

Cognitive Involvement in the Mood Response System¹

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There is currently common agreement that moods are organized responses that affect many psychological subsystems, including the cognitive subsystem. The pleasant versus unpleasant quality of an individual's mood was the dependent measure in this study, which examined cognitive correlates of mood level. A set of tasks hypothesized to change with mood, an adjective scale measuring present mood state, and four personality scales were administered to 194 students. Results indicate that three tasks—giving advice to others, estimating the probability of events, and subjective ratings of associations to words—are correlated with mood state and mood-related traits (e.g., emotional distress). Because of the measurement of mood along a pleasant-unpleasant continuum, the present findings of cognitive change can be generalized to any mood that is mostly pleasant or unpleasant. Results also indicate that individuals low in neuroticism had greater correspondence between self-reported mood and performance on affect-sensitive tasks. The changes in cognition are discussed in the context of a spreading-activation view of mood effects and a depressive-schema theory of information processing. More generally, the results suggest that moods lead to broad influences on cognitive responses over considerable portions of an individual's life-span.

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A mood can be thought of as an organized pattern of responses involving multiple psychological subsystems, including the hormonal, facial-expressive, postural, and cognitive systems (e.g., Berscheid, 1982, p. 48; Campos & Barrett, 1984, p. 229; Izard, 1977, p. 25; Lang, 1984, p. 192). Cognitive changes that occur with mood are reflected in "affect-sensitive" tasks, so labeled because performance at the tasks changes with mood. The mood-sensitive cognitions reflected by such tasks often involve an evaluation of how good or bad the environment is. For instance, people in a positive mood judge good events (such as a healthy baby being born) as being more likely than do people in a negative mood (Bower & Cohen, 1982; Johnson & Tversky, 1983). Other such tasks, however, involve perceptual-motor skills that improve or alter with good mood (Johnson, 1937). The present study identifies and examines such affect-sensitive tasks, and also examines discrepancies between self-reported mood and performance on affect-sensitive tasks. These two purposes will be discussed in turn.

AFFECT-SENSITIVE TASKS AND SELF-REPORT OF MOOD

Although affect-sensitive tasks have been identified in previous literature (e.g., Bower & Cohen, 1982; Hamilton, 1983, p. 171; Johnson, 1937; Johnson & Tversky, 1983; Lefebvre, 1981; Mayer, 1983; Velten, 1967; Wallach & Gahm, 1960), these mostly recent reports leave many questions to be explored further. First, much of the literature has concentrated on one or two emotions such as anxiety or depression—leaving other emotions unmeasured. The single moods studied are commonly measured by having people report the degree to which they're experiencing a set of feelings represented by a list of adjectives (e.g., *calm*, *sad*). Under such conditions unmeasured "stray" moods, if present, may confuse results.

One question is whether multiple moods can be studied simultaneously. It is possible, for instance, to take advantage of the fact that diverse emotions measured on adjective scales correlate with each other (e.g., sadness and anxiety tend to cooccur). Factor analysis, principal components, and multidimensional scaling of adjective scales frequently yield a pleasant-unpleasant dimension defined by adjectives such as *cheerful*, *content*, and *happy*, on the one hand and *gloomy*, *sad*, and *angry*, on the other (e.g., Mayer & Bremer, 1985; Russell, 1979). By representing self-report of emotional state along this pleasant-unpleasant factor or dimension, one can generalize a "negative" mood to depression, anxiety, or anger, and similarly generalize a "positive" mood. Thus, general laws may

be constructed which deal collectively with the moods according to their position along a pleasant-unpleasant continuum, and which then relate the pleasant-unpleasant dimension to cognition. The collective variance, from all moods combined along a pleasant-unpleasant dimension, may result in stronger effects because the variance of all the moods combined may be larger than the variance of individual moods.

