Prime Time in Cognitive Psychology

by

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In this paper I will review some very fascinating, but very curious phenomena that are currently exciting great interest in cognitive psychology. These phenomena involve subconscious memory, memory without awareness, dissociation of memories, and paradoxical discrepancies in the memories of people suffering from amnesia produced by electroconvulsive shocks, or Korsakoff's syndrome, or alcoholism. I will also discuss how these ideas extend into areas of concern to behavior therapists, namely, unconscious influences upon how people judge the behaviors, interaction patterns, personal habits, and personality traits of others and themselves. I will finish by reviewing my research on emotions and their influence on memory and thought.

Before getting to the clinical material, I will review briefly some new material on priming, since it is needed to understand the clinical material. Priming is a very popular topic in cognitive psychology, although it is rarely mentioned in the behavior therapy literature.

Priming

Priming is what William James referred to as the awakening of associations. It is indicated by the speeding up of response to a stimulus by the earlier presentation of either that same stimulus or an associated one. In identity priming, the preceding or priming stimulus is the same as the target stimulus, which the person simply reads as fast as he can. In associative priming, the prime is associated to the target word. Thus, the word rabbit will prime the person's response to the associate, hare.

Priming occurs in many different ways. Some of these are listed in Table 1 for the primed word HARE. First is reading, which is speeded up by priming. Next is interference on the Stroop test: here, primed words interfere with the subject's task of naming the ink color in

which the word is printed. Third is reading inverted words: after priming, one is faster reading a word even when it is turned upside down and backwards. Next are lexical-decisions: after priming, people are faster to decide that HARE spells a real word as opposed to a nonword like HARL. Next is the spelling of homophones, of a word sound like "hare," which in English corresponds to two words, the rabbit *hare* and the *hair* on your head. People who have been talking about rabbits will spell the sound "hare" as the word H-A-R-E without noticing the other spelling. Next, priming appears when word-fragments with missing letters are used to retrieve whole words from lexical memory. People will select the primed word as the completion, although many others are possible, such as herd or hurt. Finally, priming affects perceptual identification of weak stimuli. For example, primed words have a lower threshold when briefly flashed in a tachistoscope. Similar effects occur when the word is degraded and masked. Thus, if we delete spots of ink from the outline letters of the word (e.g., deleting pixels from the computer display of the letters), primed words can be seen despite more degrading of the print.

Insert Table 1 about here

A Theory of Priming

The major theories of priming rely on something like the logogen theory of John Morton (1969), or semantic-network theories such as that of John Anderson (1976), which assume that words have corresponding internal representations in long-term memory called logogens or units. These units serve to collect together a variety of associations and to serve as a switching juncture to pass activation from one unit to another. Some of the relevant connections for a word like HARE are shown in Figure 1. When the word HARE is presented, either visually or in

sound, it accumulates evidence from its individual letters-in-position, or from its sound. Similarly, this word unit is associated to its concept or meaning, which also is connected to a synonymous word like *rabbit*. The connections between nodes in Figure 1 represent associations which pass activation from one node to others; these associations can be raised in strength when they are activated or used. An analogy is that the lines represent water pipes, the nodes represent reservoirs, and activation is like water that is pushed down the pipes with more or less pressure, with the water accumulating at the units where the lines come together. We will suppose that a word like HARE becomes available to consciousness whenever its unit passes a threshold of activation--whenever it accumulates enough water or evidence in its favor--at which time the person would be able to say "HARE".

Insert Figure 1 about here

In this model, priming can arise in several ways. First, having read HARE before, the letter-to-word connections, labelled #1 in the figure, will be strengthened for a while, before they slowly decay back to their baseline strength, which increases with the frequency of the word in the listener's reading sample. Think of this strengthening of a connection as opening up a bigger pipe, so more activation can flow per unit time. During this period of enhanced strength, presentation of HARE will produce a greater passage of activation along these letter-to-word input lines, thus making for faster reading of HARE. This strengthening of the letter-to-word associations will also explain the word completion result, when the model is given a few letters like H_R_. Because of priming, the H and R letters alone are now more strongly associated to the HARE unit than to alternative words, and so that word is retrieved sooner from the letters than are alternative completions. This theory also explains why semantic expectations or

a thematic context such as discussions of rabbits will increase one's perception of the word HARE. Those topics cause activation of the concept of rabbit which spreads activation to the HARE word unit. Because of this activation spread, the word-node for HARE needs less activation from the sensory input channels (by the letters HARE) in order for it to pass its threshold. Thus, that word is seen sooner in degraded perceptual conditions.

This system also explains the biased spelling of the homophone sound. If we have been talking about rabbits, when we say the sound HARE, that sound will, by summation of activation, retrieve the HARE word-unit, causing the sound-to-word associations, marked #2 in Figure 1, to increase for a while. Thus, when later you are asked to spell the sound *hare*, association #2 is temporarily stronger than the other association, so that the sound is spelled HARE rather than HAIR.

Priming has been seen in many different places, in different disguises. It seems to be the basis for what are called the "top-down" influences of expectations and set on perception. Priming is involved, for example, in how people resolve ambiguous words in accordance with the surrounding semantic context. It also explains how people interpret ambiguous or reversible pictures, such as the famous wife and mother-in-law picture or the duck-rabbit picture, depending on which perceptual category has been primed by the prior context.

Associative Distance in Priming

Associative priming is not just restricted to word-word associations. Priming occurs across quite remote distances in an associative structure, even the temporary structures set up from reading a brief narrative. An experiment by Gail McKoon and Roger Ratcliff (1980) is a good illustration of this distance effect. They had subjects read a pair of 5-sentence stories, as shown in Figure 2. Having learned two such texts, the subjects received a memory recognition

test: they would be presented with a noun like COLLIE and had to decide whether or not it had been in the sentences presented. The tests were given at a very rapid pace, so that as soon as the subject decided about one word, another would be presented for his decision, sometimes from the same story, sometimes from a different story, sometimes from neither. In this situation, one can assess to what extent the preceding test word primes the decision about the current test word. McKoon and Ratcliff found a priming speed-up of recognition times which varied directly with the number of steps in the associative chain between the prime and the target word. A simple example occurs with the seventh, and last, noun in the chain. Its reaction time was reduced by 73, 48, or 35 milliseconds depending on whether the preceding prime was 1, 2, or 5 steps away in the associative chain of Figure 2. This graded effect is predicted since the prime word spreads activation out from that unit in memory, and the amount of activation spread to other associates is less the farther away they are.

Insert Figure 2 about here

Dissociation Between Priming and Conscious Recollection

Priming reflects a kind of memory, since it depends on recent experience with a familiar stimulus. However, it is a most curious kind of memory since people can show priming due to prior experience, but yet they may have no conscious recollection of the experience that primed their perceptual performance. That is, they may show memory according to one index, and forgetting according to another. The curiosity has two separate aspects: first, priming may be more sensitive than is conscious recollection in revealing an effect due to weak or subliminal stimulation; second, even for a clearly seen stimulus, the person's later conscious recollection of

it may be statistically independent of whether or not that stimulus shows a priming effect. I will briefly show some results of each kind.

Regarding the point about subliminal stimulation, Eric Eich (1984) reported a fascinating demonstration of priming memory for stimuli presented outside awareness. Eich had college students shadow, or repeat rapidly word for word, a prose passage they heard over the right ear of a headphone, as shown in Table 2. Shadowing is a very demanding task requiring great concentration. While shadowing the prose passage, word pairs were presented in the other earphone which subjects were instructed to ignore. The critical pairs were composed of a homophone and a modifier that biased one of its spellings, such as rabbit-HARE and deep-SEA. Such irrelevant messages enter sensory memory and contact their word units for a fraction of a second, but then disappear from consciousness as the person continues shadowing.

