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The Relationship of Emotion to Cognition: A Functional Approach to a Semantic Controversy

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We first review the main points in the dispute about whether emotion is primary and independent of cognition (Zajonc), or secondary and always dependent upon cognition (Lazarus), and suggest that the dispute is largely one of definition. Because definitional disputes seldom clarify substantive, theoretical points, we suggest a variety of questions regarding cognition–emotion interaction. To stimulate discussion of these issues, we propose a componential model in which emotions are seen to develop from simpler, reflex-like forms ("wired-in" sensory-motor processes) to complex cognitive–emotional patterns that result from the participation of at least two distinct levels of memory and information processing, a schematic and a conceptual level. These systems are typically activated by a continuous stimulus check process which evaluates five environment-organism attributes: novelty; pleasantness; goal conductiveness; coping potential; and consistency with social norms and self-relevant values. Questions about the relationship of cognition to emotion, and how two initially independent systems become inseparably interrelated, are transformed when viewed within the context of the dynamic, multilevel emotion processing system.

INTRODUCTION

In a recent exchange focused on the relationship of emotion to cognition, Zajonc (1980, 1984) espoused the position that ". . . affect and cognition are separate and partially independent systems and that although they

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ordinarily function conjointly, affect could be generated without a prior cognitive process" (1984, p. 117). Lazarus (1982, 1984), on the other hand, emphasised the primacy of cognition with emotion totally intertwined with cognitive processes. It is possible that the two positions have been presented in a confrontational and polemic manner because their authors have focused mainly on the definition of the psychological constructs of emotion and cognition. Definitional debates tend toward hair splitting and are often of little value for the development of the type of middle level theory that would be useful for generating important empirical work and stimulating significant changes in practice. In our judgement, these seemingly contradictory positions can only be reconciled, and the focus moved from debate to theoretically guided research, by first distinguishing between the mechanisms and processes underlying emotion and cognition and the various covert and overt reactions (or events) used to record emotional and cognitive behaviour. Once this division is made, we may find that the mechanisms underlying emotion may indeed be partially independent and separable from those underlying cognition as Zajonc suggests, while cognitive and emotional reactions may be complexly, if not completely, interwoven in virtually all episodes of emotional behaviour, as Lazarus suggests. Our goals in this paper are threefold: 1. To identify the core elements of the debate; 2. To sharpen the conceptualisation of cognition in relation to the issue of its interaction with emotion by sketching a theoretical framework that treats emotion as the construction of a multicomponent processing system; and 3. To show that this analysis can help us to replace an irreconcilable debate with a variety of specific questions about the interaction of emotion and cognition.

CENTRAL ISSUES IN THE DEBATE

Two issues were central in the debate. The first concerned the independence of the mechanisms that generate emotion from those which generate cognition. To resolve this issue, we must begin to specify in greater detail the mechanisms that produce emotion and distinguish them from those specific to cognition. The second question was whether emotion can occur prior to cognition; i.e. can an emotion appear without the prior activation of a cognitive process? To answer this question, we must be able to differentiate at least some aspects of emotional behaviour from those of cognitive behaviour. The two questions are also interrelated. If the mechanisms for emotion and cognition are not at least partially independent, then emotion cannot readily appear prior to a cognition, and as Lazarus (1982) suggests, the question of priority in time is meaningless. If the mechanisms are independent then the second question is of conceptual interest. But, even if we can identify separate mechanisms for "cognition"

and "emotion" we may find that these mechanisms operate in a completely interdependent fashion as is the case in other mechanisms in the perceptual system, such as those for generating boundary contours that outline shape and boundary completion that fill in the surface (Grossberg & Mingolla, 1985). And if their operation is interdependent, cognitive and emotional reactions will never be seen in isolation.

Neither Lazarus nor Zajonc are consistent in distinguishing between behaviour and mechanism, nor do they consider the possibility that separate mechanisms can function interdependently in constructing action. They concentrate instead upon efforts at the logical definition of emotion and cognition as can be seen by examining their statements about approach avoidance behaviour in which they agree that such reactions can be considered emotions even for very simple organisms, and that a simple match between stimulus and a neural template is all that is needed for such "emotional" choices.

> Lazarus (1982, p. 1023): "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."
> Zajonc (1984, p. 122): "Can untransformed pure sensory input directly generate emotional reactions? The answer is likely to be yes because the pattern of various findings seem to point in that direction. At the simplest level, any physical stimulus if suficiently intense produces an escape reaction. There is no doubt, therefore, that the organism is hard-wired for particular classes of reactions—at the grossest level, for approach and avoidance—to particular classes of stimuli."

The quotations also show where they disagree; i.e. whether the matching process involved in the choice to approach or avoid is or is not "cognitive".

What is Cognition?

Lazarus calls the matching process a "minimal cognitive requirement", while Zajonc insists on using phrases such as "untransformed sensory process" as the basis for responding. For Lazarus the organism's sensory or perceptual processes give meaning to the stimulus, i.e. it is an appraisal or an "evaluative perception" of the positive or negative implications of the stimulus for the organism. Lazarus would call this cognition, irrespective of whether this appraisal was made on a simple sensory level or on the level of complex, conscious reasoning. His position is that of an observer judging that a behavioural choice has had functional value or utility for the

organism, and he assumes that this value was involved in the stimulus processing itself. Because of its functional emphasis, his analysis pays little attention to the type of processing that occurs.

In contrast, Zajonc focuses on stimulus processing, reserving the term "cognition" for those steps that are clearly post-perceptual. This requires that the pure sensory input has been "transformed" by some kind of "mental work". Thus, differential behavioural outcomes that depend on the match of a stimulus to a sensory, neural unit are *pre-perceptual* and labelled as non-cognitive. As a specific example, Zajonc (1984, p. 267) refers to a frog's shift in attention and preparation for flight in response to ". . . a change in the light pattern caused by a movement of the lily pad that differs from the patterns of the previous few minutes." He assumes that, due to an appropriate pre-programming of the organism, this requires nothing more than an encoding of the stimulus by the retina and a conduction by a direct pathway to hypothalamic response centres. While it is clear that evaluative judgements by human subjects serving in studies of repeated exposure require more processing than the lily pad seen by a frog, it is clear that Zajonc (1980) believes these emotional judgements to be pre-conscious and pre-cognitive.

