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2

Emotion and MEM

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In this chapter, we outline a general cognitive architecture called MEM (a Multiple-Entry, Modular memory system, Johnson, 1983; 1990; 1991a; 1991b; Johnson & Hirst, in press), discuss the relation between emotion and cognition from the perspective of MEM, and describe results of studies of memory for affect that were motivated by this framework. We think that MEM provides a coherent way of organizing a range of empirical facts about emotion and of integrating a number of theoretical ideas that have figured prominently in analyses of emotion. In addition, considering emotion in terms of MEM highlights several issues that have received relatively little attention but that could provide useful future directions for research.

MEM

Memory serves an extraordinary range of functions, for example, remembering autobiographical events, comprehending stories, recognizing people, learning concepts, remembering telephone numbers long enough to dial them, navigating the environment, dancing, driving cars, solving geometry problems, learning how to plan and, most central to the topic of this book, developing affective responses such as preferences and fears. It is possible that a single, undifferentiated cognitive system accomplishes all this, but it seems unlikely. On the other hand, it seems even more unlikely that different specialized cognitive/memory subsystems evolved to handle each of these functions. A more likely possibility is that several subsystems evolved and work together in different combinations and degrees to flexibly meet the many cognitive demands we face. MEM is a set of working hypotheses about the minimum number of subsystems and component processes, and their configuration, that would be required for such diverse purposes.

The approach of dividing cognition into subcomponents or classes of processes in order to better understand the whole is common (e.g., Anderson, 1983; Atkinson & Shiffrin, 1968; Baddeley, 1986; Craik & Lockhart, 1972; Hasher & Zacks, 1979; Jacoby, 1983; Kosslyn, 1980; Mandler, 1980; Paivio, 1971; Posner, Petersen, Fox, & Raichle, 1988; Roediger & Blaxton, 1987; Shallice, 1988; Sherry & Schacter, 1987; Cohen & Squire, 1980; Tulving, 1983; Warrington & Weiskrantz, 1982; Waugh & Norman, 1965; Wickelgren, 1979, among others). Various proposals differ in their characterization of basic processes or subsystems. The subsystems identified in the MEM architecture express the fundamental assumption that memories reflect their origin in perceptual and reflective processes (see Johnson, 1983, 1990; Johnson & Hirst, in press; Johnson & Hirst, in preparation, for more discussion of the relation of MEM to other cognitive models).

According to MEM, memory consists of a perceptual memory system for engaging in and recording perceptual activities (seeing, hearing, etc.) and a reflective memory system for engaging in and recording selfgenerated activities (planning, comparing, speculating, imagining, etc.). As shown in Fig. 2.1, the perceptual system includes two subsystems, P–1 and P–2. P–1 and P–2 both are involved in recording perceptual aspects of experience but differ in the type of perceptual information to which they respond. As Fig. 2.2b indicates, P–1 and P–2 subsystems consist of component subprocesses. Component subprocesses of P–1 might include *resolving* stimuli (e.g., through detecting edges), *locating* stimuli, *tracking* stimuli, and *extracting* invariants from perceptual arrays (e.g., cues specifying the rapid expansion of features in the visual field). These P–1 component processes contribute to developing relations or associations involving perceptual information of which we are often unaware, such as the stimulus properties that specify that an object is moving toward one, or perceptual relations that make certain sounds seem similar (e.g., the sound of a word) even though spoken in different voices. Component processes of P–2 might include *identifying* objects, *placing* objects in spatial relation to each other, *examining* or redirecting attention to perceptually investigate stimuli, and *struc-*

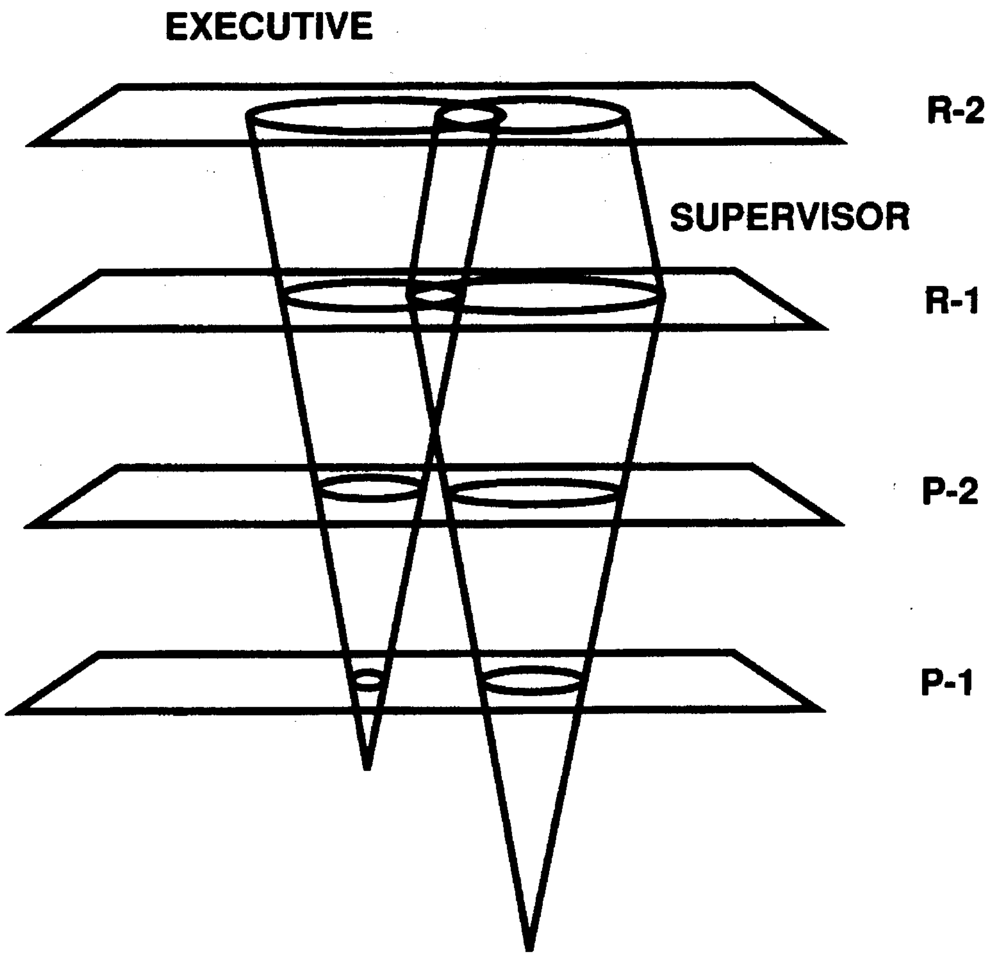

FIG. 2.1. A multiple-entry, modular memory system, consisting of two reflective subsystems, R–1 and R–2, and two perceptual subsystems, P–1 and P-2. One way reflective and perceptual subsystems interact is through control and monitoring processes (supervisor and executive processes of R–1 and R–2, respectively), which have relatively greater access to and control over reflective than perceptual subsystems. Adapted from Johnson (1991a) with permission.

turing or constructing a pattern of organization across temporally extended stimuli. P–2 processes identify and respond to a world of objects and events; they are responsible for activities (or "computations") that yield and maintain a record of such phenomenal experiences as eating an apple, seeing a deer, or hearing a siren (Johnson & Hirst, in preparation).