A second question asks if cognitive changes will be present with natural, unmanipulated moods, of the sort that occur in the classroom or workplace. Much or most of the previous literature has studied affect-sensitive tasks by manipulating mood experimentally, or by selecting psychiatric groups with emotional disturbances. When cognitive changes—however slight—are found with unmanipulated mood, they have great significance, because such slight moods are pervasive. Such an approach also provides convergent validity to prior studies using mood manipulations—an important addition to an area largely dependent upon convergent operations to draw conclusions (e.g., Mayer & Bower, 1985). In addition, naturally occurring mood is stable over time in comparison to experimentally induced moods (e.g., Isen & Gorgoglione, 1983) and therefore permits the study of multiple tasks in a single sitting. By studying multiple tasks, it can be ascertained whether different tasks predict independent portions of mood variance.

A third question addressed by the present research is whether a given task is sensitive to mood state itself or, alternatively, is sensitive to long-term mood-related traits such as neuroticism or depression. Beck (1967) states that depressives construct a schema of largely negative associations during their mood disturbance. This negative schema provides a framework for interpreting, storing, and retrieving material in a negative way. Beck's theory suggests a rationale for trait influences on cognition. On the other hand, spreading activation theory (Bower, 1981; Isen, Shalke, Clark & Karp, 1978) states that an emotion serves as an active site in memory that spreads its activation to other mood-associated concepts and events, thereby creating greater availability of those mood-associated concepts. When a mood is experienced, mood-congruent material is more readily available in memory and may bias certain judgments that depend on retrieval of such material. Spreading activation theory suggests a rationale for state influences on cognition. Several commonly used measures of mood mix state and trait measures together (Mayer & Bower, 1985). The present research uses a mood adjective scale with unambiguous present-state instructions, and two trait scales of distress (Eysenck Neuroticism; Bendig Anxiety) to examine the relationship between cognition, and state and trait measures of affect.

INTEGRATION OF AFFECT

It seems plausible that some personality dimensions moderate the relationship between cognition and self-reported mood. One traditional view of psychopathology is that it involves poor integration of various psychological functions (White, 1956). It is possible that neurotic individuals, for instance, might integrate their mood and their cognitive performance less well than healthy individuals. In addition, extraverts may show greater discrepancies in mood and cognition because they may pay less attention to internal experiences. A scale of neuroticism and extraversion (Eysenck, 1973) was therefore included in the study. In addition, greater discrepancies might also be created by a repressive personality style in which some emotional experiences are regarded as unacceptable. Weinberger, Schwartz, and Davidson (1979) have suggested that a scale combining the Marlowe-Crowne and Bendig Anxiety scales (Bendig, 1956; Crowne & Marlowe, 1964) can be used to identify repressors; these tests were included as well.

In summary, it was predicted, first, that performance on affect-sensitive tasks will correlate with a pleasant-unpleasant representation of mood. Previous studies have shown that motor speed and handwriting size increase with good mood (e.g., Johnson, 1937; Velten, 1967), as do positive judgments about the environment (e.g., Bower & Cohen, 1982). Second, it was predicted that different affect-sensitive tasks predict different portions of self-reported mood; third, that such task performance will be sensitive to mood-state as well as to trait measures of distress; and finally, that divergence between self-report of mood and task performance may be related to one or more fundamental dimensions of personality.

METHOD

Subjects

Participants ($N = 194$) in the main experiment were introductory psychology students at the University of Santa Clara, and at Cañada and De Anza community colleges, who took part in the study as an in-class exercise. A supplementary sample ($N = 355$) from the above colleges, Stanford, and Case Western Reserve Universities completed the Russell mood adjective checklist but did not participate in the main study. Data from this supplementary sample were included in the factor analysis of mood,

reported below, to add stability to the obtained factor structure of experienced mood.

Task Selection and Item Construction

The following tasks were predicted to be affect-sensitive on the basis of previous literature (see above). The development of each task followed a set of guidelines described at the end of the task descriptions.

Psychomotor Tasks

The instructions for the psychomotor tasks followed this general form: "When I say start, I want you to (perform the task) as fast as you can. You will have 90 seconds for this." There were three such tasks.

Letter Cancellation, All Letters. The booklet page for this task consisted of six columns of 10 letters across and 40 rows long. Subjects were asked to put an individual, vertical line through each letter as quickly as they could. Scoring was for the number of letters canceled, which was expected to increase with good mood.

