

Emotional influences on word recognition

RICHARD J. GERRIG and GORDON H. BOWER
Stanford University, Stanford, California 94305

We asked whether agreement between the affective quality of a word and a subject's emotional mood would cause faster identification of that word. In Experiment 1, subjects induced to feel happy or angry were required to choose which of two words had been briefly presented. The target and distractor words were pleasant, unpleasant, or neutral. Mood-congruent target words were not correctly selected more often than neutral or incongruent targets. In Experiment 2, happy or angry subjects tried to identify neutral, pleasant, or unpleasant words presented for brief durations that lengthened progressively until each word was identified. Again, recognition thresholds for mood-congruent words were not lower than those for neutral or incongruent words.

Emotional mood has been shown to influence several cognitive processes, ranging from state-dependent memory to mood-congruent productions in free associations and fantasies (Bower, 1981; Bower, Monteiro, & Gilligan, 1978). Bower outlined a theory that proposed that emotional states be represented as nodes spreading activation in a semantic network model of memory (Anderson, 1976; Anderson & Bower, 1973). Each emotion is linked to descriptions of events during which that emotion occurred, as well as to perceptual categories, themes, and words semantically related to it. Thus, emotional nodes such as "joy" or "happiness" would be one index for memories of past events that were accompanied by positive affect, whereas "sadness" and "anger" would index unpleasant memories. Emotions function as retrieval cues for events with which they have been associated. Similarly, emotional arousal should "prime" or activate perceptual categories and words related to that emotion.

The present experiments explore this theory's prediction regarding affect and perceptual recognition. Research concerning motivational influences on perception has a long history. Erdelyi (1974) reviewed that body of literature and concluded that an information processing account was at least plausible for many puzzling instances of perceptual vigilance and defense (heightened or depressed recognition of affectively toned words). For our purposes, the typical perceptual defense experiments were somewhat off target, since the typical taboo target words were not relevant to the subject's emotional state. We are here more concerned with perceptual changes when the items are directly relevant to the subject's mood.

The model of word recognition we will adopt is the logogen model of Morton (1969) grafted onto the front end of the emotional network model. Morton defined

the logogen for a specific word as a device that would "accept information relevant to a particular word response irrespective of the source of the information" (1969, p. 165). In Bower's theory, a mood like happiness or sadness would send activation to logogens representing words semantically (and connotatively) related to these mood states. For instance, when people are happy, their logogens attached to pleasant words like "joy" and "bliss" should receive activation. This subthreshold activation of mood-congruent logogens should cause "priming" of those words. In a tachistoscopic recognition experiment, the degraded stimulus information obtained from the briefly exposed word will also feed activation into the logogen. The summation of the mood-congruent stimulus activation with the mood activation may suffice to raise the relevant logogen over the threshold for response. The net effect is expected to be a lowering of the threshold for mood-congruent words. This would be "perceptual vigilance."

A second issue is whether a given emotional mood inhibits opposing emotions. Tentatively, Bower (1981) proposed that a mood like happiness might inhibit its opposite moods, like sadness or anger. If inhibition from an active happiness node lowers the spontaneous activation on negative, unpleasant words, then we would expect the happy subject to have an elevated threshold for identifying unpleasant words. This prediction is not so strongly implied by the theory, since it rests upon noncentral assumptions.

The experiments below were designed to test these implications of a lowering of perceptual thresholds for mood-congruent words and an elevation of thresholds for mood-incongruent words. The first experiment used a sensitive forced-choice method to assess word recognition accuracy. Subjects were induced by hypnotic suggestions to feel extremely happy or angry and then had a series of tachistoscopic trials wherein a pleasant, neutral, or unpleasant target word was briefly presented, followed by a forced-choice test.

The research of Gordon H. Bower is supported by Research Grant MH-13905 from the National Institute of Mental Health.

EXPERIMENT 1

Method

Subjects. The subjects were 14 Stanford undergraduates who were selected for high hypnotic susceptibility, as measured by the Stanford Hypnotic Susceptibility Scale, Form C (Weitzenhoffer & Hilgard, 1962). All subjects scored at least 10 on the 12-point scale. Subjects were run individually in a 1-h session and were either given course credit or paid.