The reflective system also includes two subsystems, R–1 and R–2. Both R–1 and R–2 allow one to go beyond perception, that is, beyond the immediate consequences of ongoing perceptual stimuli. Fig. 2.2a shows important component processes of reflection. In R–1, these

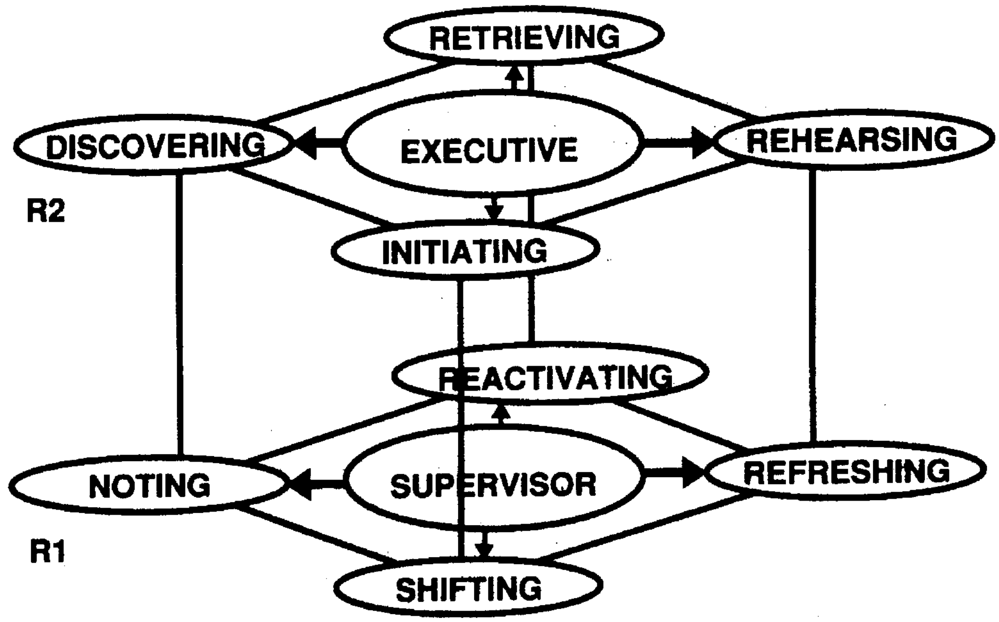

FIG. 2.2a

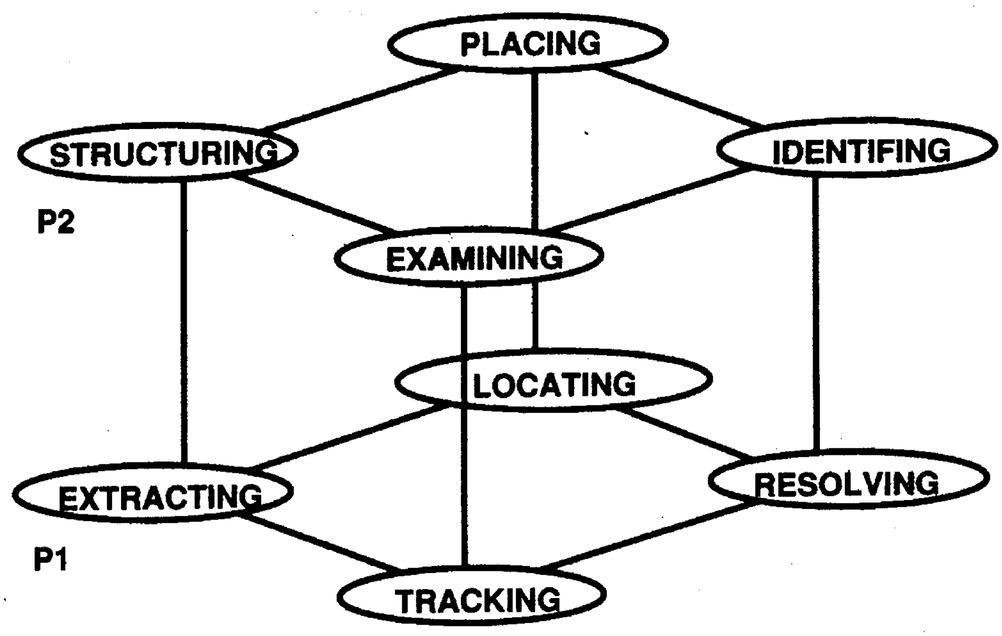

FIG. 2.2b

FIG. 2.2. Component subprocesses of (a) R–1 and R–2 and (b) P–1 and P–2. Adapted from Johnson (1991b) with permission.

component processes include *noting* relations between activated concepts, *shifting* attention to new aspects of stimulii or concepts, *refreshing* information to keep potentially useful information active, and *reactivating* information that has ceased to be part of the ongoing activation pattern. R–2 processes include *discovering*, *initiating*, *rehearsing*, and *retrieving* and are more strategic and involve more embedding of subgoals than do R–1 processes (see Johnson, 1990; Johnson & Hirst, in press). For example, a record activated by a partial match between ongoing reflection and previous reflection (e.g., noting a relation between two stimuli and being reminded of having previously noted the same relation) would be an instance of reactivating (an R–1 process). A record activated by using a strategy of presenting oneself with cues in order to find a match (e.g., trying to remember the name of a restaurant by thinking of possible people who might have told you about it) would be an instance of retrieving (an R–2 process).

R–1 and R–2 also include, respectively, *supervisor* and *executive* processes. These processes hold agendas active (e.g., remember the name of a restaurant) and monitor outcomes with respect to these agendas (Miller, Galanter, & Pribram, 1960; Nelson & Narens, 1990; Stuss & Benson, 1986) and recruit reflective component processes for these purposes. Agendas arise as a consequence of stimulus conditions (e.g., hunger to be satisfied, city streets to be navigated) and as a consequence of ongoing reflective activity (e.g., a conflict to be resolved between two equally reasonable but inconsistent theoretical ideas). Agendas differ in complexity, that is, in the complexity of the cognition required to carry them out. For example, an agenda to make old/new recognition judgments may set up decision criteria that require little more than assessing familiarity of a stimulus, activities easily controlled and monitored by the R–1 supervisor (of course, recognition tasks can under some circumstances engage additional, R–2 processes as well). An agenda to recall one's life story would be more likely to involve R–2 executive processes of specifying subgoals within more general goals (e.g., divide life into three main parts, childhood, school years, work years; within parts, use major geographic locations to cue significant events, etc.), and R–2 and R–1 might operate interactively (see next paragraph) to coordinate recall to produce a cohesive, organized product.

As shown in Fig. 2.1, agendas set in R–1 and R–2 can activate information in perceptual subsystems as well as in reflective subsystems but, typically, supervisor and executive functions have greater access to reflective memory than to perceptual memory, and greater access to P–2 than to P–1. A central feature of MEM is that the supervisor and executive processes in R–1 and R–2 can recruit and monitor each other (see overlap in Fig. 2.1), providing, among other things, a mechanism for sequencing subgoals. The phenomenal experience of volition or deliberation, or what some investigators have called effort, will, or control (e.g., Hasher & Zacks, 1979; Norman & Shallice, 1986; Shiffrin & Schneider, 1977), arises in part, from this overlap in R–1 and R–2; that is, the interaction between R–1 and R–2 creates a sense of effort or awareness of one's own thought processes.

Finally, we assume that as individuals develop from infancy, subsystems increase in functional possibilities in the order P–1, P–2, R–1, and R–2 (e.g., Flavell, 1985; Perlmutter, 1984; Schacter & Moscovitch, 1984). Learning, of course, continues throughout life in all subsystems.

A number of researchers have found it useful to think in terms of distinguishable subsystems of memory (e.g., Sherry & Schacter, 1987; Squire, 1987; Tulving, 1983). Others have begun to emphasize differences between externally derived and centrally generated processes (Craik, 1986; Jacoby, 1983; Roediger & Blaxton, 1987). MEM is both similar to and different from these approaches and could be viewed as an intersect between subsystem and processing accounts. Subsystem accounts typically posit nonoverlapping structures that handle different types of content such as procedural, espisodic, or semantic memories; process accounts tend to be associated with unitary memory models and with arguments against subsystems. MEM is a subsystem account, framed in terms of processes, in which subsystems interact to yield complex thought and behavior. In this view, all subsystems may contribute to procedural, episodic, or semantic memory, depending on specific task requirements.

It remains useful to distinguish among procedural, episodic, and semantic *tasks* in order to help characterize the functional scope of the memory system and to delineate research domains. Nevertheless, we argue against identifying tasks with subsystems because it is likely that acquisition and expression of procedural, episodic, and semantic knowledge draw on some of the same processes, though they may do so to different degrees. Note also that MEM's "modularity" is not the same as that described by Fodor (1983). According to MEM, memory has a modular capability in that organized/functional modules or groupings of processes might on some occasions operate without drawing on or being influenced by other modules (e.g., P–1 without R–2). MEM does not, however, define modules as units that are non-interacting or "impenetrable." In fact, specifying the nature of the interactions among subsystems is a major theoretical goal. An additional point of clarification is that the distinction between perceptual and reflective activity in MEM is not equivalent to "bottom-up" and "top-down" processing (e. g, Palmer,

1975) as those terms are often used. Perception is influenced by learning and by expectations based, for example, on activated perceptual schemas, and MEM's P–1 and P–2 systems include such "top-down" effects (e.g., P–2 processes help us read sloppy handwriting by interpreting letters in the context of words). Reflection involves mental activities that go beyond the phenomenal consequences of constructed perception.