Lazarus would agree that the frog has a built-in sensory and motor response to the change in light pattern but that, since the response has clear adaptive significance, it represents the outcome of a primitive appraisal process and thus would be regarded as a cognition. Hence both Lazarus and Zajonc imply various levels of stimulus matching and just disagree on whether the most simple level should be called cognitive. To a substantial degree, therefore, the issue of debate is the definition of cognition. Given the fuzzy nature of such concepts, it is unlikely that the debate can be or need be resolved on those grounds. Moreover, it is clear that investigators will explore mechanisms for stimulus matching at the pre-perceptual or sensory, perceptual (including pre-attentive and focally attended to), and cognitive levels and develop theories about the interaction between levels, regardless of the definition given to cognition.

What Is Emotion?

From our perspective, a key problem and source of difficulty in the debate is the point on which they originally agreed, i.e. accepting a simple, avoidance response as an emotion. What we would ask is; "Do simple, reflex-like behaviours constitute emotions, or does something need to be added to them to qualify for this status?" Had they discussed approach-avoidance reactions in the aplysia rather than the frog, they might both have pondered whether aplysia's 32 neurons (Kandel, 1982) were sufficient to generate all of the components needed for an emotion.

We think it is important to distinguish between emotions on the one hand, and reflexes and other highly stereotyped response mechanisms such as approach-avoidance on the other. This is not only relevant for the startle reflex which Lazarus (1982, 1984) also excluded from the emotions (see also Ekman, 1984; Ekman, Friesen & Simons, 1985). Because we see emotion as the product of a multicomponent mechanism (Leventhal, 1984), we agree that a reflex, taken alone, is not equivalent to an emotion. As Scherer (1979; 1981; 1984a) has argued, emotion represents a phylogenetically evolved adaptation mechanism that is more complex than and supersedes simple, reflex-like reactions. Whereas an amoeba will reflexively move if the temperature changes, a human facing bitter cold will feel distress, experience physiological changes and a strong urge to move, yet may stand fast. The ability to stand fast with distress permits a wider range of instrumental responses such as putting on more layers of clothing or burning the furniture. Emotional processes decouple automatic, reflex responses from their eliciting stimuli and provide the opportunity for more adaptive reactions. Other components of the emotional response such as autonomic reactions, prepare the organism for action. Furthermore, emotions have the important function of sustaining behaviour, for example, the distress one is experiencing motivates one to repair the furnace even after one has put on more clothing.

We are not suggesting that emotion has replaced reflexes or that reflexes are irrelevant to emotion: Arguing this point is as fruitless as arguing about the definition of cognition. Reflexes play a critical role as elements of emotional reactions and emotional reactions may indeed sensitise and facilitate the activation of reflexes. As we suggested earlier, the semantics of the debate cannot be resolved and it is fruitless to attempt a definitive answer to the questions, "What is an emotion?" or "What is a cognition?" The terms emotion and cognition refer to complex, behavioural compounds whose make-up changes over the organism's life-span and these behavioural compounds are the product of a changing, multi-component processing system. Thus, while each term demarks an area of research and defines an aspect of everyday experience, neither specifies a specific mechanism or a specific component of an information processing mechanism. When the relationship of cognition to emotion is viewed within a theoretical framework that treats emotion as the construction of a multicomponent processing system, questions such as "What is an emotion?" or "What is a cognition?" will vanish and be replaced by other, more important questions regarding the contribution of specific processing components to emotional experience and/or overt, emotional behaviour. We will illustrate our point by outlining a conceptual approach to emotion that allows us to specify the role of reflexive and cognitive components to the construction of emotional reactions. This outline will draw upon our

earlier, published work (Leventhal, 1974, 1979, 1980, 1984; Scherer, 1979, 1981, 1984a,b). After outlining this integration we will return to the issues discussed above.

A MULTILEVEL PROCESS THEORY OF EMOTION

The structural aspect of our emotion model derives from the perceptual motor model of emotion (Leventhal, 1974, 1980, 1984). The theory attempts to address the question of how emotions are constructed and how emotional reactions, particularly emotional experiences, change over an individual's developmental history.

The Hierarchical Structures in Emotional Processing

The central postulate of the perceptual motor model of emotion is that adult emotions are complex behavioural reactions that reflect the constructive activity of a multi-component, hierarchical processing system, all of whose levels and components are involved in virtually all emotional experiences and reactions (Leventhal, 1979, 1980, 1984). The model proposes that the components which process emotion are organised at three levels: 1. Sensory motor. 2. Schematic, and 3. Conceptual. As will be seen in the description below, the schematic and conceptual levels incorporate learning into the emotional system and allow for more complex, cognitive-emotional interactions as the organism matures biologically and experientially.

The sensory motor level of processing consists of multiple components, including a set of innate expressive-motor programmes and cerebral activating systems which are stimulated automatically, i.e. without volitional effort, by a variety of external stimuli and by internal changes of state. These component mechanisms comprise the organism's primary emotional response capabilities and generate its earliest, observable, emotional behaviours. For example, it has been observed that a neonate can be stimulated to smile and vocalise by internal, gastrointestinal activity and by changes in cerebral activation (smiling is common during REM periods, Emde, 1984). Although these reactions are evoked by internal stimuli, interpersonal communication is one of their primary functions. It has long been observed that the social stimuli, the voice and sight of the caregiver, elicit a variety of orienting and "interest" responses such as head-turning, visual fixation, and cycling movements (Brazelton, Koslowski, & Main, 1974; Wolff, 1983). More recent data suggest that smiles, frowns, and expressions of surprise, can be elicited in day-old infants in response to the same expressive reactions of an adult experimenter (Field, Woodson, Greenberg, & Cohen, 1982). While we do not know precisely how the

neonate's perceptual field is organised and what components of perception elicit these specific emotional expressions in the neonate, the available data suggest the following conclusions:

1. Expressive reactions, i.e. expressive interplay or emotional interactions, take place between infant and adult at extremely early times in the infant's life.
2. This interplay is based on an innate expressive-motor system which is prepared to react automatically, without need for "willful" or deliberate planning; to a variety of external stimuli of which interpersonal expressive cues are a major group (Fox & Davidson, in press; Trevarthen, 1984).