Materials and Apparatus. All stimuli were common four-letter words. Forty words were selected to have a happy (pleasant) affective tone and 40 to have an angry (unpleasant) tone. Each affective word was matched as closely as possible for frequency (Kučera & Francis, 1967) with a neutral word that differed by exactly one letter (e.g., FAIL-MAIL, GLEE-GLEN). Twenty neutral words were similarly matched with other neutral words. Thus the experimental stimuli consisted of 40 happy-neutral word pairs, 40 angry-neutral word pairs, and 20 neutral-neutral word pairs. An additional 15 neutral-neutral pairs were constructed to serve as practice stimuli, and 100 pairs were used to set thresholds. (Most stimulus pairs were selected from a list provided by Rumelhart and McClelland, Note 1.)

The experiment was conducted using a Data General NOVA 820 with an attached Megatek 5000 display device and a button box.

Design. To eliminate response-bias interpretations of possible mood effects (i.e., guessing of mood-congruent items), recognition was tested by two-alternative forced choices. The target and distractor items within a pair were chosen to differ in only one character to control for the redundancy of perceptual information (Reicher, 1969).

Each subject performed the experimental task in both a happy and an angry mood. In each emotional state, the subject's perceptual threshold was first determined, using a standard psychophysical technique that was intended to provide a baseline accuracy of 71% correct. Target stimuli were then presented singly at this threshold duration. Following presentation of each target word, the subject selected one of the two presented alternatives.

The same 100 word pairs were presented in each mood for each subject. A different member of the pair was used as the target in the two moods. The left-right order of the items in the choice display was also reversed from one mood to the next to eliminate any confounding of emotionally toned words with left-right response biases. The order of moods for each subject, the target word and forced-choice order for each pair, and the overall item order were randomly determined. Table 1 presents the classification scheme for the stimuli in the experiment and examples of the stimuli that one subject would have seen.

At the onset of each trial, a plus sign was displayed for the subject to fixate for 750 msec. After a 100-msec delay, the target stimulus was presented; 50 msec after the target went off, a pattern mask of random lines came on. The mask was presented

for 500 msec, and its removal was followed by presentation of the two alternative words after a 100-msec pause. The two alternatives remained on the screen until subjects indicated the item that they believed was the target by pressing the left or right button on the response box.

Procedure. Subjects sat approximately 3 ft from the display screen in a darkened room. They were first given 15 practice trials to familiarize them with the task. The target duration in the practice trials was shortened from 100 msec down to the actual starting duration of 35 or 40 msec. This insured that the subjects would understand the task without being overwhelmed by its difficulty.

Following the practice trials, the subjects were instructed to relax and a hypnotic trance was induced using an eye-closure technique (Form C, Weitzenhoffer & Hilgard, 1962). All subjects had been preselected as highly hypnotizable, so trance was easily induced. When deep trance was reached, the appropriate mood was induced by asking the subjects to recall a happy or angry emotional event from their lives. They were to replay this memory in their imagination and to reexperience the emotion of it. The subjects were then requested to experience this emotion in isolation and to increase its intensity until the mood was intense but not overwhelming. Subjects were given as much time as they needed to familiarize themselves with the emotion so that the sense of anger or happiness would be firmly implanted.

When the subjects indicated that they were in the appropriate mood, the word recognition experiment began. First, subjects' threshold durations were determined for neutral words. After the 50 threshold-setting trials, the duration so estimated was set as the stimulus duration for all of the experimental trials that followed in that mood. The subjects next received the 100 experimental trials. When these were completed, the subject's mood was changed by reinstating a neutral mood and then requesting recall and replaying of a memory of an event with the opposite affective tone. A new threshold value was then determined for this mood, and it was used for the next 100 experimental trials. When these experimental trials were completed, the subject was returned to his preexperimental mood and taken out of trance. After insuring normalization of the subjects' moods, they were thoroughly debriefed regarding the experiment.

