Mood and Memory

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ABSTRACT: *This article describes experiments in which happy or sad moods were induced in subjects by hypnotic suggestion to investigate the influence of emotions on memory and thinking. One result was that subjects exhibited mood-state-dependent memory in recall of word lists, personal experiences recorded in a daily diary, and childhood experiences; people recalled a greater percentage of those experiences that were affectively congruent with the mood they were in during recall. Second, emotion powerfully influenced such cognitive processes as free associations, imaginative fantasies, social perceptions, and snap judgments about others' personalities (e.g., angry subjects generated angry associates, told hostile stories, and were prone to find fault with others). Third, when the feeling-tone of a narrative agreed with the reader's emotion, the salience and memorability of events in that narrative were increased. Thus, sad readers attended more to sad material, identified with a sad character from a story, and recalled more about that character. An associative network theory is proposed to account for these several results. In this theory, an emotion serves as a memory unit that can enter into associations with coincident events. Activation of this emotion unit aids retrieval of events associated with it; it also primes emotional themata for use in free association, fantasies, and perceptual categorization.*

To begin this discussion of the phenomena of state-dependent memory let me cite two illustrations. When I was a kid I saw the movie "City Lights" in which Charlie Chaplin plays the little tramp. In one very funny sequence, Charlie saves a drunk from leaping to his death. The drunk turns out to be a millionaire who befriends Charlie, and the two spend the evening together drinking and carousing. The next day, when sober, the millionaire does not recognize Charlie and even snubs him. Later the millionaire gets drunk again, and when he spots Charlie treats him as his long-lost companion. So the two of them spend another evening together carousing and drinking and then stagger back to the millionaire's mansion to sleep. In the morning, of course, the sober millionaire again does not recognize Charlie, treats him as an intruder, and has the butler kick him out by the seat of his pants. The scene ends with the little tramp telling the camera his opinion of high society and the evils of drunkenness.

The second illustration involves a talk I had recently with Bernard Diamond, a forensic psychiatrist who lives in the Bay Area, about a famous criminal case he dealt with—the case of Sirhan Sirhan, the man who assassinated Bobby Kennedy in Los Angeles in 1968 (see Diamond, 1969; also Kaiser, 1970). Interestingly, Sirhan had absolutely no recollection of the actual murder, which occurred in the small kitchen of the Ambassador Hotel where he pumped several bullets into Kennedy. Sirhan carried out the deed in a greatly agitated state and was completely amnesiac with regard to the event. Diamond, called in by Sirhan's attorneys, hypnotized Sirhan and helped him to reconstruct from memory the events of that fateful day. Under hypnosis, as Sirhan became more worked up and excited, he recalled progressively more, the memories tumbling out while his excitement built to a crescendo leading up to the shooting. At that point Sirhan would scream out the death curses, "fire" the shots, and then choke as he reexperienced the Secret Service bodyguard nearly throttling him after he was caught. On different occasions, while in trance, Sirhan was able to recall the crucial events, sometimes speaking, other times recording his recollections in automatic writing, but the recall was always accompanied by great excitement.

The curious feature of the case was that material uncovered under hypnosis never became consciously available to Sirhan in his waking state, and he denied that he committed the murder. More-

This article was a Distinguished Scientific Contributions Award address given at the meeting of the American Psychological Association, Montreal, September 1980. It is respectfully dedicated to my teachers, Neal E. Miller and Frank A. Logan. I acknowledge the wise collaboration of Stephen Gilligan, Ken Monteiro, and Randy Gellerman in conducting these experiments and the help of the "Bower Industries" research group in interpreting the results.

The research was supported by Grant MH-13905 from the National Institute of Mental Health.

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0003-066X/81/3602-0129$00.75

over, he denied that he had ever been hypnotized by Diamond, denied that it was his own voice on the tape recorder, and denied that it was his handwriting—he alleged that Diamond must have hired an actor or a handwriting specialist to mimic him. Sirhan eventually did accept the theory that he must have killed Bobby Kennedy, rationalizing it as an act of heroism in the cause of Arab nationalism. But his belief was based on "hearsay," much as is my belief that I was born on a Wednesday evening—I must have been there but I sure cannot remember it.

State-Dependent Memory

What do these examples—the drunken millionaire and the hyperexcited assassin—have in common? They both illustrate state-dependent remembering. Events learned in one psychic state can be remembered better when one is put back into the same state one was in during the original experience. If the recaller's internal state is greatly changed from the internal state existing during the initial experience, then the recaller will have difficulty remembering the events. In the millionaire's case, the two states were drunk versus sober; in Sirhan's case, the two states were extreme autonomic arousal and anger versus a calm normal mood. Memories acquired in one state are accessible mainly in that state but are "dissociated" or not available for recall in an alternate state. It is as though the two states constitute different libraries into which a person places memory records, and a given memory record can be retrieved only by returning to that library, or physiological state, in which the event was first stored.

I am told by Diamond that amnesia is frequent—in about one of three cases—following violent crimes of great passion such as assaults or murders. Such crimes are often committed after an evening of heavy drinking when a family or barroom argument escalates and extreme rage explodes into excessive violence. For example, a husband may stab his wife 74 times and then experience a let-down and an overwhelming reaction of regret, remorse, and guilt—the "My God, how *could* I have done that?" reaction. Then denial, repression, and retrograde amnesia set in. Although the event may be reconstructed later under hypnosis or sodium amytal, strong affect remains connected to it. Attempts to crack the amnesia and make the memories conscious meet with only limited success, perhaps because denial and repression are so reassuring in such cases.

Clinical anecdotes make fine stories, but as an experimentalist I was challenged to produce state-dependent learning in the laboratory with normal subjects. Two of my students—Steve Gilligan and Ken Monteiro—and I have been especially interested in trying to produce state-dependent learning using different emotions such as depression, joy, fear, and anger as the states of interest. We hoped our results would tell us how memory is influenced by emotions and also how emotional thinking is similar to the pathological thinking seen clinically in the affective disorders.

So we began our attempts to produce affect-state-dependent learning in the laboratory using college students. We chose to work initially with happiness and sadness, since they are so dissimilar. For producing moods, several techniques exist. One can have subjects watch a sad movie or listen to a comedy record, or one can use a technique devised by Velten (1968) and have subjects read many self-referential statements designed to make them happy or sad. Examples of saddening statements are "Things have been going badly for me lately" and "I'm feeling very lonely, isolated, and depressed." As the subjects read such statements, they are supposed to imagine themselves feeling this way.

The technique we employed for inducing moods used imagination guided by hypnotic suggestions. We selected people who were very hypnotizable and after hypnotizing them, we asked them to get themselves into a happy or sad mood by imagining or remembering a scene in which they had been delightfully happy or grievously sad. Often, the happy scene was a moment of personal success or of close intimacy with someone; the sad scenes were often of personal failure or the loss of a loved one. Subjects adjusted the intensity of their emotion until it was intense but not unbearable, since we wanted them to function well enough to learn.[1] After getting into a particular mood for about a minute, subjects were asked to maintain this mood state at a level intensity while doing some tasks. This is when the real business of the experiments began.

The advantage of hypnosis is that almost any

[1] Our procedures have been approved by a university committee and are not harmful to our subjects (usually paid volunteers). We spend much time removing the induced moods at the end of each session, placing subjects in a relaxed, pleasantly normal state before debriefing them. We have checked periodically with some subjects after the experiment and found no ill effects so far.

emotion can be produced quickly at an intensity one can vary by instruction, and—most importantly—one can apparently keep it going for many minutes while having the subject perform several tasks. According to several indicators, the affect is real—the subject induced to feel sadness looks and sounds sad, is on the verge of tears, speaks slowly and softly, and his or her autonomic nervous system (as measured by galvanic skin response) is probably acting appropriately (Natale, 1977). Recordings made during the imaginative reconstruction of emotions have confirmed the emotions' physiological reality (e.g., Blum, 1967; Lang, 1979).

The disadvantage of hypnosis is that only 20%–25% of people are highly hypnotizable. Another disadvantage is that hypnotizable subjects may be extraordinarily compliant with any demand characteristics conveyed by the experimenter, which can complicate interpretations of the results. When necessary to avoid such complications, we sometimes mislead subjects to believe that the experiment concerns how hypnosis affects prosodic features of their speech—its intonation and pause pattern—or the expressive movements of their handwriting and that our tasks are used simply to sample their speech or writing.

INITIAL EXPERIMENTS

So, using hypnotically induced moods, we began our efforts to create an experimental analog of affect-state-dependent learning. The program almost did not get off the ground because our first two attempts failed to produce a state-dependent effect. In those experiments (Bower, Monteiro, & Gilligan, 1978), college-student subjects were put in a happy or sad mood and taught to free-recall a single list of 16 (or 20) unrelated words. They were then tested for recall after 10 minutes (or 24 hours) while either in the same mood or the opposite mood. Although recall percentages decreased over the retention interval, they were about the same whether the subjects were tested in the same or the opposite mood.