Insert Table 2 about here

At the end of the session, Eich's subjects had no recollection of the unattended words. However, when given a spelling test, they tended to spell the homophones in the manner biased by the context words presented on the unattended ear. Thus, the *rabbit* context caused them to spell the sound hare as H-A-R-E, and so on. This illustrates remembering without awareness: material that's only briefly perceived, that causes no conscious recollection later, nonetheless causes a later unconscious bias in the meaning assigned to an ambiguous sound.

Another kind of memory dissociation appears with patients who show severe amnesia when tested by the usual recall measures but, paradoxically, appear normal when their memory is assessed by priming. The original research on amnesics was done by Warrington and

Weiskrantz (1970). A more recent illustrative experiment was done by Peter Graf, Larry Squire, and George Mandler (1984) testing neurological patients with Korsakoff's amnesia, which is associated with a profound memory deficit. These amnesics first studied a list of ten words, then attempted to recall them, then did the word-completion task, in which they completed the first three letters with the first word that came to mind, not requiring it to be one of those just studied. The investigators counted how often subjects completed the fragment with a list word, although at least nine other completions were possible. Table 3 compares these two memory measures for Korsakoff's patients and matched alcoholic subjects without Korsakoff syndrome. Free recall at 10% shows the usual poor recall for the Korsakoff patients. In contrast, they did quite well on word completions, even exceeding the alcoholic controls. But, they were not aware that their word completions had been presented on the earlier list. Thus, these amnesics were remembering, but in an unconscious manner.

Insert Table 3 about here

Table 4, also from this study, shows data from patients tested within an hour after the fourth electroconvulsive shock they had received for treatment of their depression. Each ECS produces some anterograde amnesia, or poor learning, for several hours afterwards. Patients receiving ECS were compared to depressed patients who were being treated without ECS. The results fall into a pattern similar to that for the amnesics. Compared to the Depressed controls, the ECS patients did very badly on free recall; but on word completions they equaled the controls in producing primed words. Again, we see a dissociation or uncoupling between two meas-

ures of memory.

Insert Table 4 about here

A similar dissociation shows up when one tests for memories of words shown to people when they were intoxicated on alcohol. Table 5 shows results of an experiment by Hashtroudi, Parker, DeLisi, Whatt, and Mutter (1984). Subjects who learned and were tested when fairly intoxicated (4 stiff drinks) did poorly on free recall, achieving only 40% of the scores of placebo controls; on the other hand, the drunk subjects showed an equal or greater priming effect in terms of the difference in their ability to identify primed versus unprimed words when these were shown in degraded form, the 11% versus 9% figures at the bottom of Table 5.

These results for amnesics, ECS, and alcohol would probably be duplicated for old people with failing memories, or from subjects during post-hypnotic amnesia. They all show massive forgetting consciously, but quite normal priming due to their learning experiences.

Insert Table 5 about here

This dissociation was first noticed and documented by Larry Jacoby and Mark Dallas (1981) for normal subjects who were forgetting under normal circumstances. They varied the conditions of presentation of words so as to make them more or less memorable in a test for recognition memory. But they found that some variables, such as elaborative processing, which influenced conscious memory recognition had no influence whatsoever on the person's ability to

identify the word when it was presented briefly later in a tachistoscope. Oddly, whether a word was consciously remembered or not, it yielded about the same increment in priming due to its earlier presentation.

An Hypothesis Regarding Dissociation

The network theory I presented earlier can accommodate these findings of noncorrespondence. Figure 3 shows the gist of the explanation. It uses the contextual association theory of recognition memory of Anderson and Bower (1983). Presentation of a word in a study list has two effects: first, it strengthens the pre-existing letter-to-word connections, those labeled #1 in Figure 3; it is these that provide the basis for priming. Second, during presentation the subject tries to establish a new association from the word to a representation of the context or study list; it is this link, labeled #2 in Figure 3, that records in memory the fact that the word occurred in the study list. To remember that HARE occurred in the study list, the subject must form this association #2 and retrieve it during the recognition memory test.

Insert Figure 3 about here

Such a theory allows for the independence of priming versus conscious recollections. One can easily imagine that organic damage like Korsakoff syndrome, or ECS, or too much alcohol would reduce the likelihood of forming the new, #2, association to the list context, so that the person could not consciously recollect that he had seen this word in the study list. In contrast, the earlier reading of the word could have nonetheless strengthened the pre-existing letter-to-word associations, so that HARE is primed for perceptual tests. Thus, this theory can accommodate these curious dissociations between priming and conscious recollection.

Priming Social Judgments

As noted, priming effects can be seen in many different places, in different disguises. Priming helps provide people with one interpretation whenever they are faced with ambiguous stimuli. And the world of perception and language are filled with ambiguity. For such reasons, priming is probably a pervasive influence upon our judgments of other people and social interactions. Social behavior is often ambiguous and can be interpreted in different ways depending on which ideas or trait-constructs are primed. A trait concept can be primed by having the subject use the concept in some unrelated task just before he meets a stranger and forms an impression of him. If the information about the stranger is ambiguous or inconsistent, the subject tends to interpret and store it in terms of trait concepts that have been primed.

An experiment illustrating this point was done by Tom Srull and Bob Wyer (1979), using a method introduced by Higgins, Rholes, and Jones (1977). Their subjects first had the hostility concept primed by doing a scrambled-sentence task in which they had to compose a sentence out of sets of four words, such as "leg his neck broke." The words were so chosen that only one type of sentence was possible, either hostile like "Broke his leg" or nonhostile like "Gave him keys." Different subjects received differing numbers of hostile primes. Either within a few minutes or after 24 hours' delay, as part of an apparently unrelated experiment, subjects were asked to form an impression of a stranger named Donald from reading about his behavior in several situations. These behaviors were ambiguous and could be interpreted as either hostile or assertive. For example, Donald refused to pay his rent until the landlord painted his apartment; and on another occasion, he demanded his money back for a purchase that dissatisfied him. Later, subjects rated Donald on several traits. Figure 4 shows their ratings of Donald's hostility. The more priming of hostility in the preceding sentence task, the more subjects used

hostility to interpret Donald's ambiguous behaviors, so they rated Donald as more hostile, unfriendly and inconsiderate. Figure 4 also shows that the influence of the primes decays if the experimenter waits 24 hours before having the subjects read the description of Donald. That is, the primed hostility concept gradually loses its accessibility as the subject interacts with people in his social world.

Insert Figure 4 about here

Srull and Wyer reported several other findings of interest. First, although they directly primed the trait of hostility so that Donald was seen as a hostile person, the effect generalized to other traits associated with that personality stereotype. Thus, people who were primed to see Donald as hostile were also likely to judge him as unintelligent, narrow-minded, selfish, and undependable.

Second, in order to get this bias, the priming of hostility had to occur before the subject read the character description. No biasing occurred if the primes were given after the character description. Thus, the primed concept has to be available at the time the ambiguous behaviors are being encoded, before the subject has fixed upon some interpretation of his own.

Third, similar results have been obtained when positive traits like kindness or independence were primed and subjects read character descriptions that were ambiguous with regard to kindness and independence. So the priming bias is quite general for several sorts of personality traits.

Fourth, priming is exerting its influence here passively, without the subject's awareness. The subjects were misled, so none of them connected the two parts of the experiment, so they were unaware of their primed interpretation. They simply felt that Donald's hostility was obvious for all to see. Such is the nature of unconscious influences.

