (1994). Eliot was a businessman who developed a brain tumor that damaged his prefrontal cortex. Although Eliot began behaving irrationally, testing of Eliot reveals that his intelligence, attention, and memory remained unaffected by his illness. Instead, Eliot had lost the ability to experience emotion; and the lack of emotional guidance rendered decision making a dangerous game of roulette.

The notion that emotion contributes not only to an intelligent but also fulfilling life emerged most strikingly in the work on emotional intelligence. The heightened ability to monitor one's own and others' emotions, to discriminate among them, and to use the information to guide one's thinking and action has proven to be as important a determinant of life success as traditional measures of intelligence such as IQ (Goleman 1995, Mayer & Salovey 1993).
Societal changes have also influenced the direction of research on emotions. With rising health costs threatening to ravage families and finances, attention has turned to the role of emotion in cancer progression (Anderson et al 1998, Spiegel 1997), cardiovascular disease (Brezinka & Kittel 1996, Carney et al 1995), respiratory disease (Lehrer et al 1993), infectious illness (Cohen & Rodriguez 1995, Leventhal et al 1997), and immune function (Herbert & Cohen 1993, Kiecolt-Glaser et al 1994, Sternberg 1997). A second societal trend, the dawning of the information age and advances in computer vision, robotics, and telecommunications, has placed a premium on speech and facial recognition and production software. For these programs to be realistic, they must capture the emotion in the message. This need has fueled interest in the acoustic (Murray & Arnott 1993, Pittam & Scherer 1993) and rapid facial signals of emotion (Ekman 1993, Russell & Fernandez-Dols 1997). Although these represent relatively new areas of research, the economic stakes make these likely areas of new developments.

Research over the past two decades on cognition and emotion provides further evidence for the ubiquity of emotion, with the influence of emotion extending to all aspects of cognition and behavior. Perhaps of particular note in recent years are advances in our understanding of the role of emotions in attention and perception (Niedenthal & Kitayama 1994, Zajonc 1998); memory (Bradley et al 1995, Cahill 1996, Phelps & Anderson 1997); psychological defense (Paulhus et al 1997); subjective well-being (e.g. Diener & Suh 1998, Myers 1993); attitudes and persuasion (Cacioppo et al 1992, Chen & Bargh 1998); reasoning and decision making (Forgas 1995, Schwarz & Clore 1996); the meaning of expressive displays (Hess et al 1995, Rosenberg & Ekman 1994); emotional contagion (Hatfield et al 1994, Hietanen et al 1998); interpersonal relationships (Gardner et al 1998, Reis & Patrick 1996); and political information processing (Ottati et al 1992, Way & Masters 1996).

Emotions are also physiological processes and cannot be understood fully without considering the structural and functional aspects of the physical substrates (cf LeDoux 1995). Physiological investigations not only delineate underlying mechanisms but also contribute to better psychological theories by inspiring what is possible (e.g. implicit versus explicit knowledge representations) and by placing constraints on what is plausible (e.g. forward versus backward propagation). The biological (e.g. Botvin et al 1994, Cacioppo et al 1997a, Davidson 1994, Levenson 1996), biochemical (e.g. Rubinow & Schmidt 1996), and neural substrates of emotion (e.g. Damasio 1996, Davis 1997, LeDoux 1995, Neafsey et al 1993), as well as neuropsychological aspects of emotional expressions (Borod et al 1997), continued to be important and active areas of research. For instance, Shizgal (1998), in summarizing research using electrical brain stimulation to probe emotion, stated that in contrast to cognitive (i.e. perceptual and timing) channels, “the evaluative [affect-
tive] channel operates without even a pretense of objectivity." He noted that a cool stimulus applied to the skin can be pleasant if one is overheated and unpleasant if one is hypothermic. The affective value of a stimulus, he concluded, depends in part on the prevailing physiological and ecological conditions. Shizgal's (1998) physiological research implies that the brain is organized in part as an affect system, and that the operation of the affect system is not controlled in an absolute fashion by the objective features of a stimulus.

The Relativity of Emotion

The notion that there are absolute features that trigger emotional reactions was further undercut by new evidence that relativity governs the province of emotion. Kahneman and colleagues demonstrated that pain, long a bastion of absolutism, was preferred when its duration was extended while its intensity paled (Kahneman et al. 1993). Kahneman and colleagues (e.g. Kahneman 1998) offered the intriguing hypothesis that the affective representation of a complex event varied as a function of the peak experience and the experience at the end of the event (i.e. the peak-end rule).

Schwarz & Strack (1998) noted that most objective life circumstances, even when combined across a dozen domains of life, account for no more than 10% of the variance in measures of subjective well-being. Indeed, they demonstrated that the same event can increase or decrease judgments of subjective well-being depending on its use in construing one's life or its use as a standard. Specifically, Schwarz & Strack (1998) suggested that a contrast effect is likely to occur when an extreme (negative or positive) event is used as a standard against which to compare a stimulus or one's current state, whereas an assimilation effect is more likely when the extreme event is included in the transient representation of the affective event. For example, a moderately negative target stimulus (e.g. an argument with a spouse) is perceived more positively when preceded by the experience of a rare, extremely negative event (e.g. a death in the family) than when not preceded by such an event (Parducci 1995) as long as the preceding event served as a comparison standard rather than as part of the target event.

