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## Affect and Accessibility [and Discussion]

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## Affect and accessibility

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Depressed patients experience thoughts with predominantly negative content. This could be because depressed mood increases the accessibility, or availability, of negative memories relative to that of positive memories. Investigations of the effects of experimentally induced and naturally occurring variations in mood on the recall of memories of personal experiences found results consistent with this suggestion; in depressed mood the latency of retrieval of positive memories was increased, the probability of retrieval of positive memories was decreased, and the probability of retrieval of negative memories was increased. The recall of certain positive and negative words was also found to be differentially affected by mood at recall.

It is hypothesized that the effects of current mood on accessibility depend on the extent to which the events to which memories relate have previously been associated with different moods. Differences in the effects of mood on accessibility consistent with this suggestion have been obtained.

### INTRODUCTION

Depressed patients report a high frequency of thoughts with negative content. It has been suggested that such negative thoughts and interpretations of experience play an important role in the maintenance of depression (Beck *et al.* 1979), and psychological treatments aimed at modifying such negative thinking have shown encouraging results (Beck *et al.* 1979). An understanding of the processes by which negative depressive thinking arises is thus of some relevance to the improvement of psychological treatments for this condition. A possible explanation for this phenomenon, which my group has been looking at for some time, is that depressed mood in some way biases the accessibility or availability of information. If, in depressed mood, negative information and cognitions become more accessible and positive information and cognitions become less accessible, we would expect to see an elevated frequency of negative thoughts in depressed patients. This issue is, of course, directly related to those discussed in the paper presented to this meeting by Professor Bower. Our own work started quite independently of his but has shown some very close parallels.

### INDUCED MOOD AND RETRIEVAL OF PERSONAL MEMORIES

The starting point for our investigations was a study reported by Lloyd & Lishman (1975). They had taken a group of depressed patients and asked them to recall memories of personal experiences that were associated in some way with each of a series of neutral stimulus words. For each word the subject was told to recall either a pleasant or an unpleasant experience and the latency to retrieve the memory was timed. Using latency of retrieval as a measure of accessibility, Lloyd & Lishman found that with increasing levels of depression the accessibility of negative memories increased while that of positive memories decreased. Thus their study

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provided evidence of a correlation between depressed mood and accessibility. However, there are obvious problems in interpreting correlational evidence.

Our first study (Teasdale & Fogarty 1979) aimed at overcoming these problems of interpretation. Using a procedure similar to Lloyd & Lishman's, we looked at the effects on accessibility of experimentally manipulating mood state in normal subjects. We induced elated and depressed mood by using a variant of a procedure developed by Velten (1968). In this

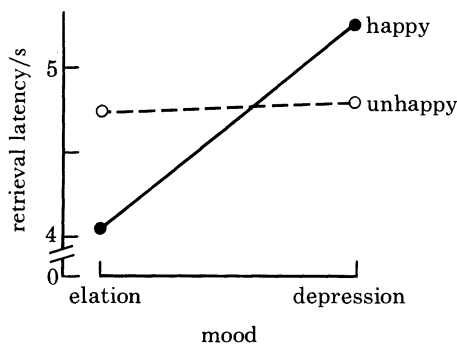


FIGURE 1. Mean retrieval latencies of pleasant (●) and unpleasant (○) memories in elated and depressed moods. (Data from Teasdale & Fogarty (1979).)

procedure subjects, by concentrating on a series of cards bearing mood relevant statements, such as 'I feel down-hearted and miserable' or 'I feel so good I almost feel like laughing', are able to get themselves quite effectively into elated or depressed moods. Once in the mood state, subjects were presented with the neutral stimulus words and asked to recall memories of past personal experiences, specified to be either pleasant or unpleasant, to each word. Figure 1 shows the effect of the elated and depressed mood inductions on retrieval latency. It can be seen that there was an effect of induced mood on the relative accessibility of pleasant and unpleasant memories but that, in contrast to the findings of Lloyd & Lishman, the effects appeared to be largely restricted to pleasant memories.