Compared to what we will undoubtedly eventually need to model human memory, MEM is a relatively simple cognitive architecture. Even so, it provides a framework for considering a wide range of phenomena and issues in cognition, including relations among direct and indirect memory measures or between attention and memory (Johnson, 1983), anterograde amnesia (Johnson, 1990; Johnson & Hirst, in press), reality monitoring and confabulation (Johnson, 1988; Johnson in 1991a), and the concept of the "self" (Johnson, 1991b). In the next section we expand on some ideas about emotion and MEM suggested previously (Johnson, 1983, 1985; Johnson, Kim, & Risse, 1985).

EMOTION IN MEM

Emotions or affective responses range from conditioned avoidance to nostalgia, from mild positive and negative evaluative impressions to ecstasy and rage. Affective experiences, like other experiences, include autonomic nervous system activity and other bodily responses and sensations, including kinesthetic feedback from voluntary movements such as raising one's fist. Of course, the degree and salience of autonomic and other bodily sensations varies widely across different types of valenced experiences and for different individuals. We are assuming here that subjects' conscious perception of their own autonomic activity (or an experimenter's detection of it) is not necessary for a response to be classified as affective. Rather, in this chapter, we use the terms emotion and affect interchangeably to refer to valenced responses of any type. Nevertheless, autonomic and other bodily responses are factors that contribute to learning and memory (e.g., as energizers and motivators), and therefore they must be incorporated eventually into general cognitive models. Here, however, we are focusing on cognitive aspects of emotion, especially cognitive contributions to affect as phenomenally experienced. How emotion is expressed (e.g., on a person's face, or in action) is not addressed although, in general, the role of learning amid individual differences should be greater as we move from P–1 to R–2 involvement.

A characterization within the MEM framework of the relation between emotion and cognition is shown in Fig. 2.3a and Fig. 2.3b. Emotion arises as a consequence of processes within subsystems (along with accompanying autonomic and motor responses) and becomes part of the record of the ongoing activities of the subsystems. In Fig. 2.3a, the circular area indicated in each subsystem represents emotions that arise from processing within that subsystem. The cylinders represent the idea that some emotions have analogs in more than one subsystem. The major point to note in Fig. 2.3a is that all four subsystems, P–1, P–2, R–1, and R–2, contribute to emotion. Each subsystem is shaded differently in Fig. 2.3a to help identify the corresponding subsystem in Fig. 2.3b (a top-down view of Fig. 2.3a).

Fig. 2.3b illustrates two fundamental points. The first point, as just indicated, is that similar emotions (analogs) are associated with different subsystems. In particular, some emotions (e.g., anger, fear) are likely to be "computed" in all subsystems. Nevertheless, although we might use the same word to refer to emotions arising from processes in different subsystems, the exact character of the emotion depends on the specific processes from which it is derived. Thus in MEM there is no single "node" (e.g., Bower, 1981) corresponding to a particular emotion. The fear you experience from seeing a fist come toward you (arising primarily from P–1 activity) and the fear you experience from imagining yourself speechless at a party (arising from R–1 activity, and perhaps embellished by R–2 activity) are not exactly the same. Emotion is the consequence of certain types of activities carried out in cognitive subsystems, and phenomenally similar feelings arise from diverse activities. Feelings are a blend of cognitive and autonomic activity and other bodily sensations. Part of the similarity among feelings generated in different situations arises from similarities in the autonomic responses produced from different patterns of cognitive activity.

The second point is that the range of possible emotions expands as we move from P–1 through R–2 subsystems. Some emotions (e.g., remorse, jealousy) arise from R–1 and R–2 activity. For example, remorse often requires the reactivation or retrieval of a prior commitment, along with the knowledge that one has failed to keep it. Thus, reflective processes are important in creating the conditions for certain emotions. Furthermore, within any particular subsystem, an emotion would be more complex if more component subprocesses were involved. So, for example, an emotion resulting from the R–1 reactivation (see Fig. 2.2) of information that had dropped from consciousness (e.g., guilt induced by seeing a person and remembering you had gossiped about him the day before) would be more complex

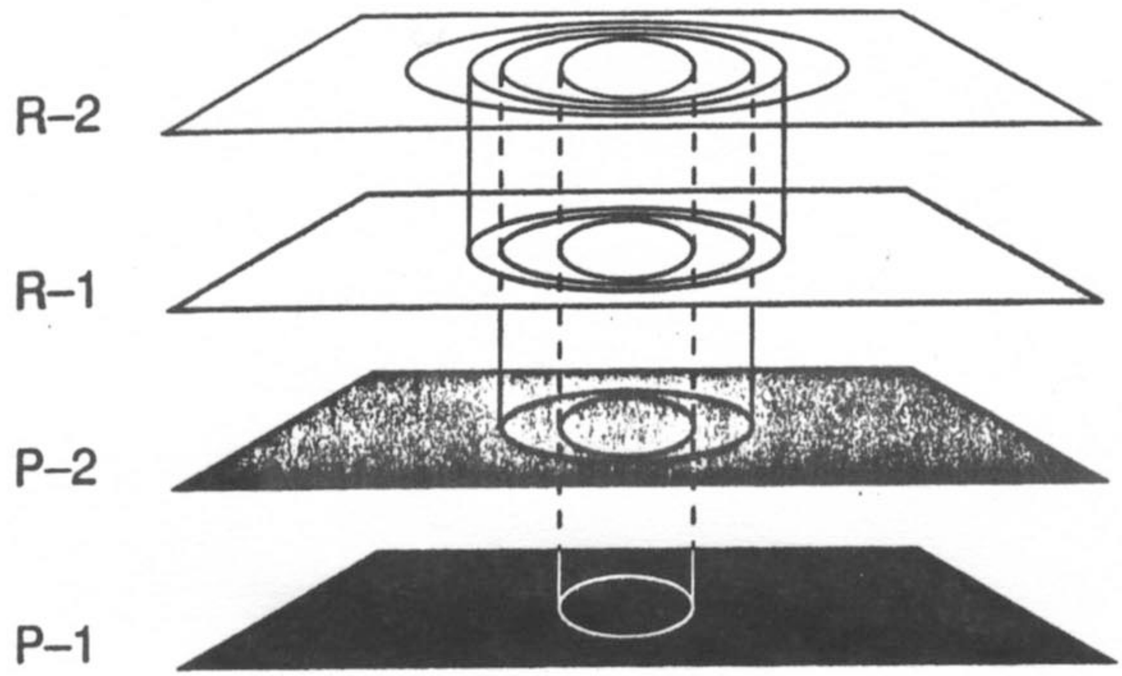

FIG. 2.3a

FIG. 2.3b

FIG. 2.3. (a) The range of emotions increases from P–1 to R–2; (b) all sybsystems in MEM contribute to affect:

than an emotion that did not require reactivation of information (e.g., sadness at watching a sick baby bird die).

Emotions arising from P–1 or P–2 activity may correspond to what other investigators have called basic or biologically primitive emotions (e.g, Plutchik, 1980; Tomkins, 1962, 1963). These emotions are thought to be evolutionarily old (Ekman, 1984), appear early in an individual's development (Leventhal & Tomarken, 1986; Lewis, Sullivan, Stanger, & Weiss, 1989), arise quickly and "automatically" (Berkowitz, 1990; Ekman, 1977), are expressed in universally recognizable configurations of facial movements (Ekman, 1973), are correlated with differentiable autonomic system activity (Ekman, 1984; Ekman, Levenson, & Friesen, 1983), may show subcortical conditioning (LeDoux, in press), may be predisposed to certain stimuli (Öhman, Dimberg, & Öst, 1985; Seligman, 1971), and serve fundamental motivational functions within the individual and communication functions among a social group (Ellsworth & Smith, 1988; Izard, 1977; Oatley & Johnson-Laird, 1987; Plutchik, 1980; Polivy, 1990; Tomkins, 1963). As an example of their communication function, expressions of emotion regulate social interaction by encouraging approach or withdrawal, depending on the situation. The pleasure one feels at simply seeing a friend is often expressed in a smile that encourages conversation.