It turned out that to produce a state-dependent effect we had to teach the subject two lists of words—one while happy, the other while sad—and then test for recall of a given list when the subject was in the same or the opposite mood. The experiment is diagrammed in Figure 1. Six groups of hypnotized subjects learned List A while happy or sad, then learned List B while happy or sad, and then recalled the target List A while happy

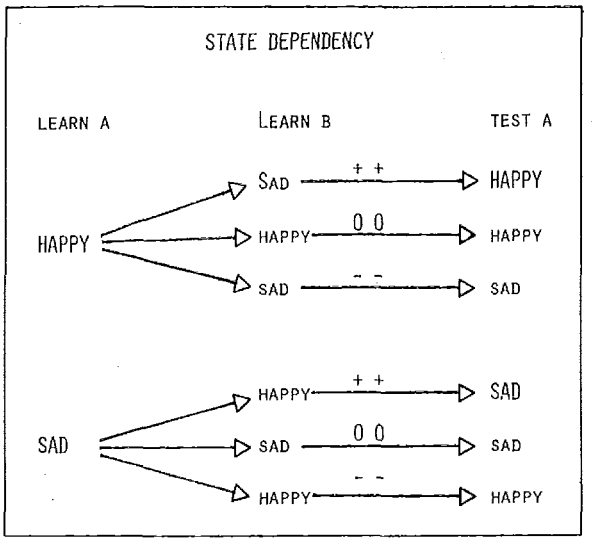

Figure 1. Diagram of six experimental conditions in which subjects are either happy or sad when they learn List A and List B and are tested on List A.

or sad. The lists were 16 words long, and memory was always tested by free recall. The groups can be classified into three functional conditions. Control subjects, marked by zeros in Figure 1, learned and recalled both lists in a single mood, happy for one half of the control subjects and sad for the other half. In the facilitation condition, marked by plus signs in the figure, the subjects learned List A in one mood, learned List B in a different mood, and recalled the target List A while in their original mood. These subjects should recall more than the control subjects because their different learning moods isolated the two lists, thus reducing interference from List B when trying to recall List A. The interference condition, marked by minus signs, is just the reverse; recall of the target List A suffers because the recall mood evokes memories of the wrong List B rather than the target List A.

When we returned subjects to their original moods, we did so by having them call up scenes different from the ones they had first used. For example, if a woman originally induced happiness by reliving a scene of herself scoring the winning goal in a soccer match, we would have her return to the happy mood by imagining a different scene, such as elatedly riding a horse along the beach. We had subjects use a second imagined situation so that any memory advantage obtained for same-mood testing would be due to overlap of moods, not to overlap of imaginary scenes.

Retention was scored as the percentage of items recalled during original learning that were recalled on the later test. These percentages are shown in

Figure 2. The mood during testing is shown on the horizontal axis, and the mood during learning is indicated for each line. The cross-over of two of the lines indicates that recall mood interacts with learning mood, which is the affect-state-dependent effect. The graph includes results for control subjects, who learned both word lists in the same mood and were tested in that mood. Compared to this baseline, state dependency shows up as better recall of the same-mood list and worse recall of the opposite-mood list.

Thus, we obtained the mood-state-dependent effect in conditions that made sense—that is, the emotional mood was a helpful feature in distinguishing the target material from interfering material. Apparently, in the earlier experiments, the one-list learning experience was so distinctive that subjects could retrieve it from memory despite an altered mood. The multiple-list situation seems a closer analog to real life, where one stores multiple experiences while in different emotional states.

Beyond the affect-state-dependent effect, one might ask whether there is any main effect of the type of emotion on learning or recalling. In all of our experiments with word lists, we have never found a difference in overall learning rate or later retention that was due to a main effect of the subject's mood. There is a mood-congruity effect in learning affectively loaded narratives, and I discuss that later. But with word lists, we find no main effect of hypnotic mood on learning or recall.[2] I suspect this reflects our control over the hypnotic subjects' motivation to do as well as they can in the learning task despite their happy or sad feelings. I do not know the extent to which real happiness or sadness (or anger or fear) would distract people from learning things in their natural environment. Perhaps strong emotions narrow the focus of attention to affectively relevant events and exclude incidental stimuli (Easterbrook, 1959). Clinical reports (e.g., Beck, 1967) and some laboratory evidence (Leight & Ellis, Note 1) indicate that depressed people are poor learners. Thus, regarding our null effect of emotional quality on learning, I emphasize the usual cautions about generalization of laboratory findings. I would like to see some naturalistic studies of what, or of how much, happy or sad people learn, either incidentally or intentionally, when they are not learning in order to please an experimenter. Our next study investigated this issue in a small way with respect to our affect-state-dependent findings.

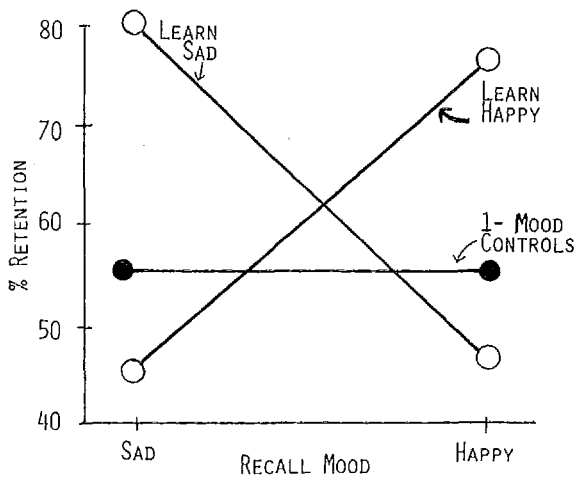

Figure 2. Percentage retention scores depending on the match between learning mood and recall mood. The sloping lines refer to subjects who learned the two lists under different moods.

REMEMBERING PERSONAL EPISODES

We addressed the issue of whether state dependency would occur for recall of actual events drawn from a person's emotional life with the help of a group of people who agreed to record such emotional events in a daily diary for a week. We gave these subjects a booklet for recording emotional incidents and discussed what we meant by an emotional incident. For each emotional incident they were to record the time, place, participants, and gist of what happened and rate the incident as pleasant or unpleasant on a 10-point intensity scale. Conscientious diary keeping is demanding, and we lost nearly half of our subjects because they failed to record enough incidents in the proper manner consistently over the week. We collected usable diaries from 14 subjects and scheduled them to return a week later. At that 1-week interval they were hypnotized, a random half were put in a pleasant mood and the other half in an unpleasant mood, and all were asked to recall every incident they could from those recorded in their diaries the week before.

It should be noted first that our subjects recorded about twice as many pleasant as unpleasant incidents during the week. This is a common finding (e.g., Holmes, 1970; Meltzer, 1930), but one cannot

[2] Moreover, we have not compared learning or recall of hypnotized with nonhypnotized subjects. That has not been the focus of our experiments. For what it is worth, my conjecture is that in *these* experiments, hypnosis is probably not having a main effect on learning or recall.

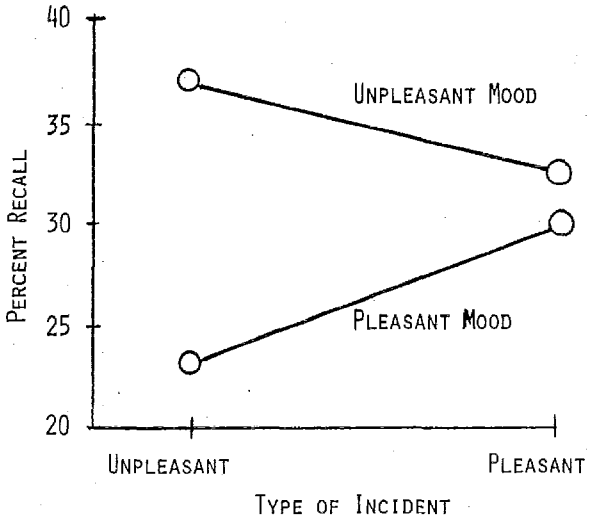

Figure 3. Percentage recall of incidents from an emotional diary depending on whether the incident was pleasant or unpleasant and whether the subject was in a pleasant or unpleasant mood during recall.

be sure whether it reflects subjects' average quality of life, interpretive categories of differing subjective widths, or faster forgetting of unpleasant experiences.

The percentages of recall for pleasant versus unpleasant emotional events are plotted in Figure 3. These data show the expected interaction: People in a pleasant mood recall a greater percentage of their recorded pleasant experiences than of their unpleasant experiences, whereas people in an unpleasant mood recall a higher percentage of their unpleasant rather than their pleasant memories.

Remember that subjects also rated the emotional intensity of each experience when they originally recorded it. These intensity ratings were somewhat predictive of recall: When each subject's intensity ratings are divided at the median, recall of more intense experiences averages 37%, and of less intense experiences, 25%. This intensity effect is important, and I return to it later.

After subjects had finished recalling, we asked them to rate the current emotional intensity of the incidents they recalled. We found here that they simply shifted their rating scale toward their current mood: If they were feeling good, the recalled incidents were judged as more pleasant (or less unpleasant); if they were feeling bad, the incidents were judged more unpleasant (or less pleasant) than originally. This should be familiar—here are the rose-colored glasses of the optimist and the somber grey outlook of the pessimist.

MOOD AND CHILDHOOD MEMORIES

The previous experiment demonstrated state dependency for recall of recent real-life incidents that were specially recorded and rated for pleasantness. However, since the recording procedure itself might have sensitized the subjects to giving us the results of interest, in our next experiment we asked people to recall childhood incidents. We induced a happy or sad mood in our subjects and asked them to describe a series of unrelated incidents of any kind from their pre-high-school days (before age 15). Subjects were asked to "hop around" through their memories for 10 minutes, describing an incident in just a sentence or two before moving on to some unrelated incident.

The next day we had the subjects categorize each incident as pleasant, unpleasant, or neutral while in a neutral mood so that their mood would not contaminate the labeling of the recalled events. The few neutral incidents recalled were discarded, and the main results are shown in Figure 4. Again, the cross-over pattern is found. Happy subjects retrieved many more pleasant than unpleasant memories—a 92% bias—whereas sad subjects retrieved slightly more unpleasant than pleasant memories—a 55% bias in the reverse direction.