In our next experiment (Teasdale *et al.* 1980) we modified the procedure of the preceding experiment so that we could examine the effects of induced mood on the probability of recalling pleasant and unpleasant memories. After elated or depressed mood had been induced, the neutral cue words were presented but this time subjects did not receive instructions to indicate whether the memory retrieved should be pleasant or unpleasant. Instead, as soon as they indicated that they had retrieved a related memory they gave a very brief description of the experience. The mood was then reinduced and the procedure was repeated for the next stimulus word. At a subsequent session, on another day, in normal mood, subjects were presented with the cue words and the brief descriptions they had given in elated and depressed mood in random order. For each they were asked to rate how pleasant or unpleasant the original experience to which the memory referred had been. By having subjects rate all the memories in normal mood it was possible to avoid confounding the effects of induced mood on accessibility with the direct effects of mood on ratings of pleasantness or unpleasantness. The percentage of memories retrieved in elated and depressed moods that were rated as pleasant and unpleasant are shown in figure 2. It can be seen that, relative to elated mood, in depressed mood the probability of retrieving happy memories was decreased and of retrieving unhappy memories was increased.

In both these studies measures intended to reflect the accessibility of positive and negative memories were affected differently by elated and depressed mood inductions. Our favoured interpretation was that this was an effect of the different moods induced. Consistent with this, internal analyses in both studies showed that subjects in whom the inductions were most effective in producing differences in mood also showed the largest effects on measures of accessibility. However, an alternative possibility was that the results observed represented effects

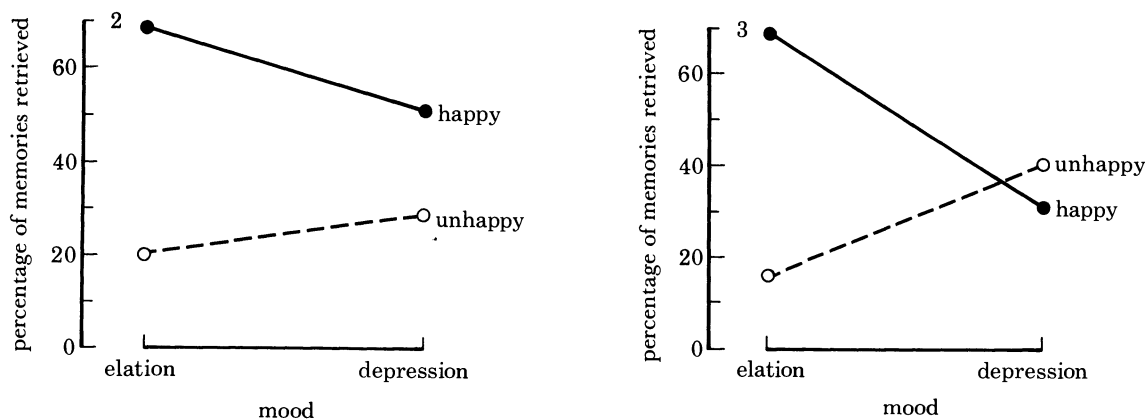


FIGURE 2. Mean percentage of memories retrieved that were of happy incidents (●) and mean percentage of memories retrieved that were of unhappy incidents (○) in elated and depressed moods. (Data from Teasdale *et al.* (1980).)

