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The Origin of Memories

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I was a first-year college student and I took a couple of friends to my parents' house for dinner. The conversation turned to droughts and I thought of an incident that happened when I was about 5 years old, and proceeded to tell the story:

> My family was driving through the San Joaquin Valley in California when we had a flat tire. We didn't have a spare, so my father took the tire off the car and hitchhiked up the road to a gas station to get the tire patched. My mother, brother, sister, and I waited in the car. The temperature was over 100 degrees, extremely uncomfortable, and we got very thirsty. Finally, my sister took a couple of empty pop bottles and walked up the road to a farmhouse. The woman who lived there explained to her that the valley was suffering from a drought and she only had a little bottled-water left. She set aside a glass of water for her little boy, who would be home from school soon, and filled up my sister's pop bottles with the rest. My sister brought the water back to the car and we drank it all. I also remembered feeling guilty that we didn't save any for my father, who would probably be thirsty when he got back with the repaired tire.

As I finished my story, my parents laughed and pointed out that the incident had not happened that way at all. We did, in fact, drive

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through the San Joaquin Valley during a drought and have a flat tire. My father did have to hitchhike to a gas station to have it fixed and the rest of us waited a very long time in the hot car. My sister complained a great deal about the heat, but nobody went anywhere for water and we did not have anything to drink until after my father came back and fixed the tire, and we drove on.

Evidently, what I had done was imagine a solution to our problem as I sat there in the car—a solution that simultaneously got rid of my fussy sister and got us something to drink. Years later, in remembering the incident, I had confused the products of my perceptual experience with the products of my imagination.

This story illustrates a fundamental question about the nature of our personal beliefs and our concept of ourself: To what extent is the life we remember, the knowledge and expectations we have, and the self we seem to ourselves to be, a product of experience and to what extent a product of our own imagination? Largely, the answer to such questions depends on our understanding of basic characteristics of the memory system. My research has primarily been directed at exploring the consequences of a memory system that records both external events derived from perceptual processes, and self-generated events such as thoughts and fantasies. I started out attempting to understand the mechanisms of confusion between the perceived and the self-generated ("reality monitoring"). A consideration of similarities and differences in memories for perceived and imagined events has led me to explore some broader implications of the differential origin of memories, and to propose a general framework for memory research (a "multiple-entry, modular memory system") that addresses these implications. The present article provides an overview of this research.

I. REALITY MONITORING

The potential for confusion between the perceived and the generated has far-ranging consequences. We may be haunted by childhood traumas that never took place (Freud, 1914/1957), or deny those that did (Masson, 1984). We may testify to events that never happened (Loftus, 1979), or cut off a friendship over words that were never said. Our self-concept is shaped by the experiences we remember (whether or not the memory is accurate) and, in turn, affects which new experiences we will remember (Markus, 1977). Furthermore, thinking about events increases their apparent frequency of occurrence (Johnson, Taylor, & Raye, 1977; Johnson, Raye, Wang, & Taylor, 1979). Therefore, many judgments based on frequency information are potentially erroneous.

For example, our subjective estimate of how happy we have been is affected not only by the "facts" (i.e., the relative number of times we have been happy and miserable), but also by past imagined happiness and misery. Our expectations for our future success will be affected not only by the relative number of times we have succeeded and failed, but also by past imagined successes and failures. To a large extent, we create our "pasts." What we generate ourselves has an advantage in memory (Greenwald, 1981; Slamecka & Graf, 1978). By selectively rehearsing events, we determine which events will be most available for voluntary recall, and these highly available events will exert a disproportionate influence on our decisions and future plans (Tversky & Kahneman, 1973). The thoughts and fantasies that we have determine the type of imaginal events that will be available to be confused with real events (Johnson & Raye, 1981).

Such considerations suggest that it would be both theoretically important and practically useful to understand the processes by which perceived and self-generated events are discriminated and confused in memory (that is, the processes of "reality monitoring"). In 1981, Carol Raye and I published a model of reality monitoring that summarized our prior work on this problem and that has served as a framework for additional research (Johnson & Raye, 1981). We proposed that as a class, internally generated memories differ from externally derived memories along several dimensions. Externally derived memories typically have more contextual attributes coded in the representation of the event than internally generated memories do. By context, we mean space and time, or the "where" and "when" of a memory. Externally generated memories have more sensory attributes. By sensory attributes we mean trace information that would specify perceptual features such as the sounds or colors of events and objects. We also proposed that externally derived memories tend to be more detailed compared to thought, which is generally more schematic. Finally, in contrast, internally generated memories typically have more cognitive operations coded in the trace. Cognitive operations are the mental operations that went on at the time a memory was established, such things as search and decision processes, imagery, comparisons, and so forth. Of course, perception involves cognitive operations, too. But, perception is characteristically more "automatic" (Hasher & Zacks, 1979; Posner & Snyder, 1975; Shiffrin & Schneider, 1977) than imagination and thought, and we proposed that automatic processes leave fewer operations in the trace compared to processes that are under voluntary control.

One way a reality monitoring process might work is illustrated in Fig. 1. Suppose you remembered something and tried to decide if you had seen it or imagined it. One way to do this is to establish decision

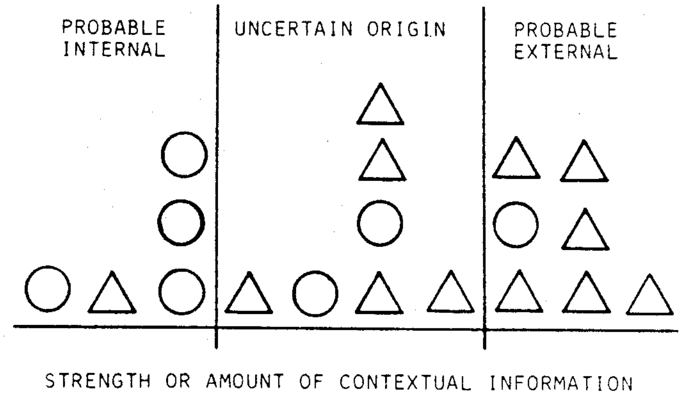

Fig. 1. Representation of a set of decision rules for judging the origin of a memory on the basis of the amount of contextual (time and place) information it includes. (In this sample, externally derived memories are represented by triangles and internally derived ones by circles.) Reprinted by permission from Johnson and Raye (1981), *Psychological Review*, **88**, 67–85.

criteria, indicated by the vertical lines. If the memory involved a lot of contextual information, you would conclude it was perceived, but if it involved very little contextual information, you would conclude it was imagined. Similar decision criteria could be applied to each of the different dimensions of information represented in memory traces. The final reality monitoring decision would be a weighted function of the various dimensions. One interesting question might be how various conditions affect the weighting given to different dimensions.