The more complex emotions that require R–1 and R–2 processing correspond to "secondary" or "derived" emotions. As compared with basic emotions, these would be more recent evolutionarily, appear later in development, arise relatively slowly and seem "constructed," may be difficult to read on other people's faces or from other nonverbal cues, may share autonomic patterns with other emotions, are likely to involve cortical processing, may be associated with a wide range of stimuli including abstract concepts (e.g., patriotic feelings toward the concept of one's country), may underlie complex motivation within the individual, and may contribute much of the nuance of our social environment.

MEM's processing subsystems not only contribute to the experience of affect, they determine the characteristics of the acquisition and retention of affect as well. Just as emotions are experienced as a consequence of particular activities in various subsystems, they can be reactivated only by appropriate probes (as suggested by the encoding specificity principle, Tulving; 1983). A related point is that different, and perhaps conflicting, emotional responses to the same nominal stimulus may coexist, mediated by different subsystems; which of these would be active would depend on contextual factors, such as the type of probe, that might favor one or the other. For example, a person once chased by a dog might feel interest or admiration at watching a guide dog for the blind work but experience apprehension or fear if the dog looked at them. Establishing different affective responses to objects or situations should be most successful if alternative emotional responses are established within the same subsystem that supports the old affect (Johnson, 1983). Thus therapeutic interventions directed at changing emotional responses (or any response, for that matter) should be most effective if they take into account which subsystem(s) are supporting that particular emotional response (Johnson, 1985; cf. Brewin, 1989; Jacobs & Nadel, 1985; Lang, 1969). This might determine, for example, the relative balance between in vivo exposure and more cognitive (e.g., restructuring) techniques (e.g., Beck & Emery, 1985; Meichenbaum, 1977).

To further clarify this characterization of emotion in MEM, we next consider several issues in more detail.

To What Extent Does Emotion Depend on Cognition?

Zajonc (1980) offered an especially provocative idea regarding the relation of cognition and emotion, namely, that affect may not be the result of cognitive processes at all but may accumulate from minimal perceptual and cognitive input (Seamon, Marsh, & Brody, 1984) and may be among the earliest reactions to a stimulus (but see Mandler, Nakamura, & Van Zandt, 1987, for evidence that judgments other than affective ones may be supported by minimal perceptual processing, and Mandler & Shebo, 1983, for evidence that evaluations may not be faster than recognition judgments). Zajonc also indicated that the separate emotion system he had in mind dealt only with simple, valenced reactions, not with more complex emotional experiences and recognized that a more complete understanding of emotional experience would require a more elaborated model.

Appraisal theories (Abelson, 1983; Lazarus, 1982; Leventhal & Scherer, 1987; Mandler, 1984; Oatley & Johnson-Laird, 1987; Ortony, Clore, & Collins, 1988; Roseman, 1984; Smith & Ellsworth, 1985) attempt to deal with these more complex emotions. They highlight the role of cognition in producing (or "computing") emotions by emphasizing that emotion is a consequence of how people construe situations. For example, Oatley and Johnson-Laird (1987) suggest that an "emotion may start by being quite inchoate: Only with substantial reasoning about the situation and its implications may the full complex emotion develop" (p. 47). Appraisal approaches vary in a number of ways, for example, in the extent to which evolutionary, biological, or cross-cultural considerations motivate the scheme suggested; whether emotions are described in terms of categories or dimensions; whether the focus of analysis is emotion words (e.g., Johnson-Laird & Oatley, 1988), ratings of autobiographical memories (Smith & Ellsworth, 1985), or logical relations among emotion-eliciting situations (e.g., Ortony et al., 1988). Appraisal approaches also differ in which emotions are viewed as basic or primary and which are viewed as derived or secondary. Ortony et al. attempted to do away with the idea of basic emotions entirely, although the hierarchical structure they propose, in which some emotions are more differentiated versions of others, results, in effect, in some emotions being more basic than others. In any event, one idea about which there does seem to be consensus among theorists who emphasize the role of cognition in emotion is that emotions differ in the complexity of cognition that gives rise to them (e.g., Fiske & Pavelchak, 1986; Leventhal & Scherer, 1987; Oatley & Johnson-Laird, 1987; Ortony et al., 1988; Smith & Ellsworth, 1985).

As others have pointed out, some of the debate about whether emotion involves cognition hinges on how one defines cognition (e.g., Berkowitz, 1990; Ekman, 1984; Leventhal & Scherer, 1987). Along these lines, MEM's subsystems provide a ready mechanism for the types of effects emphasized by Zajonc (1980), as well as the types of phenomena emphasized by appraisal theorists. Emotion that is associated with perceptual subsystems, especially P–1, would arise relatively automatically, without reflection, and seem to be elicited by stimulus properties, creating the impression of affect without "cognition" (i.e., cognition in such cases is P–1 and P–2 cognition; cf. Leventhal & Scherer, 1987.) In addition, emotion generated in any subsystem from the activation of well-learned schemas, categories, or concepts with which affect is already strongly associated would arise quickly, again yielding the impression of affect without cognition (Fiske & Pavelchak, 1986). In contrast, emotion that depended on retrieval of more information, discovering relations, and so forth—the type of evaluation initiated and monitored by R–1 and R–2 supervisor and executive processes—would be slower to arise (Fiske & Pavelchak, 1986) and would yield the impression that emotion follows cognition. Thus, the controversy between those emphasizing the immediacy and directness of emotion and those emphasizing the role of cognition disappears if we take into account variations in cognitive complexity underlying different emotions.

MEM suggests some specific ideas about how cognitive complexity might be defined in this context. Engaging more reflective component processes results in greater complexity than does engaging fewer (e.g., refreshing plus reactivation is more complex than refreshing alone, etc.). Because R–2 processes are more strategic and may involve more embedding of subgoals, R–2 processing is more complex than R–1 processing. Similarly, R–1 processing is typically more complex than P–2 processing, and so forth. For example, judgments monitored by R–1 supervisor processes tend to be made quickly, on the basis of qualitative characteristics of activated information, whereas judgments monitored by R–2 executive processes tend to involve more extended reasoning in which additional information is purposefully retrieved, including antecedents and consequences for a given event (Johnson, 1991a, 1991b). For example, suppose you expected a call from a colleague and the call did not come. Your quick, R–1 appraisal is that the person is being irresponsible and you become irritated. Suppose instead that you engaged in R–2 processes to consider why this person might not have called and remember that you said you would call her. Consequently, you might feel a bit foolish and somewhat friendly toward your colleague.

Emotion is Related to Activated Agendas

Goals and plans work in combination with comparison and evaluation processes to direct mental activity and behavior (e.g., Carver & Scheier, 1990; Miller, Galanter, & Pribram, 1960). An idea that appears in many theories of emotion is that emotions follow from the satisfaction or disruption of goals and plans (e.g., Mandler, 1984; Oatley & Johnson-Laird, 1987; Ortony et al., 1988). In MEM, goals and plans are the agendas that control processing in different subsystems. These can vary in complexity, and, especially, in the degree to which they are perceptually or situationally controlled as opposed to reflectively or self-controlled. Activated perceptual schemas function like agendas (e. g, they guide where to look, etc.) but do not necessarily require reflective control, whereas activated reflective scheme for solving certain problems (e. g, geometric proofs) require reflective control. One might experience surprise, for example, by having a perceptual schema disconfirmed or by encountering something inconsistent with a reflective schema. The phenomenal experience would be similar in the two cases, but not identical.

Activated reflective agendas are central to the idea of agency or control and, especially to self-control or self-regulation (e.g., Bandura, 1982; Carver & Scheier, 1990). One reason to be interested in agency in the present context is that agency, itself, might have motivational properties (e.g., Buck, 1985; White, 1959). Another is that the dimension of control or agency is critical for people's experience of certain emotions (Ellsworth & Smith, 1988; Smith & Ellsworth, 1985). For example, Smith and Ellsworth asked subjects to recall a time when they had experienced a particular emotion and then rate the situations along a number of dimensions. Shame and guilt were associated with self-agency, and anger, contempt, and disgust with other-agency. How then does such a sense of agency come about? Of course, many social and environmental factors in an individual's history are important in determining whether he or she feels in control in particular situations. One mechanism follows from the MEM architecture; a sense of agency and self-control arise, in part, from the interactive recruitment and monitoring that goes on between R–1 and R–2 subsystems (Johnson, 1991b). This is discussed more in the next section, which relates agency to a sense of self.