FIGURE 3. Mean percentage of memories retrieved that were of happy incidents (●) and mean percentage of memories retrieved that were of unhappy incidents (○) in elated and depressed moods. (Data from Teasdale & Taylor (1981).)

of the mood-induction procedures themselves rather than the moods they induced. For example, some of the mood induction statements were of the form 'Life is so full and interesting it's great to be alive!' It is possible that such statements may have directly primed the class of happy previous life experiences and that these effects, rather than any effects of mood, may have been responsible for the results observed. The internal analyses showing a relation between the effects of the inductions on mood and on accessibility suggested that this was unlikely. However, the issue was sufficiently important for us to repeat the previous study with the use of mood-induction procedures from which all reference to the subject's life experience had been eliminated, leaving only statements directly referring to affective state, such as 'I feel down-hearted and miserable'. Figure 3 shows the results obtained in this study (Teasdale & Taylor 1981). It can be seen that the effects of mood on probability of retrieving happy and unhappy memories were, if anything, even greater than in the previous study. The similarity of these results to the previous study encouraged us to believe that we were seeing effects of mood rather than of the induction procedures themselves. Consistent with this view, an internal analysis again showed that the effects of the mood induction on measures of accessibility were greatest in subjects where the inductions had been most effective at creating different mood states.

## RETRIEVAL OF PERSONAL MEMORIES IN DEPRESSED PATIENTS

Another way to check whether it is changes in mood that affect accessibility is to study the effects of naturally occurring rather than experimentally contrived variations in depressed mood. To do this in depressed patients has the further advantage that it allows us to check the relevance of our studies on normal subjects to depression of clinical severity. Some depressed patients demonstrate marked regular variation in their mood from one time of day to another. Some patients are at their worst in the morning, others in the evening. These diurnal variations

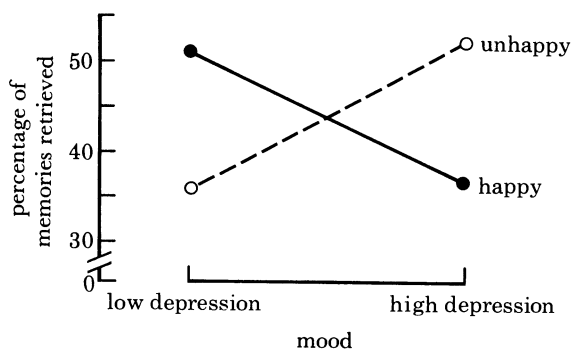


FIGURE 4. Mean percentage of memories retrieved that were of happy incidents (●) and mean percentage of memories retrieved that were of unhappy incidents (○) depending on whether retrieval occurred in the more depressed phase or in the less depressed phase of the diurnal cycle. (Data from Clark & Teasdale (1982).)

in mood are generally believed to be of internal rather than environmental origin. My colleague David Clark had the idea of taking advantage of these diurnal variations to study the effects of mood on accessibility, with the same measures of probability of recall as in the studies of induced mood (Clark & Teasdale 1982). Each patient was seen twice, once during the most depressed phase of his or her diurnal cycle, once during the least depressed phase. The memories retrieved on both occasions were rated for pleasantness in the same mood state at the end of the study. Most of these memories dated from a period some considerable time before the experiment. The results are shown in figure 4. It can be seen that the effects of natural variations of clinical depression on probability of recalling happy and unhappy memories are very similar to those observed for induced mood states. An internal analysis again showed a significant relation between the extent to which mood actually differed on the two occasions of recall and the extent to which probability of recall was affected.

## MOOD-STATE DEPENDENT LEARNING?

Our work up to this point clearly indicated that variations in mood, both experimentally induced and naturally occurring, did indeed have differential effects on the accessibility of memories of previous happy and unhappy personal experiences. How did this arise?

From the beginning of our work we had favoured an explanation in terms of state dependent learning or context-specific encoding and retrieval with mood as the relevant state or context (Teasdale & Fogarty 1979). Considerable evidence suggests that if material is originally incorporated into memory in a particular context, for example a particular drug-induced state, then subsequent retrieval of that information is better if that context is reinstated than in other

contexts or states (Tulving & Thomson 1973). It was attractive to view the differential effects of mood on accessibility of pleasant and unpleasant personal memories as further examples of state dependent learning; pleasant experiences would tend to have occurred in the context of happy mood and so would be more accessible when this state was subsequently introduced than when a depressed mood was reintroduced. The converse would be true for unpleasant events and unhappy mood.

