ing theory, to complement macroresearch with microinvestigations of simple, easily measurable behaviors such as interpersonal distance and the like. Armed with the proposed systems conceptualizations and the proposed methodology, it is hoped that social learning researchers can respond effectively to Rotter's (1975) call for a return to basic theory and a realistic consideration of its components.

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# Evidence for a Three-Factor Theory of Emotions

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Two studies provided evidence that three independent and bipolar dimensions, pleasure–displeasure, degree of arousal, and dominance–submissiveness, are both necessary and sufficient to adequately define emotional states. In one study with 200 subjects, 42 verbal-report emotion scales were explored in regression analyses as functions of the three dimensions plus a measure of acquiescence bias. Multiple correlation coefficients showed that almost all of the reliable variance in the 42 scales had been accounted for. The specific definitions provided by these equations were replicated in a second study that employed 300 subjects' ratings of 151 emotion-denoting terms on semantic differential-type scales.

An adequate description of emotions requires the identification of those dimensions that are both necessary and sufficient to define all emotional states. Studies of facial expressions of emotions have consistently yielded pleasantness–unpleasantness and level of arousal as at least two of the basic dimensions (Abelson & Sermat, 1962; Engen, Levy, & Schlosberg, 1957, 1958; Gladstones, 1962; Schlosberg, 1954). Osgood (1966) and Williams and Sundene (1965) obtained evidence for these two dimensions plus an additional third dimension that was analogous to the semantic differential potency factor. Indeed, the pleasantness–unpleasantness and arousal dimensions are also analogous to the semantic differential dimensions of evaluation and activity, respectively. Thus, the considerable evidence gathered with the semantic differential (Osgood, May, & Miron,

1975; Osgood, Suci, & Tannenbaum, 1957; Snider & Osgood, 1969) can be interpreted as showing that these three dimensions adequately describe human affective (emotional) responses to all types of stimuli.

Studies of other nonverbal expressions of emotion (including implicit-verbal, gestural, and body position cues as well as facial expressions) have similarly yielded pleasantness (or positiveness), arousal (or responsiveness), and potency (or dominance) as three primary factors (e.g., Mehrabian, 1972a, b; Mehrabian & Ksionzky, 1974).

Verbal self-reports of emotion, however, generally yielded more than three dimensions (Borgatta, 1961; Clyde, 1963; Izard, 1972; McNair & Lorr, 1964; Nowlis, 1965). In a more recent study, Bush (1973) used a multidimensional scaling technique on adjectives denoting emotions. He obtained three dimensions, which he interpreted as being analogous to the three found in studies of nonverbal communication and in studies of the semantic differential.

Russell and Mehrabian (1974) provided data to reconcile the evidence for only three dimensions [obtained in studies of the semantic differential, of nonverbal communication, and by Bush (1973)] with the evidence for a greater number of dimensions in the verbal-report domain. They showed that two of these additional dimensions taken from verbal-report studies of emotions, anger and anxiety, were defined readily as combinations of only three independent and bipolar dimensions: pleasure–displeasure, degree of arousal, and dominance–submissiveness. These three factors are independent in that any value along one dimension can occur simultaneously with any value on either of the other two dimensions. Consistent with Bentler's (1969) evidence, the three dimensions are defined as bipolar such that pleasure is a continuum ranging from extreme pain or unhappiness at one end to extreme happiness or ecstasy at the other end. Arousal ranges from sleep through intermediate states of drowsiness and then alertness to frenzied excitement at the opposite extreme. Dominance ranges from feelings of total lack of control or influence on events and surroundings to the opposite extreme of feeling influential and in control. According to these definitions, "emotion" does not merely include occasional passionate states. Rather, a person is viewed as being in some emotional state at all times, a state that can be described as a region within a three-dimensional space.

The present studies were designed to test further the feasibility of describing emotional states that have been identified in the verbal-report domain in terms of the three basic dimensions of pleasure, arousal, and dominance. Forty-two such verbal-report scales were studied in regression analyses. These regression analyses and semantic differential ratings in a second study were employed to complement multidimensional scaling and factor analytic methodologies, which have been used more commonly.