This sort of model can account for both accuracy and confusion in remembering. A reality monitoring process that evaluated memories against such decision criteria would produce discrimination between perceived and imagined events, but not perfect discrimination. Sometimes, a particularly vivid imagination (one with a lot of sensory and contextual information) might mistakenly be called perceived, or an unusually vague perception might mistakenly be called imagined.

This first type of reality monitoring process evaluates characteristics of a target trace. A second type of reality monitoring process, based on other information in memory, evaluates the target memory in light of other knowledge that you have. For example, if you had an extremely vivid memory of a money tree, you might conclude it must have been a dream or fantasy because you know money doesn't grow on trees. Thus, there are two types of reality monitoring processes—one based on evaluation of target trace characteristics and one based on more extended reasoning that draws on supporting memories or related knowledge. Hence, there are two potential sources of errors in reality monitoring: (1) a target trace not typical of its class (e.g., the memory for an imagination with a great deal of sensory detail) and (2) errors in or failure to engage in a reasoning process (e.g., you might not know that money doesn't grow on trees).

You can see the operation of both factors in my erroneous memory about the drought. There were many features of the target memory that lead me, without question, to treat the memory as an actual event; there was a great deal of sensory and contextual information and the memory was highly detailed: I remembered the car, the heat, the location, time of year, the farmhouse, the woman, the bottled-water container, the glass she set aside for her little boy sitting on the tile drainboard, the guilt I felt. . . . At the same time, I failed to engage in any critical reasoning that might have made me suspect the memory was not accurate after all, in spite of its richness. How could I have such a clear image of the woman at the farmhouse and the details of the kitchen when I was not the one who was there? Also, my mother would never have let my 12-year-old sister go up the road to a strange house all by herself.

A. Experimental Studies of Reality Monitoring

While one reasonable test of a model is whether it can plausibly account for such anecdotal evidence, we have explored some of the hypotheses embodied in the model experimentally as well. In order to do this, we have developed techniques for controlling the occurrence not only of perceptions, but also of imaginations. Our basic strategy in many experiments is to show people some simple items such as words or pictures, and to ask them to think about or imagine words or pictures. We cue the subject as to what and when we want them to think of an item; hence we know, to a degree, what they have thought about, and when and how many times they have generated each item.[1]

[1]We have largely used paradigms in which perception and imagination are discrete events in order to gain some control and specificity over imagined, as well as perceived events. Much of cognition, of course, involves thoughts that are "cotemporal" (Johnson & Raye, 1981) with ongoing perception and hence many "events" are not imagined or perceived, but some combination of both. Furthermore, a perceptual event can be perceived more or less veridically, depending on interpretive and elaborative processes influenced by prior knowledge, goals, needs, and so forth. The general principles that we derive from simpler cases in which imagination and perception are largely separate

We have gathered evidence from several different paradigms that supports our general characterization of reality monitoring. For example, the reality monitoring model predicts that if imaginations could be made more vivid, they should be more like perceptions. Thus, if we increased the sensory detail of images, subjects should have more difficulty deciding what they imagined and what they perceived. This was the rationale for an experiment comparing people who are good visual imagers with people who are poor visual imagers (Johnson *et al.*, 1979). All subjects saw pictures of common objects taken from children's books. Interspersed with these presentations were trials in which the subjects heard a word corresponding to one of the pictures, and were asked to create a vivid image of the appropriate picture. We varied the number of times each picture was shown and the number of times each picture was imagined. Later, subjects were given a surprise test which asked them to tell us the number of times each picture had been shown on the screen. They were told to ignore the number of times they had imagined the picture, and tell us only the number of times they actually saw it. The more often subjects thought about a picture, the more often they thought they had seen it. Furthermore, the good imagers were more affected by the number of times they had imagined a picture. This greater confusion between imagination and perception for good imagers compared to poor imagers would be expected, based on greater overlap between their imaginations and perceptions.

In another experiment (Foley & Johnson, 1982), we attempted to manipulate the overlap between perceived and imagined events, rather than rely on a subject variable such as ability to image. Each subject (individually) was brought into a room in which there was a confederate. The experimenter asked the confederate to say some words aloud, and asked subjects to imagine themselves saying other words. Overall, subjects heard the confederate speak a random half of the words, and subjects imagined themselves saying the other half of the words. Later on, subjects were asked to discriminate the words that they only thought from the words that the confederate actually said. In another condition, the procedure was the same except that subjects were asked

events should be applicable to cases in which imagination and perception intermingle in a more continuous manner (as in my memory about the drought), or in which, for example, earlier, perceived events are embellished by subsequent imagination (often in ways that "revise our personal history," Greenwald, 1980). Of course, imaginal embellishment of ongoing or past perceptions should, according to our reality monitoring model, be even more likely than pure fabrications to be confused with perceptions because the "target" memory is more likely to include the sort of information (detail, contextual specificity) that signals a perceptual event.

to think in the confederate's voice. Compared to thinking in your own voice, thinking in the other person's voice should increase the overlap in sensory features between imaginations and perceptions and make the later discrimination task more difficult.

When subjects thought in their own voices for half the items and listened to the confederate for the other half of the items, they could later discriminate what they thought from what the confederate said 88% of the time. On the other hand, when we had the subjects think in the confederate's voice, subjects could discriminate what they thought from what the confederate said only about 64% of the time. A third condition was included as a control condition for difficulty in thinking in someone else's voice. In this particular condition, the subject was thinking in somebody's voice other than the confederate and later was asked to discriminate words thought from words heard. That was somewhat disruptive (77% correct), but not nearly as disruptive as thinking in the confederate's voice. Like the good/poor imager study, this study is consistent with the idea that the more sensory overlap there is between memories derived from perception and memories generated via imagination, the greater will be the confusion between them.