Thus, we observed a mood-state-dependent retrieval effect when we asked normal subjects to tell us about their childhoods: What they reported was enormously dependent on their mood at the time. This is a mood-matching effect, since pre-

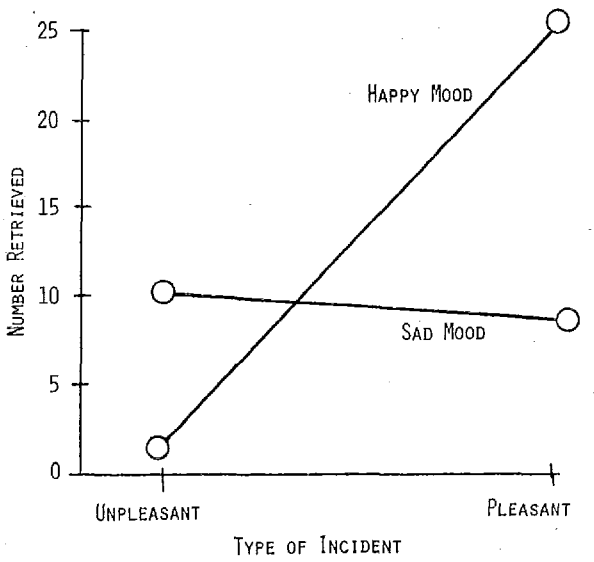

Figure 4. Number of pleasant and unpleasant childhood incidents recalled when the recaller was in a happy or sad mood.

sumably the subjects felt pleasant or unpleasant at the time such incidents were stored originally.

ALLIED RESEARCH

Several other scientists have investigated affect-state-dependent memory. Madigan and Bollenbach (Note 2) used Velten's procedure to induce happiness or sadness in their subjects and then asked them to retrieve a personal memory when prompted with neutral words such as *water*, *door*, and *chair*. The memories retrieved by happy subjects were rated as more pleasant than those retrieved by sad subjects. Teasdale and Fogarty (1979) also used the Velten procedure but specifically instructed their subjects to retrieve either a happy or sad personal memory when prompted with a stimulus word. They found that happy subjects retrieved happy memories faster than sad ones, whereas sad subjects retrieved sad memories faster than happy ones. These studies using induced moods followed an earlier study on clinically depressed patients by Lloyd and Lishman (1975), who instructed their patients to recall a happy or sad personal incident in response to neutral words. They found that the more severe the patient's depression as measured by Beck's Depression Inventory, the longer it took the patient to retrieve a pleasant as opposed to an unpleasant memory. Greater depression correlated .64 with a greater ratio of time to retrieve a pleasant relative to an unpleasant incident from memory. This is a state-dependent effect—the sadder the patient is, the quicker he or she can call up sad experiences relative to happy experiences.

Perhaps the clearest early example of mood-dependent memory was reported by Henry, Weingartner, and Murphy (1973). Psychiatric patients with bipolar manic-depressive swings were observed over several months. At several sessions throughout this period patients were asked to generate 20 free associations to each of two novel stimulus words; four days later patients would be asked to reproduce the same 40 words they had generated before. In addition, clinicians rated the change over the four days in the patients' affective states, using several mood dimensions such as degree of activation and euphoria–depression. Henry et al. found that the greater the change in patients' affective states—from mania to depression or vice versa—the more they forgot the target associations generated four days previously.

These several examples suggest that mood-dependent retrieval is a genuine phenomenon whether the mood swings are created experimentally or by endogenous factors in a clinical population (see also Weingartner, Miller, & Murphy, 1977). I develop the clinical implications of these ideas in a later section.

AN ASSOCIATIVE NETWORK THEORY OF MEMORY AND EMOTION

What kind of theory can explain these mood-state-dependent effects? I will outline one that is somewhat elaborate because I want it to fit within a general semantic-network theory of long-term memory of the type common in cognitive psychology. Examples of network theories appear in papers or books by Collins and Quillian (1969), Anderson and Bower (1973), Collins and Loftus (1975), and Anderson (1976). First, let me provide some background. Human memory can be modeled in terms of an associative network of semantic concepts and schemata that are used to describe events. An event is represented in memory by a cluster of descriptive propositions. These are recorded in memory by establishing new associative connections among instances of the concepts used in describing the event. The basic unit of thought is the proposition; the basic process of thought is activation of a proposition and its concepts. The contents of consciousness are the sensations, concepts, and propositions whose current activation level exceeds some threshold. Activation presumably spreads from one concept to another, or from one proposition to another, by associative linkages between them. A relevant analogy is an electrical network in which terminals correspond to concepts or event nodes (units), connecting wires correspond to associative relations with more or less resistance, and electrical energy corresponds to activation that is injected into one or more nodes (units) in the network. Activation of a node can be accomplished either by presentation of the corresponding stimulus pattern or by prior activation of an associated thought.

To illustrate, a simple event such as "Mary kissed me at a specific time and place" would be recorded in memory, as shown in Figure 5, in terms of new labeled linkages between my prior concepts of Mary, myself, and kissing. The links are labeled S to denote the subject and P the predicate of the proposition. Learning consists of establishing these associations and increasing their strength. Later when asked, "What did Mary do?" activation of the Mary concept will transmit activation to the Event 19 node and thence to its branches, causing the model to retrieve the other links and thus recall that "Mary kissed me."

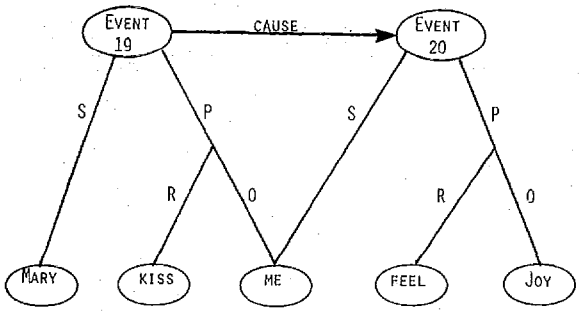

Figure 5. A semantic-network encoding of a proposition ("Mary kissed me") and an emotion it causes. Lower circles, or nodes, represent preexisting concepts, and lines represent new associations. S = subject; P = predicate; R = relation; and O = object.

Figure 5 also shows a causal link from the event to an emotional reaction—namely, the emotion of joy. The emotional interpretation of an event that creates such links is itself largely molded by cultural or personal rules of intricate subtlety—but this is not the place to elaborate on that. The network encodes the fact that Event 19 caused Event 20, and the latter involves a primitive node for the emotion of joy.

The semantic-network approach supposes that each distinct emotion such as joy, depression, or fear has a specific node or unit in memory that collects together many other aspects of the emotion that are connected to it by associative pointers. In a recent paper, Clark and Isen (in press) have proposed a similar conception. Figure 6 shows a schematic for a small fragment of the many connections to a given emotion node—say, sadness for Emotion 3. Collected around this emotion node are its associated autonomic reactions, standard role

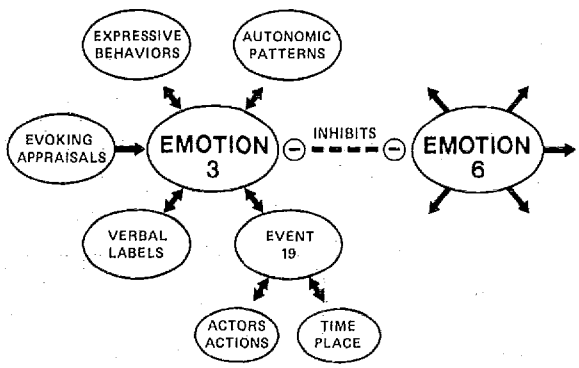

Figure 6. Small fragment of the connections surrounding a specific emotion node or unit. Bidirectional arrows refer to mutual exchange of activation between nodes. An inhibitory pathway from Emotion 3 to Emotion 6 is also shown.

and expressive behaviors (that is, the way we display sadness), and descriptions of standard evocative situations which when appraised lead to sadness. Also included are the verbal labels commonly assigned to this emotion such as sadness, depression, and the blues. Some of these various linkages are innate, while others are learned and elaborated throughout acculturation.

In addition, each emotion unit is also linked with propositions describing events from one's life during which that emotion was aroused. This was illustrated in Figure 5 with the Mary-kissing incident that caused joy. The emotion aroused at that time became associated by contiguity and causal belongingness with the evoking event. As a second example, the grief felt at the funeral of a friend would be associated with a node containing a description of things noticed at the funeral.

These emotion nodes can be activated by many stimuli—by physiological or symbolic verbal means. When activated above a threshold, the emotion unit transmits excitation to those nodes that produce the pattern of autonomic arousal and expressive behavior commonly assigned to that emotion. Each emotion may reciprocally inhibit an emotion of opposing quality, as fear inhibits joy and sexual arousal. If two emotion nodes are activated at once and they are not mutually inhibiting, then the subjective impression and expressive behavior pattern may be a blend or mixture of the two pure patterns. For example, sadness mixed with surprise may blend into disappointment (see Plutchik, 1980a, 1980b).

Activation of an emotion node also spreads activation throughout the memory structures to which it is connected, creating subthreshold excitation at those event nodes. Thus, a weak cue that partially describes an event, such as "kindergarten days," may combine with activation from an emotion unit to raise the total activation of a relevant memory above a threshold of consciousness. Thus, the sad person becomes conscious of thinking about, and will recall some sad event from, his or her kindergarten days. This recall constitutes reactivation of a sad memory and sends feedback excitation to the sadness node, which will maintain activation of that emotion and thus influence later memories retrieved.

