

BY BRUCE BOWER

College students usually do not undergo hypnosis before taking a test, but six groups of students at Stanford University did just that recently. They were not taking an academic test, though. They were taking an emotional test.

Under the direction of psychologist Gordon Bower, who describes his work in the February AMERICAN PSYCHOLOGIST, the hypnotized students were asked to put themselves into a happy mood by imagining scenes in which they had been "delightfully happy." For some, it might have involved a memory of scoring the winning goal in a soccer match, for others maybe an exhilarating horseback ride along the beach.

While still in the happy mood the students were asked to learn a 16-item list of unrelated words. After completing this task, some groups learned a second list in their original happy state and the rest learned the new list in a sad mood that had been hypnotically induced by the same imaginative technique.

To end the experiment, the students were tested for recall of the first list. Some were "happy," and had been throughout the entire experiment. Others were told to put themselves back into a happy mood after learning the second list in a sad mood. And some remained "sad" after learning the second list, although they had learned the first list while "happy."

Bower then redid the experiment, but had the students learn the first list in a sad mood. The results were the same. Recall for the first list was better if a student was in the same mood during recall as when the list was first learned. This "mood-state-dependent memory" was even stronger if the second list had been learned in the opposite mood.

Memories acquired while the students were happy, for example, were mainly accessible if they were recalled in a happy state. But the same memories suffered in recall when the students were sad.

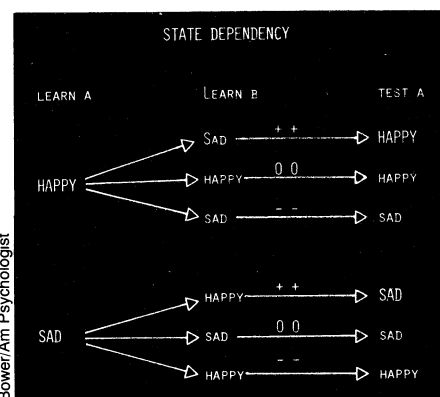
"It is as though the two states constitute

different libraries into which a person places memory records," says Bower, "and a given memory record can be retrieved only by returning to that library, or physiological state, in which the event was first stored."

Additional clues to the organization of these memory libraries were found. Recall of personal experiences recorded in a daily diary and childhood experiences was found to be greatly dependent on the students' mood at the time of recall. Happy persons remembered many more pleasant than unpleasant experiences. This pattern held less strongly for sad persons.

Delving further, it was found that angry people generated angry associations to neutral words, told hostile stories about ambiguous pictures and were prone to find fault with others. Also, if readers of a story were sad, they paid more attention to sad sections of the material and recalled more about sad characters.

Some of these findings are not so surprising, but they provide a beacon for psychological researchers who have tended to study attention, memory and thinking without taking into consideration the role of emotion and motivation.



The diagram shows the three stages of Bower's experiment. Memory for list 1 improved when subjects' mood was the same during learning and recall.

Despite this fragmentation of inquiry, "state-dependent" effects stand firmly on a body of previous experimental findings. Memories acquired under the influence of mood-altering drugs such as marijuana, amphetamine, Thorazine, alcohol and barbiturates have proved to be accessible only when the same drug is taken again. Herbert Weingartner and colleagues at the National Institute of Mental Health tested the recall of psychiatric patients undergoing broad swings between manic and depressed states and found that the greater the change in patients' emotional states, the more they forgot a list of word associations they had come up with four days before. A number of other investigators, using both animals and human beings, experimental settings and clinical populations, have found that the ability to check out necessary volumes of memory from one's "library" is at times dependent upon the mood one was in when the memories were filed.

This effect is especially apparent when subjects are tested for free recall ("What were the words in the list that you learned yesterday?"). It is not strong when subjects are tested for recognition ("Is this one of the words in the list you learned yesterday?"). Experiences may remain locked in memory storage, only to be retrieved when the right emotional state, with its related physiological changes, comes along.

Emotions, of course, are only part of the environment in which learning and recall take place. The rest of the environmental "context," as it is called by investigators, can affect memories similarly—even if the context is under the sea. Alan Baddeley and colleagues of the Medical Research Center in Cambridge, England, found that scuba divers who learned lists of unrelated words either on the shore or 10 feet below the ocean's surface were able to recall significantly more words when they were in their original learning environment.

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## ... Memory

ment. Many other environmental effects on memory have been reported, but there is no systematic understanding of how the "context" works.

"The word 'context' is usually a cover word for 'ignorance,'" says Bower. "It's a hunting license to look for whatever you're interested in."

But enough examples remain in the scientific traps that have been set to suggest that mood plays an important role in memory retrieval. Some researchers add that "context-bound" memories of unique personal experiences and events are more susceptible to emotions than are "context-free" memories of general rules that guide behavior and language.

Others warn that emotions are experienced differently by college students and manic-depressives. Generalizations about the effects of mood on memory may be premature.

And some, such as Elizabeth Loftus of the University of Washington in Seattle, say that emotional effects on memory are "somewhat fragile." To gauge those effects she is conducting an experiment in which college students, those staples of academic research, are shown an upsetting, violent film. Later, the students reinstate their mood during the movie by imagining its scenes and going over their initial reactions. Their memory for what happened during the movie is then measured.

"We may find no effect of the emotional state on memory," says Loftus, who adds that some studies show that a high level of anxiety tends to shorten the attention span and hinder memory.

Whether Loftus finds a "mood-dependent" effect or not, it appears that the assumption that memory fades over time is not true. It grows. Every time an event is recalled it changes and takes on new shades of meaning from succeeding events, increased understanding, a new context or emotional state, suggestions by others and other people's recollections. Research, much of it done by Loftus, suggests that these factors help to produce the variety of conflicting memories drawn upon by eyewitnesses to the same accident or crime.

This malleability of memory puts a crimp in scientific efforts to understand the relationship of mood to learning and recall. Also, there are disagreements over what is the best way to experimentally induce emotions. Some investigators prefer hypnosis, others insist drugs work better and several use less direct means, such as the "upsetting movie."

But Bower stands by his findings. "The main point of my article," he says, "is that with one trivial manipulation in the laboratory we produced patterns of state-dependent memory that were similar to what has been observed among long-term manic depressives." □

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