Another prediction from the reality monitoring model is that if the cognitive operations involved in self-generated events are reduced, it should be more difficult to discriminate them from perceptions. One class of self-generated events that should have relatively little information about cognitive operations is dreams. This is because dreams typically do not involve consciously controlled processes such as comparing, searching, etc. This led us to the counterintuitive prediction that it should be relatively difficult to tell your dreams from someone else's. In an experiment investigating this prediction, we compared reality monitoring of dreams with reality monitoring of similar information generated consciously (Johnson, Kahan, & Raye, 1984). Participants in the study were people who lived together (husbands/wives, roommates, lovers). Each pair was issued a tape recorder and packets of instructions. Each night, before they went to bed, subjects (each privately) opened an envelope that described the condition they would be in that night.

There were three conditions in the study. In the dream condition, subjects were instructed to report whatever dreams occurred that night to their partners in the morning. In the read condition, subjects read a dream (taken from some other subject), and were instructed to report the dream they read to the partner the next morning. Subjects were instructed to try to imagine they were actually having the dream as they read it. An example of a dream that was given to subjects to read is shown in Table I.

TABLE I
Sample of a Dream Used in the Read Condition[a]

I am walking through the country and I come up to this old house. I know that the old man who lives there has died. When I get there, there is a younger man, the old man's son. He is selling cheese and I think that it is very absurd that this guy could be selling cheese when his father just died. I think that the cheese is actually his father somehow; he is selling his dead fathers's body. Anyway, he is selling the cheese and he invites me into his house and he offers me this large banquet—cheese, wine, and meat and all this food. It is really a great banquet. So I eat the banquet with him and I stay there awhile and I find out that the old man left this giant storehouse of cheese. There is all this cheese there that somehow he made, so I stay there and start selling the cheese also.

[a]From Johnson *et al.* (1984).

Finally, in the third condition, which we called the schema condition, the instruction packet subjects opened the night before contained a dream-schema, or set of cue words (e.g., the cues corresponding to the dream in Table I were *country, old man's son, cheese, invites me, selling*), which subjects were instructed to use to create a dream-like fantasy. That is, subjects made up a "dream" in the schema condition, and reported this made-up dream to their partners the next morning. The cues used to make up a dream in the schema condition were elements taken from the read items. A subject would never get the whole version and the schema version of the same dream, of course.

Subjects thought they were in a study about communication and mood and dropped off their tapes to the laboratory at the end of each week. We transcribed their morning reports to each other and took brief segments out of them. We mixed these with segments from another pair of subjects to make up a memory test. Later we brought the subjects to the laboratory and asked them to try to identify whether each segment was from one of their reports, one of their partner's, or new. Thus we compared their ability to reality monitor in the real dream condition with their ability to discriminate what they reported from what their partner reported in the read and schema conditions. These conditions varied, we thought, in the amount of cognitive operations that should have been engaged in when the target memory was established. The real dreams should have relatively little information about cognitive operations because they were unconsciously generated. Reading and imagining yourself in a dream, or making up a dream from a schema, are more active and involve many more conscious cognitive operations. According to the reality monitoring model, cognitive operations are stored as part of the event and should provide cues later about the origin of the event.

Briefly, the results indicated that people were quite able to tell what dreams they had read from what their partner had read, or what they had made-up from what their partner had made-up. As predicted, they had much more difficulty discriminating their own dreams from their partner's dreams. These results are consistent with the idea that unconsciously generated information is more likely to be confused in memory with perceptions than is consciously generated information.

A similar point about the importance of cognitive operations is made by the results of one of our laboratory studies (Johnson, Raye, Foley, & Foley, 1981). For presented items, subjects were shown a category and an instance of the category, and for generated items, they were shown the category and a letter and had to generate an instance of the category starting with that letter. (The first letter of the instance was always presented with the category name.) We used the first-letter cues to control how hard it would be for the subjects to generate an appropriate instance. For example, Animal-D would be an easy item because Dog is a very common or highly available associate of Animal. Animal-P would be just a little bit harder because, for most people, Pig is a slightly less available instance of the animal category.

Later, subjects were shown various instances of categories such as *apple*, *pig*, etc., and asked which ones they had been shown and which ones they generated themselves. People were better able to tell whether they had generated or perceived less available instances, such as Pig, than more available category instances, such as Dog. What was particularly interesting was that the identification of origin test came 10 days after the first phase of the experiment. Thus, whatever cognitive operations occurred in the few milliseconds difference in time it took to generate Pig compared to Dog had consequences 10 days later.

We think that generating a highly available response such as Dog to the cue Animal is more like perception in that it is relatively automatic and not much under conscious control. The more automatic a response is, that is, the less voluntary it is, the fewer cognitive operations stored with the trace, and the more easily it should be confused with perceptions.

Dywan and Bowers (1983) have recently shown that hypnotized subjects recall more false "memories" as well as true memories, compared with nonhypnotized subjects, and suggest this finding could be interpreted within a reality monitoring framework. If hypnosis increases the vividness with which subjects imagine possibilities as they are recalling, fewer of the false possibilities will be rejected because more will exceed the reality monitoring criterion for sensory detail. Another possibility in addition to the one considered by Dywan and Bowers is that memories generated under hypnosis are like dreams in that they include fewer cognitive operations cues—this would also make imagined items seem more real. In general, including in the normal waking state, those ideas that come to us most easily should later be quite difficult to disentangle from perceptual events. Ideas that are both effortless *and* vivid should seem especially real.