As we shall point out momentarily, emotional reactions based on "pure sensory-motor" processes may be short lived, as these unconditioned reactions are very likely to play a key role in associative learning (Seligman, 1971) and will quickly become the focus for schematic conditioning.

We suspect that Zajonc would regard these automatic, reflex-like reactions as emotions and, because they have adaptive significance, so too might Lazarus. Zajonc might also regard them as pre-perceptual. We believe they can be regarded as emotional reactions because they are likely to include the activation of several central neural components in addition to the central motor template that generates the overt expressive reaction. We think it would be an error, however, to assume that neonatal reactions are stimulated by pre-perceptual processes, i.e. to view them as reactions to an unenriched sensory process, rather than reactions to a neonatal perception (Yates, 1985). What is clear is that the organisation (content and form) of the experience and behaviour of the neonate will differ in many ways from those of an adult as neonatal emotional experience and behaviour is constructed mainly by sensory-motor processing components: Adult emotional responses will reflect the additional input of components at both the schematic and conceptual levels of processing. And because we cannot tap the infant's conscious system, we may believe, but we do not know, that these uninhibited, infant, expressive-motor reactions are accompanied by subjective feelings, an outcome we would expect of spontaneous, uninhibited, emotional expressions in the adult (Cupchik & Leventhal, 1974; Kraut, 1982). The one thing which is clear is that expressive reactions are the most visible component of the infant's several (autonomic and central neural) automatically elicited emotional behaviours. And while sensory motor reactions intercede between sensation and response, i.e. they are constructive and generate "emotional" meaning (Leventhal, 1984), infant emotional behaviours are undoubtedly less sensitive to socially defined meanings and more limited in conscious content than are adult

emotional reactions. The domain of stimulation to which the infant responds is likely to be confined to events which we would describe as perceptual and immediate.

The second, schematic, level of processing integrates sensory-motor processes with image-like prototypes of emotional situations. Schemata are created in emotional encounters with the environment and are conceptualised as memories of emotional experiences: They are concrete representations in memory of specific perceptual, motor (expressive, approach-avoidance tendencies and autonomic reactions), and subjective feelings each of which were components of the reactions during specific emotional episodes. One or more schemata may form a "memory" of concrete instances that is prototypical of a class of episodes (Yates, 1985). The eliciting perception, i.e. the emotionally provocative object, will be perceived in accord with the level of perceptual-cognitive development of the individual and may emphasise different features—e.g. vocal tone, face, touch, etc. at different ages. The expressive and autonomic motor reactions in the schematic unit will also vary in organisation over time. Generalised schemata, i.e. prototypes, will emerge as similar, motor and subjective states are evoked and combined in memory with the perceptual features derived from multiple situations (Posner & Keele, 1968).

The activation of schemata links a current stimulus setting with the schemata or prototype typical of prior emotional episodes and organises the experience of emotion and emotional behaviour. Schemata bring to current emotional experience and behaviour short-term temporal expectancies, i.e. the awareness of immediate prior elicitors and immediate consequences. A fascinating study by Blass, Ganchrow and Steiner (1984) suggests that schematic conditioning contributes to emotional processing at an exceptionally early age. These investigators conditioned infants' expressive, emotional reactions, the key indicator of which was lip licking, to a CS that preceded sucking a sweetened liquid. Moreover, failure to confirm expectations during extinction, i.e. absence of the US, sweetened water, after the CS, aroused anger and crying in their two-day-old infant subjects.

Schematic processing is also automatic and does not require the participation of more abstract, conceptual-level processing. Because virtually all post-neonatal emotional reactions will evoke schematic structures, it is clear that all childhood and adult emotional behaviours will reflect complex integrations of what both Lazarus and Zajonc would call cognition (memory of situational stimuli), with expressive and autonomic motor responses and subjective feeling. It is also clear, as Zajonc (1980) suggests, that the component mechanisms underlying the expressive-motor level of construction will remain partially independent of the associative processes involved in schema formation and can continue to provoke perceptually based, emotional reactions.

The complexity of the schemata, and hence the complexity of the integration of cognitive, motor, and subjective events, will vary over time. For example, it is likely to take weeks of repeated experience before the infant's schema of "mother" incorporates more than the most salient perceptual attributes of her presence such as her characteristic touch and motor tension, vocal tone, face and eyes in an amalgam with the motor components of the infant's smile and the infant's subjective sense of pleasure. Given the great variety of situations in which the "same" emotions are elicited in different persons, similar subjective feelings and similar expressive responses may be accompanied by highly varied autonomic reactions and instrumental responses. For example, if an infant is subjected regularly to vigorous physical stimulation (tickled and/or swung in the air) when it smiles at its parents, strong autonomic and skeletal motor reactions will be linked with its smiling response, its subjective pleasure, and its interpersonal memories; i.e. its memory schema of happiness might be described as "euphoric" or excited. By contrast, an infant whose smiles generate nothing more than soft, parental coos and endearments will have mild overt motor and covert autonomic responses linked in what might be called a schema of calm happiness. Thus, the intensity and perhaps the pattern of autonomic reaction associated with a specific emotion may depend upon prior conditioning (Grossman, 1967).

The final level of processing is the conceptual. The growing infant gradually forms the capacity to reflect upon, abstract, and draw conclusions about the environment and his or her emotional response to it. Thus, conceptual processing activates propositionally organised memory structures which have been formed by comparisons over two or more emotional episodes. Conceptual processing is also volitional and can evoke emotions by accessing schemata. Thus, conceptual processing involves memories *about* emotion and mechanisms or procedures for the volitional use of these memory structures.