Letter Cancellation, Letter C. The booklet page and procedure was the same as the previous task, except only the letter *c* was to be canceled. Scoring was for the number of letters canceled, which was expected to increase with good mood.

Geometric Patterns. (This task was untimed.) Subjects were asked to "draw four squares in any arrangement, but to make sure that one square contains the other three squares inside it." The instructions were at the top of an otherwise empty page. Scoring was for the diagonal of the largest box drawn; its length was expected to increase with good mood.

Memory/Judgment Tasks

Category Exemplars. Subjects were asked to list as many category members (up to 12), as they could from the categories "personality traits," "types of relationships," "habits," "types of physical contact," and "emotions." Scoring was for the difference in the number of pleasant versus unpleasant words listed, as rated by the experimenters. More pleasant words were expected to be listed by individuals in a good mood.

Probability Estimation. Stimuli were 20 statements concerning war, illness, health, and professional and economic success; 10 pleasant events

and 10 unpleasant events were used. Subjects expressed their estimates as percentages. Scoring was for the difference in estimation of pleasant versus unpleasant events. It was predicted that people in good moods would predict that pleasant events occur more frequently than other events.

Social Relations. Each of the 10 items in Social Relations consisted of a brief vignette describing an individual facing a dilemma, and then four pieces of advice, which were relevant to the person in the situation. Those four pieces of advice varied in their affective content. Each of the four pieces of advice was rated by six graduate-student raters on a 3-point scale where 1 was unpleasant advice or lacking in confidence, 2 was neutral or inappropriate advice, and 3 was pleasant advice or expressing confidence. A subject's score was simply the sum of the average rated values of the items they endorsed. Pleasant advice was predicted to increase with pleasant mood.

Association Ratings. Subjects were asked to rate 15 words, including 6 pleasant, 6 unpleasant, and 3 neutral words, according to "how many associations, images, and situations come into your mind in response to that word." The score was the difference in ratings of pleasant versus unpleasant words. As pleasant mood increases, associations to pleasant words, relative to unpleasant words, were expected to increase.

General Guidelines in Development of the Affect-Sensitive Tasks

Where applicable, items constituting a task were of types scored both positively and negatively, with equal numbers of each. To encourage problem-centered attention and discourage self-presentational bias, test items never inquired about or referred to the task-taker; items often had an answer that was, in principle, knowable, or answers that were obviously incorrect (e.g., What is the likelihood a fifty-year-old man will suffer a heart-attack?). In this way, the overall scale gave the appearance of an achievement test.

Affect Assessment and Control Variables

Adjective Checklist. Russell's (1979) adjective checklist, used with the Meddis (1972) response format, constituted the principal present-mood measure. This scale was designed, in part, to measure the first pleasantness-unpleasantness dimension of mood. Adjectives were randomly ordered.

Personality Scales. Two sets of personality scales were administered. The first 120 subjects of the main sample received a short factor-based scale to assess introversion-extraversion and neuroticism (Eysenck, 1973). The final 75 subjects received a combined Marlowe-Crowne and Bendig anxiety scale, consisting of 53 items (Weinberger et al., 1979).

Procedure

Subjects in the main sample were tested by a male experimenter in 15- to 50-person groups. A single booklet containing the above tasks and instructions was distributed. Task order followed the order of discussion above; thus, subjects were naive regarding the mood measure until the end of the affect-sensitive tasks. Suggested times for completing each task were announced and these suggested times were by and large followed by the group. Testing time was approximately 40 minutes for the affect-sensitive tasks, and 15 minutes additional for the mood and personality scales.

RESULTS

Factor Analysis of Russell Scale

The purpose of the factor analysis was to extract a factor scale representing a pleasant-unpleasant dimension of mood. Because different mood scales and factor techniques yield different results (e.g., Meddis, 1972; Nowlis, 1965; Russell, 1979), no strong claim is made concerning the actual underlying factor-structure of a mood; measuring the pleasant-unpleasant factor was most important. Data for the analysis came from the 194 students in the main experimental condition and the 355 students from the supplementary sample. Using a principal components procedure, 10 factors were extracted with eigenvalues greater than 1.0. Rotation by a varimax procedure yielded the desired pleasant-unpleasant first factor. This was followed by seven unipolar factors defining dimensions of sleepiness, liveliness, calmness, dominance, arousal, submission, and anxiety, respectively. The remaining 2 factors were defined by doublets of adjectives and were therefore discarded. (Interestingly, an oblique rotation of the factors yielded only one difference: the positive adjectives loading on the first factor shifted to the liveliness and calmness factors, leaving a mostly unipolar, unpleasant-mood first factor.) Factor scales were

estimated according to the multiple regression method (Heerman, 1963) using those adjectives with factor loadings greater than $r(549) = .25$. The relationship between the factor scales and personality scales is discussed next.