Although satisfaction and disruption of plans and assignment of agency or control are clearly basic mechanisms in emotion, it is important to note that not all emotion is related to activated agendas. For example, emotions could arise in MEM from P–1 or P–2 processing in the absence of any particular ongoing agenda (e.g., the fear you might feel if you woke from a nap under a tree just in time to see a tree branch falling toward you) other than, perhaps, some constant background agenda to preserve one's well-being.

The Development of Emotion

We have proposed that the range of emotions people experience grows out of the multiple processing subsystems they have available. We have also suggested that these subsystems develop in a specific order—P–1, P–2, R–1, and R–2. It follows that emotional range and nuance should develop as the various subsystems develop; that is, an infant who is functioning largely on the basis of P–1 processes would have a much narrower range of emotions than a child who has begun to use R–1 and R–2 processes. This is consistent with Lewis et al.'s (1989) argument that secondary emotions are not observed until appropriate cognitive development has taken place. Lewis et al. emphasized the development of a self-concept as a prerequisite for certain emotions, for example, embarrassment, empathy, and envy, and for the yet later development of standards and rules requisite for emotions such as pride, shame, and guilt. Similarly, Oatley and Johnson-Laird (1987) argued that only with the development of a reflective sense of self can the full set of complex emotions occur.

Elsewhere, one of us (Johnson, 1991b) has suggested that the self arises and is maintained, at least in part, as a by-product of reality monitoring (Johnson & Raye, 1981) processes that are a necessary consequence of the MEM architecture. Because we are capable of reflection as well as perception, we had to develop mechanisms for discriminating the products of reflection from those of perception. Engaging in such reality monitoring would create a sense of self even if one did not develop through other mechanisms. Furthermore, in MEM, the phenomenal experience of self-control arises in the course of the mutual recruiting and monitoring between R–1 and R–2 processes. Thus these mechanisms involved in reality monitoring and R–1/R–2 interaction could underlie development of the aspects of the self that are emphasized by Lewis et al. (1989), especially self–other differentiation and the ability to consider the self as a separate entity. (Rose Zacks wonders if this is the MEM version of "I think, therefore I am.") Even emotions that are not so clearly dependent on an articulated idea of self as are embarrassment or shame probably develop during childhood in order of their cognitive complexity; for example, sadness is less cognitively complex than is regret and thus should appear earlier in development.

How is Emotion Represented in Memory?

One of the most influential current conceptions of emotion among cognitive psychologists is that emotion is represented in memory as part of a more general associative network (Berkowitz, 1990; Bower, 1981; Clark & Isen 1982). For example, Bower (1981) proposed that emotions are represented by nodes in memory. Primary emotions (e.g., joy, anger, fear, sadness, surprise) are directly represented by nodes, and other emotions (e.g., disappointment, contempt) may be blends or mixtures of activation from these primary nodes. For example, disappointment may be sadness mixed with surprise. A node representing a particular emotion is connected to nodes representing propositional representations of episodic events during which the particular emotion was present, and to nodes that produce the pattern of arousal and expressive behavior associated with that emotion. These nodes, like other nodes, send and receive spreading activation and are connected to other nodes with varying degrees of strength. Hence if some aspect of an event is activated, through spreading activation, an emotion may be activated as well. Conversely, activation of an emotion (by, for example, the person's mood state) may activate events to which it is associated (Blaney, 1986; Eich, 1989).

In a recent review of emotion, Leventhal and Tomarken (1986, p. 601) questioned whether it is accurate to describe "verbal, perceptual, subjective experiential, autonomic, and expressive events as structurally similar nodes linked by a common type of associative bond (Bower, 1981)." They expressed here an understandable discomfort with dealing with all information as if it were equivalent. There are marked phenomenal differences in various aspects of experience, for example, in the realization that it was a Volvo that ran into your car, compared with your feelings of increased heart rate, cold sweat, and so forth. But representational inadequacy is not a problem unique to emotion (see also LeDoux, in press). When cognitive psychologists represent aspects of memories such as "blue" or "round" or "in my office" or "with her husband" in an associative or propositional format, the notation seems pale in comparison to the experience, and many subtleties are lost. Current representational schemes provide "place-holders" for the types of information that cognitive theorists know must be represented somehow in memory and propose to deal with empirically and theoretically; emotion has been added to the list of information to be represented by these place holders.

MEM is a set of hypotheses about the functional organization of cognitive processes at the level of a global architecture. Any number of representational formats (associative networks, connectionist networks, episodes, cases, production rules, propositions, schemas, mental models) could be incorporated into MEM. Of course, the value of postulating particular representational formats is that they imply more specific hypotheses about processing (e.g., Collins & Quillian, 1969; Pirolli & Anderson, 1985). But whatever the representational format (or combination of formats) we adopt, it seems reasonable to reject the idea that the memory system is undifferentiated. For example, it seems unlikely that an emotion such as fear is represented as a single node or a set of units in an undifferentiated associative network. Minimally, the idea that emotions are embedded, along with other information, in an associative network would have to be expanded to take into account multiple networks with some kind of internal cohesiveness corresponding to subsystems of memory such as those postulated in MEM. A similar argument holds for other representational formats. It is likely, in fact, that the type of representational format that is most useful for theoretical analysis depends on the subsystem in question; for example, connectionist networks may be more appropriate for characterizing perceptual processes and propositional representations more appropriate for some types of reflective activities. Without making a commitment to one or another representational format at this point, and leaving the exploration of implications of various formats for MEM for the future, we can still make progress on developing a broader view of what must be represented in memory and the functional relations among types of information and types of cognitive processes.

Neuropsychology of Emotion

The range of cognitive, motor, and autonomic system activity involved in computing, expressing, and reinstating various affective experiences suggests a correspondingly complex underlying anatomy, physiology, and biochemistry of emotion (e.g., Damasio & Van Hoesen, 1983; Heilman, Watson, & Bowers, 1982; LeDoux, 1987, this volume). For example, Heilman et al. (1982) pointed out that "emotion . . . depends on varied anatomic structures, including: cortical systems for producing the appropriate cognitive set, limbic structures for activating the brainstem and thalamic activating centers and for controlling the hypothalamic output, the hypothalamus for regulating endocrine and autonomic responses, and the brainstem and thalamic activating systems for producing cortical arousal" (p. 58). This complexity includes potential differences in the relative contributions to emotion of right and left hemispheres (e.g., Heilman et al., 1982; Kinsbourne & Bemporad, 1984; Leventhal & Tomarken, 1986). Such an intricate set of interrelations invites questions from many perspectives.

For us, a goal for the future is to integrate MEM with available information about the neurobiology of emotion and cognition. In doing so, we would assume that bodily sensations and motor activity combine with P–1, P–2, R–1, and R–2 processing as part of complex processing circuits. Across the full range of emotions, it is the intersect of bodily state and the type of perceptual and reflective processing defining the relevant circuit that gives emotion in any particular case its distinctive phenomenal qualities. Disruption of function anywhere along these circuits should have effects on emotional experience or behavior; we are particularly interested in potential selective effects on affect from selectively disrupted cognition. Because we work from a cognitive perspective, we would label such complex emotion circuits in terms of the perceptual and reflective subsystems that participate, even though all may involve some common neurological structures (e.g., the amygdala). Of course, the exact nature of these various emotion circuits remains to be specified (see LeDoux, in press, for an intriguing example of LeDoux and colleague' efforts to trace out what, in terms of MEM, would be a P-1 emotion circuit).