The subjects were in each mood for approximately 10 min. No objective measure was available to insure that the subjects maintained mood intensity for this length of time. However, both the subjects' subjective reports of their mood states and the experimenter's impression indicated that the appropriately intense affects were maintained. Previous successful research with hypnotically induced mood has included experimental tasks of this duration (Bower, 1981).

Results

A preliminary analysis was carried out on the subjects' derived threshold values to test for any systematic differences between the moods. The mean threshold durations were 33.2 msec for subjects while in a happy mood and 33.1 msec while in an angry mood. These durations obviously do not differ [$t(13) = .18, p > .05$]. Next, we checked for practice effects in threshold determinations. The difference between the threshold values found in the first and second moods was not reliable [$t(13) = 1.42, p > .05$]. Thus, the threshold was fairly stable across the experimental session, and the method used to determine the threshold was reliable. However, the values that were being set proved somewhat too low, since overall accuracy was at 64% rather than at the 71% intended.

Table 1 presents the mean percentages of correct identifications across subjects for mood-related words

Table 1
Design and Results of Experiment 1

| Target Type | Subject's Mood | | | Mean | |
|------------------|----------------|----|-----------|------|----|
| | Happy | PR | Angry | PR | PR |
| Mood-Congruent | GLEE glen | 58 | main PAIN | 69 | 64 |
| Neutral | NINE nice | 58 | fail MAIL | 69 | 64 |
| Mood-Incongruent | mail FAIL | 62 | NICE nine | 60 | 61 |
| Neutral | pain MAIN | 64 | GLEN glee | 71 | 67 |
| Neutral | five GIVE | 64 | give FIVE | 64 | 64 |
| Average | | 61 | | 67 | 64 |

Note—PR = percent correct recognition; each figure is based on 420 observations. Target stimuli in each cell are capitalized.

separated from their yoked neutral words. The hypothesis expects subjects to identify mood-congruent targets more than neutral or mood-incongruent targets. The data in Table 1 show no evidence for this mood-congruence selection. For example, the first two rows indicate that the percent correct identification when the target was the neutral word was identical to that when the target was the congruent emotional word of the pair. Comparing Line 1 with Lines 3 and 5 in Table 1, we note that all the predictions failed when subjects were happy, and the differences observed when subjects were angry were too small to be significant. To check for statistical significance, we computed a contrast for each subject between the number of items correctly recognized for mood-congruent words and the total number of items recognized correctly in the other cells. This contrast indicated no support for the hypothesis of mood-congruent facilitation in perceptual recognition [mean = .93 words; $t(13) = .28$, $p > .05$]. The only suggestive evidence was a slightly depressed accuracy for nice-word targets when subjects were angry, but even this percentage was not reliably lower than performance on its yoked neutral control words.

Discussion

No evidence was found to support the hypothesis that recognition would be facilitated for mood-congruent words or inhibited for incongruent words. Perhaps our task was so difficult that any mood-related facilitation was eliminated by impoverished external stimulation. The task may have required so much concentration that the subject's mood may have been insufficiently salient to produce an effect.

The facilitation was expected to be small. Because the stimuli were sampled from a very broad spectrum of pleasant or unpleasant words, any particular congruent word would only be expected (or activated) to a very low level. While in the aggregate these small increments were expected to cause a higher percentage of recognition, perhaps the single-letter discrimination required (e.g., FAIL MAIL) was just too difficult to reveal a small effect.

As a second attempt to observe mood-congruent facilitation, another experiment was performed using an easier recognition task. Also, we used stimulus words that were more closely related semantically to happy and angry moods, so that greater priming of these targets might be expected.

EXPERIMENT 2

The method of Experiment 2 closely approximated that used in a successful demonstration by Postman and Brown (1952). Their subjects first received either success or failure experiences on a perceptual task. When presented later with words that were either success or failure toned, their subjects were able to report the items that were congruent with their prior experiences at significantly lower thresholds than the matched neutral words. The thresholds for incongruent items were identical to those for the yoked neutral words. Assuming that success leads to happiness and failure to sadness, their results with success and failure words can be interpreted as support for a mood-congruent effect. Activation spreading from the happy mood would facilitate

recognition of the success words, whereas activation from the sad mood would facilitate recognition of failure words.