Yet other ways were discovered in which the determinants of emotion are relative. Brendl & Higgins (1995) reviewed evidence that an incentive is greater when it is compatible with a person's goal (see also Shah et al. 1998). Counterfactual thinking, or comparing objective outcomes with imagined outcomes that "might have been," was shown to leave bronze medalists at the 1992 Summer Olympics apparently happier than silver medalists (Medvec et al. 1995; see also Roese 1997) even though, by objective standards, an Olympic silver medal is of higher value than a bronze medal. Similarly, stories or confabulations that place an evocative event in a historical context were shown to be as important a determinant of the emotions elicited by the event as the event-
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itself (Harvey et al 1995, Kitayama & Masuda 1995, Traue & Pennebaker
1993). In addition to the perceived valuation of a stimulus or endstate, inves-
tigators demonstrated that the rates of movement toward or away from the
endstate are important determinants of emotion in and of themselves (Carver &

Research concerning cognitive appraisals represented an especially active
area of relativity research, complementing the research that emphasized the
features of the emotional eliciting stimulus by focusing upon the relativity of
the internal elicits of the emotional experience. Indeed, more than 100 ar-
ticles, various books (e.g. Lazarus 1991, Omdahl 1995), and special issues
of academic journals (e.g. Cognition and Emotion, Psychological Inquiry) were
devoted to the topic in recent years. The premise in cognitive appraisal theories
is that the appraisal of the significance of a stimulus involves "relational mean-
ing"—the import of an event in conjunction with the conditions present in the
environment and personal goals, beliefs, and adaptational resources (Lazarus
1994). Accordingly, universal antecedents are defined in terms of appraisal
dimensions rather than stimulus features (e.g. Ellsworth 1994, Frijda 1994).
Roseman et al (1996) argued that appraisals of unexpectedness, situational
state, motivational state, probability, control potential, problem source, and
agency differentiate 17 emotions, whereas in a cross-cultural study Scherer
(1997) found that fewer appraisal dimensions of the eliciting event provided a
reasonably good account of the major emotion categories (e.g. joy, sadness,
fear, anger, disgust, shame, and guilt) (see also Fitness & Fletcher 1993, Frijda
1993). Importantly, suggestive evidence that the unfolding of cognitive appra-
sais were themselves influenced by subcortical neural structures long asso-
ciated with emotion emerged from neuropsychological cases such as Scott et
al.'s (1997) report of a patient with lesions of the left and right amygdala (see

Cognitive appraisals may be more important for some types of emotional
elicitors than others. In an illustrative line of research summarized by Ohman
et al (1998), two types of emotional conditioning were identified. In one type
of conditioning, the knowledge that the conditioned stimulus (CS) and uncondi-
tioned stimulus (US) are associated in time is explicit (i.e. expectancy-based
learning)—that is, autonomic responses occur on the same trials on which sub-
jects develop the expectancy that the CS is followed by the US. This learning
does not require an aversive US (Hamm & Vaitl 1996), is accessible to con-
sciousness, and modifies responses related to orienting responses (LeDoux
1995, Ohman et al 1998). In a second type of visceral conditioning, the knowl-
dge that the CS and US are associated in time is implicit (Ohman et al 1998).
This learning appears most reliably when an aversive US is combined with a
fear-relevant CS (e.g. snake, angry facial display), results in an enhanced star-
tle response and tachycardia, is relatively resistant to extinction, and, although not dependent on conscious awareness of the CS-US contingency, it modifies the perceived valence of the CS as revealed by ratings (Davey 1992, Schell et al 1991, see Ohman 1993). The hippocampus appears to be especially important in the explicit learning of emotional expectancies, whereas the amygdala appears especially important in the implicit emotional conditioning. For instance, Bechara et al (1995) found that two patients with bilateral lesions of the amygdala learned the conditioning contingencies but did not acquire conditioned skin conductance responses in aversive conditioning paradigms. Patients with bilateral hippocampal damage, in contrast, failed to learn the conditioning contingencies but acquired conditioned skin conductance responses. Together, these studies suggest that cognitive appraisals may play a more important causal role in human autonomic conditioning based on explicit than implicit knowledge (LeDoux 1995, Ohman et al 1998).