Applications of Priming to Behavior Therapy

Let me begin to tie in these trait-priming results to the interests of behavior therapists. The points I'll touch on are listed in Table 6. First, on the issue of diagnosis, clients, and probably therapists too, often communicate about behavior using action categories that refer to the meaning or intention behind their actions. Social behavior, especially in conversations, is often ambiguous. Thus, therapists must decide whether a client who argues with them is being assertive or hostile, whether he is showing persistence or motivated resistance. Was that remark by the client sincere or sarcastic, was that an insult or an indirect compliment? I suggest that all of us use categories to describe social actions, and these categories can differ depending on our priming.

Insert Table 6 about here

Diagnosis in therapy. These priming results should caution behavior therapists on how easily stray trait labels can distort their own or their patients' interpretation of ambiguous behaviors. If a therapist sees a hostile patient at 10 o'clock, he may be primed to easily see hostility in the actions of his 11 o'clock patient; the depressed patient the therapist talks to at 1 o'clock may tip him towards perceiving more symptoms of depression in his 2 o'clock patient. Of course, the most likely source of trait priming for the therapist is the patient himself. Most

patients arrive at their intake interviews with a distorted self-concept, which must be changed, and with an elaborate theory of what is wrong with them, often couched in trait terminology, even psychiatric categories. The fact that the therapist listens to these self-concepts and self-diagnoses could introduce some bias into diagnosis, because the mentioned traits will have been primed for categorizing the patient's later behavioral reports. And this influence can be substantial, since we know from work by Mike Mahoney (1976) and Mark Snyder (1983) that all of us succumb to a confirmation bias. Given a diagnostic hypothesis to test, we all generally ask questions and seek information that would confirm that hypothesis--which, of course, is not the best way to go about it.

Vicious circles. Priming may be the mechanism by which clients' poor self-image is actualized and their worst fears come true. Thus, if a depressed person expects others to be unfriendly or critical of him, he will more readily project that interpretation onto others' remarks, thus preserving his expectations and his low self-esteem. Overly anxious clients who dread a heart-attack, or agoraphobics who fear a panic attack, have primed themselves to interpret any physiological irregularity as a sign of an imminent attack. Thus, they over-react, begin to hyperventilate, and proceed into a vicious circle of physiological panic. Similar vicious circles exist for insomnia, sexual impotence, and other disastrous prophecies of anxious clients.

Modeling. Another illustration of priming in an area relevant to behavior therapy is modeling or observational learning. Modeling explains many maladaptive behaviors that clients bring into therapy. Modeling is used in therapy not only to teach people novel adaptive behaviors but also to increase their performance of familiar behaviors that they know but are not now performing.

An experiment by Charles Carver and his associates (in press) has shown that some of the influence of modeling comes about by its priming in the observer the behavior trait exhibited by the model. Thus, a person who merely observes a model acting in a clearly hostile, aggressive manner will have the hostility concept primed. As a result, the observer is now more likely to interpret others' behavior using hostile categories; he is also likely to act in a more hostile manner, even in situations quite unrelated to the modeling scene.

Carver's subjects watched a film of a business man criticizing his secretary in a very hostile manner. Later, apparently as part of another experiment, subjects formed an impression of a new person, like the man, Donald, you saw before, who was described as behaving in ambiguous ways. Afterwards, the hostility-primed subjects rated Donald as considerably more hostile and unfriendly than did control subjects who had seen a neutral film. Thus, observing a model's hostility increased the use of hostile concepts in interpreting someone's behavior.

In a second experiment, Carver and his associates demonstrated that priming of hostile concepts, by the scrambled-sentence procedure mentioned earlier, led subjects to behave more hostilely when they later were assigned to teach another subject in a learning task. The more priming of hostility the subject received in the unrelated sentence-task, the more severely he punished the other subject. Thus, priming influenced the subject's interpersonal behaviors, not just his interpretation of others'.

Displacement of aggression. Priming of a trait concept increases its accessibility in general, across all contexts, regardless of their similarity to the initial priming situation. For instance in Carver et al.'s experiment, hostility primed by reading sentences transferred to delivering more intense electric shocks to train a student who had just made a mistake. The wide range of transfer is reminiscent of displacement of aggression, in which provoked aggres-

sion is blocked from direct expression, but is expressed against a safe target. Compared to the classical analysis of displacement given by Dollard and Miller (1950), the priming hypothesis differs in that it does not require a generalization gradient of displaced aggression related to the similarity between the provoker and the eventual victim of aggression.

Self-control strategies. Turning to another application, we noted that priming decays with time, especially when incompatible ideas are aroused in the interim. This spontaneous decay is exploited in self-control procedures in which behavior therapists teach clients to control their anger by "counting to ten" before responding or to reduce their stress by concentrating on relaxing and breathing deeply. This is good advice, and it works for obvious reasons.

Goal-priming. Extending the priming idea one further step, a likely source of priming is the goal or motive that the person sets to guide his performance. In cognitive psychology, goals are conceived as active elements, that may be conscious or preconscious, that spread activation to goal-related categories of perception and action-plans, making these more accessible. One implication is that people are more likely to notice or perceive objects that satisfy an active goal. Thus, a person stranded without water in the desert comes to have such a strong desire for water that he begins to see mirages of water or an oasis in the distance. People who are hungry are especially sensitive to street-signs advertising restaurants or foods. A laboratory experiments on this topic by Wispe and Drambaern (1953) showed that hungry subjects have a lower threshold for seeing food-related words in degraded perceptual conditions.

Slips. If a motive is aroused but then suppressed because its direct expression would be punished, the categories to express that motive would nonetheless be primed and ready to appear in a speech error or slip of the tongue. Thus, if a person is angered by his boss but unable to retaliate, his suppressed anger may come out in a motivated slip, substituting a hos-

tile word for one that sounds like it, so that instead of saying "My boss is all heart" he says "My boss is all hurt." This is similar to Freud's idea about motivated slips: priming acts through a kind of unconscious, persisting activation of concepts that agree with the motive. The priming hypothesis differs from Freud's theory of slips by saying, first, that suppressed intentions are only one of many factors influencing slips; and second, that the intentions expressed in slips were usually conscious just a few minutes ago and were consciously suppressed. The priming theory would suppose that the intentions causing the slips are not repressed and unretrievable, as Freud seems to have argued.

Emotions and Cognition

I now come to my final topic, and that is how emotions and mood states influence cognitive processes such as memory and thought.[2] My research group has conducted several studies which have found three powerful effects of emotion.

First, emotion influences what people can retrieve from memory. Here we find emotion state-dependency, in that people best remember an event if at the time of recall they can return to the same emotional state they were in when they learned about it.

Second, we find that people's feelings cause them to learn selectively about material that agrees with or supports those feelings: We call this the mood-congruity effect, and it suggests that people's feelings cause congruent material to become more salient, to arouse more interest, to cause deeper processing, and so to be better learned.

Third, we find that emotions cause powerful distortions and biases in people's thinking and judging. People's judgments of other people, of themselves, of their future turn out to be easily biased by their mood of the moment, often in ways they're not aware of.

Now, the emotions we study in our experiments are simply happiness, sadness, and anger, most often induced in university-student volunteers through the use of suggestions, with the suggestions in some experiments emphasized through hypnosis. Our subjects are asked to get themselves happy or sad by remembering some happy or sad experience, and replaying that slowly in their imagination. They are instructed to maintain that mood during the experimental task. After the experiment, we cancel the suggestions so that subjects leave feeling pleasantly relaxed.

Selective retrieval.

Turning to the experiments on mood-dependent retrieval, the most reliable effects arise by asking happy or sad subjects to recall unselected personal events from the past few weeks. An experiment by Mark Snyder and Phyllis White (1982) gave the results in Figure 5. This shows that happy people retrieved more memories of happy events, whereas sad people retrieved more sad events. A similar result occurs if you ask happy or sad people to recall events from their remote childhood. Since subjects felt appropriately happy or sad when these life events were stored in the first place, this illustrates mood-dependent retrieval.