B. Autobiographical Memories

While most of our work has been under relatively controlled, laboratory conditions, we have also attempted to determine if our reality monitoring model can be extended to more naturally occurring, autobiographical memories. The dream study described above represents one step in this direction—a sort of field study in which we introduced a manipulation and some controls. In another series of studies, we are investigating reality monitoring for various kinds of naturally occurring, autobiographical events. One reason to move in this direction is to see if the same characteristics of memories that are important in the laboratory are important in this more natural context. Another is that autobiographical memories are embedded in a rich network of other memories and this is the context in which we should most readily see the more extended reasoning processes that we have postulated come into play in reality monitoring decisions.

In one study of autobiographical memories, each subject was asked to remember one actual, "perceived" event, and one imagined event. Examples of perceived events were a trip to the library, a social occasion, or a trip to the dentist. Examples of imagined events were a dream, a fantasy, or an unfulfilled intention. The category of event to be remembered was specified for each subject. Once the subject had the event in mind, we asked them, in the case of perceived events, how did they know that it actually happened and that they had not just imagined the event. In the case of imagined events, we asked them how they know that the event did not actually take place.

Table II shows the major types of explanations subjects offered to the "how do you know" question. There were basically three types of explanations and the percentage each was given is shown separately for perceptions and for imaginations. There was a very clear pattern in subjects' responses. For perceptions, subjects were very likely to refer to characteristics of the target memory trace itself (38% of the responses were of this type). For example, subjects mentioned temporal information such as the day or time of the school year, or they referred to location information ("I know exactly where it happened"), or they referred to sensory detail ("I remember the exact color of his shirt").

TABLE II
Reality Monitoring of Autobiographical Memories

	Perceptions (%)	Imaginations (%)
Target memories	38	7
Supporting memories	44	17
Extended reasoning	18	77

Another category of response that was very frequent for actual perceptions (44%) was the subjects own supporting memories. For example, "I know it happened because I can remember I had the note on my calendar." Or "I still have the invitation." Actual events are embedded in anticipations before the fact (such as buying something to wear) and consequences after the fact (such as later conversations about the event or later regrets). People frequently refer to these supporting memories to justify their belief that an event really happened.

As you can see, for imaginations, people referred to characteristics of the target memories or to supporting memories much less often. Rather, the overwhelmingly most frequent response for imaginations involved extended reasoning processes (77%). For example, the subjects would refer to their general knowledge about the world. "In this fantasy I was a doctor but really I was too young to be a doctor, so it must be only a fantasy." Or, "The event breaks physical laws about time and space."

Table II summarizes the information subjects used to justify their decisions about the origin of a memory; though this was the information subjects drew upon first, it does not exhaust the totality of the available information in memory. In another study, we attempted to make a more complete assessment of trace characteristics of autobiographical events. Subjects were asked to imagine a particular event and then went through a rating check list that had a number of dimensions on it. The events were the same as in the previous study.

First, there are some ways in which perceived and imagined events (at least those that we selected to study) did not differ. They did not differ significantly in the amount of detail they seemed to involve about the major events; they did not differ in terms of whether the subjects felt they were spectators versus participants in the action (we are, for the most part, participants in our memories). They did not differ in terms of whether the event seemed to have serious implications at the time, whether the memory was particularly revealing about the person, in how often people thought they discussed them, or whether subjects had positive or negative feelings at the time of the event.

There were some ways in which perceived and imagined memories did differ. Imaginations seemed more complex, they seemed to involve more intense feelings, and people felt they had thought about them more often since the event. Perceived events, on the other hand, had more visual detail, more taste, and the general setting was clearer. As you would expect, they seemed more realistic.

Overall, our investigation of autobiographical memories suggests conclusions similar to those from our laboratory studies, and fits our model reasonably well. Perceived and imagined events are potentially discriminated on the basis of a number of cues. Especially important among these are whether they give rise to supporting memories, the clarity of the temporal and spatial information, and the amount of visual detail.

One speculation that arises from these results is that we protect ourselves against confusion between fact and fantasy by confining daydreaming to certain times (e.g., falling asleep) or certain locations (e.g., bed or a favorite chair). If fantasies were a more continual part of ongoing activity, they would more easily become woven into the daily fabric of life (as was the case with my childhood memory). They might then later include unique temporal or spatial information or give rise to a larger number of supporting memories, and thus seem more like actual events. Perhaps some delusional people, or those with distorted thoughts, do not fantasize more (or even differently) than the rest of us, but rather have fantasies that are less isolated from actual events.

All of the effects of failing to differentiate the origin of events are not necessarily negative. We can capitalize on confusion; for example, I can increase the probability that I will feel competent tomorrow by selectively reviewing and imagining successes today. As Goldfried and Robins (1983) describe, therapists use this technique to encourage a new self-image and new behaviors in their clients. Goldfried and Robins also point out that clients may undermine the impact of successful therapeutic experiences by continuing to cognitively review their failures, causing them to conclude that failures have occurred at a higher rate than they actually have (Johnson *et al.*, 1977).

In general, we have little information about the consequences in memory of thinking about past events. For example, all aspects of an event that were initially processed perceptually are not incorporated to the same degree into subsequent thoughts about the event; thought itself has certain properties and limitations. Furthermore, we do not know much about the relative effects of re-representation versus imagination. For example, which would have the greater impact on a person's self-concept, reviewing past real successes or imagining new ones? Which would have the greater impact on the person's ability to cope with potential anxiety-arousing situations?

It may be possible to specify habitual modes of thought that affect reality monitoring. Depressed people, for example, may engage in more negative thoughts than nondepressed people (Beck, 1976), producing more negative candidates for confusion with real events. Conversely, depressed people may produce fewer positive thoughts that also could be later confused with real events (cf. Alloy & Abramson, 1979). (Confusion can work for us as well as against us.) The reduction in cognitive capacity associated with nonclinical depression apparently does not produce a general disruption in reality monitoring. Hasher and Zacks (1979) found that depressed adults were no more likely than nondepressed adults to confuse real and imagined pictures. However, the materials used in the study were neutral. The effects of depression may be quite selective; depressed subjects might have trouble identifying the origin of negative information or more personally relevant information.