A critical aspect of conceptual processing is that it nests emotional reactions within a longer term temporal context. That is, both eliciting events and emotional reactions are now embedded in a temporal framework that includes awareness of antecedence and consequence that extends over a long, if not indefinite, time period. This temporal framework is typically part of a larger set of conceptual structures, such as that for the self system (Lewis & Brooks-Gunn, 1979; Rosenberg & Gara, 1985) and for similar structures that represent key people in the social environment. A number of more "tightly" structured perceptual schemata may be organised under a conceptual model of self.

The hierarchical structural aspect of our model clearly suggests the need to reformulate the basic elements of the Lazarus–Zajonc debate. First, it makes clear that a number of innate, sensory motor mechanisms are likely

to be responsible for the very earliest behaviours that are labelled emotional. Thus, we can not only distinguish "emotional" (expressive with approach avoidance) from "non-emotional" reactions, we can also distinguish some of the component mechanisms underlying what we call emotional and cognitive behaviour. We also may prefer to label the stimuli and processing systems that elicit these behaviours as sensory-perceptual rather than cognitive. This would accord with Zajonc's and our own, earlier suggestion (Leventhal, 1970) for separation of the two types of process.

Second, the perceptual-motor model suggests that very early in the organism's emotional development, i.e. with the very first emotional reactions, these automatic, sensory motor components are joined by the increasingly complex components that make up schematic, memory-dependent processing. As stimulus appraisals are an intrinsic part of schematic emotional constructions, one might not only argue, as does Lazarus, that emotion and cognition are integrated in experience and behaviour, but that they are also bound together in the underlying processing system.

Third, an emotional reaction may be experienced as different, changed, or in some way distorted if one or more of the components typically found in adult emotion is absent. For example, Hohman's (1966) adult paraplegic patients whose injuries removed autonomic feedback from their emotional reactions, reported that some of their emotions (anger and fear but not sadness or sentimentality) were changed and seemed to be "as if" emotions rather than real ones. The perceptual motor model predicts that such effects will occur only when the prototypic schemata for those adult emotions contained the missing component, as there will then be a mismatch between perceptual memory and ongoing experience. But, if autonomic turbulence was not a part of the history of that specific emotion, there would be no mismatch between the schema and current experience. Other types of mismatches can generate the experience of "as if" or strange and alien emotions, and these experiences probably bolster our personal belief in the hypothesis that emotion and cognition are independent of one another.

Fourth, we have hypothesised that once a schema is formed, it can be aroused by the activation of any one of its component attributes: i.e. a schema of an emotional episode could be activated by the perception of a similar stimulus event, by the activation of central neural mechanisms that generate subjective feelings (Davidson, 1984), or by the arousal of expressive behaviours or autonomic responses. Thus, while we may characterise a stimulus, e.g. a live snake, as "emotional" because it is a reliable activator of autonomic or expressive behaviour, its activation of the cognitive or perceptual components of the schema is likely to be so nearly simultaneous in time with the activation of the expressive and autonomic components, as

to negate the significance of Zajonc's suggestion that emotional mechanisms operate prior to and independent of cognitive mechanisms. Finally, as with other developmental models, the model makes clear that major changes occur in emotional experience and emotional behaviour, due to developments within levels of processing and in the relationship between levels over the individual's life span. These changes alter the organisation and meaning of perceptual events generated by external and/or internal stimuli. Thus, as Lazarus would suggest, there is continual interaction of "cognitive" and "emotional" processes in the continued development and updating of the individual's emotional life. There has been far too little study of these developmental processes in the adolescent and adult years (Peters, 1970: for recent work see Diener & Emmons, 1985; Leventhal, Leventhal, & Prohaska, 1986).

The Sequential Stimulus Checks

In a paper reviewing the relationship of fear to attitudinal and behavioural change, Leventhal (1970) presented evidence showing that fear and cognitive processing proceeded with a substantial degree of independence, i.e. as parallel response systems, but were linked to an as yet undefined, preattentive process. Lazarus (1966) had suggested that emotion was linked to a cognitive, appraisal mechanism and at a later point in time also suggested that coping with fear and coping with objective problems proceeded somewhat independently of one another (Lazarus & Launier, 1978). While recognising the importance of cognitive processing of events, or the meaning of events, as antecedents to emotional reactions, these theorists did not specify in detail which cognitive processes give rise to particular emotions and how these cognitive processes might work. This critical issue transcends the debate. Regardless of the degree of independence of emotion and cognitive mechanisms, theories of emotion will remain primitive unless they address the nature of the process and the type of cognitive contents that give rise to particular emotions.

Scherer's (1981, 1984a, 1986b) component process model of emotion outlines a mechanism for the ongoing appraisal of environmental events and presents specific hypotheses regarding the pattern of meanings that will precede particular emotional states (for other such efforts, see Weiner, Russell, & Lerman, 1979; Smith & Ellsworth, 1985). Apart from reaffirming the multicomponential nature of emotion, the theory hypothesises that specific emotions are brought into play by the operation of a series of stimulus evaluation checks (SECs). These checks are performed by mechanisms that continually scan the objects in the perceptual field, with different patterns or outcomes of the check process seen as giving rise to different emotions. Identifying the content of these checks and describing

the checking mechanism and process will provide the needed, detailed specification of the evaluation or appraisal process that typically, though not always, precedes emotional responses (see Arnold, 1960; Lazarus, 1968; 1984).

Rather than debate about how much of this processing should be called cognitive, a decision that will be difficult and, perhaps, arbitrary, the model makes specific suggestions to assist in the study of the check process. First, the model assumes that the check process can occur at different levels of complexity, i.e. at both cognitive and perceptual levels and that emotion can be generated by activity at any one or all of these levels. It attempts to further specify these mechanisms by identifying their concrete content; i.e. the specific criteria used to evaluate or check perceptions generated by external and/or internal events. Unfortunately, the very use of the word "evaluation" seems to smack of cognitivism. It is hard to think of more neutral terms to describe this activity that can presumably be performed by a variety of mechanisms, but given that the check process occurs at multiple levels, it is clear that some check operations may be conveniently labelled perceptual and others cognitive.