Emotion and Amnesia

In MEM, emotion may be influenced primarily by perceptual processes or it may be influenced primarily by reflective processes. This suggests one strategy for investigating emotion is studying affect in patient populations who have deficits in either perceptual or reflective processes. Johnson and Hirst (in press; Johnson, 1983, 1990) have described anterograde amnesia as a deficit of reflection. According to this view, amnesics have a relatively intact perceptual system and a disrupted reflective system, especially disruption of the component processes of reactivation and retrieval (see Johnson, 1990, and Johnson & Hirst, in press, for more complete discussions). According to this view of amnesia, and consistent with the characterization of emotion in terms of MEM described earlier, those affective responses that depend largely on perceptual processes should be intact in amnesics and those that depend on reflection should be disrupted. We have explored this hypothesis by studying three amnesic patient groups: Korsakoff amnesics (Johnson, Kim, & Risse, 1985) and nonalcoholic anterograde amnesics of mixed etiology, and patients diagnosed as having Alzheimer' s Disease (Multhaup, Johnson, Phelps, Hirst, Mattes, & Volpe, in preparation). Subjects were tested in two situations, one in which affective responses normally should be largely determined by perceptual aspects of the situation (the melodies study), and one in which affective responses normally should be more likely to involve reflective processes (the Good Guy/Bad Guy study).

The Melodies Study. Subjects heard tape recordings of brief (6–8 sec) excerpts of unfamiliar Korean melodies, played on a piano. Each melody was played 1, 5, or 10 times, in random order. These melodies were then mixed with new melodies from the same pool and presented to subjects in random order. Subjects rated each melody on a 5-point scale, indicating how much they liked it.Under such circumstances, normal subjects often prefer items to which they have previously been exposed, a phenomenon called the mere exposure effect (Seamon et al., 1984; Zajonc, 1980; see Bornstein, 1989, for a review). (The fact that this effect does not necessarily depend on old/new recognition of the stimuli [e.g., Seamon et al., 1984] is one type of evidence that Zajonc used to argue that emotion can occur in the absence of cognition.) We assumed that preferences for the melodies in the present situation would largely be determined by their perceptual properties, including any changes in perceptual processing as a consequence of experience with them (e.g., increased fluency, Jacoby & Dallas, 1981; perceptual organization, etc.). Thus, we expected normal acquisition of affect in amnesics under these circumstances.

The preference scores for the three amnesic groups and their respective controls are shown in Table 2.1a (collapsed across frequency of presentation, which did not reliably affect preferences; see also Mandler & Shebo, 1983). For both the Korsakoff and the Alzheimer studies, there was a main effect for type of item (old vs. new), and type of item did not interact with group (amnesic vs. control). Subjects preferred old melodies to new ones, and this preference effect was similar in size for patients and controls. In the anterograde amnesic study, there was no overall old/new effect, but when the groups were analyzed separately, the amnesics preferred the old melodies to the new ones ($p < .05$, one-tailed) whereas the

TABLE 2.1
Mean Preference Ratings and Recognition Probabilites
for Patients and Controls

a. Mean Preference Ratings for Old and New Melodies

	Korsakoff Patients (n = 9)*	*Korsakoff Controls (n = 9)*	*Anterograde Amnesics (n = 5)*	*Ant. Amn. Controls (n = 5)*	*Alzheimer Patients (n = 12)*	*Alzheimer Controls (n = 12)*
Old	4.10	3.77	4.13	3.47	3.90	3.69
New	3.74	3.46	3.76	3.27	3.58	3.49

b. Probability of Correctly Recognizing Old Melodies

	Korsakoff Patients[a] (n = 9)	*Korsakoff Controls[a] (n = 9)*	*Anterograde Amnesics[b] (n = 5)*	*Ant. Amn. Controls[b] (n = 5)*	*Alzheimer Patients[b] (n = 12)*	*Alzheimer Controls[b] (n = 12)*
1 Exp.	.42	.64	.65	.73	.53	.65
5 Exps.	.75	.89	.55	.88	.64	.81
10 Exps.	.61	.97	.70	.93	.72	.86

*Note: Korsakoff data adopted from Johnson, M. K., Kim, J. K., & Risse, G. (1985).
[a]Subjects were given a forced-choice recognition test.
[b]Subjects were given a yes/no recognition test. Scores are the average proportion correct'on target and distractor items.

controls did not, although the old/new difference was in the expected direction.

Subjects in all three studies were also tested for recognition memory on a comparable set of melodies (which melodies were tested for preference and which for recognition was counterbalanced across subjects). Recognition scores are shown in Table 2.1b. The data for Korsakoff patients and their controls is based on forced-choice recognition and the data for anterograde amnesics, Alzheimer's patients, and their respective controls, on yes/no recognition; otherwise, testing conditions were similar. It is apparent in Table 2.1b that increasing the number of exposures generally improved recognition (although not significantly so in the case of the anterograde amnesics and their controls), and all amnesic groups showed a marked disruption in recognition relative to their controls.

Recognition is a complex task that tends to draw on both reflective and perceptual processes (e.g., Mandler, 1980, in press). Impaired performance in amnesics on recognition tests is consistent with the idea that they have impaired reflective processes (Johnson, 1983; Johnson & Hirst, in press). The fact that amnesics profit from repetitions on recognition tests is consistent with other findings (Hirst, Johnson, Kim, Phelps, & Volpe, 1986; Hirst, Johnson, Phelps, & Volpe, 1988; Johnson & Kim, 1985; Weinstein & Johnson, 1990), suggesting that some of the processes involved in recognition are intact in amnesia, presumably those drawing on perceptual processes.

Because amnesics and controls were markedly different on recognition but quite similar on preference, and recognition was generally more sensitive to number of exposures than was preference, these data suggest that although both recognition and preference draw on perceptual records recognition and preference in this situation involve somewhat different information or attribution processes. In addition, our primary prediction was supported: The preserved acquisition of preferences for melodies in our three amnesic groups is consistent with the idea that affect that is the consequence of perceptual processes is preserved in amnesia. A related finding is Tranel and Damasio's (1990) report that a severe amnesic (patient Boswell) picked the person who had given him numerous treats significantly above chance when asked to "choose the person you would go to for rewards." This observation is consistent with what we would expect from the MEM framework and our findings from the melody studies, namely that for amnesics as well as normals, affect can become associated with perceptual properties of stimuli. The next study suggests, however, some limitations in the affect that is supported only by perceptual cues.

The Good Guy/Bad Guy Study. This study investigated acquisition of affect in a situation involving much more reflection than would be likely in the melody study. The same three amnesic groups were studied (except that one Alzheimer patient from the melody study was not tested in the Good Guy/Bad Guy Study and there were seven additional Alzheimer patients and six additional Alzheimer Controls). All subjects initially were shown a photograph of a young man, whom we called Bill, and asked to rate him on several personality characteristics (e.g., honesty, intelligence). Then they were shown a photograph of a young man, whom we called John, and asked to rate him on the same attributes. Subjects next heard a tape of some "biographical" information that depicted Bill as a bad guy (e.g., he stole things, broke his wife's arm) and John as a good guy (e.g., he helped his father, he got a Navy commendation for saving someone's life). We did not, of course, expect the amnesics to recall this information as well as the controls. But we were interested in the impact that the biographical information might have on an indirect measure of affective memory—subjects' subsequent impression ratings of the two men.

The exact details of the studies varied somewhat to accommodate exigencies of scheduling (these studies were conducted in the context of other studies that were not necessarily the same across amnesic populations) and, especially, the greater cognitive impairment of the Alzheimer patients. Korsakoff and anterograde amnesics and their corresponding controls rated both men on 20 attributes using a 5-point scale, listened to the biographical information once, and made their second impression rating after approximately 1–2 hours. They heard the biographical information a second time at the end of the first session, returned for a second session after 2–7 days, and rated the men again. They heard the biographical information a third and final time during the second session, and then after about an hour there was a recognition test and the subjects rated the men again. Korsakoffs and their controls returned once more after an average of 20 days and were asked to recognize the target pictures and to rate the men a final time. Alzheimer patients and controls rated each of the men on 7 characteristics on a 3-point scale, heard the biographical information 3 times and rated the men after about a 5-minute delay. They returned 1 month later and were asked to recognize the target pictures and to rate sentences from the biographies for how good or bad the actions were (the results indicated that the Alzheimer patients understood the general meaning of individual sentences of the biographical information). After this comprehension test and a 5-minute delay, they gave impression ratings again. The 5 impression ratings from the Korsakoffs and controls are shown in Fig. 2.4a, the 4 impression ratings from the anterograde amnesics and controls in Fig. 2.4b, and the 3 impression ratings from the Alzheimer patients and controls in Fig. 2.4c.