Naturally Occurring Affect and Its Relation to Personality Traits

If the mood factor scales are valid, they should intercorrelate with the personality scales in predictable ways. The two personality scales measuring emotional distress (Neuroticism and Anxiety) correlated with the mood scales labeled depression/elation, sleepiness, liveliness (negatively), and anxiety (see Table I). Extraversion showed a slight negative correlation with the first depression/elation factor, and a higher, positive relation with dominance. The Marlowe-Crowne, which is an indicator of conforming, defensive behavior (Millham & Kellogg, 1980), correlated with only one subscale of the checklist (sleepiness). Perhaps this was because defensive subjects perceived sleepiness to be a less risky affect than sadness. The intercorrelation between the mood and personality scales were consistent with the theoretical expectation.

Self-Reported Moods and Affect-Sensitive Tasks

It was predicted that selected tasks would correlate with the pleasant-unpleasant factor of the mood scale (see Table II). Three cognitive tasks

Table I. Intercorrelations Between Mood Factors and the Four Personality Scales

Factor name	Variance explained ^a	Neuroticism	Extraversion	Marlowe-Crowne	Bendig
Depression/elation	25%	.30 ^d	-.20 ^b	-.16	.57 ^a
Sleepiness	10%	.34 ^a	-.12	-.29 ^c	.37 ^d
Liveliness	5%	-.30 ^d	.19 ^b	.14	-.35 ^d
Calmness	5%	.06	-.12	.10	-.25 ^b
Dominance	3%	-.22 ^b	.30 ^d	.03	-.34 ^d
Arousal	3%	-.17	.11	-.10	.01
Submissiveness	2%	.06	.04	.13	.26 ^b
Anxiety	2%	.22 ^b	-.17	-.11	.39 ^a
N	549	116	116	73	73

^aThe percentage of total mood-scale variance explained by the factor.

^b $p < .05$ (two-tailed tests).

^c $p < .025$.

^d $p < .01$.

^e $p < .001$.

Table II. Intercorrelations Between Affect-Sensitive Tasks and the Mood Adjective Checklist^a

Task name	Factor I full sample	Factor I half sample	Neuroticism	Bendig
Speed	.07	.10	-.02	-.08
Geometry	.08	.07	-.08	-.30 ^d
Categories	.02	.06	.15	.08
Social	.16 ^c	.21 ^c	.07	.16
Probability	.18 ^d	.27 ^a	-.10	-.26 ^c
Association	.31 ^a	.43 ^a	-.35 ^d	.01
Multiple R	.31 ^d	.44 ^c	—	—
N	183-192	85-90	128-120	71-73

^aFactor I and the affect-sensitive tasks are reversed where necessary so that high values always indicate positive moods and judgments.

^b $p < .05$ (one-tailed tests).

^c $p < .025$.

^d $p < .01$.

^e $p < .005$.

showed such relationships: social relations, probability estimation, and word ratings. As mood becomes happier, people believe pleasant events are more likely to occur, they give more positive and encouraging advice, and they report more associations to pleasant words. There was no significant relationship between mood and either motor speed task (combined together as Speed in Table II). The geometry task showed a similar lack of relationship; this held true even with analyses that took into account possible interactions between mood and extraversion (e.g., Wallach & Gahm, 1960). Category listing also showed no relationship with mood. Returning to the three cognitive tasks predictive of mood, their intercorrelations were nearly identical at about the $r(194) = .20$ level ($p < .001$). A regression of the three tasks against self-report of mood showed that both word association and the probability estimation tasks contributed significantly to the multiple R; this finding suggests that the three tasks are partially independent predictors of mood.