Classical conditioning has traditionally provided a valuable paradigm for studying behavioral preference in nonvertebrates and nonprimates, and more contemporaneously it has been used to examine the mechanisms underlying the learning and memory of affective associations. The evolutionary advantage is obvious; recognizing the neutral trappings of a predator as a danger signal allows organisms to avoid becoming a meal. Additional evidence for the special status accorded to motivationally significant stimuli can be found in research on orienting responses. Orienting responses to threat-related stimuli are found whether the stimuli are masked or not, whereas orienting responses to neutral stimuli are found for unmasked but not masked stimuli (Dimberg & Ohman 1996, Ohman 1993). According to Ohman’s theory of the orienting response, evolution has sculpted perceptual and attentional systems to provide preferential access to those classes of stimuli with adaptive significance for organisms (Ohman et al 1998). Based on comparative data, Hunt & Campbell (1997) have further suggested that orienting responses to neutral stimuli may have evolved from earlier, more motivational basic responses, answering the questions “Is it dangerous?” or “Is it food?” rather than the “What is it?” response posited by Pavlov.

THE AFFECT SYSTEM UNDERLYING EMOTION

Evolutionary forces do not value knowledge or truth per se but species survival. Hunt & Campbell’s provocative proposition underscores the primeval importance of a system that differentiates between hostile and hospitable stimuli (1997). The human brain and body have been shaped by natural selection to perform this affective categorization and to respond accordingly. Affective categorizations and responses are so critical that organisms have rudimentary reflexes for categorizing and approaching or withdrawing from cer-
tistant to extinction, and, although the CS-US contingency, it modifies by ratings (Davey 1992, Schell et al 1993). As various authors have noted, an additional adaptive advantage is conferred to species whose individual members have the capacity to learn based on the unique environmental contingencies to which they are exposed, to represent and predict events in their environment, to manipulate and plan based on representations, and to exert some control over their attentional and cognitive resources.

Zajonc's influential paper "Preferences Need No Inferences" underscored the utility of the affect system as an object of study (1980). Evidence that the neural circuitry involved in computing the affective significance of a stimulus (i.e. evaluative processing) diverges at least in part from the circuitry involved in identification and discrimination (i.e. nonevaluative processing) was provided by Shizgal (1998) in a series of studies involving brain stimulation in rats and by Cacioppo and colleagues (Cacioppo et al 1996, Crites & Cacioppo 1996) in a series of studies of ERP topographies in humans. For instance, investigations of the spatial distribution of late positive potentials across the scalp have revealed a relatively symmetrical distribution during nonaffective categorizations, whereas the spatial distribution of the late positive potentials associated with affective categorizations were more right lateralized (Cacioppo et al 1996). This asymmetrical activation is consistent with the importance of the right hemisphere in emotion (see Tucker & Frederick 1989). Furthermore, the similarities in ERP topographies indicate that affective and nonaffective appraisals are not entirely different but rather rely on a number of common information-processing operations.

In the last chapter on emotion in the Annual Review of Psychology, LeDoux covered in detail some of the neural substrates of the affect system (1995). Here, therefore, we focus on the structure and operating characteristics of the affect system.

Operating Characteristics of the Affect System

Stimuli and events in the world are diverse, complex, multidimensional—in short, seemingly incomparable. Yet each perceptual system has evolved to be tuned to specific features, resulting in the expression of these stimuli on a common metric (Tooby & Cosmides 1990). Seemingly incomparable stimuli and events can also be conceived as being expressed on common motivational metrics (Cacioppo & Berntson 1994, Lang 1995, Shizgal 1998). As Ollman et al note, "Evolution has primed organisms to be responsive to stimuli that more or less directly are related to the overall task of promoting one's genes to prosper in subsequent generations.... Stimuli of these types are embedded within emo-
tional systems that help regulate behavior within 'critical functional domain' (Ohman et al. 1998).

Information is lost in translating a multidimensional representation of a stimulus onto a common motivational metric (i.e., a currency function). However, as Shizgal states, "the information lost due to the collapsing of multiple dimensions is essential for identifying the stimulus and distinguishing it from others. ... The circuitry that computes instantaneous utility must diverge from the perceptual circuitry subserving identification and discrimination" (Shizgal 1998). As noted above, there is now considerable evidence for differences in the circuitry in affective processing versus the processes of identification and discrimination.

From classical learning theory came the principle that motivational strength increases as the distance from a desired or undesired endstate decreases. Currency functions, in essence, represent the activation function for motivational strength. Perceptual activation functions tend to be negatively accelerating, and this appears to describe the activation function for emotion as well (Boysen et al. 1996, Kemp et al. 1995). For example, Boysen et al. (1996) demonstrated that, for chimpanzees judging the differential incentive values of candy arrays, the relative effectiveness of a given increment in payoff diminished as the base size of the payoff increased. The activation function for affective responses is thus reminiscent of microeconomic marginal utility functions.

Stages and Channels of Evaluative Processing

One distinction Shizgal (1998) made between the evaluative (affective) and perceptual channels is that the former is constructed not to return objective properties of the stimulus but to provide a subjective estimate of the current significance of these properties. How many evaluative channels are there? Most have posited one in which subjective, valent information is derived from the flow of sensation (e.g., Green et al. 1993). Studies of the conceptual organization of emotion, for instance, suggest that people’s knowledge about emotions is hierarchically organized and that a superordinate division is between positivity and negativity (e.g., Lang et al. 1990).