NETWORK THEORY OF STATE-DEPENDENT RETRIEVAL

The network view of emotional behavior has several implications. Of immediate interest is that it explains mood-state-dependent retrieval. The rel-

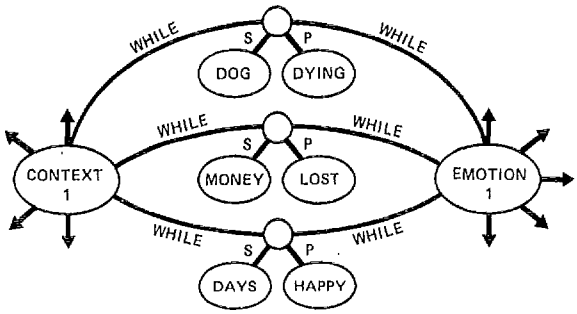

Figure 7. The crucial connections for explaining mood-state-dependent retrieval. The subject has studied many adjective-noun phrases (dying dog, lost money, happy days, etc.) in Context 1 while feeling Emotion 1. The associations indicated (and many others) are weakly formed.

evant associative connections for this process are isolated and emphasized in Figure 7, which illustrates a part of the associative network encoding the learning of materials used in one of our experiments. The subject learned brief adjective-noun phrases such as "dying dog," "lost money," and "happy days" in the context of learning List 1 while experiencing Emotion 1 (see Gilligan & Bower, Note 3). During learning the phrases became associated to the unit describing Context 1 and to the emotion unit active at that time. Later, when asked to recall events that occurred in Context 1, the subject activates the Context 1 node in memory, and activation spreads out from it as the subject searches for relevant items. But Context 1 is a weak, overloaded cue because it is associated with many things, so any one connection is subject to heavy interference. Suppose, however, that during recall the subject is returned to the same distinctive emotional state he or she was in during learning. Then, activation from that Emotion 1 node also will spread along its associative links to the target items, where it will summate with the activation spreading from the Context 1 cue to the items. The summation of activation at the intersection nodes causes the target events to become more accessible to recall when testing occurs in the same mood as learning. In contrast, if the mood is altered between learning and recalling, say to Emotion 2, recall suffers because the benefits of intersection from two search cues are absent; moreover, the search from the different emotion node will call up interfering associations that will compete with recall of the correct target items.

This theory works more or less the same for recall of experimental items or of real-life episodes from the recent past or from one's childhood. The specification of the material to be recalled is partly contained within the Context 1 node as either "List A learned today" or "last week's events" or "childhood incidents."

Network theory also explains a significant qualification about state-dependent learning. This qualification is that the state-dependent effect occurs best with free recall, when minimal cues are given for retrieval of the targets, but the effect is greatly reduced when memory is tested with more adequate cues such as occur in strongly cued recall or recognition tests. To illustrate, if recall were prompted with a predicate of a phrase, such as "dying" for recall of "dying dog," recall would be much higher than free recall, and the state-dependent effect would be reduced. We have found this result, and so have Jim Eich and his associates (Eich, Weingartner, Stillman, & Gillin, 1975) in several studies with drugs. Figure 7 suggests why this is expected: A strong cue like the predicate of a phrase—say, "dying"—will retrieve the stored event relatively directly, because that cue is close to the target noun (of "dog") and that pathway has no competing associations. With such a cue, the memory-search process starting from the weak Context 1 cue, which otherwise would have to occur in free recall, becomes unnecessary, and it was that search that was facilitated by reinstating the emotional mood of learning. Thus, the search clue provided by mood reinstatement is unnecessary when adequate retrieval cues are provided for the memory targets, so the matching of moods between input and output has relatively little effect. Incidentally, this suggests that the drunken-millionaire incident from the Charlie Chaplin movie is fiction rather than fact; Charlie in the flesh would have been recognized by the sober millionaire, although he would have been unable to recall without prompting the people he had met the night before.

Similarity of Emotions

I now want to address the topic of similarity among different emotional states. Within learning theory, the state-dependent effect is viewed as a generalization decrement in which an internal context associated with target memories is altered. Switching from happiness to sadness would seem to be one of the larger shifts possible on this generalization gradient, but one could in principle investigate generalization from any training emotion to any testing emotion and get some idea of how similar the emotions are as internal contexts.

Over the years several people have proposed theories of emotions and have tried to devise scales for the similarities of emotions. However, such scaling is done not with the emotions themselves but with verbal labels for emotions. The vocabulary of emotional terms is a messy mixture of words whose referents differ along several dimensions such as the subjective quality of the feeling, the cause of the feeling, the object or aim of the feeling, the duration and intensity of the feeling, and even dominant character traits. Since the time of the ancient Greeks a belief has persisted that the many hundreds of terms for emotions will be reduced upon scientific analysis to terms for just a few primary emotions of varying intensities and varying objects or causes. One prominent suggestion is that emotions are related like colors around a color circle, with a few primary emotions that can be mixed in various proportions to create other emotions. But there is disagreement about what the primary emotions are and where the several emotions are to be located.

One proposal for an emotion circle, that of Robert Plutchik (1980a, 1980b), is shown in Figure 8. Plutchik factor-analyzed similarity judgments of many emotion terms and came up with the eight primary emotions shown in the inner circle: joy, acceptance, fear, surprise, sadness, disgust, anger, and anticipation. Proximity around the edge of the circle indicates the similarity of the emotions.[3] Diametrically opposed emotions on the circle should be farthest apart. Thus, joy and sadness are supposed to be opposites, as are anger and fear. Joy is supposed to be closer to anger or fear than to sadness; similarly, anger is closer to sadness than to fear.

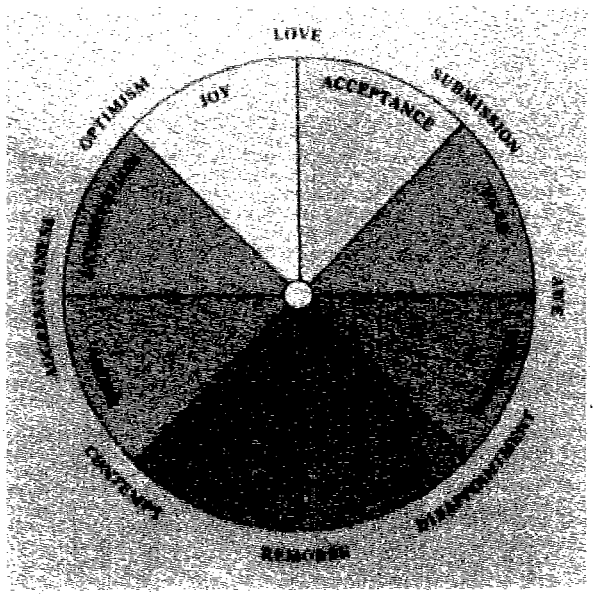

Figure 8. The eight primary emotions (inner labels) and their adjacent blends (outer labels) obtained by factor analysis of similarity judgments of emotional terms. (From "A Language for the Emotions" by R. Plutchik, *Psychology Today*, February 1980, p. 75. Copyright 1980 by Ziff-Davis Publishing Company. Reprinted by permission.)

I wondered whether our memory-retrieval procedure could provide some independent corroboration of this picture if we indexed the similarity of two moods by the generalized retention of learning from one mood when it was tested in the other mood. Perhaps that procedure could help us decide whether anger was more similar to sadness than to fear, whether joy was more similar to fear than to sadness, and so on.

A Stanford undergraduate, Bret Thompson, did his honors project with me on this topic. All subjects were hypnotized and taught four different word lists, each list under a different emotion—either joy, sadness, fear, or anger. Each list consisted of 16 rare words from one taxonomic category; the four lists were of birds, trees, mammals, and fish. After induction of a specific mood, subjects were given two study-and-recall cycles on a list. Then their moods were switched and they were given a new word list to learn for two trials.

After studying the four lists, subjects were tested on the lists in the order they had been learned. Subjects were cued with the category and serial position of the target list: They were told, for example, "Now, recall the fish list; it was the second one you learned." Before recalling each list, however, subjects were again put in one of the four emotional moods in a balanced order. Subjects were tested on one of the lists in the same mood that they had learned it in, on one list in the opposite mood (according to Plutchik's circle) from the one they had learned it in, and on two lists in the mood halfway around the circle from the mood they had learned them in. These halfway shifts were always in a clockwise direction in the circle shown in Figure 8. The experiment was hard work for subject and experimenter alike, but it illustrates the utility of hypnosis for altering emotional moods.

There are 16 possible combinations of four learning-and-recall moods, and Thompson ran out of good hypnotic subjects and time (graduation

[3] An equivalent measure is the length of the direct chord connecting the two emotions. Also, distance of an emotion from the center of the circle corresponds to its intensity (e.g., annoyance, anger, then rage).

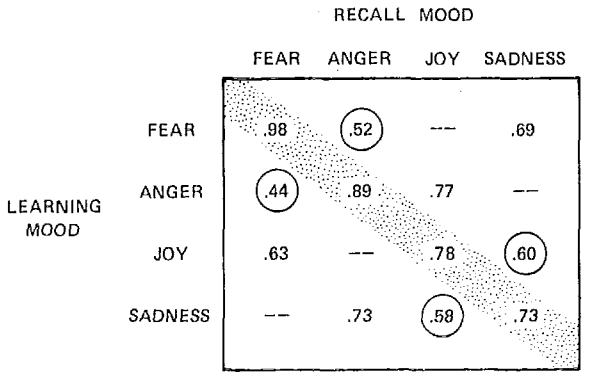

Figure 9. Matrix of percentage retention scores for a list learned in the mood shown in the row and tested in the mood shown in the column. The same-mood conditions on the main diagonal are shaded; the opposite-mood conditions are circled.

beckoned) before the "counterclockwise" conditions were run. The results we were able to collect are shown in Figure 9. The entries are the percentage retention scores for a list learned in the mood shown in the row and tested in the mood shown in the column; each entry is the mean for 4–8 subjects. The data are extremely orderly given the few subjects.