Insert Figure 5 about here

Elsewhere, I have proposed an associative network theory to explain such results (Bower, 1981). An emotion is represented as a unit in the memory system that becomes associated with events that are perceived as causing that emotion to be aroused. When that emotion is aroused again later, even if by another means, it activates its associated memories. That simple theory seems to explain most of the results.

Selective learning.

Moving on to the second effect I mentioned, people learn more about material that agrees with their mood. In one experiment done by my student, Stephen Gilligan (1982), subjects had been made happy, sad or angry just before they imagined themselves involved in 36 briefly described episodes, one-third of which were written to provoke happiness, one-third sadness, and one-third anger. After returning to a neutral mood, the subjects recalled the episodes, with the results shown in Figure 6. This shows selective learning: subjects who were happy during learning learned more happy episodes, whereas sad and angry learners learned more sad and angry episodes, respectively. We have several ideas about why such selective learning arises, but it would take us too far afield to go into them here.

Insert Figure 6 about here

Emotional Influences on Thinking

I want now to discuss some influences that emotions have on thoughts and judgments. As indicated earlier, when emotions are strongly aroused, then concepts, themes, and rules of inference associated with that emotion will become primed and ready for use. Thus, the emotional person will interpret his world and bias his judgments in a manner congruent with his feelings. Some of these effects are listed in Table 7.

Insert Table 7 about here

First, happy, sad or angry subjects give free associations to words, and, secondly, make up imaginative stories for the TAT which directly reflect their emotional state. For example, sad subjects give sad associates and make up sad stories. This is understandable because the emotion stimulates into readiness certain words and themes to which it is associated.

Third, mood biases people's snap judgments about familiar people or topics. We find that happy subjects give very friendly, charitable descriptions of their acquaintances, whereas angry subjects give uncharitable, critical assessments. This bias may be explained by supposing that people have stored a variety of impressions about familiar persons, and the subject's current mood causes retrieval of primarily positive or negative memories of that person. In this manner, a quick evaluation of that person will be biased by the preponderance of one-sided opinions that come to mind.

Fourth, emotion influences people's forecasts or judgments of the likelihood of future events. After inducing a happy or depressed mood in our subjects, Bill Wright and I had them estimate the subjective probabilities of many personal and international events in the future, some positive or blessings, others, negative or disasters. The results in Figure 7 show that relative to subjects who felt neutral, happy subjects overestimated the likelihood of blessings and underestimated the likelihood of disasters; sad subjects did the reverse, overestimating the likelihood of disasters and underestimating that of blessings.

Insert Figure 7 about here

This shift between optimism and pessimism is explainable if people often estimate the likelihood of an event according to how many supporting facts can be quickly retrieved from memory. Thus, a positive or a negative mood will affect the relative numbers of positive or negative facts that come to mind: Therefore, subjective likelihoods will be biased in the mood-congruent direction.

Self-efficacy. As a further extension, David Kavanagh and I (in press) found that people's predictions about their own performance are influenced by their feelings. Subjects who were induced to feel happy or sad were asked to estimate the likelihood that they would be able to perform successfully a diverse range of activities. These included success in romantic encounters, skill in diverse interpersonal situations requiring assertiveness, intellectual skills, and physical and athletic skills. Figure 8 shows the result. The efficacy score is the person's estimated likelihood of his or her success across activities. Relative to neutral controls, happy people believe they will succeed at most activities, whereas sad people believe they are likely to fail. This difference in estimates held up across all types of activities. The effect may be explained by noting the differing numbers of positive or negative facts that subjects recall about themselves when they are feeling happy or sad. These mood-effects on self-efficacy judgments are significant for action, because we know from Albert Bandura's work with patients with strong fears that these self-efficacy predictions determine whether a person will attempt a threatening activity and how long he will persist when it's unrewarded. The benefits of psychotherapy are often reflected or mediated through changes in the patient's feelings of efficacy or mastery about those behaviors that formerly caused him problems.

Insert Figure 8 about here

Impression formation. Moving to my next point, we also find that a person's mood strongly affects his social judgments, the impressions he forms of other people. Social perception is highly subjective and evaluative, because we have to read the intentions hidden behind people's words and actions. In that reading, our current emotional premise strongly influences how we interpret others' behavior. Thus, happy people tend to be charitable and positive in their interpretation and impressions of others. Angry people tend to be overly critical, ready to find fault, and to take offense. They may take out their anger on innocent bystanders who had nothing to do with arousing their anger. This is the basis for scapegoating.

Self-observation. These emotional influences on personal judgments also apply when people judge themselves and their own behavior. For instance, depressed patients criticize themselves unjustly for what they perceive as their incompetent actions. In an experiment with Joseph Forgas and Susan Krantz (in press), we investigated whether someone's emotional state would influence their moment-by-moment perception of their own behavior. Specifically, we asked whether fairly well-adjusted college students would see themselves as incompetent and socially unskilled if they looked at themselves while feeling sad and rejected, but see themselves as positive and socially skilled if they looked at themselves while feeling happy.

In a two-day experiment, we first interviewed subjects for 20 minutes about personal topics, and this interview was video-taped with their knowledge and consent. Later, they learned how to score video-taped interviews for positive pro-social or negative anti-social behaviors. Examples of positive behaviors were smiling, leaning forward, and contributing friendly remarks: negative behaviors were frowning, looking away, and so on. Subjects learned to score such behaviors every 10 seconds while watching a stranger on a video-tape. Following this, they were hypnotized. Half of them were asked to remember and replay in imagination a

moment of social success, when they had performed well and felt good about themselves. The others were asked to recall and replay a moment of social failure, when they had felt embarrassed or socially rejected because of something awkward or shameful they had done. Subjects were then asked to maintain their mood while they looked at the 20-minute video-tape of themselves being interviewed the day before. Every 10 seconds they were to mark at least one positive, negative, or neutral behavior they observed in themselves.

Figure 9 shows the percentages of all their observations that fall into the pro-social and anti-social categories. People in a bad mood saw themselves in the video-taped interview as exhibiting many more negative, socially inept actions than positively skilled ones. In contrast, subjects in a good mood saw themselves exhibiting more positive, pro-social actions than negative ones. These differences are "all in the eye of the beholder," since neutral judges rated the two groups as having equal proportions of positive and negative behaviors. Remember these are moment-by-moment perceptual judgments, so the fact that they are affected by the observer's mood indicates the ambiguity of body language and conversation. It thus appears that social behavior is almost a blank screen where viewers project a picture according to their mood. They can even project a picture onto themselves, one which varies according to their current feelings.

Insert Figure 9 about here

Such emotional influences on social judgments can be explained by the associative network theory. The perceiver's mood activates and primes into readiness certain mood-congruent concepts, hypotheses, and inference rules. These are then used as likely hypotheses for classify-

ing the ambiguous gestures, phrases and expressions of a person during a conversation.

Final Comments

I have been reviewing the concept of priming and following the thread of its many manifestations throughout a number of different topics. I have touched on a theory of priming, remote associates, amnesia, ECS, remembering without awareness, passive biasing of trait descriptions, priming effects due to behavioral modeling, displacement of aggression, Freudian slips, and emotional biases in memory, thought, forecasts, self-efficacy judgments, and self-observations. What is remarkable is how easy it is to trace these threads throughout so many different areas of psychology. It is almost as though one can be primed to see instances of the concept everywhere. My mother once said of me when I was a child that if she gave me a toy hammer, I discovered that everything needed to be pounded. Well, I suggest that behavior therapists try out my toy hammer of priming; I am sure that you will find it is a most useful tool to pound on many theoretical puzzles in behavior therapy.

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Footnotes

[1]Invited address to the Fourteenth Congress of the European Association for Behavior Therapy, meeting in Brussels, Belgium, Sept. 17-20.