One reason underlying this superordinate division in emotional knowledge may be that physical constraints restrict behavioral manifestations to bivalent actions (approach/withdrawal). Evolution favors the organism that can learn, represent, and access rapidly whether approach or withdrawal is adaptive when confronted by a stimulus. Accordingly, mental guides for one’s actions in future encounters with the target stimuli—attitudes (e.g., Cacioppo & Berntson 1994), preferences (e.g., Kahneman 1998), and conceptual organizations of emotion (e.g., Ortony et al. 1988)—also tend to be more expected and stable when organized in terms of a bipolar evaluative dimension (ranging from very good and not at all bad to very bad and not at all good).
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"Acording to the model of evaluative space (Cacioppo, Bernson, Cacioppo & Berntson, 1997b), the common metric governing approach/withdrawal is a single dimension at response stages but is the consequence of two interven- metrici (i.e., evaluative channels)—the activation function for positivity and the activation function for negativity—at the inaugural affective process- stages. Further, multiple modes of activation are posited to exist for the two evaluative channels: (a) reciprocal activation occurs when a stimulus has op- posing effects on the activation of positivity and negativity; (b) uncoupled ac- tivation occurs when a stimulus affects only positive or only negative evaluative activation; and (c) nonreciprocal activation occurs when a stimulus in- creases (or decreases) the activation of both positivity and negativity. This model thus does not reject the reciprocal activation that is assumed in subjective reports of affect, and demanded in behavioral manifestations of affect, but rather subsumes it as one of the possible modes of activation and explores the antecedents for each mode of evaluative activation.

Evidence for the existence of multiple modes of evaluative activation has been observed across all levels of analysis (cf. Cacioppo & Berntson, 1994). For instance, Hoebel (1998) reviewed evidence that whereas morphine has reciprocal effects on neurochemical processes underlying approach and withdrawal behavior, food restriction alters neurochemical effects underlying approach behavior in an uncoupled fashion. At the verbal level, Goldstein & Strube (1994) demonstrated the uncoupled activation of positivity and negativity in affective reports collected from students at the beginning and end of three consecutive class periods. The intensity of positive and negative reactions on any particular day were found to be uncorrelated. Moreover, exam feedback activated positivity and negativity differently. Students who performed well on an exam showed an increase in positive affect relative to their beginning-of-class level, whereas
their level of negative affect remained unchanged; and students who performed poorly showed an increase in negative affect but no change in positive affect.

Such distinctions between positive and negative affective processes have also been observed in (a) uplifts and hassles (Gannon et al. 1992, Zautra et al. 1990); (b) mood states (Lawton et al. 1992, Zautra et al. 1997); (c) organization of self-knowledge (e.g. Showers 1995, Showers & Kling 1996); (d) self-regulatory focus (e.g. Higgins 1997); (e) self-efficacy (Zautra et al. 1997); (f) personality processes (Robinson-Whelan et al. 1997, Rusting & Larsen 1998, Watson et al. 1992); (g) achievement motivations (Elliot & Church 1997, Elliot & Harackiewicz 1996); (h) attitudes and persuasion (Cacioppo & Berntson 1994); (i) emotional expressivity (Gross & John 1997); (j) social interactions (Berry & Hansen 1996, Cacioppo et al. 1997b); (k) affect toward political leaders (Marcus & Mackuen 1993); and (l) intergroup discrimination (Blanz et al. 1997, Brewer 1996).

However, Green et al. (1993) questioned the notion that positive and negative affect were separable on methodological grounds (see also Bagozzi 1993, Marsh 1996). Specifically, they argued that measures of affect typically rely on similarly worded scales with identical endpoints. This feature, they argued, can lead to positively correlated measurement error effectively suppressing the magnitude of the true negative correlation between positive and negative affective states. Thompson et al. (1993), in contrast, suggested that methodological artifacts (e.g. carryover between unipolar positive and negative rating scales) could instead inflate the negative correlation between positive and negative rating scales, and they recommended segregating self-report measures of positive and negative affect to avoid self-presentational biases.