A related issue in verbal-report studies of emotions is the problem of acquiescence bias in responses to single adjectives (Bentler, 1969, 1973). The present studies therefore included a measure of acquiescence, the tendency to agree with an item irrespective of its content, to test its contribution to reports of emotional states when they are assessed with a single-adjective format.

## STUDY ONE

### Method

*Subjects.* Subjects were 200 University of California undergraduates who participated in the study to fulfill a course requirement.

*Materials.* Pleasure–displeasure, arousal–nonarousal, and dominance–submissiveness were assessed with Mehrabian and Russell's (1974, Appendix B) scales. Each of these three scales consists of six items in a 9-point semantic differential format. Subjects responded to 43 additional scales: the 42 listed in Table 1 plus McNair and Lorr's (1964) Confusion Scale (which is not listed there because of its obtained low reliability). Each of Johnson and Myers' (1967) scales (Happiness, Arousal, Anger, Fear, and Depression) consisted of two items in a Thurstone-type format. The version of Spielberger, Gorsuch and Lushene's (1970) State Anxiety Scale, taken from Izard (1972, p. 92), was in a single-adjective format. The remaining scales, those of Izard (1972, Table 10–1), McNair and Lorr (1964), Nowlis (1965), Thayer (1967), and Zuckerman and Lubin (1965), also employed single-adjective checklists. The 255 items taken from all the adjective checklist scales were randomly intermixed and presented to subjects as a single list. Each item on this list was answered on a 5-point scale labeled: not at all, slightly, moderately, considerably, very strongly.

A total of 200 emotion-eliciting situations was used as the stimuli. Each of these situations was described in a small written paragraph. These situations were designed to include a wide variety of physical surroundings and social events and, especially, to elicit a great variety of emotions. Sixty-five of the descriptions, taken from Mehrabian and Russell (1974, Appendix A), focused on the physical properties of situations. Two examples follow:

> You are sitting on a deserted beach in the late afternoon. The water is dark blue, and the waves are crashing loudly. The whole beach is hidden completely from the outside by the sand dunes behind it.

> It is pouring rain, and you have been walking across a field on your way somewhere. The ground has completely turned to mud, and it is very soft and slippery. The sky is a dark gray, and the only sound is the constant drumming of the rain.

An additional 135 situations[1] were written to focus on the interpersonal and social aspects of situations. Two examples follow:

> You have decided to end a long-standing relationship. You've just told the other person about your decision.

> You are jumped by a stranger while walking home. He takes a swing at you and you grab him. You can easily overpower him.

*Procedure.* Each subject read a description of one situation and was asked to pause and imagine himself in that situation, seeing himself really there. He was then asked to imagine

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[1] A list of the 135 situations and a matrix of correlations among the 42 emotion scales is available as NAPS Document #2895. Remit in advance $3.00 for microfiche or $5.75 for photocopy to: ASIS/NAPS, Microfiche Publications, P.O. Box 3513, Grand Central Station, New York, NY 10017.

how *he* would feel there and to describe his feelings on the various emotion scales provided, using first the measures of pleasure, arousal, and dominance (Mehrabian & Russell, 1974, Appendix B), then the five Johnson and Myers' (1967) scales, and finally the 255-item adjective checklist. Data from the first rating procedure were termed Set A.

Each subject then repeated this procedure once with a different emotion-eliciting situation, which was selected randomly from the set of 200. Data from this second rating were termed Set B. Altogether, each subject rated two situations, and each situation was rated by two subjects.

*Design.* Since our hypotheses concerned interrelationships among emotional state descriptors, the data obtained were instances of descriptions of emotional states. In order to generalize to other such instances, a large sample of emotional states was needed and this was obtained by using both a large number of subjects and a large number of emotion-eliciting situations.