[2]The following material is largely excerpted from Bower (1983).

Figure Captions

Figure 1. Schematic representation of memory unit corresponding to the word HARE with its associations to sensory inputs and to concepts. Units are in circles, and lines represent associations.

Figure 2. A narrative that links concepts in a linear chain, which is shown to the right. (Adapted from McKoon & Ratcliff, 1980).

Figure 3. Schematic illustration of relevant associations for describing dissociations between priming and recognition memory.

Figure 4. Hostility rating of a stranger related to number of primes for subjects who read about him either 0 or 24 hours after receiving the primes. (Redrawn from Srull & Wyer, 1979.)

Figure 5. Number of happy and sad memories of recent events reported by happy and sad subjects. (Based on Snyder & White (1982); adapted with permission.)

Figure 6. Average free-recall percentages of happy, angry, and sad episodes by subjects who studied them while they were happy, angry, or sad. (Data from Gilligan (1982); reprinted with permission.)

Figure 7. The average probability estimates of positive events ('blessings') and of negative events ('disasters') for subjects in a happy neutral, or sad mood. (Data from W. F. Wright & G. H. Bower (unpublished), with permission.)

Figure 8. Average self-efficacy score, or prediction of performance skill across diverse activities, for subjects who were feeling sad, neutral, or happy about themselves. (Data from D. Kavanagh & G. H. Bower (in press); with permission.)

Figure 9. Self-observation of positive and negative behaviors by subjects feeling good or bad about themselves. (From J. P. Forgas, G. H. Bower, & S. E. Krantz (in press); with permission.)

Table 1

Listing of Methods for Demonstrating Priming

Reading Speed : Read "HARE"

Stroop Interference : Ink color of HARE

Inverted Reading : What's HARE

Lexical Decision : Is HARE a word?

Spell "Sound" : H-A-R-E

Word Completion : What is H _ R _ ?

Perceptual Speed : See "hare" in t-scope

Degraded Identification : 

Table 2

Illustration of Material from Eich's Experiment

Attended Ear	Ignored Ear
The man was walking in the street when a car came around the corner and headed towards him. He jumped out of the way in the nick of time. He yelled at ...	rabbit-HARE garden-SHOE deep-SEA book-DOG

Table 3

Comparison of free recall and word-completion percentages

(From Graf et al., 1984)

	Korsakoff	Alcoholics
Free Recall	10	40
Word Completion (chance = 10%)	58	42

Table 4

Free Recall vs. Word-Completion

Percentages (From Graf et al., 1984)

	ECS	Depressed
Free Recall	18	45
Word Completion	57	54

Table 5

Percentages of words free recalled and identified in degraded form. (From Hashtroudi et al., 1984)

	Sober	Drunk
Free Recall	.21	.09
Perceptual Identification		
Primed	.34	.23
Unprimed	.25	.12
P-U Effect	.09	.11

Table 6

Applications of Priming in Behavior Therapy

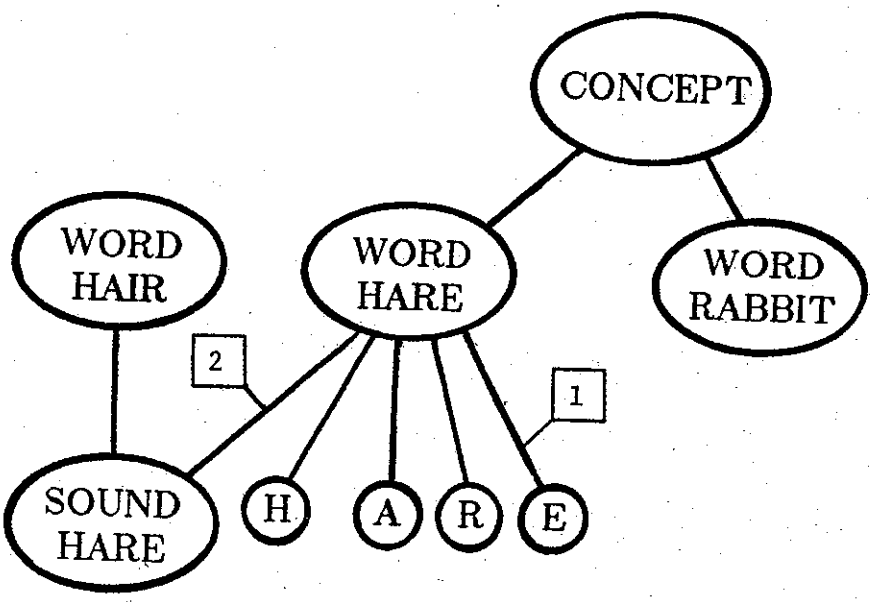
1. Self-diagnosis and therapist's diagnosis
2. Triggers vicious circle of anxiety
3. Impact of modeling
4. Displacement of aggression
5. Self-control strategies
6. Goal-related categories
7. Freudian slips

Table 7

A Listing of Some Cognitive Processes Influenced by Emotion

1. Free associations
2. Themes of fantasies (T. A. T. stories)
3. Snap judgments of people
4. Judgments of event likelihood
5. Self-efficacy judgments
6. Interpersonal perception
7. Self-perception

FIGURE 1



The SHEPARD beckoned the COLLIE.

The COLLIE nudged the SHEEP.

The SHEEP grazed the PASTURE.

The PASTURE delighted the GOATS.

The GOATS scaled the ROCKS.

The ROCKS dotted the HILLSIDE.