This suggestion seemed quite consistent with our results for memories of personal experiences. However, at first glance, it seemed to have difficulty accounting for some results that we obtained when we began to look at the effects of induced mood on recall of verbal material.

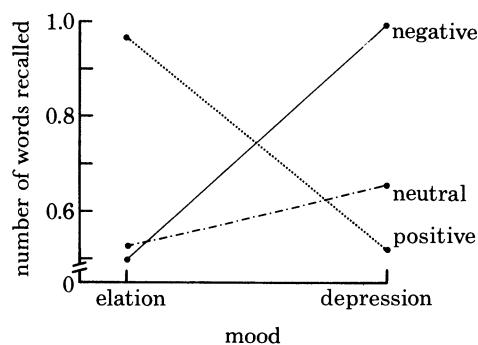


FIGURE 5. Mean number of positive (···), negative (—) and neutral (---) personality trait words recalled in elated and depressed mood. (From Teasdale & Russell (1983).)

#### INDUCED MOOD AND WORD RECALL

Our first experiment in this area (Teasdale & Russell 1983) followed up some findings of a previous investigation by Alice Isen and her colleagues (Isen *et al.* 1978). In normal neutral mood, subjects were exposed to a single presentation of a list containing positive, negative and neutral personality trait words. Examples of positive words were 'kind' and 'considerate', and examples of negative words were 'impolite' and 'ungrateful'. Either happy or depressed mood was then induced and subjects were asked to recall as many of the previously presented words as possible. After a break, the procedure was repeated with a different word list and the alternative mood induction. Results are shown in figure 5. More positive trait words were recalled in elated than in depressed mood; the converse was true for negative trait words, while recall of neutral trait words was unaffected by induced mood. We subsequently replicated these effects for women by using a between-subjects design and a musical rather than verbal mood-induction procedure (Clark & Teasdale 1983).

It was not immediately clear how an explanation in terms of state dependent learning could account for these results, as the paradigm used in this experiment differed in important respects from the normal state dependent learning paradigm. In the latter, material learnt in mood A would be better recalled in mood A than in mood B, and the converse would be true for material learnt in mood B. These effects would be similar for all types of material. In the present paradigm, positive, negative and neutral words were all presented in the same neutral mood state within the experiment and subsequent recall of all words occurred either in induced happy mood or in induced depressed mood. Within a given mood induction, the change in mood context from encoding to retrieval would have been the same for all three classes of words. None



the less, recall mood appeared to have powerful differential effects on the extent to which positive, negative and neutral words were recalled. The effect could not be accurately described as state dependent learning. However, the material best recalled in a given mood state was clearly that most congruous with the mood. For convenience, we can refer to this effect as one of mood congruous recall.

#### BOWER'S ASSOCIATIVE NETWORK THEORY OF MOOD AND MEMORY

At the time that we were thinking over the results of our previous experiment, Bower published a paper in which he outlined an associative network theory of mood and memory (Bower 1981). This had the great attraction to us of being able to explain both mood-state