In the procedure used, subject and situation were confounded since each subject responded to a different situation. The confounding of situation and subject is often implicit in studies of the description of emotions. For example, Lorr, Daston, and Smith (1967) asked each subject to rate the way he felt during the previous 2 days. McNair and Lorr (1964) asked each of their subjects to rate his feelings during the previous week. And Izard (1972, p. 140) asked each of his subjects to recall a situation or event in his life and to rate how he felt there. In these studies, situation and subject were confounded in that each subject had undoubtedly been in a different situation. Such confounding is not a problem in studies of this sort since the data are to be generalized to the population of descriptions of emotional states. The relevant question, then, is the extent to which an adequate sample of emotional descriptions, generally by a person in a situation unique to that person, was obtained. In the present study, two different sets of data (Sets A and B) were obtained to allow a test of that generality through a cross-validation procedure.

## Results and Discussion

*Reliability.* For each emotion scale, a Kuder–Richardson (Kuder & Richardson, 1937) internal consistency reliability coefficient (KR 20) was computed with data from both the first (Set A) and second (Set B) ratings; there were thus 400 observations from 200 subjects. The resulting coefficients were .93 for pleasure–displeasure, .88 for arousal-nonarousal, and .79 for dominance–submissiveness, all of which were considered adequate. Reliability coefficients for 42 of the 43 remaining scales were also considered adequate and are reported in Table 1. The single exception was the .30 reliability for the 5-item Confusion Scale of McNair and Lorr (1964), and this scale was not analyzed further. In general, the reliability data for these scales indicate that, despite occasional arguments to the contrary, verbal report measures of emotional states can be highly reliable.

*Intercorrelations among the various emotion scales.* Correlations among the 42 scales that had adequate reliability were computed with data from Set A (*n* = 200) and separately with data from Set B (*n* = 200). The resulting correlations for each pair of scales were then averaged after using the Fisher transformation. The final correlations obtained[2] showed that there was considerable overlap even among scales labeled different-

[2] The matrix of correlations is available; see footnote 1.