The main diagonal is shaded and shows same-mood retention scores. These scores are the highest in each row; they are not 100%, of course, since much forgetting occurs in a four-list learning design and a different imagined situation was always used to reinstate the same mood at testing. The opposite-mood entries are circled and are the lowest entries in each row, whereas the combinations of moods halfway around the circle from each other account for the intermediate scores in each row. To clarify the main result, I calculated the average retention scores after pooling conditions (cells) according to Plutchik's emotion circle, classifying a learning–recall emotion pair as same, opposite, or halfway around the circle. Retention was best when recall was tested in the same mood (85%) and worst when tested in the opposite mood (54%); surprisingly, the average retention for the moods classified as halfway around the circle was almost halfway between the same and opposite mood retention percentages (70%). I presume this is just a numerical coincidence, but nonetheless it is remarkable considering the different measures of emotional similarity that are being compared.

While these results are consistent with Plutchik's emotion scaling solution, the experiment has insufficient resolving power to corroborate all the details of Plutchik's proposal in contrast, say, to deRivera's (1977), Izard's (1977), or Roseman's (Note 4). However, the results do exclude some claims and place some constraints on theorizing besides those provided by intuitive or logical analyses or those stemming from analyses of similarity of the meanings of emotion words. The theoretical area of emotions and their similarities is in desperate need of such constraints provided by different converging sources of evidence.

Emotional Effects on Cognitive Processes

Leaving state-dependent memory for a while, I want to mention a few other influences of emotion on cognitive processes. These influences are implied by the network model of emotion and spreading activation. Table 1 lists and categorizes these processes. The current emotional state of the subject should influence associative processes, the interpretation of ambiguous situations, and the salience of congruent emotional material. We have begun research on each of these topics, and I can report briefly our preliminary findings.

Free associations. We found powerful effects of people's moods—happiness, sadness, or anger—on the free associations they gave to neutral words. For instance, a subject who was happy was given the stimulus word *life* and gave as chained free associates the words *love, freedom, fun, open,* and *joy*. Another subject, who was angry, responded to *life* with the associates *struggle, toil, fight,* and *compete*. Not all responses were so obvious, but many were. In one experiment, 15 hypnotic subjects generated chained associates to five words when they were happy and to another five words when they were angry. As a quick measure of the happy versus angry content of their associations, we asked two judges to decide for each free-as-

TABLE 1
Three Sets of Cognitive Processes Influenced by Emotion

Associative Processes
In free associations
Semantic elaboration
Interpretive processes
Imaginative stories (Thematic Apperception Test)
For ambiguous social scenes
For assessing familiar people, etc.
Salience of mood-congruous material
Selective attention to it
Priming and perceptual pop-out?
Selective learning in narratives

sociate chain whether it showed happiness or anger. Judges were also allowed a "can't decide" category, since some protocols were completely uninformative. Ignoring cases in which the judges were undecided, we found they judged "anger" accurately 81% of the time and "happiness" accurately 73% of the time (chance was 50%). The 2×2 contingency correlation between the subject's mood and the judgment of the subject's free associations was .53 ($p < .01$). Thus, these moods evoked discriminably different word associations.

Since performing this experiment, I have learned that the same emotional influence on free association was reported in earlier work by Fisher and Marrow (1934), who used hypnosis-induced moods, and by Madigan and Bollenbach (Note 2), who used moods induced by the Velten procedure. To account for such results, the network theory proposes that the prevailing mood acts as a constant source of activation so that the associations receiving the highest activation lie on intersection points in the network between the mood and the stimulus word. Thus, the responses typically satisfy joint constraints suggested by the mood and the stimulus word.

Elaborations and inferences. It seems likely that mood affects the way people elaborate on or draw inferences from interpersonal events and that their expectations and predictions are positive or negative depending on their mood. For instance, suppose the following sentence occurs in a story and we ask the reader to predict what is going to happen next: "John came home late from an office party to find his wife waiting up for him." If the reader is angry, he or she should predict conflict and nasty interchanges, whereas if the reader is happy, he or she should predict happy, loving interchanges. Although we have not collected the relevant observations, the mood influences seem quite likely, since—in theory—social inferences are selected in much the same way as associations to stimulus words are.

Imaginative constructions. Mood should bias the interpretation of ambiguous scenes, since categories related to that emotion are primed and used. Because of this and because mood affects associations, it should also affect "imaginative" constructions. In one experiment, we showed 15 happy or angry subjects five pictures from the Thematic Apperception Test (TAT) and asked them to make up stories about what was going on in the pictures. For example, one picture shows a man bending over the shoulder of a seated woman, and one subject told this story:

> This old guy is [angry—expletive deleted] at his wife because she burned the broccoli. This is a typical thing to set him off, as he can't stand anything out of the ordinary. She is getting sick and tired of his tantrums which she's seen lots before.

I suppose you can guess that this subject was angry. Another picture shows a woman looking out over fields and farmland bathed in sunshine. In response to this picture, another subject told this story:

> This lady is looking over the beautiful country. The lady has wandered here from a campsite nearby and is soaking in the beauty of the surroundings. She has never felt this good before. She feels like her whole life will be changed by these magical moments. She will communicate her joy to others in the world. Her mission is to spread happiness.

Of course, not all TAT stories convey the subject's mood so obviously. We asked our two judges to decide whether a random TAT story had been produced when the subject was happy or angry. Considering only protocols where the judges could reach a decision, we found they classified as "angry" 77% of the TATs generated by angry subjects and classified as "happy" 63% of the TATs generated by happy subjects (chance was 50%). The 2×2 contingency correlation between the subject's mood and the judged mood of the subject's TAT story was .40, which is significant. While mood clearly influenced the content of TAT stories, I would have liked to see a stronger effect.

Interpreting interpersonal interactions. Mood should also bias the categories used in interpreting interpersonal scenes, especially when they are ambiguous. The happy person seems ready to give a charitable, optimistic interpretation of events in his or her social world, whereas the grouch seems determined to find fault, to take offense, or to take the uncharitable view.

An illustration of this is reported in an experiment by David Roth and Lynn Rehm (1980). They videotaped some psychiatric patients undergoing a routine psychiatric interview. Later the patients were asked to view the videotape and code their own behavior during the interview according to the number of socially skilled positive behaviors they showed (such as smiling and head nodding) and the number of negative or socially unskilled behaviors they showed (such as scratching, drumming their fingers, and looking away). Half of the patients were clinically depressed, and half were not. Interestingly, the depressed patients "perceived" their interview behavior on videotape as containing about twice as many unskilled negative behaviors as skillful positive behaviors, despite the fact that objective raters saw them emitting more nearly equal amounts of positive and negative be-

haviors. On the other hand, nondepressed patients "perceived" about twice as many positive as negative behaviors in themselves. The significant point is that depressed people perceived their own behavior much more negatively than was warranted. It is, of course, just this depressional bias that clinical psychologists try to alter by retraining programs that help clients to reinterpret the events of their lives.

A recent experiment done in collaboration with Joseph Forgas and Susan Krantz replicated the Roth and Rehm (1980) findings on normal college students induced by hypnosis to feel socially competent or incompetent. These feelings were aroused by having hypnotized subjects remember, and relive the feelings of, either an occasion when they succeeded gloriously by acting in a socially adept manner or an occasion when they failed and were rejected and embarrassed by acting in a socially inept, awkward manner. Subjects who felt socially rejected perceived themselves (by their "objective counts") in a videotaped interview as exhibiting many more negative, socially inept acts than positive, socially skilled acts, but this negative bias did not generalize to judgments of behavior of a partner interviewed with them. In contrast, subjects who felt in a good mood perceived many more positive, pro-social actions than negative actions both in themselves and in their interview partners. Thus, people who were feeling socially rejected were inclined to "dump on" themselves but not on others; those who were feeling the glow of social success had a Pollyanna bias to see the good qualities in others as well as in themselves.

Just as the depressed person will interpret a social remark as denigrating or pitying, so the angry person will interpret it as a hostile insult and the socially anxious person will interpret it as a put-down or a rebuff. Social interactions are ambiguous, and we have to read the intentions hidden behind people's words and actions. In that reading, the emotional premise from which we begin strongly influences what we perceive as others' intentions. This phenomenon is understandable within the semantic-network theory. The current mood activates and primes mood-congruent categories into readiness, and these are used in expectation-driven or top-down processing to classify and assimilate indeterminate experiences (see Wyer & Srull, 1980).

Snap judgments. Semantic-network theory also implies that mood will influence snap judgments about familiar people or objects about which we have stored heterogeneous impressions. Isen, Shalker, Clark, and Karp (1978) found that subjects who were feeling good after receiving a small gift were more positive in rating the performance of their TVs and their cars for a mock consumer survey. Following that lead, we had our subjects give "thumbnail personality sketches" of familiar people in their lives (e.g., cousin, uncle, friend, teacher); some characters were described while the subjects were happy and others while they were angry. Their snap judgments were influenced by their passing mood. Again, if we exclude undecidable cases, our two judges judged the character descriptions given by happy subjects as happy 84% of the time and the character descriptions given by angry subjects as angry 59% of the time. The 2×2 correlation was .45 and significant. The angry subjects may have given more ambiguous sketches, since people typically hold primarily positive opinions about friends and relatives, the subjects of the sketches.