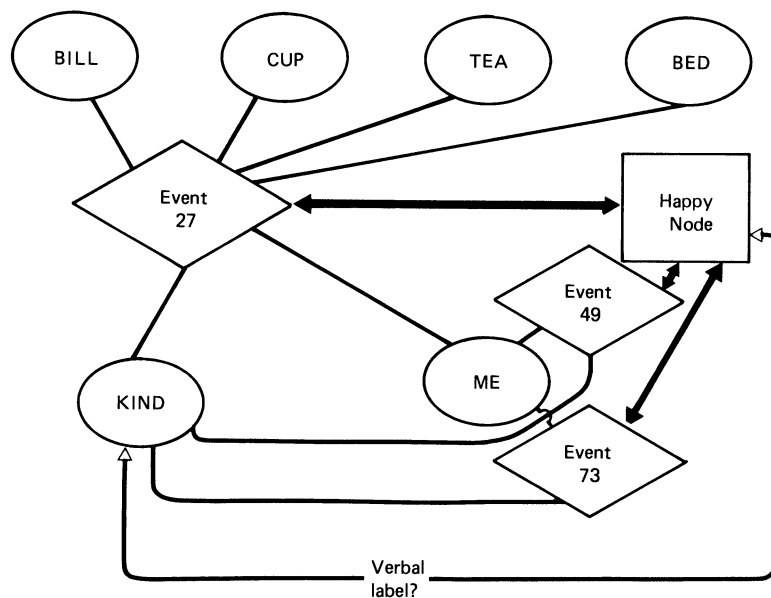


FIGURE 6. Highly simplified portion of the associative network representing the memory of three happy events: event 27 = 'I thought Bill was *kind* when he brought me a cup of tea in bed'; event 73 = 'Mary said "You are *kind*" when I helped look after her children'; event 49 = 'I thought Paul was *kind* when he sent me flowers'. For clarity of presentation, concept-event linkages are only shown for event 27, and propositional relations between concepts have been omitted.

dependent effects and mood congruity effects. It achieved this by proposing that a form of mood-state dependency applied not only to memories of words as events, in the sense of visual or auditory stimuli encountered at particular times and places, but also to activation of the concepts denoted by the words. I can best explain this by summarizing Professor Bower's theory and illustrating its application to the mood congruity effects we obtained. Like other semantic network theories of long-term memory, Bower suggested that human memory can be modelled 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 propositions are recorded in memory by establishing associations among the concepts used to describe the event. So, in figure 6 we see a highly simplified portion of the associative network representing the memory of a woman. Three events are illustrated, each represented by the intersection of connections from pre-existing concepts. For clarity of presentation, the

propositional relations between concepts have been omitted. A person is conscious of the sensations, concepts and propositions whose current activation level exceeds some threshold. It is proposed that activation spreads from one concept to another, or from one proposition to another, by associative linkages between them. An analogy would be an electrical network in which terminals correspond to concepts or event nodes, 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 in the network. Activation of a node can occur either as a result of presentation of the corresponding stimulus pattern or by prior activation of an associated thought. Bower incorporated the effects of mood or emotion into this semantic network approach by proposing that each distinct emotion such as joy, depression, or fear has a specific unit or node in memory. These emotion nodes can be activated by physiological or symbolic verbal means. Each emotion node collects together aspects of the emotion connected to it by associative links. Among these are propositions describing events from one's life during which the emotion was aroused: the emotion at the time of an event becomes associated by contiguity and causal belongingness with the evoking event. Thus, in figure 6, three events are shown, each of which made the woman feel happy and so established a link with the happy emotion node. Activation can flow through the links from the emotion node to representations of events, and vice versa. The extent to which activation can pass along these linkages is related to the extent to which the mood, concepts and clusters of propositions representing events have been previously associated.

I shall apply this model to our experimental finding of mood congruous recall of personality trait words. Positive and negative trait words often denote concepts related to personal evaluation. For this reason, it is likely that activation of such concepts will have occurred in the encoding of events associated with distinct emotional states, congruent with the hedonic tone of the concepts. For example, the three events represented in figure 6 involved positive interpersonal evaluations which both activated the node for the concept 'kind' and made the woman feel happy, activating the happy emotion node. As a result, direct or indirect associative links between the 'kind' node and happy emotion node would be strengthened. When the woman subsequently feels happy, for example as a result of the mood induction in our experiment, activation will spread out from the happy emotion node through associative links to the representations of these events. Activation from these event nodes will subsequently converge through associative links on the node for the concept 'kind'. In our experiment, this node, along with those corresponding to the other words in the word list that we presented, will have been recently directly activated by presentation of the word itself. In subjects recalling in induced happy mood, this direct activation will be supplemented for positive trait concepts by activation originating from the happy emotion node. This will not be available for words corresponding to neutral and negative concepts because these will not previously have been preferentially activated in happy moods. It follows that, in happy mood, positive trait words will be more available for recall than negative or neutral words. Conversely, negative trait words will be more available than positive or neutral in induced depressed mood. In other words, although subjects encounter positive, negative and neutral words in the same mood context in the experiment, the concepts which the three types of word denote will have been associated to considerably different extents with elated and depressed moods in subjects' lives before the experiment. The associative network theory of mood and memory accounts for mood congruous recall in terms of such differential prior associations of moods and concepts.