## TABLE 1
### Regression Equations and Reliability Coefficients for the Emotion Scales of Study One

| Scale | Number of items in scale | Standardized regression weights | | | | | | $R_t$ | $R_z$ | Internal consistency |
|---|---|---|---|---|---|---|---|---|---|---|
| 1. Happiness (Johnson & Myers) | 2 | +.87P | +.20A | +.07D | +.29PA | | +.12Aq | .83 | .63 | .88 |
| 2. General activation (Thayer) | 7 | +.42P | +.48A | +.08D | +.11PA | | +.35Aq | .76 | .73 | .94 |
| 3. Vigor (Nowlis) | 3 | +.37P | +.44A | +.11D | +.10PA | | +.38Aq | .73 | .71 | .87 |
| 4. Arousal (Johnson & Myers) | 2 | +.32P | +.66A | +.08D | | | | .73 | .64 | .81 |
| 5. Elation (Nowlis) | 4 | +.87P | +.07A | | +.17PA | | +.23Aq | .87 | .61 | .92 |
| 6. Enjoyment (Izard) | 3 | +.88P | +.05A | | +.16PA | | +.18Aq | .87 | .42 | .94 |
| 7. Vigor-activity (McNair & Lorr) | 6 | +.55P | +.38A | | +.09PA | | +.36Aq | .76 | .73 | .88 |
| 8. Interest (Izard) | 3 | +.37P | +.29A | | | | +.38Aq | .59 | .58 | .67 |
| 9. Surgency (Nowlis) | 5 | +.62P | | +.08D | +.11PA | | +.38Aq | .68 | .52 | .81 |
| 10. Egotism (Nowlis) | 4 | +.20P | | +.11D | +.12PA | | +.55Aq | .56 | .36 | .68 |
| 11. Surprise (Izard) | 3 | +.16P | +.37A | −.11D | | | +.43Aq | .61 | .57 | .86 |
| 12. Nonchalance (Nowlis) | 2 | +.50P | −.51A | | −.15PA | | +.23Aq | .64 | .55 | .75 |
| 13. Friendliness (McNair & Lorr) | 4 | +.76P | −.08A | | +.07PA | | +.28Aq | .74 | .46 | .84 |
| 14. Social affection (Nowlis) | 4 | +.64P | −.19A | | | | +.34Aq | .66 | .44 | .84 |
| 15. General deactivation (Thayer) | 7 | +.41P | −.69A | −.08D | −.14PA | −.10PD | +.33Aq | .75 | .64 | .86 |
| 16. Concentration (Nowlis) | 8 | +.20P | | | | | +.56Aq | .55 | .35 | .79 |
| 17. Anger (Johnson & Myers) | 2 | −.68P | +.22A | +.10D | −.16PA | | +.14Aq | .72 | .55 | .85 |
| 18. Aggression (Nowlis) | 6 | −.69P | +.07A | +.08D | | | +.45Aq | .86 | .60 | .91 |
| 19. Anger-hostility (McNair & Lorr) | 8 | −.67P | +.08A | +.05D | −.11PA | | +.45Aq | .85 | .60 | .94 |
| 20. Hostility (Zuckerman & Lubin) | 30 | −.77P | +.11A | | −.09PA | | +.11Aq | .82 | .52 | .96 |
| 21. Anger (Izard) | 3 | −.60P | +.13A | | −.16PA | | +.42Aq | .80 | .58 | .94 |
| 22. Disgust (Izard) | 3 | −.61P | | | −.10PA | | +.44Aq | .80 | .65 | .91 |
| 23. Contempt (Izard) | 3 | −.53P | | | −.07PA | | +.61Aq | .78 | .64 | .86 |
| 24. Fear (Johnson & Myers) | 2 | −.47P | +.37A | −.14D | −.09PA | | +.27Aq | .68 | .67 | .80 |
| 25. Tension-anxiety (McNair & Lorr) | 9 | −.43P | +.23A | −.07D | −.06PA | | +.53Aq | .81 | .77 | .83 |
| 26. Anxiety (Nowlis) | 3 | −.38P | +.24A | −.08D | | | +.50Aq | .77 | .72 | .78 |

TABLE 1 *(Continued)*

| Scale | Number of items in scale | Standardized regression weights | | | | | | $R_1$ | $R_2$ | Internal consistency |
|---|---|---|---|---|---|---|---|---|---|---|
| 27. Fear (Izard) | 3 | -.31P | +.22A | -.08D | -.10PA | | +.47Aq | .70 | .66 | .94 |
| 28. Anxiety (Spielberger et al.) | 19 | -.75P | +.36A | | | | +.13Aq | .85 | .74 | .94 |
| 29. Anxiety (Zuckerman & Lubin) | 21 | -.74P | +.25A | -.07D | -.08PA | | +.16Aq | .86 | .74 | .95 |
| 30. High activation (Thayer) | 5 | -.33P | +.40A | | | | +.52Aq | .82 | .74 | .78 |
| 31. Depression (Zuckerman & Lubin) | 40 | -.82P | -.10A | -.09D | | | +.10Aq | .87 | .70 | .97 |
| 32. Depression-dejection (McNair & Lorr) | 13 | -.58P | | -.11D | | +.05PD | +.51Aq | .88 | .74 | .94 |
| 33. Depression (Johnson & Myers) | 2 | -.66P | | | | | +.22Aq | .72 | .58 | .70 |
| 34. Distress (Izard) | 3 | -.65P | -.09A | | | | +.45Aq | .83 | .71 | .88 |
| 35. Fatigue–inertia (McNair & Lorr) | 6 | -.41P | -.43A | | | | +.44Aq | .72 | .69 | .90 |
| 36. Fatigue (Nowlis) | 4 | -.36P | -.52A | | +.10PA | | +.40Aq | .71 | .67 | .84 |
| 37. Fatigue (Izard) | 3 | -.30P | -.53A | | | | +.41Aq | .69 | .65 | .83 |
| 38. Sadness (Nowlis) | 3 | -.59P | -.08A | | | | +.43Aq | .77 | .65 | .86 |
| 39. Deactivation (Thayer) | 3 | -.28P | -.55A | | | | +.39Aq | .65 | .60 | .81 |
| 40. Skepticism (Nowlis) | 3 | -.41P | | -.12D | | | +.54Aq | .73 | .58 | .79 |
| 41. Guilt (Izard) | 3 | -.27P | | | | | +.53Aq | .59 | .48 | .74 |
| 42. Shyness (Izard) | 3 | | | -.20D | | +.09PD | +.44Aq | .51 | .41 | .77 |