At the same time, there may be fairly stable individual differences in reality monitoring that are reflected in memory even for neutral material. For example, Durso, Reardon, and Jolly (1984) found that field-dependent subjects were less able than field-independent subjects to differentiate what they said from what someone else said. (This was not a general discrimination deficit because the field-dependent subjects were not less able to differentiate between words said by two other speakers, or between words they themselves generated overtly and words they only thought.) Thus, there may be certain cognitive styles or capacities [as illustrated in the good/poor imager study reported by Johnson *et al.* (1979)] that are associated with more or less confusion between the perceived and the generated. A number of developmental theorists have proposed that children have more difficulty than adults separating fact from fantasy. A review of several of our studies directed at this issue is provided by Johnson and Foley (1984).

C. Dissociation between Origin and Other Variables

Results of studies such as those described earlier, in which we can affect the difficulty of reality monitoring by manipulating features of memories such as sensory characteristics or cognitive operations, or in which we investigate the features of autobiographical events, are generally consistent with the proposition that memories for perceived and imagined events differ in characteristic ways, and that these differences are used for reality monitoring. Additional evidence that externally derived and self-generated events constitute different classes of events in memory comes from studies showing that certain variables interact with the origin of information.

For example, consider an experiment from our laboratory showing a dissociation of origin and type of memory test. Subjects perceived pictures on some trials, and on other trials they imagined pictures. On half of the trials, subjects were asked to look at and rate the ease of drawing common objects such as knives, gloves, telephones. On the other half of the trials, they were asked to imagine line drawings of common objects and rate the ease of drawing the picture they were imagining. The rating task was simply an orienting, or cover task, to require subjects to attend to both perceived and imagined items. Whether the items were imagined or perceived was counterbalanced across subjects. Half of the subjects later were given our typical identification-of-origin test; that is, they were shown a word and asked to say whether it referred to an item that was perceived, imagined, or new. The other half of the subjects later were given an old/new recognition test. Words were presented and subjects were asked simply to indicate whether or not the item had been on the previous list. Thus, one test determined whether the subjects had origin information and the other test determined whether subjects had occurrence information.

We found that the origin of the information interacted with the test. If subjects had to make origin judgments, they were faster on the perceived than on the imagined items. On the other hand, if they had to make old/new judgments (that is, occurrence judgments), they were faster on items they had imaged than on the ones they had perceived.

If perceived and imagined memories were essentially alike (differing perhaps in the amount of some single commodity such as strength), we would expect them to maintain their relative difficulty under different test conditions; for example, perceived should always be easier. However this was not the case. The test condition interacted with the origin of the information, suggesting that perceived and imagined memories differ qualitatively and that different tests are differentially sensitive to these characteristics.

A similar finding has been reported by Jacoby (1983). In the first phase of the experiment, subjects either read words (e.g., *cold*) or generated words from antonym cues (*hot*–???). Later tachistoscopic perceptual identification of the targets (e.g., *cold*) was better for the words that had been read than for the words that had been generated. In contrast, on a recognition (old/new) test, performance was better for the generated words than for the words that had been read.

There is also some evidence that internally generated memories and externally derived memories comprise systems that are differentially disruptable. A dissertation by Phil Harvey (1982) compared thought-disordered and non-thought-disordered schizophrenics in two types of tasks. In one task, the subjects were asked to discriminate words that one person said from words that another person said (the Listen–Listen condition). In the Listen–Listen condition, the subject must differentiate words from two different external sources. In another condition, the subjects were asked to discriminate what they said aloud from what they only thought (the Say–Think condition). In the Say–Think condition, the subject spoke half of the items and imagined him or herself speaking the other half of the items. The Say–Think condition required the subject to differentiate words from two classes of internally generated memories—those ideas realized in overt action and those which were not. Thus, the manipulation in this study was whether the discrimination was between two externally derived types of memories (the Listen–Listen condition) or between two internally generated types of memories (the Say–Think condition).

The thought-disordered schizophrenics did not have any particular difficulty discriminating between what two other people said compared to the non-thought-disordered schizophrenics and normal controls, but they did show a deficit in their ability to discriminate what they said from what they only thought.

You might suppose that the Say–Think task is simply more difficult for any clinically impaired group. However, manics showed just the opposite pattern—thought-disordered manics were not any worse at discriminating what they thought from what they said compared to non-thought-disordered manics and normal controls. They did have quite a disruption in their ability to discriminate between what two other people said. So, it is as if the thought-disordered manics had a selective disruption in discriminating between memories for externally perceived events, and the thought-disordered schizophrenics had a selective disruption in their ability to monitor memories within the class of internally generated events. This deficit could account for some of the symptoms in thought-disordered schizophrenics, such as the unclear references in their speech—schizophrenics may assume that they have said aloud things they have only thought. In any event, the major point here is that the results are consistent with the idea that externally derived and internally generated information are different in significant ways.

II. A MULTIPLE-ENTRY, MODULAR MEMORY SYSTEM

Perceived and generated memories could be viewed as "areas" in an n-dimensional space making up a unitary memory system, in which the dimensions represent characteristics of memories. I think, however, that the above data indicate that perceived and imagined memories differ in a more fundamental way. In order to represent this difference and to provide a framework for further work on the implications of the origin of memories, I have suggested that perception and imagination are functions of distinguishable subsystems of memory (Johnson, 1983). This idea is embodied in a model called a Multiple-Entry, Modular Memory System (MEM). The point of departure for this model is that the most striking thing about the memory system is the many functions it must support—everything from autobiographical recall (summer vacation, breakfast this morning), to identifying new exemplars of concepts (e.g., chair, bird), to learned emotional responses such as loving someone or fear of elevators, to skills such as playing tennis or making conversation at cocktail parties. It is very likely that a reasonably complex memory system, composed of several subsystems, has evolved in order to satisfy these many functions. Therefore, a very simple model will probably not be sufficient.

A second point of departure is that whatever subsystems of memory have developed, they probably have come to work simultaneously in almost all situations. Thus any particular event is multiply encoded or stored in a number of subsystems, because any particular complex event is composed of many aspects.