## DIFFERENCES IN MOOD CONGRUOUS RECALL

If effects of current mood state on the accessibility of concepts depend on the extent to which the concepts have previously been activated in association with distinctive mood states, it follows that there are likely to be differences both between people and between concepts in the effects of mood on accessibility. This is because individuals are likely to differ in their life experience, and because not all negative concepts are likely to have been equally activated in bad moods, nor will all positive concepts have been equally activated in good moods. It is worth noting here that although at least three separate studies (Isen *et al.* 1978; Teasdale & Russell 1983; Clark & Teasdale 1983) have demonstrated mood congruous recall for personality trait words, with their obvious personally evaluative connotations, it has been more difficult to demonstrate such effects with other types of verbal material (see, for example, Bower *et al.* 1982).

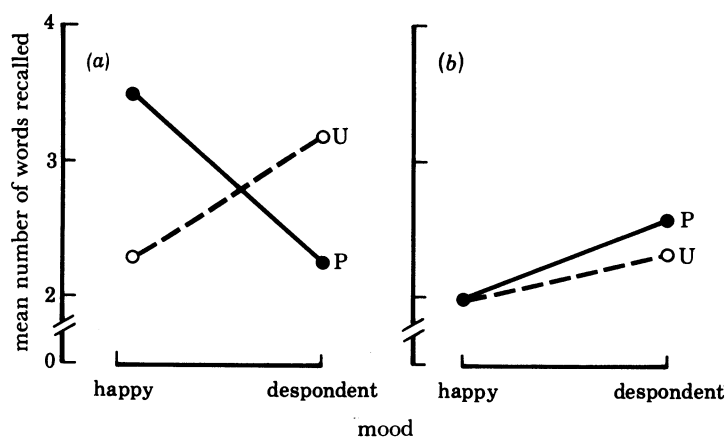


FIGURE 7. Mean number of pleasant (P) and unpleasant (U) trait words recalled by (a) women and (b) men in happy and depressed moods. (Data from Clark & Teasdale (1983).)

Let us now consider differences between individuals. While most people would agree that it is not good to be stupid, for example, the actual links between the node for this concept and the sad emotion node are likely to be quite different in someone who has largely experienced the concept as applied to others than in someone who, as a child, was repeatedly told by overcritical parents that he or she was stupid, and felt rejected and sad as a result. The concept 'stupid' is much more likely to become activated and accessible in subsequent depressed moods in the latter case than in the former. Such individual differences in the type of concepts and memories that become accessible in depressed mood could be an important factor in determining whether an initially mild depressed mood lifts or becomes more intense and persistent (Teasdale 1983). Because depression is more common and persistent in women than in men, we were particularly interested in the possibility of sex differences in the effects of mood on accessibility. For this reason, my colleague David Clark conducted an investigation (Clark & Teasdale 1983) to pursue trends of sex differences emerging from our earlier work. The design was essentially similar to our earlier study except that an incidental recall paradigm was used. Male and female subjects were presented with positive and negative words, including personality trait words, in neutral mood. Recall was tested after elated or depressed mood had been induced by a musical mood induction. The results are shown in figure 7. It can be seen that whereas the women showed clear evidence of a differential effect of recall mood on the number of pleasant