A recent investigation by Nelson (1998) addressed these methodological concerns and found evidence for the operation of multiple modes of evaluative activation. Nelson (1998) used a structural modeling approach to examine the structure of affect toward two different social categories—African Americans and the poor—while accounting for correlated measurement error among the observed variables. Nelson's analyses of the structure of the emotional responses toward the poor revealed substantial independence between positive and negative factors. This two-factor model was significantly better than the bipolar model even when the effects of correlated measurement error were extracted. This result is precisely what would be expected if positive and negative affect were separate dimensions at a basic level. Nelson's analyses of the structure of students' emotional responses toward African Americans, however, revealed a bipolar model to be sufficient when the effects of correlated measurement error were considered. This latter result illustrates that affect is not invariably organized in a bipolar or a bivariate structure but rather the structure of affective response is influenced by the mode of evaluative activation elicited by the stimulus (Cacioppo & Berntson 1994).
Methodological issues are important to consider, but assuming that the affect system consists only of a single bipolar evaluative channel can also be costly in terms of the fertile avenues of research it precludes. Brain imaging studies, for instance, have tended to contrast positive and negative states, a procedure that impedes the differentiation of the conditions in which positive and negative processes are separable. This may be unwise because, although preliminary at this juncture, some brain imaging studies suggest that different neural structures may be involved in positive and negative hedonic processes. George et al., for instance, used PET during the recall of happy, sad, or neutral memories while viewing congruent happy, sad, or neutral faces (George et al. 1995). Comparisons between the sadness-minus-neutral and the happy-minus-neutral conditions revealed that, rather than reciprocal changes in blood flow to the same brain regions, a change from sad to happy affective state produced increased cerebral blood flow to distinguishable brain regions (see also Lane et al. 1997).

Research on cortical asymmetry is also consistent with the notion of specialized evaluative channels for processing of positive and negative information that are subsequently integrated in the production of an affective response (e.g. Davidson 1993, Davidson et al. 1990). In a study by Sutton & Davidson, for instance, resting EEG asymmetries were compared with scores on Carver & White's Behavioral Approach System/Behavioral Inhibition System measure, a self-report instrument designed to assess individual differences in the tendency to approach or withdraw and to experience concomitant affective states (Sutton & Davidson 1997, Carver & White 1994). Consistent with the notion that positivity and negativity are separable systems differentially associated with left and right hemispheric activation, respectively, greater relative left hemisphere activity at midfrontal electrode sites was positively correlated with behavioral activation system scores and negatively correlated with behavioral inhibition system scores. Similarly, studies using computerized tomography to investigate the relationship between the location of stroke-related lesions and affective symptoms showed that the severity of post-stroke depression was positively related to lesion proximity to the left frontal pole but negatively related to lesion proximity to the right frontal pole (Robinson & Downhill 1995). Robinson and colleagues further observed that patients with right lateralized infarctions were more likely than their left-hemisphere-lesioned counterparts to display inappropriate cheerfulness.

The evidence for the separability of positive and negative evaluative processes becomes more controversial when one turns to the literature on the conceptual organization of moods, affect, and emotion. Among the best known research bearing on the centrality of people's net positive and negative feelings is Osgood et al.'s classic work on the measurement of meaning (1957). In multiple studies and cultures, evaluative bipolar word pairs (e.g. pleasant-
unpleasant) were found to comprise a fundamental dimension underlying people’s understanding of the world. Conceptually similar results have been found in crosscultural, multidimensional scaling studies of emotional feelings (e.g. Bradley & Lang 1994, Larsen & Diener 1992) and in crosscultural ratings of emotionally evocative pictures (e.g. Lang et al 1995). Thus, the two-dimensional representation that best represents people’s conceptual organization of affect and emotion may tend to be positive/negative X active/inactive rather than positive/negative X non-positive/negative. Given that psychological states such as conflict, ambivalence, and inconsistency among beliefs about an attitude object tend to be unexpected, nonharmonious, and unstable, people’s conceptual organization of evaluative processes and affective states (e.g. moods) may tend toward a bipolar structure because of the operation of motives to maintain a simple and psychologically consistent representation of the world.

In sum, the common metric governing approach/withdrawal can perhaps be best conceptualized as a single dimension at response stages with the bivalent affective response consequence of two intervening evaluative channels, one for positivity (appetition) and one for negativity (aversions). Consistent with the notion that input from these evaluative channels is combined with antagonistic effects on action dispositions and behavior, a bivalent organization of affect is more likely to be observed as one moves down the neuraxis (see Berntson et al 1993, Cacioppo et al 1998). For instance, relative to neutral states, negative states tend to potentiate startle eyeblink whereas positive states tend to inhibit it (see reviews by Filiot et al 1998, Lang et al 1990) because of the modulating effects of the amygdala (Davis 1997, Lang 1995).

The value of considering the additional complexities introduced by multiple evaluative channels and modes of evaluative activation derives not only from the data it explains but also from the questions it generates and the bridges it builds across data previously thought to be separate. Research in areas of inquiry as distinct as coping in chronic pain patients (Zautra et al 1995), classroom performance and academic motivation (Elliot & Church 1997), frequency and quality of social interactions (Berry & Hansen 1996), blood and organ donation (Cacioppo & Gardner 1993), and racial prejudice (Schofield 1991) all support the wisdom of considering the two motivational systems as functionally separable.