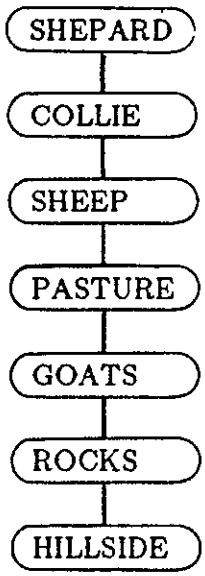


FIGURE 3

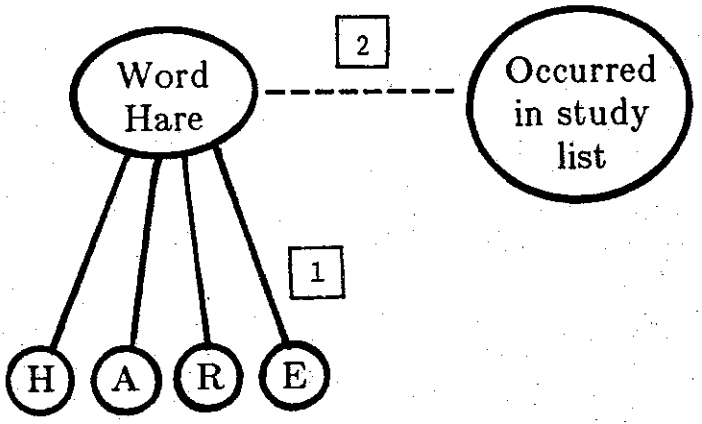
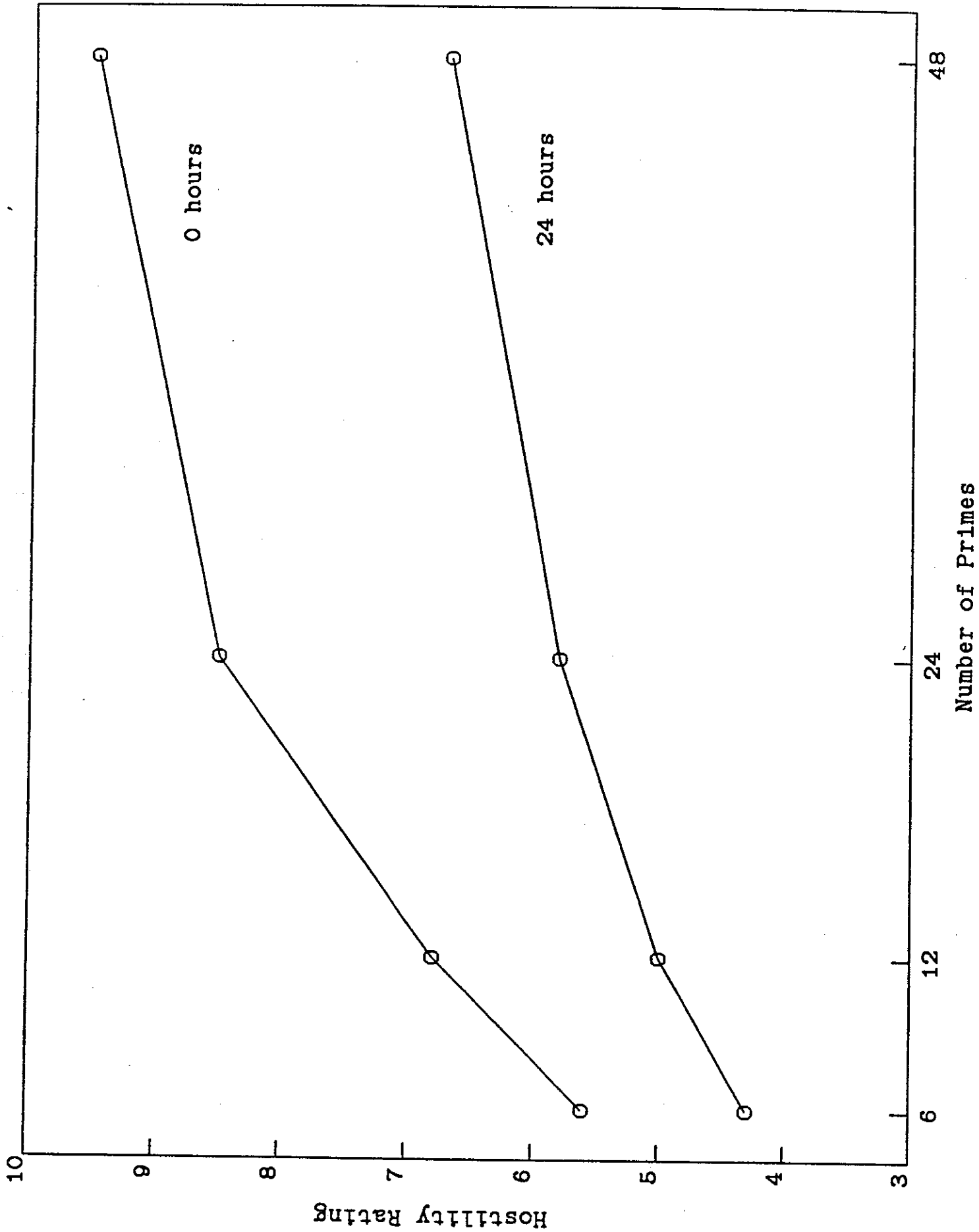