Consider a complex activity such as beachcombing. Certain types of learning take place relatively automatically, such as learning to localize sounds on the beach, and learning to walk on sand; through practice we come to adjust our behavior to map into subtle cues which are not themselves phenomenal objects of perception. There are other things that we learn that are responses to organized percepts. We might learn, for example, that a certain configuration of seaweed means that we are likely to find a certain type of shell, or that certain rock formations signal likely tide pools. There are still other aspects of what is learned that seem to involve more strategic, reflective activity. This type of learning requires that we see relationships that are not immediately apparent within the present temporal or spatial frame of reference. For example, we might learn where and when we can walk our dog on a restricted beach and avoid running into the police. Thus, while an event, such as beachcombing, is taking place, various aspects of the event are being encoded or recorded. In MEM, it is assumed that there are interacting, but distinguishable, subsystems of memory—the sensory, perceptual, and reflection subsystems—that record these various types of information (Fig. 2).

The subsystems differ in the types of associations or relationships to which they are maximally sensitive. The sensory system develops associations involving elementary aspects of perception such as brightness, location, and direction of movement, and probably plays a large role in many skills, such as developing hand–eye coordination, learning to make appropriate postural adjustments to changes in external cues, and learning other largely stimulus-driven tasks. The perceptual system records phenomenally experienced perceptual events, that is, objects in relation to each other. The reflection system records the active thinking, judging, and comparing that we do. It records our efforts to imagine what things look like in their absence or to organize them in categories. It records our attempts to control what happens to us and our commentary on the events that do happen to us. Within the reality monitoring framework discussed earlier, the sensory and perceptual subsystems

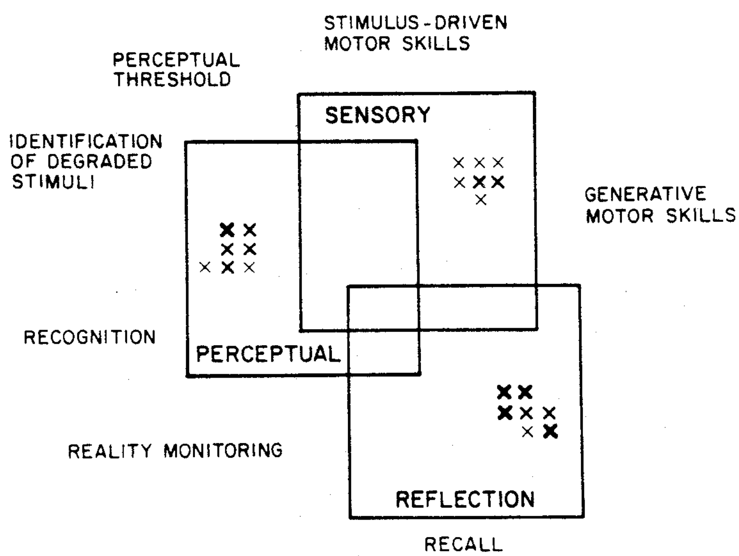

Fig. 2. A particular event creates entries in three subsystems of memory: sensory, perceptual, and reflection. The shading indicates activated entries, the darker the shading the greater the likelihood that the activation will recruit attention. Various memory tasks are listed near the subsystem(s) that they are most likely to draw upon. Reprinted by permission from Johnson (1983), *in The psychology of learning and motivation*. New York: Academic Press.

record externally derived events and the reflection subsystem records internally generated events.

Experience comes to us in recurring patterns. That is, there are frequent relationships among elements, or correlations between events. We never experience exactly the same event twice, but come to recognize and behave similarly toward similar events. A vast amount of our knowledge consists of representations of these recurring patterns. Such representations are often called *schemas*. The concept of schema and related concepts such as *cognitive context, script,* or *frame* are currently widely used in cognitive psychology, including cognitive social/personality (e.g., Abelson, 1976; Fiske, 1982; Markus, 1977) and cognitive therapy (e.g., Goldfried & Robins, 1983). They are attractive concepts, especially because they seem to capture the organized quality of knowledge and to provide mechanisms for inferential processes. However, one danger of the widespread adoption of terms such as *schema* to represent knowledge (just as it was a danger of the widespread adoption of *association* to represent knowledge) is that it tends to encourage the tacit assumption that all knowledge is fundamentally alike. The "laws" at the most general level may be the same (i.e., knowledge is a function of experience; generalization is a function of similarity), but such laws do not provide very effective guidelines for teaching and learning. They may represent global characteristics of the memory system, but they do not capture local differences in the system that determine exactly what is learned or remembered in a given set of circumstances. (What are the relevant experiences in this situation? What are the dimensions of generalization in this situation?) For example, it does not seem reasonable that schemas for a Spanish "r" sound, for the concept of a chair, for what to expect in a restaurant, and for how to behave toward authority figures or talk to a potential date are not different in any interesting and critical ways. It seems unlikely that all facts, beliefs, expectancies, skills, and feelings were acquired in the same way. By extension, it seems equally doubtful that they will most effectively be changed in the same way.

In short, a general consequence of a multiple-entry memory system is that the origin of knowledge, beliefs, or emotions will determine the conditions under which they will be available and also will determine effective methods of change. Furthermore, various components of knowledge or emotions (as in the beachcombing example) will not necessarily be simultaneously available or change at the same rate.

The MEM model addresses a range of issues and findings from the cognitive literature, such as distortion versus accuracy in memory, reality monitoring, the lack of correlation between various measures of memory and the dissociation between origin and other variables, the relation between memory and awareness, the relation between memory and emotion, and disruption of memory function (Johnson, 1983). For example, because various measures of memory do not necessarily tap into the same subsystems, they will not necessarily be correlated or affected in the same way by variables. Whether memory appears accurate or distorted will depend on whether perceptual or reflective entries are accessed, and the extent to which they are confused. Some learning will be accompanied by attention and involve a great deal of reflective activity; other learning will take place automatically, without awareness. Sometimes emotion will depend on reflective activity (Lazarus, 1982; Weiner, 1982) and sometimes it will depend largely on sensory/perceptual features of a situation (Zajonc, 1980). Finally, the MEM model provides a framework for investigating problems of disrupted memory function (e.g., schizophrenia, amnesia) and for interpreting the outcomes of such studies. The next section illustrates the importance of considering the origin of memories in the context of a discussion of emotion.