The partial segregation of the positive and negative evaluative channels in the affect system not only confers an additional flexibility of orchestrating appetitive and aversive motivational forces via modes of evaluative activation, but also affords evolution the opportunity to sculpt distinctive activation (i.e. currency) functions for positivity and negativity. Interest in differences in the effects of positive versus negative information has grown substantially in recent years. Not only have numerous articles and several major reviews on the
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POTIVITY OFFSET The positivity offset is the tendency for there to be a 
weak positive (approach) motivational output at zero input, an intercept differ-
ence in the affective system. As a consequence of the positivity offset, the mo-
tivation to approach is stronger than the motivation to avoid at low levels of 
evaluative activation (e.g. at distances far from a goal). What might be the pos-
sible evolutionary significance of the positivity offset? Without a positivity 
offset, an organism in a neutral environment may be unmotivated to approach 
ovel objects, stimuli, or contexts. Such organisms would learn little about 
novel or neutral-appearing environments and their potential value or threat.
With a positivity offset, however, an organism facing neutral or unfamiliar 
stimuli would be weakly motivated to engage in exploratory behavior. Such a 
tendency may have important survival value, at least at the level of a species.

How might this evolutionarily endowed tendency manifest itself in the 
present day? One line of evidence may be the prevalence of "unrealistic opti-
mism," the tendency to expect generally positive outcomes for unknown fu-
ture events (Brinhaupt et al 1991, Hoorens & Buunk 1993, Pulford & Colman 
1996, Regan et al 1995). A second line of evidence may be the robust "positiv-
ity bias" found in impressions of neutral, unknown, or ambiguous human 
and nonhuman targets (Klar & Giladi 1997, Sears 1983, Peeters 1991). Finally, 
research concerning the "mere exposure" effect demonstrates that affectively 
nutral stimuli may be evaluated positively even when presented outside of 
conscious awareness (Bornstein 1989, Harmon-Jones & Allan 1998). These 
lines of research support the existence of a positivity offset in a myriad of do-
mains; when asked to evaluate stimuli or situations that by objective standards 
should be affectively neutral (e.g. the unknowable future, the "average" per-
son, an unfamiliar Chinese idiom), people show a consistent tendency to re-
spond in a mildly positive fashion.

NEGATIVITY BIAS Exploratory behavior can provide useful information 
about an organism's environment, but exploration can also place an organism 
in proximity to hostile stimuli. Because it is more difficult to reverse the con-
sequences of an injurious or fatal assault than those of an opportunity unpursued, 
the process of natural selection may also have resulted in the propensity to re-
act more strongly to negative than to positive stimuli. Termed the negativity bias, this heightened sensitivity to negative information is a robust psychological phenomenon (see reviews by Cacioppo & Berntson 1994, Cacioppo et al 1997b, Peeters & Czapinski 1990, Taylor 1991).

Miller's research on rodent behavior provided some of the earliest evidence for a negativity bias through determining that the slope for the avoidance gradient was steeper than the slope for the approach gradient (Miller 1961). Forty years later, evidence supporting a negativity bias has been found in domains as varied as impression formation (e.g. Skowronski & Carlston 1989), person memory (e.g. Ybarra & Stephan 1996), blood and organ donation (e.g. Cacioppo & Gardner 1993), hiring decisions (e.g. Rowe 1989), personnel evaluations (e.g. Ganzach 1995), and voting behavior (e.g. Klein 1991, 1996). It has been found to characterize the judgments of children as well as adults (e.g. Aloise 1993, Robinson-Whelen et al 1997). Taylor summarized a wide range of evidence showing that negative events in a context evoke stronger and more rapid physiological, cognitive, emotional, and social responses than neutral or positive events (Taylor 1991; see also Westermann et al 1996). As further evidence, Itô et al (1998) have recently uncovered ERP evidence consistent with a negativity bias in the affect system.

In sum, negative emotion has been depicted previously as playing a fundamental role in calibrating psychological systems; it serves as a call for mental or behavioral adjustment. Positive emotion, in contrast, serves as a cue to stay the course or as a cue to explore the environment. This characterization may help account for evolutionary forces sculpting distinctive activation functions for positive and negative affect; the separable activation functions serve as complementary, adaptive motivational organization. Species with a positivity-offset and a negativity bias enjoy the benefits of exploratory behavior and the self-preservation benefits of a predisposition to avoid or withdraw from threatening events. The features reviewed in this section represent only the rudimentary operations of an affect system, however. Work on the relativity of emotion shows that cognitive factors and physiological states affect the extent to which appetitive or defensive motivations are aroused, and recent work suggests that self-regulatory focus also influences approach and withdrawal gradients (Carver & Scheier 1990, Higgins 1997, Shah et al 1998). The organization of the affect system warrants further study as a reflection of our evolutionary heritage and as a continued force in the shaping of even our most civilized responses.