FIGURE 4


0 hours
24 hours
Hostility Rating
Number of Primes
10
9
8
7
6
5
4
3
6
12
24
48

FIGURE

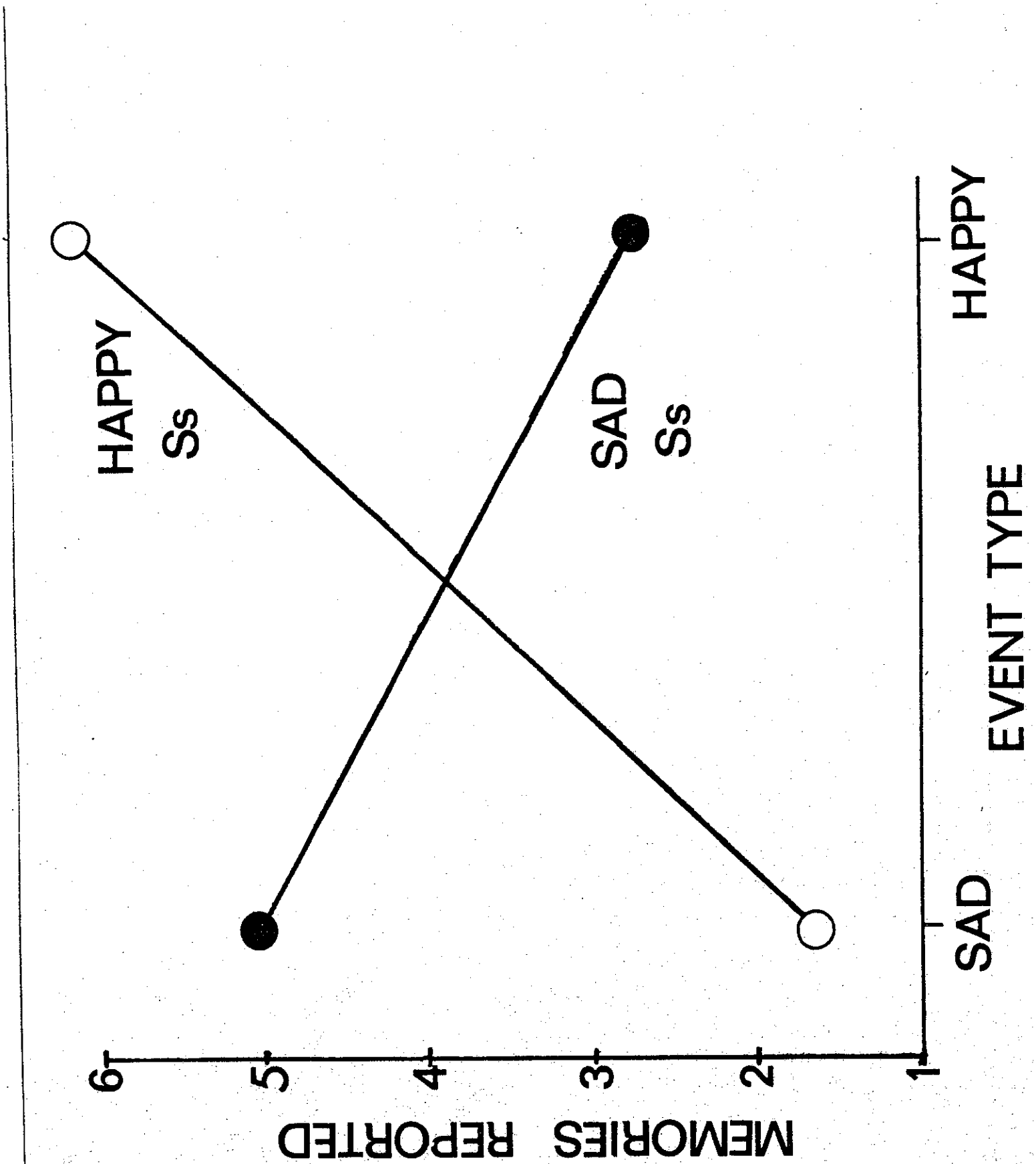

HAPPY
Ss
SAD
Ss
6
5
4
3
2
1
MEMORIES REPORTED
SAD
HAPPY
EVENT TYPE

FIGURE 6

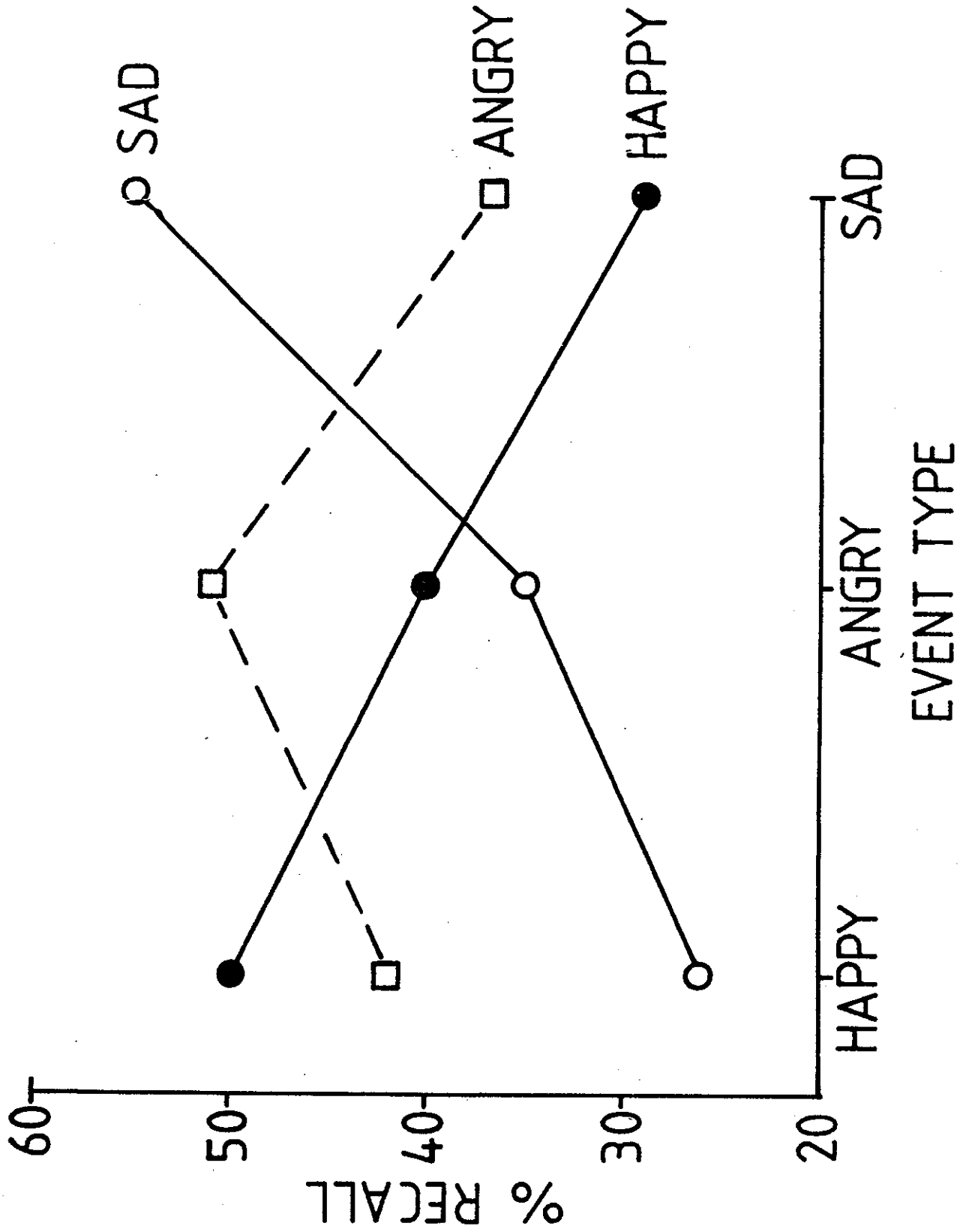

SAD
ANGRY
HAPPY
60
50
40
30
20
% RECALL
HAPPY
ANGRY
SAD
EVENT TYPE