Both control and amnesic patients initially rated the good guy and the bad guy approximately equally (which is to be expected because pictures were counterbalanced with biographies). The three control groups look quite similar. After hearing the biographical information, they subsequently gave the good guy more favorable ratings and the bad guy less favorable ratings, and these effects persisted over considerable retention intervals (approximately 20 days in Fig. 2.4a, a week in Fig. 2.4b, and a month in Fig. 2.4c). All amnesic groups also showed some impact of the biographical information on impression ratings. Consider T4 in Fig 2.4a and Fig 2.4b. At this point, both Korsakoffs and anterograde amnesics had heard the biographical information three times, with the last presentation being approximately one hour earlier, and they showed more favorable impressions of the good guy than the bad guy. (Interestingly, for the Korsakoffs, impressions persisted for 20 days; see T5). Turning now to the Alzheimer's patients, at T2 they also had heard the biographical information three times (presented in a single session rather than in two sessions as in the other groups) and they also showed differential impressions for the two men when tested 5 minutes after the last presentation. Furthermore, in the Alzheimer group, larger differences on impression ratings were associated with less severe impairment on the Global Deterioration Scale (Reisberg, Ferris, deLeon, & Crook, 1982). Overall, the amnesic patients look generally similar to each other in that the biographical information affected their impression ratings, but the impact was muted compared to effects on the corresponding controls.

Subjects were also tested for recall of the biographical information. Whereas control subjects generally recalled some biographical details, amnesics from all patient groups recalled very little, although some did have the sense that Bill was bad and John was good. In contrast, recognition of the pictures of Bill and John (when each was paired with a distractor) was remarkably good. After an average delay of 20 days, the Korsakoff patients and their controls all recognized both target pictures. Similarly, the anterograde amnesics and their controls all recognized both targets after approximately an hour retention interval. After a 1-month delay all Alzheimer controls and 17 of 18 patients recognized both target pictures. In an additional session 6 months later (with no intervening exposure to the pictures) 14 of 14 Alzheimer controls recognized both target pictures,

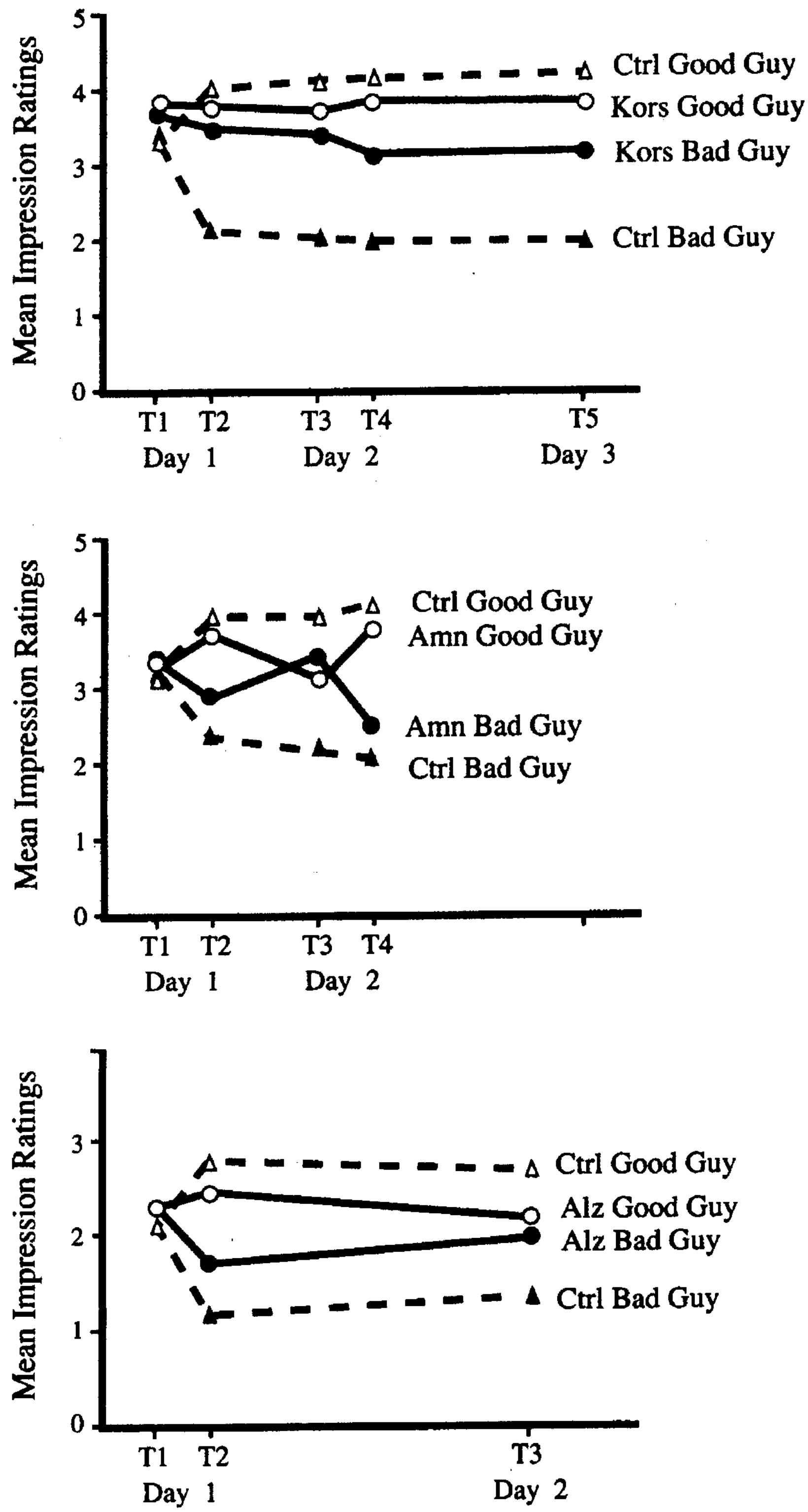

FIG. 2.4. Impression ratings of (a) Korsakoff patients (n = 9) and their controls (n = 9), (b) anterograde amnesics (n = 5) and their controls (n = 5), and (c) Alzheimer patients (n = 18) and their controls (n = 18). FIG. 2.4 Adapted from Johnson, M. K., Kim, J. K., and Risse, G. (1985).

as did 12 of 14 Alzheimer patients (4 patients and 4 controls could not be contacted after the 6-month delay).

In summary, whereas the patient groups showed normal acquisition of preferences for melodies, their acquisition and retention of evaluative impressions about Bill and John was severely disrupted. There are a number of differences in these two studies that might have influenced the results. One interpretation of the difference in outcome between the melody and the Good Guy/Bad Guy studies is that, whereas preferences for melodies depend largely on perceptual processes, evaluative impressions and preferences for people are likely to depend on reflective activity and, most importantly, on its later reactivation. For example, positive affect is likely to accumulate as one hears different positive things about a person and is reminded of earlier positive things. Similarly, negative affect is likely to accumulate as one hears different negative things and is reminded of earlier negative things. Furthermore, impressions may also be influenced by comparing a person to other people you have known, and by making comparative judgments between possible behaviors of the people being thought about. These are cognitive activities that depend on an intact reflective system (especially reactivation and retrieval processes), both for carrying them out and for reviving them later. Normal subjects would be able to engage in such activities and to retrieve them later thus reinstating affective impressions, whereas amnesics would be severely impaired.

The Happy/Sad Study. Another study we conducted with Alzheimer patients provides additional evidence that the impact of some kinds of affective information will be markedly reduced when reflection is disrupted. Patients and controls (18 of each) were shown line drawings of scenes (e.g., a man and a woman sitting at a table). For each one they were told either a "happy" story (e.g., the man and woman are enjoying great success in their restaurant business) or a "sad" story (e.g., the woman is confronting the man about stealing money). The pictures themselves were affectively neutral and whether the story that was paired with a particular picture was happy or sad was counterbalanced across subjects. Approximately 15 minutes later, subjects were shown pairs of pictures, each including one that had been paired with a happy story and one paired with a sad story, and were asked to choose the sadder of the two pictures. This test did not require subjects explicitly to recall the stories and thus, like the preferences and impression ratings in the melody and Good Guy/Bad Guy studies, provided an indirect measure of retention of affective information.