Assuming heterogeneous impressions have been stored about familiar persons, we may suppose that current mood causes retrieval of primarily positive or primarily negative memories of a familiar person. In this way, the summary evaluation is thus biased by the *availability* of the positive versus negative features that come to mind (see Tversky & Kahneman, 1973). This is just an affect-state-dependent effect in disguise.[4]

DEMAND CHARACTERISTICS?

While I prefer to interpret these influences of mood on cognitive processes as *automatic,* I realize that the simple effects are consistent with a "demand" interpretation. According to this latter explanation, the hypnotized subject figures out what results the hypnotist wants and, being suggestible, proceeds consciously to behave in that manner. For instance, subjects induced to feel angry and asked to make up a TAT story may think they are being asked implicitly to tell an angry story and thus tell one. The same interpretation can be applied to the free-association task and the character-description task.

Devising experiments and arguments to distinguish between the automatic versus demand-compliance interpretation of our results presents a real

[4] An interesting question is whether these temporary mood-induced alterations in positive versus negative opinions will persist after the person reverts to a neutral mood. Self-perception theory (Bem, 1972) implies that change in a persisting opinion will vary with the subject's explanation of the cause of his or her biased descriptions.

challenge. However, I have a few relevant arguments. First, our mood suggestions appear to influence behavioral and physiological indexes of "real emotion," and the emotions appear not the least bit faked. The suggested anger causes an increase in heart rate, reddening of the face, clenching of the fists and jaws, and so forth, and hypnosis-induced sadness can produce real tears and a slumping bodily carriage. These manifestations suggest that we are causing fluctuations in "real feelings" and not just response biases. It is moot whether one can enact or reproduce these emotional signs without feeling the emotion. Certainly the standard instruction to method actors for enacting emotional displays is to remember a personal emotional experience and relive the detailed feelings (and behaviors) associated with it (see, e.g., Stanislavski, 1936). This is nearly the same method as the one we use with our hypnotic suggestions.

If the emotion is regarded as "real," then the demand hypothesis is backed into the claim that it is possible for a person to feel an emotion like anger or sadness and yet not be led "naturally" or automatically to give angry or sad associations; rather the claim is that the person consciously adopts this mode of behavior only to please the experimenter. There are several ways to collect relevant control data. In one control procedure, illustrated in the research of Isen et al. (1978) mentioned earlier, a naturalistic event (e.g., a small gift) is used to produce a mood, and the later test situation is made to appear completely unrelated to the mood-inducing event. Nonetheless, Isen et al. found reliable increases in their "happy" subjects' satisfaction with their TVs and cars in a mock consumer survey. Such designs preclude a demand interpretation. To the same end, we have repeated some of our cognitive-task experiments using happy or sad music in the background as a more unobtrusive form of mood manipulation.

In a second control procedure, used by Teasdale and Fogarty (1979), subjects are instructed to retrieve a pleasant or unpleasant memory in response to a prompting word. Teasdale and Fogarty found that retrieval of pleasant memories took longer for sad subjects, whereas retrieval of unpleasant memories took longer for happy subjects. Since the experimenter's demand was for the subject to respond as rapidly as possible in all cases, the demand hypothesis cannot account for the differential results. Similarly, in several experiments Bower, Gilligan, and Monteiro (in press) found no effect of recall mood on selective recall of happy versus sad events from a narrative read earlier when the subject was in a neutral mood. The demand hypothesis would have predicted a large selective effect in such situations, whereas the mood-congruity theory (to be discussed later) would predict the null effect that was actually found.

A third way to control for the demand hypothesis is to deliberately mislead subjects regarding "experimenter demand" and to note whether the allegedly "automatic" emotional effects on behavior nonetheless persist. We have made two small beginnings in this direction. In one study, Robert Vallone and I had 20 subjects listen to happy or sad classical music, ostensibly to render numerous aesthetic judgments throughout 40 minutes. "Coincidentally," the subjects were asked to help another experimenter by completing some word associations and TAT stories to pass the time between periods of judging the aesthetic quality of the music. We found that compared to subjects who listened to happy music, subjects who listened to sad music produced word associations and TAT stories that were rated as significantly sadder by blind judges. In a second study, Randy Gellerman and I collected free associations and TAT stories from 20 hypnotized subjects after misleading them to believe that we were interested in how hypnosis-induced moods affect handwriting (its size, slope, jaggedness, loops) and that the tasks they were assigned were for the purpose of collecting handwriting samples. We reinforced and elaborated on this cover story in several ways throughout the session. A postexperimental questionnaire validated the effectiveness of this handwriting cover story. Subjects wrote two TAT stories and five free-association chains in a happy mood and also in an angry mood. We were interested, of course, in the affective content of what they wrote, not in their handwriting. Judges' ratings of the happiness or angriness of the protocols showed the content to be significantly influenced by subjects' moods. Free associations were strongly affected; deleting "can't decide" cases, judges correctly identified the affective state of the respondent 77% of the time from the free associations and 61% of the time from the TAT stories. An earlier pilot experiment with four misled subjects showed that their personality sketches of acquaintances varied discriminately (63% accurate judgments) with happy versus sad moods, as did their TAT stories (74% accuracy). Thus, while the responses generated by misled subjects do not perfectly reveal their moods, the amount of mood revealing seems about equal to that shown by earlier subjects not misled with the handwriting story. However, we have not com-

pared in one experiment the magnitude of mood-revealing responses by misled versus regularly instructed subjects.[5]

These attempts to rule out the demand hypothesis are a motley aggregation. One frustrating aspect of the demand hypothesis is that it is conceptually very close to a quite reasonable theory of emotional behavior—namely, the role-enactment theory of Averill (1980). It also resembles the role-enactment theory of hypnotic behavior (Sarbin & Andersen, 1967). Testing the implications of the "automatic priming" hypothesis versus the "demand" hypothesis of mood will probably continue as an important item on the research agenda.[6]

Salience of Mood-Congruous Material

Let us put aside the exact interpretation of these production studies and return to the enumeration of the implications of the network theory of emotion. The final category listed in Table 1 is mood-congruity effects, which should be found in several distinct arenas of cognitive functioning.

Selective attention. I expect that emotion will enhance the salience of mood-congruent material for selective attention and learning. We have not investigated selective attention, but it is my prediction that subjects should actively attend to material consistent with their feelings. An analogy is that our feelings are like a magnet that selects the iron filings from a heap of dust, drawing to itself whatever incoming material it can use. For example, in watching a scene between a happy and a sad character with other factors being equal, viewers should spend more time looking at the character whose mood is most similar to theirs. Similarly, they should look more at mood-congruent words in an array and listen more to mood-congruent messages or music in a dichotic listening situation. Eye-fixation records could provide a simple test of this prediction.[7]

Perceptual pop-out. An emotion should cause congruent words to "pop out" at the perceiver. An indirect test was done by Gerald Clore, a professor from the University of Illinois visiting in my lab during 1980.[8] Clore had happy or angry subjects look at a target word in a tachistoscope and classify it rapidly as pleasant or unpleasant in quality. On critical trials, the centered target word would be closely surrounded top and bottom with distractor words of the opposite quality. If these distractors were to intrude into the subject's attention, his or her response to the target would be slower and more prone to errors. Clore expected such intrusions, especially when the distractor words agreed with the subject's mood. For example, pleasant distracting words should pop out at a subject in a happy mood, causing more errors and slower reactions to an unpleasant target word, and more so than for a subject in an angry mood. Clore's preliminary results were quite encouraging, especially the intrusion errors. Subjects in a pleasant mood made more errors in the "unpleasant target, pleasant distractors" condition than in its reverse, whereas subjects in an angry mood made more errors in the "pleasant target, unpleasant distractors" condition than in its reverse. Unfortunately, the effect was small, so Clore is trying to amplify it in further experiments.

In a second experiment, Clore used the Stroop color-naming task as an indicator of mood priming of congruent words or phrases. If pleasant phrases are primed selectively by a pleasant mood, then the happy subject should suffer greater interference and be slower in naming the ink color of happy phrases than of neutral or unpleasant phrases. On the other hand, an angry subject should suffer more interference in naming the ink color of unpleasant phrases than of neutral or happy phrases. Preliminary results showed that emotional subjects were generally slower at naming the color of pleasant *and* unpleasant phrases (vs. neutral ones), but there was no interaction of mood with specific types of phrases. That is, happy subjects were slower at naming the color of unpleasant as well as pleasant phrases, and similar results were found for angry subjects. However, when subjects were in a neutral mood, they took

[5] One might also investigate a condition in which nonhypnotized (but susceptible) subjects are asked to simulate the behavior of the "handwriting" subjects. Specifically, subjects could be asked to *write* in the manner they think a hypnotically happy or sad subject would write responses for the three tasks—free associations, TAT stories, and character descriptions. These subjects could thus be told the "handwriting" cover story and be asked to simulate the writing of happy or sad subjects in each task, but they would *not* be made to feel happy or sad. Network theory would predict their productions to have considerably less affective content than those of the subjects induced to feel an emotion.

[6] Incidentally, the demand hypothesis is not plausible as an explanation of the earlier studies on state-dependent memory. There the instructions emphasized that subjects were to recall all materials to the best of their ability.