More specifically, Scherer has proposed that five types of check are performed during the organism's ongoing scanning of its perceived environment: 1. A novelty check; 2. A check for intrinsic pleasantness; 3. A check for relevance and/or conduciveness to meeting goals or plans; 4. A check for ability to cope with the perceived event; and 5. A check for the compatibility of events (including actions) with self concept and social norms, at least in the case of humans. It has been hypothesised that these stimulus evaluation checks (SECs) always occur in this order (at least in the initial evaluation of an event) as several of the later checks seem to require the outcome of earlier ones. These criteria for evaluation have been chosen on the basis of their adaptive significance, emotion generally being seen as a phylogenetically evolved mechanism that optimises flexible adaptation to highly complex social and physical environments. In other words, it would seem that an organism requires the information obtained by these SECs in order to choose an appropriate response to a specific event.

A more detailed description of these SECs is provided in Table 1. Some states for which our language provides emotion words may be the outcome of only one SEC—surprise, for example, can be seen as a positive outcome of the novelty check; enjoyment as a positive outcome of the intrinsic pleasantness check. Most common emotions, however, are differentiated or characterised by specific outcomes of a series of checks. Anger, for example, can be seen as the result of an event evaluated as relevant to and obstructing a goal when the coping check indicates that the organism has the power or resources needed to overcome or disregard the obstruction. Fear would result from a similar outcome of the goal-conduciveness check,

TABLE 1
Sequence of Stimulus Evaluation Checks (SECs)

1. *Novelty check*
   Determines whether there is a change in the pattern of external or internal stimulation, particularly whether a novel event occurred or is to be expected.

2. *Intrinsic pleasantness check*
   Determines whether a stimulus event is pleasant, inducing approach tendencies, or unpleasant, inducing avoidance tendencies; based on innate feature detectors or on learned associations.

3. *Goal/need significance check*
   Determines whether a stimulus event is relevant to important goals or needs of the organism (relevance subcheck), whether the outcome is consistent with or discrepant from the state expected for this point in the goal/plan sequence (expectation subcheck), and whether it is conducive or obstructive to reaching the respective goals or satisfying the relevant needs (conduciveness subcheck), and how urgently some kind of behavioural response is required (urgency subcheck).

4. *Coping potential check*
   Determines the causation of a stimulus event (causation subcheck), and the coping potential available to the organism, particularly the degree of control over the event or its consequences (control subcheck), the relative power of the organism to change or avoid the outcome through fight or flight (power subcheck), and the potential for adjustment to the final oucome via internal restructuring (adjusting subcheck).

5. *Norm/self compatibility check*
   Determines whether the event, particularly an action, conforms to social norms, cultural conventions, or expectations of significant others (external standards subcheck), and whether it is consistent with internalised norms or standards as part of the self concept or ideal self (internal standards subcheck).

Reproduced from Scherer (1986a, p. 147).

but would be a negative outcome of the coping potential check. Such predictions are developed in greater detail elsewhere (Scherer, 1984a, 1984b, submitted).

Scherer has suggested three developmental aspects to the SEC process: 1. The sequential use of the checks as the organism evaluates specific, concrete events (a microgenetic level of analysis); 2. The use of an increasing number of checks and the increased differentiation and complexity of the checks as one moves up the evolutionary ladder (a phylogenetic analysis); and 3. An increase in the complexity of each check over the life course of the individual (an ontogenetic level of analysis). The latter two types of development suggest that very simple organisms and newborn infants use fewer SECs, e.g. they would not check for fit between self concept and norms, and the checks they use are simpler than those of more evolved and/or more mature organisms. Organisms at higher levels of

biological and social development use more and more complex checks which produce evermore complex emotions. In humans, the most elaborate changes in the check process occur with the differentiation within each check. Development brings new goals and new possibilities for surprise, new interests and values and new possibilities for obstruction, new coping resources and new possibilities to master or fail to master various obstructions. Thus, ever more complex social events, e.g. challenges and insults, become relevant to these increasingly complex checks. As Hebb (1946) insisted, the adult homo sapien is potentially the most emotional of all animals.

The sequence theory of emotional differentiation stresses functional criteria in the evaluative process. The assumption is that each of the SECs can be performed by mechanisms of differential complexity or evolutionary sophistication (Scherer, 1984a). As stated earlier, we believe it far more fruitful to explore the substance and operation of the checks in the hierarchical system than to fret over the definitional issue as to when the checks are "cognitive."

Processing Levels and Stimulus Evaluation Checks

We are proposing an integration between the processing levels of the Perceptual-Motor model and the sequential Stimulus Evaluation Check process, as we believe it can steer the emotion-cognition controversy away from potentially sterile semantic arguments about what is a cognition, and lead to more concrete, operationalisable questions about the substance and operation of specific evaluation checks at different processing levels. At the same time, this approach forces us to reconsider some of the basic issues relevant to the definition of the emotion concept. While far from complete and subject to future revisions, a rough outline of the model is presented in matrix form in Table 2.[1] The sequential evaluation checks are listed in the horizontal, and the structural levels in the vertical dimension. The matrix shows that each of the evaluation checks can be performed by different mechanisms on each of the three structural levels and that the autonomic and central-nervous systems make different contributions to the check process at each level.

For example, as shown in the matrix, Novelty (Table 1) is likely to be detected on the sensory-motor level by the rate and intensity of stimulus onset (see Graham, 1979) which produces the orienting response. Thus, novelty checks at the sensory-motor level, would be based upon the processing of rapid onset stimulation and the earliest experience of novelty would emerge from these orienting experiences. (Because rapid onset stimuli are often intense, they will evoke both orienting and defence reactions. The latter might be the result of the second SEC, intrinsic

TABLE 2
Processing Levels For Stimulus Evaluation Checks

	Novelty	*Pleasantness*	*Goal/need Conduciveness*	*Coping Potential*	*Norm/self Compatibility*
Conceptual Level	Expectations: cause/effect, probability estimates	Recalled, anticipated, or derived positive-negative evaluations	Conscious goals, plans	Problem solving ability	Self ideal, moral evaluation
Schematic Level	Familiarity: schemata matching	Learned preferences/ aversions	Acquired needs, motives	Body schemata	Self/social schemata
Sensorimotor Level	Sudden, intense stimulation	Innate preferences/ aversions	Basic needs	Available energy	(Empathic adaptation?)