A. The Role of Subsystems in Emotion

Feelings, opinions, and attitudes may originate with experiences that are perceptual or that are more self-generated. For example, after a traffic accident, the squeal of brakes may be associated in the perceptual system with fear. Right after the accident you might start thinking about its consequences (e.g., you will miss appointments, lose work time, suffer the inconvenience of getting the car repaired). Frustration or anger may be associated with these reflective activities. Later, hearing the squeal of brakes may directly revive some components of the total affective response to the accident (e.g., the fear); the revival of other components (e.g., frustration) will be more dependent on recalling earlier reflective activity. That is, feelings may be associated with specific sensory and perceptual stimuli, or they may be associated with more extensive reflection. We can reexperience some of our original feeling by reperceiving some of the same stimuli or by regenerating what we thought. (This may, of course, be especially hard to do for some memories, such as those from childhood.)

Thus, the major assumptions about emotion in the MEM model are these: (1) Emotions are part of the information represented in memory, just as are perceptual features and other descriptive information. (2) Given components of a particular affective reaction to an event may be associated largely with one or another aspect of an event. Furthermore, these different relations between components of events and components of affect may be mediated by different subsystems of memory. (3) Access to emotional reactions depends largely on activation of the appropriate information in the appropriate subsystem. (These same points could be made with respect to action as well as emotion. That is, memory models eventually must represent action and emotion.)

Other investigators have assumed that emotion is stored in memory. Bower (1981) proposed that memories of events are represented by a semantic network, and that some of the nodes within the network represent various emotions. A later expansion of the model (Bower & Cohen, 1982) is based on the same assumption that long-term memory represents emotional reactions to an event: "Parsimony recommends the idea that emotional reactions to experiences should be stored along with nonemotional features in the same memory medium, according to the same storage principles, and retrieved by the same principles" (p. 397). Clark and Isen (1982) proposed a similar model.

Some investigators have further tried to specify "where" in the overall associative or schematic network emotion is stored. For example, Fiske (1982) suggested that affect is stored with the "generic knowledge structure" for a category. More in line with what is proposed in the MEM model, Scheier and Carver (1982) assume that affect may be encoded at various levels of abstraction: "if one imagines a hierarchy of levels of abstraction at which a stimulus can be construed, it seems clear that affective reactions can be encoded at virtually any level. Some levels of construal are almost immediately available to perception, but others may require a good deal of processing" (p. 179). In a similar spirit, Leventhal (1982) suggests that "emotion can attach to and interact with both perceptual and abstract cognition" (p. 122).

A study investigating the acquisition of affect by amnesics illustrates that it might be useful to think of emotion as associated with multiple subsystems (Johnson, Kim, & Risse, 1985). People suffering from Korsakoff's syndrome have had a long history of alcohol abuse resulting in a marked difficulty learning new information after the onset of the illness (anterograde amnesia). A particularly interesting aspect of this sort of amnesia (and others, as well) is that while some functions of memory are profoundly disrupted, others remain largely undisturbed. For example, Korsakoff patients find it virtually impossible to learn a paired-associate list made up of arbitrary pairs of words (Butters & Cermak, 1980), but appear to learn to read upside-down text (a difficult task) at a normal rate (Cohen & Squire, 1980).

One thing many situations resulting in normal memory capacity in amnesics have in common is that they draw on relatively nonreflective processes. They require little reflection either during the initial exposure to the material or during the subsequent test for memory. That is, the tasks are largely perceptual and stimulus driven. In the MEM framework, performance in such situations is supported by entries in the sensory and perceptual systems, leading to the suggestion that these systems are relatively intact in Korsakoff patients and that the major disruption is in the reflection system.

With relatively intact sensory and perceptual systems, amnesics should be capable of acquiring affective reactions, but they should show a deficit in those situations in which the affect depends greatly on reflective activity. To test these predictions, we developed two situations that we expected should vary in the relative amounts of perceptual and reflective involvement in establishing affective reactions in normal subjects. In one, we looked at the development of preferences for previously unfamiliar melodies. We expected this would be a good example of the type of affective response that may develop in the absence of extensive reflective activity. In the case of melodies, preferences often feel like relatively direct responses to perceptual qualities of stimuli. We used the exposure effect paradigm (Zajonc, 1968); Zajonc has reported studies showing that preferences in normal subjects build up with mere repeated exposures to stimuli such as melodies, even when subjects cannot recognize having experienced the stimuli before. We expected that Korsakoff patients should be relatively normal in developing preference through mere exposures in this type of situation. In our experiment, both Korsakoff patients and control subjects (matched for age and education) liked melodies we had previously played for them better than new melodies. Most importantly, there was no group difference: the exposure effect shown by Korsakoff patients was equal to that shown by control subjects. In contrast, our Korsakoff subjects showed the usual deficit relative to normal subjects in their ability to discriminate melodies which they had heard before from melodies which they had not heard before.

In the second situation, we devised a task that we thought would be much more likely to draw on reflective functions. The subjects were shown pictures of two young men and were asked to give their impressions of each by rating him on several characteristics, such as honesty, politeness, intelligence, and optimism. Then subjects heard a few paragraphs describing events in the life of each person. One man was depicted as a "good guy" (he helped his father, he got a Navy commendation for saving someone's life, etc.), and the other was depicted as a "bad guy" (he stole things, broke his wife's arm in a fight, etc.). After a retention interval, the patients were shown each picture again and were asked about their impressions. In all, they heard the biographical information three times and the retention interval between the last exposure to the biographical information and the final impression ratings was approximately 20 days.

Prior to the biographical information, both normal and Korsakoff subjects rated the good and bad guy equally (as would be expected because the assignment of pictures to autobiographical "facts" was counterbalanced). After the normal subjects heard the biographical information there was a dramatic change in the ratings, with the good guy being rated more favorably and the bad guy less favorably. For the Korsakoff subjects there was also an interaction between time and the man being rated; the ratings started out the same for the good guy and the bad guy and then diverged significantly, but the effect was much smaller than that shown by the controls. We also assessed memory for the biographical information. The control subjects recalled about 36% of the information they had heard and the Korsakoff subjects recalled virtually nothing.