Naturally Occurring Strong Moods

Most people in a classroom setting probably don't experience strong moods. For this reason, the half sample experiencing stronger affect was examined separately. Setting cutoff points at $+/- .67$ standard deviations from the mean on mood selects the half sample experiencing the strongest moods over multiple samples. As expected, the prediction for the subgroup improved substantially (Table II, column 2).

State Versus Trait Effects

It had been predicted that both state mood and trait characteristics would influence affect-sensitive tasks. An examination of Table II supports earlier findings (e.g., Gotlib & McCann, 1984; Hamilton, 1983) that trait measures of anxiety, neuroticism, and depression correlate with task performance. In comparison, mood-state measures correlate with performance even more strongly than trait measures in this sample.

Divergence of Self-Reported Mood and Task Indications of Mood

It was predicted that personality dimensions would moderate the relationship between self-reported mood and task performance. An emotional integration measure was therefore calculated as follows. First, a linear composite of the three affect-sensitive tasks that correlated with mood was formed, based on the multiple regression beta-weights. Then, those individuals who were one-third of a standard deviation below the mean on affect-task performance and one-third above the mean on self-report of mood were classified as nonintegrators. Those individuals showing the reverse pattern were also added to the nonintegrators' group. There was no confounding of mood and nonintegration (biserial $r = -.05$, n.s.). Nonintegration correlated positively with neuroticism ($r(120) = .25$, $p < .01$, two-tailed), as was hypothesized. It did not, however, relate to the repression scores, as identified according to Weinberger et al. (1979), nor did it relate to extraversion, and this contradicted our hypotheses.

DISCUSSION

In our experiment we examined several issues concerning the nature of affect-sensitive tasks and the problem of the integration of cognition and affect.

The Pleasant-Unpleasant Mood Dimension and Affect-Sensitive Tasks

It was predicted that mood could be represented along a pleasant-unpleasant dimension, and would then correlate with performance on cognitive tasks. It was indeed possible to recover a pleasant-unpleasant mood factor from the Russell Adjective Scale, and from it to predict aspects of some task performance.

The cognitive tasks correlated with mood on the whole. A pleasant mood led to the following changes: Advice giving became more pleasant; the probability of pleasant events increased, relative to unpleasant events; and more associations were brought to mind by pleasant words than by unpleasant words. The reverse was true for negative moods. This result is compatible with findings of cognitive changes reported in the depressive realism literature (e.g., Nelson & Craighead, 1977; Alloy, Abramson, & Viscusi, 1981), although no claim is made here about the relative accuracy in judgment of depressed versus happy people (cf. Coyne & Gotlib, 1983, pp. 496–498). These results successfully generalize such earlier findings to two new domains of affect-sensitive tasks (advice giving and word ratings), and the tasks used here are especially interesting because they do not directly involve self-relevant statements. The present tasks inquire about "objective" phenomena (e.g., the likelihood of the average marriage ending in divorce). One additional finding that was not clear until now is that these cognitive tasks are all also intercorrelated at about the $r = .20$ level. This suggests that the tasks may measure similar cognitive changes. The association and probability tasks, however, both contribute independently to a regression prediction of mood at significant levels. Thus, there is some evidence that the tasks are partially independent, as well.

The two motor speed tasks were not statistically predictive of mood, although they correlated in the predicted direction. In spite of this finding, there can be little doubt that motor retardation is a part of at least some forms of depression (e.g., Depue & Monroe, 1978). It may be that there were not enough severely depressed individuals in the present sample to obtain a significant effect. A task related to motor speed is the geometrical figure drawing task, which measures motor expansion. Here it was expected that larger figures would be indicative of more positive mood. Although the effect was in the predicted direction, the hypothesis was again not confirmed. To some extent, the subjects' choice of pattern influenced the size of the rectangle drawn. When analyses were done within pattern type, suggestive results were obtained. It may therefore be useful to continue use of this task in group settings, using modified instructions.