pleasantness, at the sensory-motor level.) On the other hand, novelty as unfamiliarity requires information processing by the next higher, schematic level. Familiar stimulus patterns must be stored in the form of schemata before the familiarity–unfamiliarity of new events can be assessed by matches at this level. A change in the mother's vocal tone or appearance can evoke the perception of novelty only when an infant has stored a schema of her face and voice. To process novelty or unexpectedness in a lengthy sequence of events would seem to require a stored, conceptual

[1]As the reader will note, traditional psychological constructs make up almost all of the cell entries in Table 2. One might ask, therefore, whether the concept of emotion is needed to explain the checks and their behavioural correlates. As noted above, we assume that the sensory-motor level is accessed more easily and more quickly than the schematic and conceptual levels. If sensory-motor appraisal and reactions can take care of an event, that is, if the resulting reflex action provides the appropriate adaptive response, no further processing is needed. But should this type of adaptative response be called an emotion? It might be more reasonable to use the term emotion when the adaptational process demands the participation of a phylogenetically evolved mechanism that transcends the reflex level, enabling more flexible behavioural reactions in complex environments. Thus, it could be argued that emotion occurs only when the sensory motor level by itself cannot take care of the problem and schematic or conceptual processing is required. It is clearly debatable whether states elicited by a single check, such as the occurrence of surprise following the evaluation of novelty, are, or are not, emotions. Some theorists explicitly exclude states such as surprise and boredom from their emotion lists. For most emotions to occur it is clear that several and not just one of the checks in the sequence need to operate.

representation of cause-and-effect and probability relationships over a substantial period of time. For example, one would experience surprise and a sense of novelty upon entering a restaurant if a singing waiter related the menu in recitative, required you to choose by repeating his lines, and performed this routine prior to your being seated; the form and sequence would violate the usual restaurant script in substance and order: i.e. entering, being seated, reading the menu, ordering, etc.

The evaluation of Pleasantness on the sensory-motor level is hypothesised to be the product of innate feature detectors that produce either a reflexive assimilation of the stimulus or defence (as has been shown for example for sweet and sour taste; Ganchrow, Steiner, and Daher, 1983). On the next higher, schematic level, we would expect learned "hedonic schemata" (representations of perceptual experiences conditioned to motor traces—expressive and autonomic—and subjective feelings) which are activated when the appropriate CS patterns are encountered. The appraisal of hedonic tone at the conceptual level is somewhat more difficult to describe, though it is likely to involve "appreciation" of more complex stimuli such as words with double meanings, or reference to events that foretell future joys. The anticipation or recall of positive or negative evaluations of persons and events also seem to belong here, along with artistic appreciation, or the hedonic evaluation of events that have not been encountered before.

Let us pause and consider for a moment how this approach might help to redirect discussion of one of the central empirical aspects of the controversy—Zajonc's argument that affect is primary because he has found that affective evaluation can take place without conscious stimulus recognition (Kunst-Wilson & Zajonc, 1980). This would be explained in our model as a form of schematic processing. We would assume that repetition has initiated schema formation or the association of one or more simple stimulus attributes to motor (expressive and autonomic) and subjective reactions. When the "familiar" stimulus is encountered yet again, its match to the perceptual schema would be rapid, and would elicit a partial emotional reaction that would be experienced along with the perception of the stimulus. A matching process is clearly involved in this effect, as increased liking, the presumed sign of emotional involvement, is restricted to those stimuli which have been repeated. If emotion were activated independently of the match process it would affect all stimulus judgements. The amount of information needed for a match that can stimulate liking would be far less, however, than the amount of information needed for a sufficiently sharp match for the respondent to produce a verbal report of recognition of the stimulus as distinct from other stimuli. This interpretation is similar to that of the Lazarus and McCleary (1951) findings where shock associated words gave rise to GSR at a lower threshold of stimulus exposure than that needed for accurate verbal recognition. A gross dis-

crimination was adequate to exceed chance for the two choice task of the GSR, shock versus non-shock, but a more detailed match was needed to report which of ten shock or ten non-shock words had been viewed (Eriksen, 1958).

For the goal/need check we can expect different types of motive structures to underlie the appraisal of conduciveness at each of the levels. Thus, conduciveness is likely to be assessed at the sensory-motor level by appraising the degree to which the stimulus meets basic needs for nutrition, social stimulation, unobstructed airways, and freedom of movement. If need-relevant stimuli are encountered the sensory-motor appraisal of conduciveness would result in reflexive responses such as sucking or smiling for the first two needs, or struggling and wriggling for an obstruction of the last two: If these reflex responses are accompanied by expressive change, neural activation of approach avoidance, etc. they would qualify as sensory motor emotion. A matching of inputs to schemata would be required to test the conduciveness of a stimulus for meeting the demands of acquired or secondary needs and motives, i.e. to meet the demands of organised schemata. On the conceptual level, finally, we expect symbolically represented goals and plans in the best tradition of cognitive psychology, the evaluation of stimuli and events taking the form of complex assessment strategies.

The criteria for appraising coping potential are the organism's available energy, power, and ability to deal with an event in such a way as to maximise adaptation. It seems likely that this check occurs at the sensory-motor level by relatively simple feedback mechanisms within the autonomic and voluntary motor systems that provide moment-by-moment signals of tiredness and fatigue when coping is failing, and create contrasting feelings of alertness and energy when coping is effective. Subjective states serve, among other functions, as signals and regulators of the status of the organism's adaptive capacity (Leventhal & Mosbach, 1983). While these regulating signals operate automatically and effect immediate activity in the infant, they can also be involved in more complex, conceptual decision making. For example, cancer patients in chemotherapy treatment often monitor their energy level and believe they are doing well if they feel energetic. Though this feeling may have no relationship to the eventual outcome of their disease and/or treatment it may be the only continually usable source of information for making such decisions (see Ringler et al., 1985). On the schematic level we would postulate more complex self schemata including both physical attributes and attributes of social power (e.g. position in dominance hierarchy, etc.). The conceptual level would bring entirely new criteria to bear on this check such as the organism's assessment of its problem solving ability, i.e. the capacity to find resources or select strategies for dealing with a particular situation.