Literature Cited

Cacioppo JT, Marshall-Goeldel BS, Tassinary LG, Perry RE. 1995. Rudimentary determinants of attitudes: classical conditioning is more effective when prior knowledge about the attitude stimulus is low than high. J. Exp. Soc. Psychol. 28:207–33
Diener E, Lucas RE. 1998. Personality and


Green DP, Goldman SL, Salovey P. 1993. Measurement error masks bipolarity in af-
omography of psychological functions ex-
mplified by experimentally induced emo-
tions. Radiologe 35:283-89.
Gross J, John OA. 1997. Revealing feelings:
faces of emotional expressivity in self-
reports, peer ratings, and behavior. J. Pers.
Gross J, Levenson RW. 1995. Emotion elic-
Guyll M, Contrada RJ. 1995. Trait hostility
and ambulatory cardiovascular activity:
responses to social interaction. Health
Psychol. 17:30-39.
Hann M, Vist D. 1996. Affective learning,
awareness and arousal. Psychophysiology
33:696-710.
Harnon-Jones E, Allan TB. 1998. Probing the
more exposure effect with psychophysio-
logical indices of affect. Psychol. Sci. In
press.
Hagemann D, Naumann E, Becke G, Maier S,
Barnsall D. 1998. Frontal brain asymme-
try and affective style: a conceptual rep-
Harvey JH, Semin K, Scott PK. 1995. fifty
years of grief: accounts and reported psy-
chological reactions of Norman people.
Hatfield E, Cacioppo JT, Rapson RL. 1994.
Emotional Contagion. New York: Cam-
bridge Univ. Press.
Herbert TB, Cohen S. 1993. Depression and
immunity: a meta-analytic review. Psy-
Hess U, Banse R, Kappas A. 1995. The inten-
sity of emotional expression is determined by
underlying affective state and social situa-
Facial electromyographic responses to vo-
cal affect expressions. Psychophysiology.
In press.
Am. Psychol. 52:1280-1300.
Hofbauer B. 1998. Neural systems for rein-
forcement and inhibition of behavior: rele-
vance to eating, addiction and depres-
sion. See Kahanen et al. 1998.
Hoorens V, Bunck BF. 1993. Social compari-
sion of health risks: focus of control, the
person-sensitivitiy bias, and unrealistic op-
Hsee CE, Salovey P, Abelson RP. 1994. The
quasi-accelerating reaction: satisfaction as
a function of the change of velocity of out-
come over time. J. Exp. Soc. Psychol. 30: 96-111.
Hunt PS, Campbell BA. 1997. Autonomic and
behavioral correlates of appetitive condi-
Hurlburt RT. 1997. Randomly sampling think-
ing in the natural environment. J. Consul.
Ito TA, Cacioppo JT, Lang PJ. 1998. Eliciting
affect using the International Affective
press.
Ito TA, Larsen JT, Smith BK, Cacioppo JT.
1998. Negative information weighs more
heavily on the brain: the negativity bias in
Psychol. In press.
Izard CE. 1992. Basic emotions, relations
among emotions, and emotion-cognition rela-
Izard CE. 1994. Emotions and universal facia-
expressions: evidence from developmental
Izard CE, Ackerman BP. 1997. Emotions and
self-concepts across the life span. Annu.
Kahneman D. 1998. Objective happiness. See
Kahanen et al. 1998.
Kahnen D, Diener E, Schwarz N, eds. 1998.
Doctric Psychology: Scientific Perspecti-
In press.
Kahanen D, Fredrickson BL, Schreiber CA,
Reddelmeier DA. 1993. When more pain is
preferred to less: adding a better and. Psy-
chol. Sci. 4:401-5.
Kamarck TW, Shifman SM, Smithline L,
Goodie JL, Falty IA, et al. 1998. Effects of
stress strain, social conflict, and emotional
activation on ambulatory cardiovascular
activity: daily life consequences of recur-
ing stress in a multiethnic adult sample.
Kelmer D, Elkan P. 1996. Affective intensity
and emotional responses. Cogn. Emot. 10:
223-28.
Kemp S, Lea SEG, Fussett S. 1995. Experi-
ments on rating the utility of consumer goods:
evidence supporting microeconomic theory.
J. Econ. Psychol. 16:543-61.
Kisicel-Glaszer JK, Makovec W, Cacioppo JT,
Glaszer R. 1994. Stressful personal relations-
ships: endocrine and immune function.
In Handbook of Human Stress and Immune-
Kittayana S, Manuda M. 1995. Reappraising
time over time. J. Exp. Soc. Psychol. 30: 111—126.

PS, Campbell BA. 1997. Autonomic and
flavorial correlates of appetitive condi-

Ur R.T. 1997. Randomly sampling think-
ing in the natural environment. J. Consil. in Psychol. 55: 941—945.

Y. Cacioppo JT, Lang PJ. 1998. Eliciting
feeling using the International Affectiive
picture System: trajectories through
press

Larsen JT, Smith NK, Cacioppo JT.
98. Negativity and negative emotions as
a威胁 on the brain: the negativity bias in

CE. 1992. Basic emotions, relations on
emotions, and emotion—cognition at-

BE. 1994. Inmate and universal facial ex-
spressions: evidence from developmental


man D. 1998. Objective happiness. See
Iman et al. 1998. In press

man D, Diener E, Schwarz N, eds. 1998.
Demic Psychology: Scientific Perspec-
——Enjoyment, Suffering, and Well-
by York: Cambridge Univ. Press.

man D, Fredrickson BL, Schreiber CA,
Jelmley DA. 1993. When more pain is
ferred to less: adding a better end. Psy-
. Sci. 4: 601—5.