and unpleasant trait words recalled, men showed no trace of this effect. This sex difference in recall could not be explained in terms of differences between men and women in the effectiveness of the mood induction or in the rated pleasantness of the words, because men and women were very similar in both these respects. It seemed that we had a genuine sex difference. The associative network model suggested that this was a result of differences between men and women in the extent to which concepts related to the trait words had previously been activated in elated or depressed mood. Could we demonstrate this? It is obviously very difficult to get a direct measure of this aspect of previous experience. However, it is possible to get subjects to estimate how frequently they normally use concepts. When Clark did this he found, as he had predicted, that women reported using concepts related to the trait words employed in the experiment significantly more often than men. Further, within the women, there was a significant positive correlation between the extent to which women reported using a concept and the extent to which the related word showed a difference in recall between elated and depressed moods. The more frequently used concepts showed the biggest effect of mood on accessibility. Presumably, the more often a mood-related concept is used, the more chance it has to be activated in association with congruent mood, and the stronger will be the associative links established with the emotion node. As a result of greater activation flowing through these links, words related to frequently used mood-related concepts will be more likely to show effects of recall mood in this type of experiment. Thus, to the extent that we were able to put it to the test, the associative network model's explanation for sex differences in effects of mood on accessibility was supported.

#### CONCLUSION

I shall conclude by returning to the problem with which we started: can the negative thinking of depressed patients be explained by effects of depressed mood differentially biasing the accessibility or availability of positive and negative cognitions? I think we can conclude fairly confidently that, at least as far as memory is concerned, our studies have demonstrated effects of mood state on the relative accessibility of positive and negative material. The associative network model of mood and memory proposed by Bower, and by others such as Clark & Isen (1982), appears to account satisfactorily for the data currently available. Further, it can be fruitfully applied to the issues of vulnerability and maintenance in clinical depression (Teasdale 1983).

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### Discussion

MARY PICKERSGILL (*Bedford College, London, U.K.*). It is clearly not purely accidental that recent experiments on state-dependent learning, whether with depressed patients, mood induction in normal subjects, or normal subjects varying in self-rated depression, have all examined recall along the dimension(s) thought to be relevant to the ‘disorder’ of clinical depression and its treatment by cognitive means, that is happy–pleasant to unhappy–unpleasant. One can, however, rate mood or ask subjects to rate their own mood along a number of other dimensions, some usually found to be correlated, for example anxiety and depression, and others not. It is, incidentally, questionable whether the words used as stimuli to be recalled and possibly also to evoke memories can be so easily categorized: pleasant words may exemplify positive meaning of relatively little personal emotional significance and it is quite possible for an individual to rate the memory he has in response to a word generally rated as pleasant as ‘sad’ or ‘painful’. However, before asking on what dimensions words recalled can be related to emotions, one should perhaps raise the more fundamental question of how many emotional states there are, on which learning might be expected to be dependent, and also how much of the variance in individual differences in recall may be accounted for by a particular state-dependency? Further, might there be a possibility of using the method in reverse, for example by correlating subjective ratings of the emotional content or hedonic tone of memories or words recalled with measures of subjective mood states taken before learning? This could offer a way of discovering which emotional dimensions or categorizations had most salience in the experimental situation.

S. M. LAVELLE (*Department of Experimental Medicine, University College, Galway Republic of Ireland*). As regards the number of different moods, one can consider the evidence from facial expression of emotions, which is thought to be biologically determined and innate. Analysis of expression reveals six cardinal emotions: joy, surprise, disgust, anger, fear and sorrow. Other emotions can be read as mixtures of these (Ekman & Friesen 1975).

Assuming that any mixture of emotions may obtain, the number of possible moods would approach  $(2^6 - 1)$ . Excluding the positive emotion, joy, and the neutral one, surprise, the number of negative moods would be  $(2^4 - 1)$ . If for any emotion, two levels of intensity are accepted, the number of possible moods would approach  $(3^6 - 1)$ . Excluding joy and surprise, the number of possible negative moods would be  $(3^4 - 1)$ .

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