Not surprisingly, it is difficult to conceptualise checks for the compatibil-

ity between current views of self with social and personal norms at the sensory motor level. Locating the rudiments or simple prototypes for these phylogenetically and ontogenetically early steps is difficult as they are covered over by our own complex history of socialisation which leads us to view them, inappropriately, as highly intellectual structures. One possibility is that the infant's experiences of pleasantness and unpleasantness following his or her own actions give rise to early schema of what is and is not acceptable or "normative" (Kohlberg, 1969). On the other hand, we may be able to conceptualise it as a very basic empathy process in which an organism follows some kind of social convention, mimicry, or emotional contagion (Field et al., 1982; Meltzoff & Moore, 1977). This will require much further thought and examination of ethological findings. On the schematic level, we again expect self concept and rudimentary norm schemata that allow one to evaluate the compatibility of an event or action with desired states. It is clear that 10- and 12-month-old infants make use of the emotional expression and behaviour of their mother to evaluate the appropriateness of their behaviour, i.e. to establish behavioural norms, in specific situations. For example, infants will be friendly or distant to an approaching stranger (Feinman & Lewis, 1983), or curious and cross, or fearful and will not cross the visual cliff (Sorce, Emde, Campos, & Klinnert, 1985) after scanning and appraising their mother's emotional expression. On the conceptual level, finally, we would place such highly conscious and symbolic mechanisms as abstract moral reasoning and evaluation of self-realisation potential (Kohlberg, 1969).

Two features of the hierarchical check process need to be made clear. First, different checks at different levels may give rise to what may or may not be the same behavioural expression. For example, motor constraint may evoke aggressive crying and pushing in the newborn, and removal of a favourite toy may elicit frustration and aggressive crying in a five-year-old child. The sequential check hypothesis would argue that a coping check preceded the anger component in each response. An immediate question that one would raise about such observations is whether both of these behaviours include anger components, i.e. whether the cries signal only distress in the neonate and distress and anger in the five-year-old. A decision would require establishing that both reactions included specific expressive components of anger (Sternberg, Campos, & Emde, 1983) and the activation of neurological centres associated with the approach component of anger (Fox & Davidson, in press). If components of the anger pattern are visible in the infant, it would then be necessary to demonstrate the dependence of these reactions upon a competence check. Given that we cannot assess appraisals by interview with such young subjects, investigators would need to use multiple, convergent manipulations presumed to alter felt competence in order to demonstrate that the prior presence of

such a check is necessary to elicit anger. If the sensory motor process for felt energy is the basis for the infant's check for ability to cope, we would expect an exhausted infant, or an infant with a brief history of non-reward for anger display, to show distress but not anger in response to constraint. Manipulations for the five-year-old would be based upon more complex, pre-operational, schematic processing.

Second, development changes the ease and relative frequency of use of different processing components and causes shifts in the degree to which different levels play the dominant role in emotional processing. Thus, as the organism matures, schematic mechanisms will play an increasingly important part in the construction of emotional experience and behaviour relative to sensory motor mechanisms. As mentioned earlier, this shift in dominance may result in inappropriate perception and emotional response to situations, and the need to unlearn or desensitise or reorganise emotional schemata. For example, an adult conditioned to perceive and respond with obedience and positive affect to parental authority may be unaware of his or her own (sensory-motor?) anger when he or she confronts punitive and frustrating behaviours from an unreasonable supervisor. A treatment protocol would require bringing to awareness the individual's hidden anger and the cues stimulating it. Another possible outcome during the "transition" from dominance by one (e.g. schematic) to another (e.g. conceptual) level of processing, is that a less complete, slower operating, but more complex set of conceptually driven check processes will be competing with the highly automated, more complete series of checks that exist at the lower, schematic level. This could result in what appears to be emotional variability and/or emotional regression, i.e. actions that seem unpredictable, "simpler" or out of step with the individual's development. For example, adolescents may have difficulty separating criticism of their performance from criticism of themselves and express distress, shame, and anger when a tutor provides corrective feedback to improve the quality of the young person's performance. Indeed, feedback intended to enhance esteem may have just the opposite effect.

FINAL CONSIDERATIONS

Which emotions result from which checks on which levels? We would assume that many of the predictions made earlier for the simple sequence model (Scherer, 1984a, 1984b) would still hold. However, we assume that the resulting emotional state in all of its components (expressive, physiological, subjective feeling) will differ according to which of the levels have been involved. This raises the issue of bottom-up versus top-down processing. If swiftness of processing is considered, one might expect simpler, sensory-motor processes to be accessed first which would imply

that bottom-up processing has precedence over top-down. While this may be true in the very earliest stages of development, as the individual matures schematic and even conceptual processing will become increasingly rapid, automatic, and "lazy and mindless" (Langer, Blank & Chanowitz, 1978). Indeed, we expect most if not all emotional processing to be initiated at the middle, or schematic level. Experience with specific persons, objects, and events develops schemata which encapsulate their history in perceptual memories or "identities" (Hebb, 1949) that then organize current emotional experience (Bruner, 1957; Yates, 1985). Conceptual, or top-down effects, will impact on the emotional processes in a variety of ways, particularly by sensitising classes of schemata relevant to situations that are related at a more abstract or semantic level. This does not mean that sensory-motor processing is completely set aside with development. For example, if you hear a noise which fails to match the schemata of noises experienced upon entering your home, the mismatch can be a stimulus to fear (depending on other checks). If this mismatch occurs in the deep of night, the darkness will prime sensory-motor reactions and add to and strengthen the fear response (Bowlby, 1973).

Many of the issues raised by our approach are still wide open and require extensive theoretical and empirical study. This is particularly true for the question of the response patterning as a result of the specific outcomes of checks conducted at different levels (Scherer, 1984a, 1986a, 1986b). It would seem profitable to explore these questions using both developmental and comparative approaches in order to allow an analytical separation of the levels since it is likely that in the human adult all of the checks and all of the levels are involved most of the time (see Lazarus, Coyne & Folkman, 1984).