Postman and Brown's (1969) subjects were shown the list of mood-related and neutral words in random order, with the brightness of each stimulus being increased successively for each word until it was recognized. The present experiment employed the same general method, except that we varied presentation duration rather than brightness. Also, the words were directly related to the induced mood rather than being mediated through success and failure. It was predicted that the average duration for correct recognition would be less for mood-congruent items.

Method

Subjects. Twelve Stanford undergraduates were drawn from the same highly hypnotizable pool as in Experiment 1. The subjects were run individually and were either paid or given course credit.

Materials and Apparatus. The experimental session was shortened so that subjects could be expected to maintain a hypnotically induced mood. Five synonyms for happy and angry were chosen and matched for frequency of occurrence in written English (Kučera & Francis, 1967), length in letters, and number of syllables to 20 neutral words. Five neutral words were chosen arbitrarily to be used in the practice session.

Experiment 2 used the same apparatus as the first experiment.

Design. Subjects were presented with the list of words, one at a time, in random order at each duration level. When a stimulus was correctly recognized, it was removed from the list without any feedback to the subject. When all items were successfully identified, the session was ended.

In the practice session, the stimuli were initially presented for 25 msec. This duration was incremented by 5 msec/cycle through the list until all items were successfully recognized. The duration at which the first practice item was identified, less 15 msec (three steps), was taken as the starting duration for the experimental session. This was intended to insure that the subjects would perform below threshold on all of the experimental words on their first presentation.

Each trial began with fixation of a presented plus sign for 750 msec. After a 100-msec pause, the word for that trial was presented for the appropriate duration, and then a pattern mask of random lines came on the screen for 500 msec. The subject was given ample time to try to identify the word. Each new trial was initiated by the experimenter. Because of time constraints, the task was performed in only one mood by each subject: Six subjects were tested following a happy-mood induction and six following a sad-mood induction.

Procedure. The subjects received a brief practice session to familiarize them with the procedure. It was emphasized that they were to guess as soon as they had any hypothesis about a word's identity. They were also informed that words successfully recognized would be removed from the list. At no time was any feedback given regarding the subject's response on a trial.

Following the practice session, a hypnotic trance and appropriate mood were induced using the same method as in Experiment 1. Then the experimental words were presented in randomized-list cycles using the drop-out method until all items were correctly recognized. The subject was given time after each presentation to generate a response. After a response or a period of silence, the next trial was presented. Following the experimental session, the subjects' moods were normalized, and the subjects were removed from trance and debriefed.

The subjects were required to maintain their moods for a period of 15-20 min. There was no evidence in the pattern of subjects' responses to suggest mood dissipation.

Table 2
Mean Recognition Thresholds (in Milliseconds)
for Recognition Experiment

| Stimulus Type | Subject's Mood | | |
|------------------|----------------|-------|-------|
| | Happy | Angry | Total |
| Mood-Congruent | 50 | 40 | 45 |
| Neutral | 57 | 42 | 50 |
| Mood-Incongruent | 56 | 35 | 40 |
| Neutral | 51 | 40 | 46 |
| Total | 51 | 39 | 45 |

Note—Each figure is based on 30 observations.

Results

The subjects' guesses (before the correct answer) were submitted to three judges. The judges read these guesses and tried to determine the mood (happy or angry) that the subject was in when they were made. [This method has been used with earlier experimentation (Bower, 1981), in which judges were able to determine moods reliably from free associations.] The mean number of guessed words, not counting repetitions, produced by each subject was 16, with a range from 2 to 66. The three judges correctly classified the subject's mood from his guesses only 53% of the time; this is essentially chance performance. Of the five subjects for which all three judges agreed, 40% were identified incorrectly. Furthermore, the judges' confidence ratings of these judgments averaged only 2.90 (with a score of 1 representing low confidence and 7 high). Thus, unlike subjects' free associates, the guesses were not noticeably mood related. Thus, if any mood-related reduction in threshold were to be obtained, it could not be attributed to mood-congruent guesses.