[7] In a study that came to my attention after this was written, Izard, Wehmer, Livsey, and Jennings (1965) reported that in a binocular rivalry situation (using a stereoscope), subjects in a good mood "perceived" a happy face more than an angry face, whereas subjects in an unpleasant mood perceived the angry face more than the happy face.

[8] I thank Professor Clore for permission to discuss his preliminary findings.

the same amount of time to name the color of all three types of phrases—pleasant, unpleasant, and neutral. Clore and I are uncertain how to interpret this general emotion effect, so the cautious course is to await replication of the experiment.

Recognition threshold. The network theory of emotion would predict tachistoscopic recognition thresholds for mood-congruent words to be lower than those for neutral words. In theory, emotional activation spreads to the word nodes labeling an emotion; these word nodes act like "logogens" (Morton, 1969) that integrate activation from top-down sources (context, expectations, mood) and from sensory evidence. Thus, a logogen that is already partially activated by the mood context should pass its threshold for recognition with less sensory evidence than needed otherwise. An experiment by Postman and Brown (1952) provided evidence for this, namely, lower recognition thresholds (i.e., less bright exposures were needed) for success-versus-failure words for subjects who had just experienced success or failure in an unrelated task. We are presently repeating that experiment with different hypnotically induced moods. It is not clear whether the effect, if replicable, will be due to a change in sensitivity or in response-guessing biases.

MOOD CONGRUITY IN LEARNING

The main work we have done on the salience effect concerns selective learning. In one experiment (Bower et al., in press), subjects were made happy or sad by a posthypnotic suggestion as they read a brief story about two college men getting together and playing a friendly game of tennis. Andre is happy—everything is going well for him—while Jack is sad—nothing is going well for him. The events of the two men's lives and their emotional reactions are vividly described in the story, which is a balanced, third-person account. Once our subjects finished reading the story we asked them to tell us who they thought was the central character and who they identified with. We found that readers who were happy identified with the happy character, thought the story was about him, and thought the story contained more statements about him; on the other hand, readers who were sad identified with the sad character and thought there were more statements about him.

Our subjects recalled the text the next day while in a neutral mood, and the results are shown in Figure 10. Subjects recalled more facts about the character with whom they had identified. Eighty

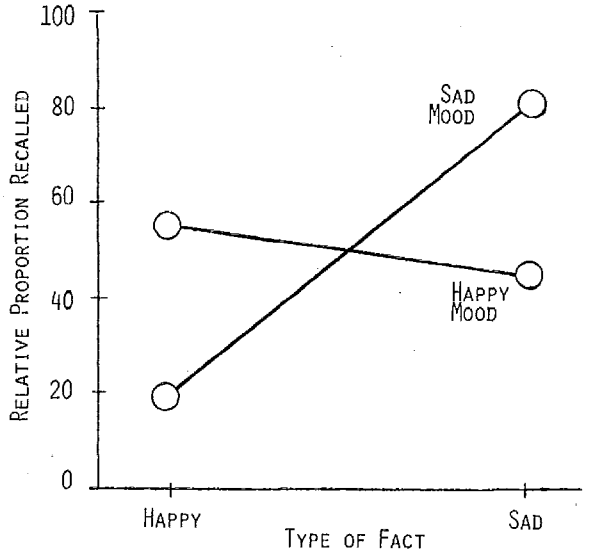

Figure 10. Relative percentages of recall of facts about the happy character versus the sad character by readers who were happy or sad.

percent of the facts recalled by the sad readers were about the sad character; 55% of the facts recalled by the happy readers were about the happy character. This is a mood-congruity effect with the selection according to the character the statement was about. It is not a state-dependent effect, because these subjects were in a neutral mood during recall.

In another experiment (Bower et al., in press) we had subjects read some simulated psychiatric interviews in which a psychiatrist leads a patient through several sessions of hypnosis-induced age regression. The patient in the narrative briefly describes a series of unrelated happy incidents and sad incidents from his life. Our subjects were made to feel happy or sad while reading this by posthypnotic suggestion. Later they recalled the narrative, and the results are shown in Figure 11.

Here again, people learned more about incidents congruent with their mood. Happy readers recalled about one and one half times as many happy incidents as sad incidents, whereas sad readers recalled about one and one third times as many sad as happy incidents. So the mood-congruity effect occurred for happy versus sad incidents related by a single character.

EXPLAINING THE MOOD-CONGRUITY EFFECT

How does one explain the mood-congruity effect? Why is mood-congruent material more salient and

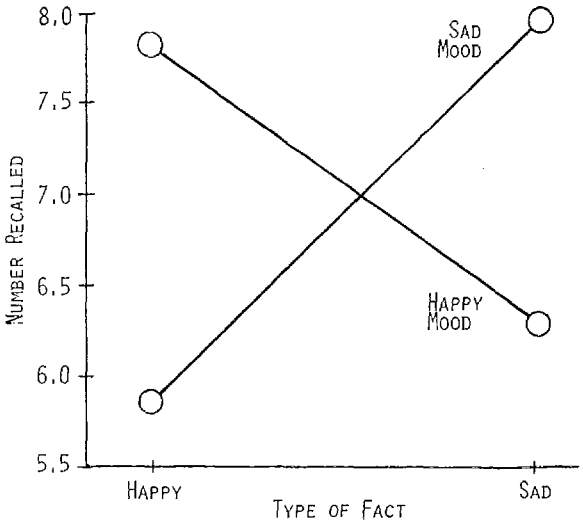

Figure 11. Number of happy versus sad story incidents recalled by readers who were happy or sad. (One character in the story described both types of personal incidents.)

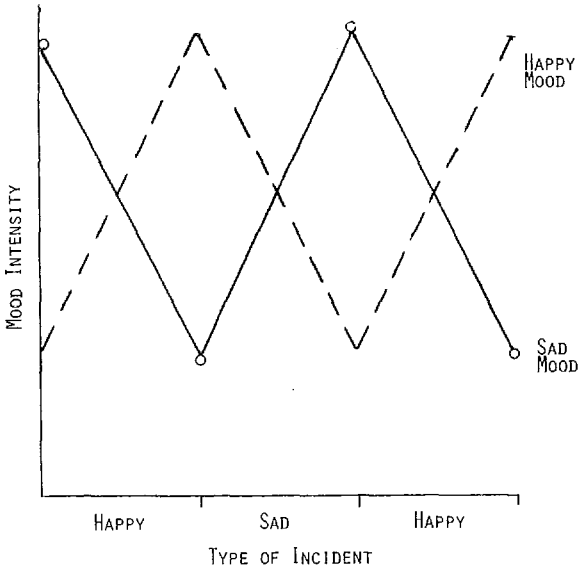

Figure 12. Hypothesized fluctuations in intensity of a happy person's and a sad person's moods as they listen to a story containing first a happy incident, then a sad one, and then another happy one. Congruous events heighten mood intensity, whereas incongruous events cause it to wane.

better learned? Several explanations come to mind, but two seem better than the others.

Selective reminding. The first hypothesis is that when one is sad, a sad incident in a story is more likely than a happy incident to remind one of a similar incident in one's life, and vice versa when one is happy. The further hypothesis is that such reminding is itself an event that enhances memory of the input event. This occurs perhaps because the old memory allows one to elaborate on the input event or to infuse it with greater emotion. In other work (Bower & Gilligan, 1979), we have found that event descriptions that remind one of some specific incident from one's life will be better remembered than those that do not cause such reminiscence. To summarize—this hypothesis states that the mood-congruity effect is produced by selective reminding.

Emotional intensity. The other hypothesis, which complements the first, is that the mood-congruity effect comes from the influence of emotional intensity on memory. The idea is depicted in Figure 12, which shows hypothesized fluctuations in the intensity of the felt emotion as a happy and a sad subject read a series of happy and then sad incidents. Although our hypnotized subjects in several experiments tried to maintain steady moods, they reported that a mood's intensity would wane when they read material of the opposite quality. Thus, happy subjects would come down from their euphoria somewhat when they read about a funeral or unjust suffering, whereas these topics would intensify sad subjects' feelings. If the congruity of the material with mood causes such fluctuations in mood intensity, then the effect on memory should follow if we assume that people are more likely to remember events associated with more intense emotional reactions, at least within reasonable limits. This intensity hypothesis has been proposed and supported in research by Dutta and Kanungo (1967, 1975), and I mentioned some of our evidence for it earlier.

How does intensity affect memory? At present there are too many explanations of how the intensity of an emotional reaction to an event enhances memory for that event. In real life, events that evoke strong emotional reactions are typically events involving personally significant goals, such as attaining life ambitions, elevating one's self-esteem, reducing suffering, receiving love and respect, or avoiding harm for oneself or loved ones. Because of their central importance, such goal-satisfying events are thought about frequently and become connected to many other plans and self-conceptions in one's life. For this reason alone, an important (or intense) emotional event in one's life will be better remembered. As a second factor, intense emotional experiences tend to be rare and unique compared to our all too numerous run-of-the-mill experiences. The distinctiveness of these intense experiences would also insulate them from interference, thus enhancing memory of them.

While these two factors—importance and distinctiveness—are doubtless implicated in memory of real-life emotional experiences, neither factor is applicable to the differential recall results shown in Figures 10 and 11 or to the intensity variations hypothesized in Figure 12. Therefore, let us consider a network theory to handle this intensity interpretation of our mood-congruity results.