We have focused on the hierarchical stimulus-check process as it seems most relevant to the cognition–emotion debate which developed in the framework of the processing of external stimuli. The check aspect of the combined model suggests a variety of testable hypotheses about the impact of specific perceptual–cognitive representations on emotional states. But we must reiterate that our attention to this eliciting role of cognition is not meant to imply that emotional reactions are always led or provoked by a prior, cognitive check process. This becomes clear when we analyse the processing of internal states. Internal events can function as stimuli: Sensations from the body can be processed as benign or as signs of disease, much as we process external cues. The response to imagery may also fit this "stimulus to response" sequence and be compatible with most of the points raised in the check hypotheses. There are, however, changes in the internal processing system itself that can have profound effects on sensory-motor processes and the availability of schemata and conceptual contents. These include variations in the level of neurotransmitters and the level of hor-

mones distributed throughout the system, and homeostatic effects such as hormonal rebounds subsequent to prolonged stress (Mason, 1972) and opponent affects (Solomon & Corbit, 1974). These changes could alter the organism's mood or tonic emotional state, and bias the check process so as to confirm expectations associated with specific emotional schemata. Changes induced by the season, time of day, and physical health, and repeated activation of specific emotions may also affect mood or tonic emotional states, influence the way information is processed, and alter emotion–cognition interactions.

Indeed, our model makes clear that two separate issues have been confused in the emotion–cognition debate. The first concerns the problem of response elicitation, which deals with timing and the events that are prior and lead to response changes. The second deals with the organisation or the relationship between the components that are present in the response system when a response occurs. With respect to the first question, we can all recognise occasions when changes in the way we perceived or interpreted situations, e.g. interruptions (Mandler & Watson, 1966), served to elicit or alter our emotional states, and we can all recognise occasions when our emotional states, our fears, joys, or anger, preceded and biased our interpretations or subsequent situations. Precedence in time at this molar level is not, however, germane to the Zajonc–Lazarus debate: Their argument seems to focus on time differences at a micro level, i.e. in the domain of eliciting mechanisms. Answers to such "micro" questions may only be resolvable through physiological analysis and they may also be irrelevant to the bulk of emotion theory. With respect to our question on the organisation of emotion and cognition, we believe that it will be extremely rare to find emotional reactions totally separated from perceptual or cognitive reactions in the human animal. Indeed, it may be difficult if not impossible for a human being to experience a truly free-floating emotion except in those rare situations that elicit only sensory motor processes and "emotion like" reflexes. Such events are likely only in the neonate, as schematic and conceptual components are universally present in adult emotional processing. Hence, "emotion" and "cognition", as labelled by our protagonists, are always intertwined in emotional behaviour and emotional experience. Indeed, as we have pointed out, this intertwining is obvious in the studies of repetition and liking that Zajonc (1980) cites as examples of the independence of affect from cognition; the positive feelings are attached to the frequently repeated stimulus and not to other stimuli. And when feelings break free of a cognition they gravitate to other objects and thoughts in the perceptual field (Zillmann, 1983).

While its impact has been dramatic, we would suggest that the question, as phrased by Zajonc (1980), of the temporal priority of emotion relative to cognition may be difficult to settle and relatively unimportant for

progress in the field. The arousal of a schema, whether by an external or internal stimulus or a shift in level of a hormone or neurotransmitter, implies the simultaneous activation of cognitive (situation) and emotional (expressive, subjective feeling) components. What may take more or less time, or what may be more or less salient, is the ability of the observer to identify, label, and report upon the "emotional" and "cognitive" attributes of consciousness. Thus, the relative temporal lag or salience of the cognitive and/or emotional response components may not correspond to temporal lags or differences in the underlying schematic mechanism. As expressed before in the analogy we drew between emotion and cognition to the perception of objects, surfaces are seen only in relation to contours and contours only in relation to surfaces even though their mechanisms are independent (Grossberg & Mingolla, 1985): Emotional surfaces may only be felt within cognitive or perceptual contours. (Note: This is in basic agreement with the position expressed by Lazarus, Coyne and Folkman, 1984, p. 234.)

At the outset we suggested that a debate about the relationship between emotion and cognition should be carried out in the context of an emotion theory. Returning to this point we note that when emotion and cognition are considered in such a context their relationship proves much more complex than suggested by the Lazarus–Zajonc debate: The issues go beyond the independence of emotion and cognition or their ability to exist "alone", and their relative priority in time. Indeed, when placed in the theoretical context of the present model, these questions appear much less important for the psychology of emotion than one would have thought at the outset. While our current model will undoubtedly have to be revised, there is little question that both the evaluation criteria and the various structural levels are strongly implicated in the elicitation of emotion. [Viz. there is now convergence of opinion on the factors involved in the processing of antecedent situation (cf. several contributions in Shaver, 1984) as well as the well-documented role of the structural levels stressed in many of the classic emotion theories.] Thus, one might want to reach consensus on a definition of the word "cognitive" in demarcating which of the processing described in Table 2 deserves that label. Should it be restricted to the conceptual level or does some of the schematic level qualify, too? Zajonc (1984, p. 119) seems to suggest that the point is best settled on a neurophysiological level by using the criterion of transformation of "pure sensory input" by "higher mental processes". However, this is likely to be a difficult task given the remarkable degree of interdependence of the various neural structures, and deciding whether what is higher or lower in a psychological model corresponds to higher or lower in a particular physiological model. This issue is hardly vital for progress in emotion research though, and one might want to utilise a more functional approach to investigating the nature of emotional structures and processes.

In summary, if the key questions raised by the Lazarus–Zajonc controversy (the independence of emotional and cognitive responses; the priority in time of emotional and cognitive responses) are as secondary as we have implied, the debate's value will not lie in attempted answers to those questions. It will lie instead in having provoked theoretical and empirical analyses that led to quite different, empirically addressable questions concerning emotion–cognition relationships. That is a contribution that will be significant and lasting.

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