DK, TW, Shiffrin SM, Smithline L,
Mackley EM, et al. 1998. Effects of
on ambulatory cardiovascular ac-
vity: daily life consequences of recur-
runt stress in a multiracial adult sample.

D, Ekman P. 1996. Affective intensity

S, Lea SEG, Fussell S. 1995. Expertis-
ons on rating the utility of consumer ds.
educator supporting micro-ec-
tic theory. J. Econ. Psychol. 16: 543—61.

Glaser WK, Cacioppo JT, ser R. 1994. Stressful personal rela-
shions: endocrine and immune function.
handbook of Human Stress and Immu-
San Diego: Academic

ASMAD M. 1995. Reappraising
cognitive appraisal from a cultural per-
ge of perspective. Psychol. Ing. 6: 217—23.

Klar Y, Gilad EB. 1997. No one in my group
can be below the group's average: a robust
positivity bias in favor of anonymous

Klein JG. 1995. Negativity effects in impres-
sion formation: a test in the political arena.

Klein JG. 1995. Negativity in impression
of presidential candidates revisited: the 1992

Kutas M, Federmeier KD. 1998. Minding the
body. Psychophysiol. 35: 3—40.

Lane RD, CARNEL EM, Alvern GL, Schwartz
OE. 1997. Neuronal correlates of care-
hlessness, sadness, and disgust. Am. j.

Lang PJ. 1995. The emotion probe: studies of
motivation and attention. Am. Psychol. 50:
372—379.

Emotion, attention, and the startle reflec-
Psycho. Rev. 97:77—97.

International Affective Picture System (IAPS): Technical Manual and Affecti-
er Ratings. MMH Center. Study Emot. Atten.

Lang PJ, Bradley MM, Fitzsimmons J, Cuthbert
and activation of the visual cortex: an fMRI

Larsen R. 1991. Day-to-day physical symp-
toms: individual differences in occurrence,
duration, and emotional concomitants of


Larsen RJ, Bilgray DW, Cutler SE. 1996. Af-
cet intensity and individual differences in

New York: Oxford Univ. Press.

Lazarus R. 1994. Universal antecedents of
the emotions. See Ekman & Davidson 1994.

Lazarus RS. 1995. Vexing research prob-
blems inherent in cognitive-mediation theories
of emotion—and some solutions. Psychol. Ing. 6: 183—96.

LeDoux J. 1995. Emotion: clues from the

Lehrer PM, Jakobsen S, Hochron SM. 1993.
Asthma and emotion: a review. J. Asthma
20: 1—21.

Levenson RW. 1996. Biological substrates of
empathy and facial modulation of emo-
tion: two facets of the scientific legacy of

Leventhal H, Patrick-Miller L, Leventhal E,

Ley JS. 1992. An introduction to prospect

of Emotions. New York: Guilford.

Litt MD, Convey NL, Morse P. 1998. Biologi-
cal momentary assessment (BMA) with
reduced algorithmic problem-solving methods.
Health Psychol. 17: 48—52.

Maddock RJ, Buonocore MH. 1997. Activi-
tion of right posterior cingulate gyrus by the
auditory presentation of threat-related words: an fMRI study. Psychol. Rev. 75:
1—14.

Marcus GE, Mackuen MB. 1993. Anxiety,
enthusiasm, and the vote: the emotional un-
derpinnings of learning and involvement
Rev. 87: 672—85.

Marcus H. 1996. Positive and negative global
self-esteem: a substantively meaningful
70: 810—20.

Mayer JD, Salovey P. 1993. The intelligence
of emotional intelligence. Intelligence 17: 33—42.

McGuire TR. 1993. Emotion and Behavior
Genetics in Vertebrates and Invertebrates.
New York: Guilford.

When less is more: counterfactual thinking
and satisfaction among Olympic medal-

Culture and Emotion. Boston: Allyn & Ba-
nom.

Miller NE. 1961. Some recent studies on con-
lict behavior and drugs. Am. Psychol. 16: 12—14.

Murray JR, Arnett JL. 1993. Toward the simu-
lation of emotion in synthetic speech: a re-
view of the literature on human vocal emo-

London: Aquarian.

Neale SE, Tereberry RR, Harlow KM, Ruit
GK, Fryzuk RJ. 1993. Anterior Cingu-
lar Cortex in Rodents: Connections, Vis-
orial Control Functions, and Implications

Nisenea CA, de Haan M. 1997. A Neurobehav-
tional approach to the Recognition of Facial Expressions in Infancy. New York: Cambridge Univ. Press
Ohman A. 1993. Fear and anxiety as emotional phenomena: clinical phenomenology, evolutionary perspectives, and information-processing mechanisms. See Lewis & Haviland 1993, pp. 511-36
Taylor SE. 1991. Asymmetrical effects of positive and negative events: the mobil-