Network theory requires only a minor elaboration to deal with these results. The needed links are labeled 1 and 4 in Figure 13. First, we assume that descriptions of emotional events feed excitation into the corresponding emotion node. Thus, if a hypnotic suggestion has made a person happy and a happy event occurs, that will feed excitation back to the happiness node along Link 1, and this will keep the emotion node firing with a persistent reverberating activation. This persisting activation will cause more growth in the strength of the association of the emotion node with the event node (Link 2) as well as strengthen the associations within the event description itself. In contrast, when a happy subject reads about a sad event, this will send activation to the sadness emotion node via Link 4. This, in turn, will inhibit or dampen the prevailing happiness mood, so that Link 3 will not be used as much and thus will be weaker. The outcome is that links to the mood-congruous events are stronger than links to the incongruous events, as illustrated by the thickness of Link 2 versus Link 3 in Figure 13, and these differing associative strengths are revealed in free recall. This theory has several implications that we are currently testing, but this is not the place to discuss them.

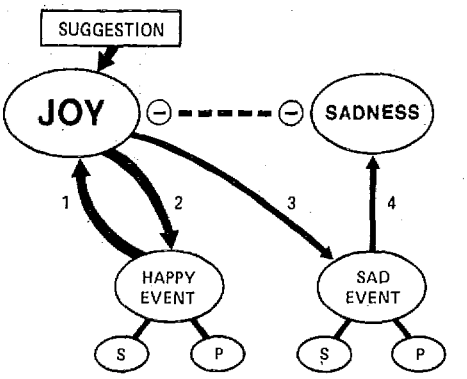

Figure 13. Fragment of network theory to account for the effect of emotional congruity and intensity on memory of an event. Influences (Links 1 and 4) of an event on its proper emotional appraisal are shown, as are the new associations (Links 2 and 3) that are developed to connect the prevailing emotion of joy to the to-be-remembered events.

Speculative Extensions

Having reviewed some evidence for mood-congruity and mood-dependency effects, perhaps I will be excused for speculating about a few of their implications.

Mood perpetuation. One obvious phenomenon explained by mood dependency is mood perpetuation—the tendency for a dominant emotion to persist. This tendency is relevant in psychopathology. Thus, a person in a depressed mood will tend to recall only unpleasant events and to project a bleak interpretation onto the common events of life, and these depressing memories and interpretations feed back to intensify and prolong the depressed mood. Thus, the vicious circle of depression spirals.

A similar circle can occur with anxiety and worry. We see this in the worrywart, the hypochondriac, the chronically overprotective parent, and those of us who awaken in the middle of the night worrying over some item, which leads to worry over another and another. The mild negative tone of one worry primes and makes more available the negative aspects of some other personal concern, and so one free-associates through the recent worries of one's life. These are commonsense observations, but they are explicable by the network theory of emotion.

Self-control of moods. Common sense also prescribes various home remedies for worry, depression, and foul moods, and we have all been taught them as part of folk wisdom. These home remedies include distracting oneself or replacing the worry with escape fantasies—as in watching TV, whistling past the graveyard, or reading a good novel. These habits for controlling one's thoughts and moods can be switched on when a negative mood arises; when carried out, such thought routines reduce or replace the negative mood. They are learned means of self-control that vary in effectiveness across individuals. One class of therapies for depression focuses on restructuring the way depressed people think about and evaluate events in their lives in hopes that they will fill their minds with positive thoughts and feelings (see, e.g., Beck, Rush, Shaw, & Emery, 1979).

Other habits of thought we have all learned are various means for prolonging pleasurable mood states. After receiving good news or winning a prize or victory, we go out and celebrate with our friends to prolong the glow. Clark and Isen (in press) refer to these mood-altering methods as

"controlled" effects (learned strategies), in contrast to the "automatic" priming effects of mood on thematically relevant content.

Dream recall. Several further effects seem interpretable as examples of state-dependent retention. One of these is the impoverished quality of dream recall shown by most people. It is a fact that most people demonstrate massive forgetting of their dreams (Cohen, 1979), which is surprising considering that such bizarre, emotionally arousing events would be very memorable if we had witnessed them in the waking state. But the sleep state (even the REM state of dreaming) seems psychologically quite distinct from the waking state. Some evidence suggests that people show sleep-state-dependent learning (Evans, Gustafson, O'Connell, Orne, & Shor, 1966). Such state dependency would help to explain the forgetting of dreams. What is then puzzling is how with social reinforcement people can learn to remember and report their dreams at higher rates (see, e.g., Garfield, 1974).

Infantile amnesia. State-dependent retention may also explain the phenomenon of infantile amnesia—the fact that people can retrieve very few memories from the first year or two of their lives. In this view, as infants mature, their brains gradually change state, so that early memories become inaccessible in the more mature state. The problem with this hypothesis is that it leads to no novel predictions to distinguish it from the plethora of competing explanations of infantile amnesia (see White & Pillemer, 1979).

Drug dissociation and mood. State-dependent effects have been reported most often for centrally active drugs (see Ho, Richards, & Chute, 1978). Of course, most drugs are ineffective as state-dependent agents. It is an interesting fact that most of the drugs that produce state-dependent effects also produce radical shifts in emotional mood (see Weingartner, 1978). The successful state-dependent drugs are marijuana, amphetamine, Thorazine, alcohol, and barbiturates like Demerol, all of which are frequently abused mood-altering drugs. Thus, one might conjecture that these drugs achieve their state-dependent effects by virtue of their impact on moods. But there are apparent exceptions to this unqualified generalization. For example, physostigmine produces state-dependent learning, yet it seems to have little emotional effect beyond some elevation in "arousal." Nevertheless, the previous conjecture warrants further investigation.

Dissociative amnesias. One of the more exotic appeals of state dependency as a theory is that it characterizes the dramatic dissociations seen clinically in hysterical fugues and cases of multiple personality. In many cases of fugue, the person was experiencing some horribly aversive, even traumatic, crisis, and the fugue presented an escape to a calmer situation and mood (see Nemiah, 1979). For example, Patty Hearst was locked in a small dark closet and repeatedly beaten, raped, and terrorized by her captors before she allegedly "snapped" and came out as Tania, the accepted and beloved revolutionary; later, in reverting to her former self she seemed unable to recall much about what happened to her as Tania (see Watkins, 1976, 1978). In multiple personality cases, the alter egos often coordinate with different predominant moods or emotional styles of expression. In the famous "Three Faces of Eve" case (Thigpen & Cleckley, 1957), Eve White was a dutiful, faithful, inhibited housewife, whereas her alter ego, Eve Black, was an uninhibited, aggressive, seductive party-girl on the lookout for a good time with men, booze, and dancing.

In a well-documented case reported by Ludwig, Brandsma, Wilbur, Bendfeldt, and Jameson (1972), a young man (Jonah) had three alter egos. One ego state (King Young, the lover) came out when Jonah wanted to make sexual advances to women, another (Usoffa Abdulla, the warrior) came out when he got into fights and brawls, and the third (Sammy, the slick con man and shyster) came out to help get the other two egos out of trouble. Jonah is a particularly clear example of different sets of beliefs, values, and memories clustered around different motivational complexes.

One way scientists try to understand a clinical phenomenon is by attempting to synthesize it in the laboratory, and so it is interesting to fantasize about creating temporary fugue states and multiple personalities in the laboratory. These may simply represent one pole on a continuum of dissociation. The best laboratory analogs of fugue that we have so far are hypnotic trance and suggested posthypnotic amnesia for the events that take place while under the trance; these are effective perhaps because they are sincere, intense role enactments. I suggest that another key to creating dissociated states is through different emotions. That is, multiple personalities, or different "ego states" as Watkins and Watkins (1979) call them, may be particularly compelling role enactments that have become suffused with distinctly different moods, with the role's behavior perpetuating its mood. Thus, when Jonah feels angry and aggressive, one set of memories, beliefs, and competencies are activated (as Usoffa Abdulla); when he feels ro-

mantically or sexually aroused, a different set of memories, beliefs, and competencies are activated (as King Young).

Could it happen to any of us? As adults we adopt many different roles in different situations in relation to spouse, parents, children, colleagues, and so on. Suppose that by some means these roles were to become invested with distinct emotions, such as feelings of sexuality, of filial piety or parental love, of anxiety, or of anger. The emotion associated with each role would move the several role behaviors partially in the direction of memory dissociation. Thus, the person enacting the role of the sexy lover might be temporarily unable to retrieve memories of events that happened when he or she was enacting the role of the angry, aggressive business executive at the office. The point is that a distinctive mood, emotional tone, or set of emotional conflicts associated with a role could easily cause events occurring during enactment of that role to be partially dissociated from, and inaccessible to, other states of the person.

Concluding Comments

I have described two basic phenomena: first, the mood-congruity effect, which means that people attend to and learn more about events that match their emotional state, and second, mood-state-dependent retention, which means that people recall an event better if they somehow reinstate during recall the original emotion they experienced during learning. I have outlined a semantic network theory to explain these effects and to integrate several related findings. These include the influence of emotion on associations, interpretive processes, imaginative reconstructions, perception, and selective learning.

Before closing, let me add a final comment. I am a cognitive psychologist, and cognitive psychologists have been criticized—perhaps rightly—for ignoring the role of emotion and motivation when they study the operation of some cognitive function like attention, or memory, or thinking. Well, I have now studied emotions and their impact on selective perception, imaginative thinking, and memory. The emotions studied were powerful ones, and represented extremes that people feel only occasionally in everyday life. Yet the emotional effects we have found so far seem understandable to me in terms of ideas that are standard fare in cognitive psychology—the ideas of emotion nodes situated in an associative network and the spreading of activation throughout that network. Perhaps this is as it should be—theories developed in one field aiding our understanding of phenomena from another field. Certainly it is the goal of all basic science.

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