Table 2 presents mean recognition durations for each type of item in each condition. There was a significant difference between total level of recognition in the two moods [$t(238) = 4.22, p < .0001$]. Angry subjects recognized the words at a lower threshold than did happy subjects.

To test for mood-congruent facilitation, difference scores of recognition durations were formed between the emotional words and their yoked neutral words. The difference scores for mood-incongruent words were then subtracted from those for mood-congruent words to form one score for each subject. There was no evidence for the hypothesis of mood-congruent facilitation of words in the recognition task [mean = -2.58 msec; $t(11) = -.89, p > .05$].

Discussion

Again, we have found no evidence for simple mood influences on perception of mood-related words, neither significant

facilitation nor interference. Although angry subjects had lower thresholds than happy subjects, that outcome admits of too many interpretations to be interesting. In truth, the results were disappointing, especially the failure to confirm the Postman and Brown (1952) findings in a modified setting.

Perhaps we can salvage a hypothesis from these negative results by comparing them with the range of mood-related influences on cognitive processes reported elsewhere (see Bower, 1981; Bower & Cohen, in press). Here, we have found no impact of mood on low-level pattern recognition; in contrast, our other experiments (such as free associations) found large mood influences on thematic responses to the meaning of words. A plausible conjecture is that mood will influence only retrieval speed of the affective properties of words but will not influence "lower level" pattern identification processes that reflect highly overlearned, automated skills. This hypothesis would imply that retrieval of affective connotations of words would be mood sensitive. Thus, for example, when judging whether two words agreed in pleasantness, happy subjects should be faster in judging connotative agreement of two happy words than that of two angry words, and vice versa for angry subjects. Experiments aimed at that connotation retrieval hypothesis are yet to be done.

REFERENCE NOTE

1. Rumelhart, D. E., & McClelland, J. L. *An interactive activation model of the effect of context in perception: Part II (CHIP 95)*. La Jolla: University of California at San Diego, Department of Psychology, 1980.

REFERENCES

- ANDERSON, J. R. *Language, memory, and thought*. Hillsdale, N.J.: Erlbaum, 1976.
- ANDERSON, J. R., & BOWER, G. H. *Human associative memory*. Washington, D.C.: Winston, 1973.
- BOWER, G. H. Mood and memory. *American Psychologist*, 1981, **36**, 129-148.
- BOWER, G. H., & COHEN, P. R. Emotional influences on memory and thinking: Data and theory. In S. Fiske & M. Clark (Eds.), *Affect and social cognition*. Hillsdale, N.J.: Erlbaum, in press.
- BOWER, G. H., MONTEIRO, K. P., & GILLIGAN, S. G. Emotional mood as a context of learning and recall. *Journal of Verbal Learning and Verbal Behavior*, 1978, **17**, 573-585.
- ERDELYI, M. H. A new look at the new look: Perceptual defense and vigilance. *Psychological Review*, 1974, **81**, 1-25.
- KUČERA, H., & FRANCIS, W. N. *Computational analysis of present-day American English*. Providence, R.I.: Brown University Press, 1967.
- MORTON, J. The interaction of information in word recognition. *Psychological Review*, 1969, **76**, 165-178.
- POSTMAN, L., & BROWN, D. R. The perceptual consequences of success and failure. *Journal of Abnormal and Social Psychology*, 1952, **47**, 213-221.
- REICHER, G. M. Perceptual recognition as a function of meaningfulness of stimulus material. *Journal of Experimental Psychology*, 1969, **81**, 275-280.
- WEITZENHOFFER, A. M., & HILGARD, E. R. *Stanford hypnotic susceptibility scale: Form C*. Palo Alto, Calif.: Consulting Psychologists Press, 1962.

(Received for publication December 15, 1981.)