State versus Trait Influences on Cognition

The present results demonstrate that cognitive changes covary with both state and trait measures of affect. As noted in the introduction, trait influences support depressive-schema theories (e.g., Beck, 1967); state influences support spreading activation theories (e.g., Bower, 1981). The state relationships appear to be somewhat stronger in this sample, although

this may be a function of the particular tests used. It should be noted that the schema and activation theories of mood change are not conflicting, and the effects they predict can, in fact, operate together. Thus, a depressive can interpret new information according to a depressive schema, and this information processing can be biased further if a sad mood facilitates the retrieval of additional negative thoughts.

The present study has gone beyond earlier work in minimizing demand effects. First, the questions on the affect-sensitive tasks ask nothing directly about the subject. Second, mood was measured after task performance, thus limiting subjects' knowledge of the purposes of the study until the end of the cognitive measures. A demand effect is also an unlikely explanation of the present results for the following reasons: One of the most transparent tasks—category exemplars (in which a subject lists members of a category such as "types of physical contact")—showed no relation with mood at all; further, the Marlowe-Crowne, which measures a naive social desirability (Millham & Kellogg, 1980), also showed no relevant relationship to the mood scale.

The Covariance of Mood and Cognition in Everyday Life

When combined in a multiple regression, our tasks predict about 10% of the variance of self-reported mood, or 20% for the half sample experiencing more extreme mood. It is worthwhile to put the strength of this relationship in perspective. First, the correlations between mood and cognition will be stronger than reported to the extent that mood was weakened by the testing situation. Second, mood relates to many tasks including advice giving, odds figuring, and subjective association-strength, and these relationships should generalize to further tasks involving evaluation.—Such high generality is not usually considered in evaluating a regression coefficient, but it is clear that the identification of such general relationships is a central goal of scientific research. Third, whereas situations may come and go, moods tend to recur. Because some individuals will return to the same mood month after month, year after year (e.g., Emmons & Diener, 1985), the present findings represent a subtle manifestation of a relationship that, when aggregated over extended periods of time, is of much greater magnitude. For instance, a depressive's divorce may result from judgments about how unloving, unintelligent, and unattractive the spouse is, and how unlikely it is that the spouse will change for the better. The depressive may give the spouse negative or discouraging advice that will cast a pall over the relationship, and may finally inventory all the negative

thoughts the offending spouse brings to mind. Over time, each biased decision or judgment will provide the basis for yet another biased decision.

Discrepancies Between Mood and Task Performance

Izard has defined emotion as involving "the integration of a particular set of neurochemical, motor, and mental processes" (Izard, 1977, p. 25). We also predicted, however, that subgroups of individuals might not coordinate their thinking with their moods. For instance, neurotics might integrate feelings and cognitive changes more poorly than others. This turned out to be true (although the same lack of integration was not present among repressors or extraverts, as had also been predicted). The content of the short form of the neuroticism scale used here concerns both confusion and instability of affect. It is reasonable that instability of affect would make it difficult to keep track of how one feels, because those feelings would be constantly changing. The relationship between confusion and poor emotional integration is even more direct, for if one cannot concentrate on how one is feeling, one will have difficulty comprehending one's own feelings. The divergence between self-reported mood and affect-linked cognition deserves further intensive study. Such comparisons may enable us to identify individuals who cannot cope with their feelings and assist them to better integrate their emotions.

SUMMARY

To summarize, the relationship between cognitive changes with mood and self-report of mood can yield valuable information about the influence of mood on cognition, and about an individual's integration of cognitive change and self-report of mood. Mood can be represented along a pleasant-unpleasant continuum and will be predictive of changes in cognitive performance. In particular, estimates of the likelihood of positive events, the number of associations brought to mind by pleasant and unpleasant stimuli, and the pleasantness of advice people give are all related to mood. These changes in performance are related to both mood state and trait distress/anxiety. This finding supports both depressive schema theory and spreading activation models of cognitive change. The relationship between mood report and cognition appears moderated by trait neuroticism, which produces greater discrepancies between self-reported mood and mood-related thinking. Before such a finding is fully interpretable,

however, more must be understood about the discrepancies between emotion and thinking. It is clear that there is a rich fabric of relationships among personality, mood, and cognition that is important to the understanding and assessment of personality.

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