Alzheimer patients chose the sad picture at a level above chance but were significantly below the controls. When given a new set of items 2 months later and with similar acquisition and testing procedures, the patients were somewhat more impaired than previously (the interaction between group and session was $p < .06$). In a third session 1 month after the second session, we tested subjects on the items that had been presented in sessions 1 and 2. For half the items subjects were to select the sadder of two old pictures and for the other half the familiar picture from an old/new pair. Whereas controls were able to choose the sad picture above chance both for items seen 1 month earlier and for items seen 3 months earlier, Alzheimer patients were at chance on items from both retention intervals. This was not, however, because the patients remembered nothing from the original experience. The Alzheimer patients were above chance (though below controls) for both retention intervals in their ability to discriminate old pictures from new pictures in the forced choice recognition test. Thus, as in the Good Guy/Bad Guy study, for Alzheimer patients, some affective information was initially available, but it did not persist. In contrast, in both the Good Guy/Bad Guy and the happy/sad study, the recognition performance of Alzheimer patients was surprisingly good considering the substantial retention intervals involved.

Although our control subjects did not show any decrease in their impressions of the Good Guy and the Bad Guy over the retention intervals we used, perhaps with enough time they would begin to look like amnesics. The muted affective responses associated with poor recall in amnesics may help explain such phenomena as the reinstatement of Richard Nixon to national acceptabilility. Those of us who lived through the Watergate hearings and Nixon's resignation from office may now have negative reactions when we read about him or see him on TV, but as it becomes more difficult to recall his specific misdeeds, and what we thought about them at the time, the original rage is gone. Perhaps we don't forgive and forget—rather, we forget and forgive. However, we should not conclude from these studies that emotion is necessarily short-lived compared to other information, although this might be true in some cases (Suengas & Johnson, 1988). Perhaps the relative durability of affective aspects of experience depends on the subsystem that gives rise to the emotion as well as the intensity of the emotion experienced. In the Richard Nixon example, affect would involve a great deal of reflection. In contrast, some investigators have emphasized the potential durability of affective responses arising from what would be P–1 and P–2 processing in MEM (Brewin, 1989; Jacobs & Nadel, 1985).

Memory for Perceived Versus Imagined Events

Empirical studies of emotion and memory have focused on a range of phenomena, for example, on accuracy of recall or recognition of details of emotional events (e. g, Christianson & Loftus, 1987; Loftus & Burns, 1982), emotion as a cue to event recall (e.g., Bower, 1981), and effects of mood on memory (see Blaney, 1986, for a review). In our lab, we have been primarily interested in factors that influence the likelihood that emotion will be a qualitative part of a memory. Our studies with amnesics suggest that recapturing affect depends on whether it is possible to reinstate the records of the initial processing that led to the initial affective response. Other studies from our lab have investigated memory for various aspects, including emotion, of complex events. In one study (Suengas & Johnson, 1988, Experiment 3), subjects either imagined (guided by a script) or actually engaged in a number of "minievents" such as wrapping a package, having coffee and cookies, and writing a letter. Subjects then rated their memories for half the situations using a Memory Characteristics Questionnaire (MCQ) that included items assessing such qualitative characteristics of their memory as visual detail, spatial information, emotion, and so forth. The next day subjects returned and rated their memories for the other half the items (they also rated the first half again, but those data are not of interest here). Comparison of Day-1 with Day-2 ratings provide us with information about the retention of various qualitative characteristics of memories for both actual and imagined events.

Two things seemed to us to be particularly interesting about these data. One was that ratings decreased more for imagined than for perceived events on questions that assessed visual and other perceptual detail. Because perceptual qualities provide highly salient information for discriminating perceived from imagined events in memory (Johnson, Foley, Suengas, & Raye, 1988; Johnson & Raye, 1981), the more rapid loss of perceptual information in imagined events than in perceived events would be quite functional. The second was that items assessing apperceptive qualities of memories (thoughts and feelings) showed a relatively rapid loss over the retention interval for both perceived and imagined events. Thus, relative to other information, the kind of mild affect generated by ordinary events appears to be forgotten quickly. Again, we thought this finding was interesting with respect to reality monitoring because results of another study (Suengas & Johnson, 1988, Experiment 1) had suggested that thinking about apperceptive aspects of real and imagined events after the fact might reduce their discriminability. If apperceptive qualities were forgotten rapidly, this would reduce the chances that these qualities might be thought about later and create potential difficulty in reality monitoring.

Using a similar minievents paradigm, Hashtroudi, Johnson, and Chrosniak (1990) compared young (mean age = 19.8) and older (mean age = 68.7 years) adults' memories for perceived and imagined complex events. In addition to the MCQ ratings, subjects recalled the events after rating them on Day 2. Again we found greater forgetting of visual detail for imagined than for perceived events. This time, the decrease in thoughts and feelings was not so marked; however, the initial apperceptive ratings in the younger group were somewhat lower than in the previous study, so perhaps ratings did not have so far to fall. In this study, one of the most interesting findings was that older individuals indicated in their ratings that they had better memory for thoughts and feelings than did younger subjects. Consistent with this, in recalling the events, older subjects reported thoughts and feelings and evaluative statements more often than did younger subjects. In contrast, older individuals reported fewer colors, references to nonvisual sensory information, spatial references, and actions than did younger adults. These findings are consistent with the possibility that, in remembering events, there may be a tradeoff between perceptual and affective information (Christianson & Loftus, 1987; Deffenbacher, 1983; Easterbrook, 1959; Mueller, 1979).

To explore reality monitoring, after a 3-week retention interval, subjects were phoned and asked to indicate whether each event (wrapping the package, etc.) was perceived or imagined. Older adults were significantly worse at reality monitoring than were younger adults. This result is consistent with the findings reported by Suengas and Johnson (1988), suggesting that attention to affective qualities of memories might reduce accuracy of reality monitoring. Our conclusions here are tentative because both age groups were near perfect and not all subjects were reached by phone. However, other evidence of poorer reality monitoring in older adults has been reported (Cohen & Faulkner, 1989; Rabinowitz, 1989, but see Hashtroudi, Johnson, & Chrosniak, 1989).

After these data were published, we did additional exploratory analyses and saw an intriguing pattern. The correlations between subjects' ratings of their memories on clarity (a factor largely assessing visual qualities) and the subjects' certainty in the accuracy of their memories was about the same for older (.71) and younger (.76) subjects, but the correlation between the thoughts and feelings factor and certainty in accuracy was significantly higher for older subjects (.51) than for younger subjects (.35). This pattern suggests that older subjects give greater weight to thoughts and feelings in making reality monitoring judgments. If so, it would be consistent with the idea that there are differences between younger and older adults in what is most salient (Hasher & Sacks, 1988). The potential impact on reality monitoring for any age group of differential attention to emotional aspects of experience remains to be explored.

CONCLUSIONS

Among the most central ideas in the emotion literature, and one about which there is considerable consensus, is that emotions differ in the degree of cognitive complexity that gives rise to them. A number of models have been offered to account for this (e.g., Oatley & Johnson-Laird, 1987; Ortony et al., 1988; Roseman, 1984; Smith & Ellsworth, 1985). All add to the developing picture of emotion and, perhaps more importantly, each suggests somewhat different directions for research. In this present chapter, we have tried to show how a number of current ideas about emotion fit within MEM, a general cognitive architecture that characterizes subsystems of mental processes and relations among them. Looking at emotion from this framework highlights a number of interlocking areas for future empirical investigation. These include: an analysis of the relation between emotion and cognitive complexity as indexed in terms of MEM's subsystems and component processes (e.g., retrieving, noting, shifting, rehearsal); conditions controlling a sense of agency and their associated impact on emotional experience; the relation between cognitive development as characterized in MEM and emotional development; the relation between specific cognitive deficits as characterized in MEM and emotional experience and affective memory; and a comparison of the emotional qualities of memories for real and imagined events and the impact of such memories on thought and behavior. Finally, two additional challenging issues are evaluating the usefulness of alternative representational formats for emotion and MEM, and relating MEM to what is currently known about the underlying neurobiology of emotion and cognition.

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