In this second situation, Korsakoff patients clearly developed less extreme impressions of the two men compared to controls. In contrast, the development of preferences for melodies in Korsakoff patients was the same as that in normal controls. Differences in the results of the two situations are interpretable within the MEM framework. Compared to the melodies, in developing preferences for people there is much more room for reflection functions to operate, especially when the subject is receiving specific details about the lives of the people. Some affective responses are presumably tied to perceptual features of the pictures. Other components of the affective reaction are presumably tied to whatever reflection activities subjects engaged in while hearing the autobiographical information (e.g., evaluating the severity of misdeeds, comparing the men to other people subjects have known, etc.). Later reinstatement of the perceptual cues from the pictures should serve to revive some affective components. Other aspects of the total affective response should depend on reinstatement of the previous reflective activity. Normal subjects could cue themselves with recall of specific autobiographical details and should therefore have a more embellished affective response.

At first, the suggestion here that specific recall contributes to emotional response may seem at odds with an apparently well-supported conclusion in the literature on affect and cognition that recall and evaluation are independent (Anderson & Hubert, 1963; Dreben, Fiske, & Hastie, 1979; Fiske, 1981, 1982). For example, Dreben *et al.* asked subjects to rate their impressions of people on a scale from most to least likeable after hearing several sentences about each person (e.g., "Alan bought groceries for an elderly lady next door who was ill"). Afterward, subjects were asked to recall the sentences. The weight that a particular piece of information had in determining the impression was unrelated to the probability it was recalled. Fiske (1982) suggests that when instances of a concept are encountered, whatever affect occurs is linked to the category to which the instances belong. Hence, individual instances (encounters or attributes) do not have to be recalled in order to generate affect, only the "top level of the schematic structure," that is, the category. I would agree that specific recall is not necessary for affective response. In fact, the MEM model provides one mechanism by which this is possible, namely, the idea that different components of affect may be mediated by different subsystems. However, it seems doubtful that recall of specifics does not contribute to affect at all. Global affective judgments could be mediated by an averaged, schematized concept, as Fiske suggested. Such a mechanism might be sufficient for making relative affective judgments, e.g., do I like Nixon better than Reagan? On the other hand, absolute levels of affect (how "steamed-up" I get), and perhaps subtle variations in quality of affect, very likely depend on the availability of specific information.

B. Analyses of Learning and Memory in Clinical Contexts

The foundation of behavior therapy is that people have become what they are largely through learning processes. Consequently, if we want to change what we feel and do, we need procedures based on an understanding of how the learning and memory system works. Within the field of experimental psychology in the last 20 years, the most dramatic change in analyses of learning and memory processes has been a shift in emphasis from external factors (e.g., stimuli) to internal factors (e.g., thought). This shift has been paralleled by the evolution of cognitive–behavior therapy (Goldfried & Davison, 1976; Kendall & Hollon, 1979; Mahoney, 1974). These developments are encouraging but could easily lead to a reactive deemphasis of the amount of control exhibited by external factors. Even very complex, highly "cognitive" behavior may be supported in part by fairly "low-level" sensory/perceptual entries in memory. MEM emphasizes both external and internal factors at the expense of neither.

Analysis of perceptual features and analysis of thought processes are not in opposition, but complementary (Johnson & Raye, 1981; Johnson, 1983). Within the MEM framework, perception and thought contribute different components to a memory, knowledge, belief, or emotion. The relative weighting of these components in a given situation should determine, for example, whether behavioral (e.g., *in vivo* exposure) or more cognitive (e.g., restructuring) therapies are most appropriate. Furthermore, consideration of similarities and differences between perception and thought might generate hypotheses about functional cues. Phobias, for example, are often treated by having the client imagine the feared situation, in combination with relaxation training. "The assumption is that an imaginary aversive scene is a functional equivalent of the real situation; enabling a person to confront a fantasized representation of what he is afraid of is assumed to be analogous to his learning to face the situation in real life" (Goldfried & Davison, 1976, p. 113). There is reason to believe, however, that perception and imagination differ in significant ways. The fact that imaginal procedures work suggests that some stimuli that elicit anxiety are rather schematic perceptual features of events, capable of being imagined by most people. Another interesting possibility is that the functional cues may not really be perceptual at all. Anxiety may be attached to self-generated processes (e.g., anticipations of catastrophies) and not to specific situational cues themselves (Ellis, 1979). Imaginally based techniques (and other cognitive techniques) should work best where the most direct cues for the unwanted emotion are self-generated.

Again, the multiplicity of entries that may support learning should be emphasized. This is especially clear in the case of complex skills, such as social skills. Some components of skilled social behavior are coded in the reflective system; for example, the individual may prepare in advance a number of topics to introduce into the conversation. These can be practiced in imagination and hence be readily available for later use. Other components of skilled social behavior may rely more on ongoing perceptual cues. For example, knowing when to maintain eye contact and when not to, what distance between people is acceptable, what posture is appropriate to the situation, all probably involve relatively subtle cues. The relevant cues may be hard to specify, but with *in vivo* practice and feedback the appropriate cues may be picked up by the perceptual system.

A number of writers (e.g., Goldfried & Davison, 1976) have emphasized that behavioral therapy does not consist simply of a fixed number of laboratory-based techniques applied in well-defined situations. Rather, they point out that the therapist must spend much time and effort attempting to isolate and define the problem(s) and must continually be inventive about suggesting potential courses of treatment. I do not think this lack of precision can be entirely attributed to a temporary state of ignorance in the field. It reflects, rather, the nature of the human cognitive system. The therapist must assess each new situation and be inventive because learning (and relearning) in any given situation is a specific set of responses, mediated by different subsystems, to specific features of that situation. Research findings and cognitive theories can suggest the sorts of relations to look for, but not which of these are most critical in a given situation. A major role of theory is to alert the therapist to factors that might otherwise go unnoticed or might receive insufficient attention. One theme of this article is that the origin of information is an important consideration in assessing knowledge and in the process of change. We have only just begun to explore the consequences of a memory system that records both perceptual events and those we generate ourselves.

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