FIGURE 7

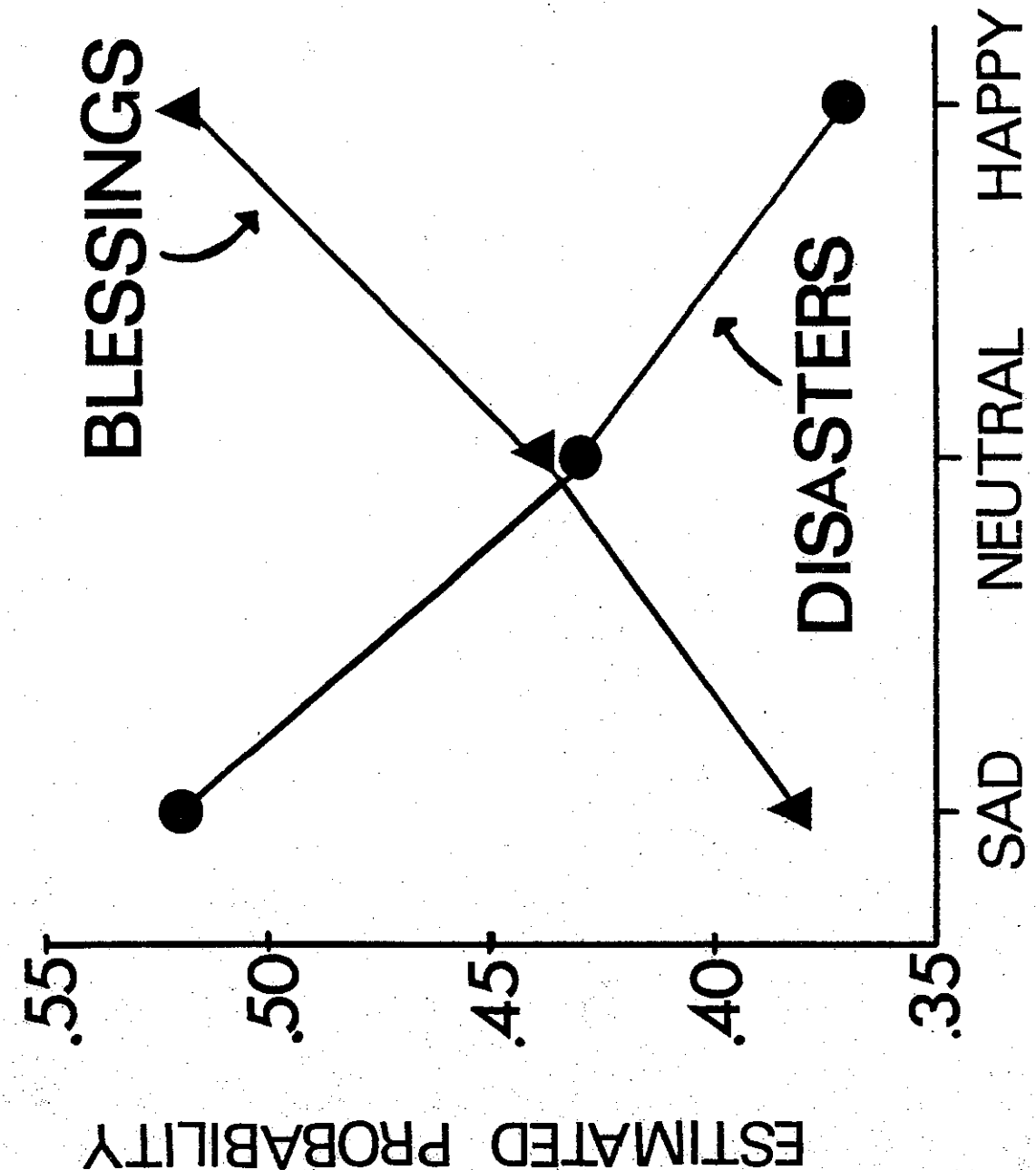
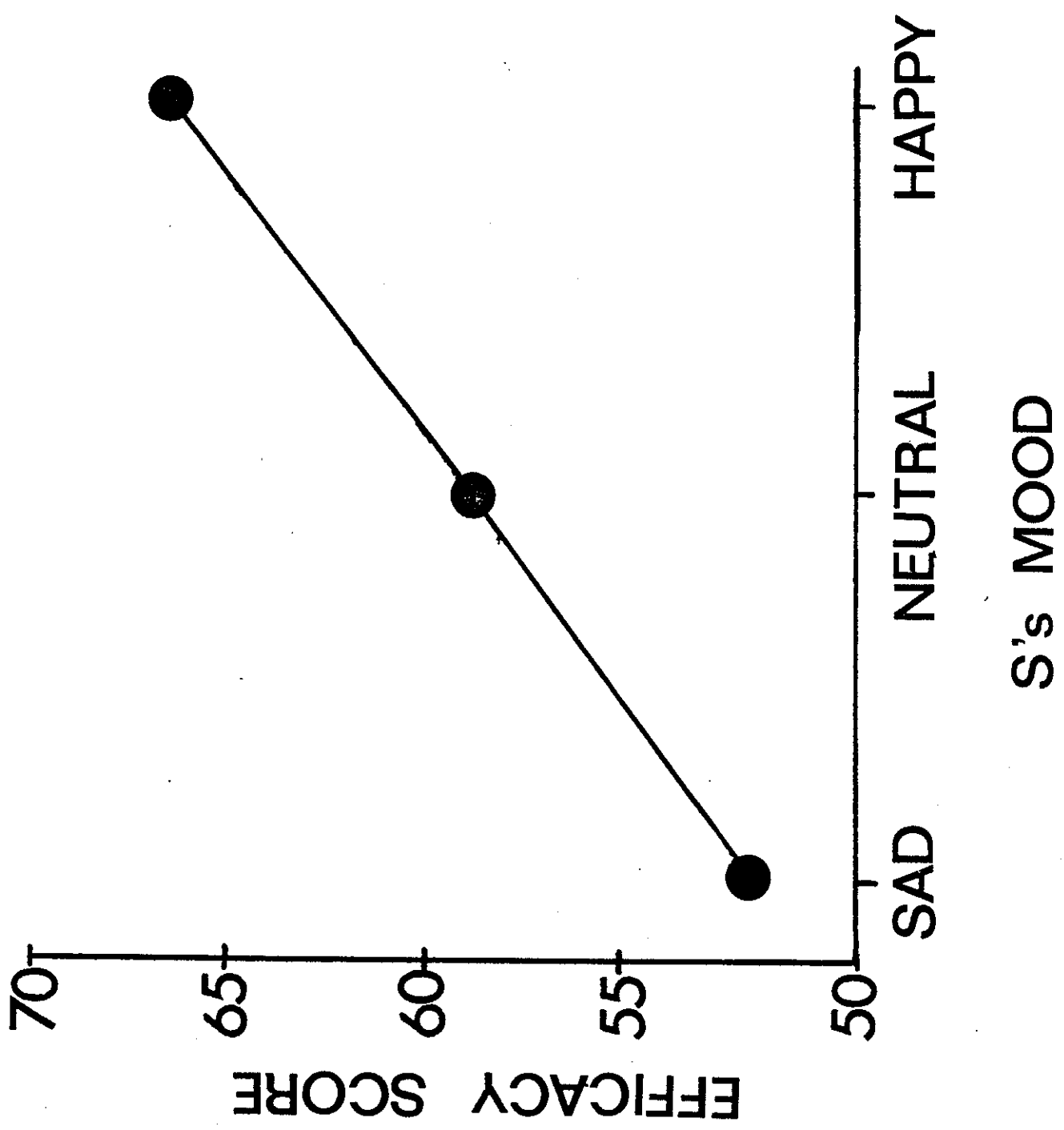
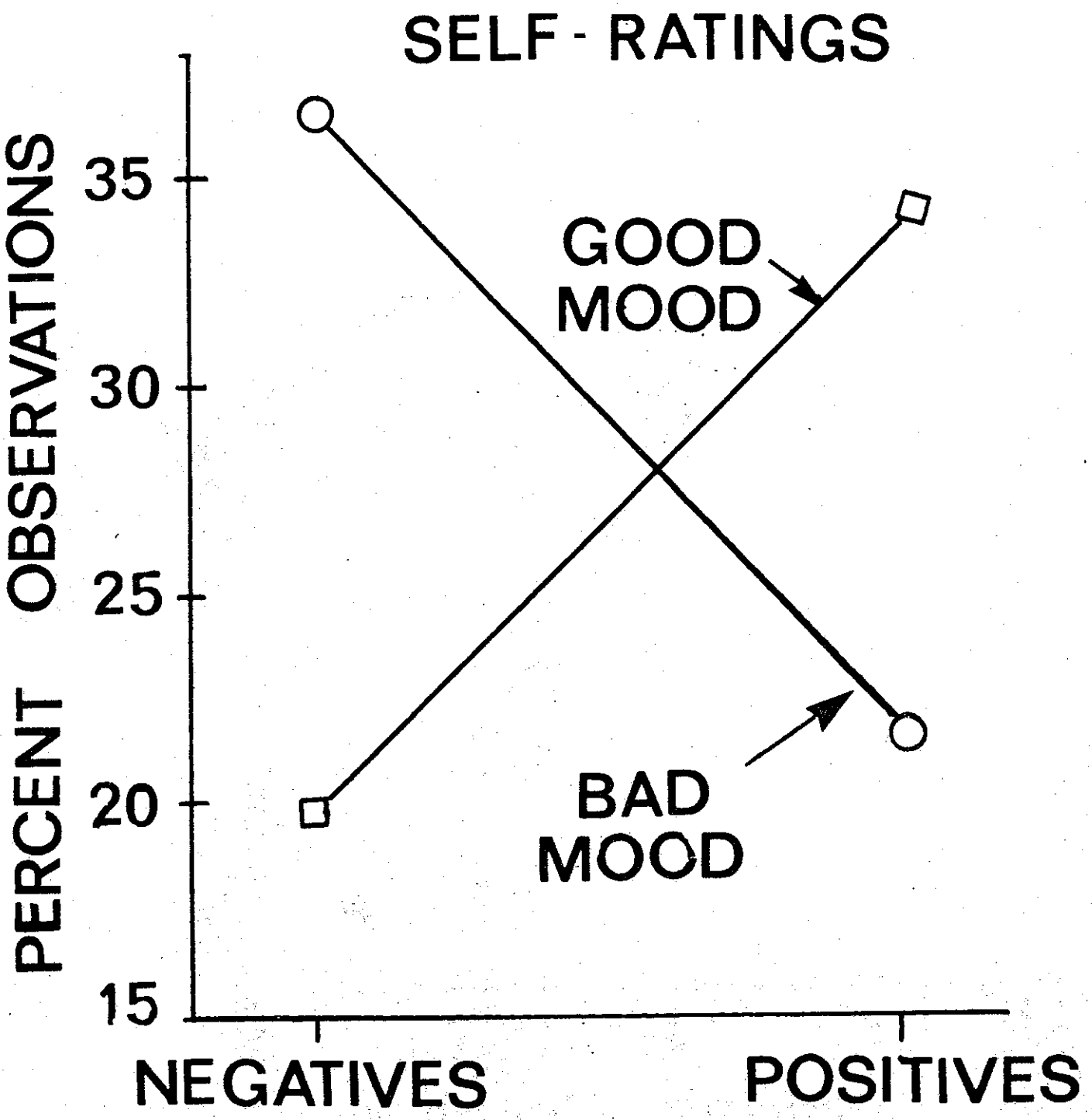

BLESSINGS
DISASTERS
.55
.50
.45
.40
.35
ESTIMATED PROBABILITY
SAD
NEUTRAL
HAPPY
S's MOOD

FIGURE 8




SELF - RATINGS
PERCENT OBSERVATIONS
35
30
25
20
15
GOOD MOOD
BAD MOOD
NEGATIVES
POSITIVES