*Note.* P is pleasure, A is arousal, D is dominance; PA and PD refer to interaction terms; Aq is acquiescence. All variables were standardized before performing the regression analyses. $R_1$ is the averaged multiple correlation coefficient resulting from the double cross-validation procedure using $\beta$ weights. $R_2$ is the averaged multiple correlation coefficient from the double cross-validation procedure using unit weights. The internal consistency of each scale was assessed with the Kuder and Richardson (1937, Formula 20) reliability coefficient.

ly. For example, Zuckerman and Lubin's (1965) Hostility Scale correlated .84 with both their Anxiety and their Depression Scales; the latter two intercorrelated .85. This finding is consistent with previous evidence (Lubin & Zuckerman, 1967).

The observed redundancy among the 42 scales shows that there is a need for a description of emotions that predicts these relationships and that a relatively simple description should be possible. Parenthetically, this redundancy should also caution investigators concerned with assessing an individual's emotional state. Since an anxious person, for example, would tend to score high on a variety of scales listed in Table 1, scales whose labels range from anger to depression, assessment with these scales would not easily and unambiguously determine a single emotional state for that person.

*Interrelations among the pleasure, arousal, and dominance scales.* The pleasure and arousal scales intercorrelated .03, the pleasure and dominance scales intercorrelated .40, and the arousal and dominance scales intercorrelated .15. In addition, a possible curvilinear relation between pleasure and arousal was assessed since some investigators (e.g., Berlyne, 1960) hypothesized that pleasure is an inverted-U shaped function of arousal level. A quadratic regression coefficient of -.16 was obtained in a regression analysis with standardized pleasure and arousal variables and data (400 observations) from both Set A and Set B, showing a small though significant curvilinear (inverted U) relationship. This relationship, together with the .04 linear correlation between pleasure and arousal, however, accounted for less than 5% of the variance in pleasure scores. These results imply that it is incorrect to equate pleasure with intermediate arousal and to equate displeasure with extremes of arousal. Rather, pleasure and arousal must be defined as independently varying dimensions.

The intercorrelations obtained among the measures of pleasure, arousal, and dominance are not incompatible with their assumed independence. Generally, across any particular sample of emotional states, nonzero linear or curvilinear relationships may be seen among the pleasure, arousal, and dominance measures. For instance, previous studies that employed a different set of emotion-eliciting situations yielded some results opposite to those reported here: Pleasure was a U-shaped function of arousal and, in addition, the correlation between the pleasure and dominance scales, unexpectedly high in the present data, was considerably lower, though still positive (Mehrabian & Russell, 1974, Table 8.8).

The correlations among the measures of pleasure, arousal, and dominance were sufficiently low to permit the regression analyses reported below since the multiple regression method used employs a technique similar to partial correlation. That is, in testing the contribution of domi-

nance to each emotional state, the analysis first partialled out the overlapping contribution of pleasure.

*Acquiescence.* A separate acquiescence score was computed for each subject's response to each emotion scale listed in Table 1. For a given scale, the subject's responses to all items on the adjective checklist, irrespective of content or scoring direction, were summed, excluding those items that were part of that scale. For example, the subjects' acquiescence scores used in Eq. (1) (Table 1) for Johnson and Myers' (1967) Happiness Scale employed responses to all 255 items of the adjective checklist since the items for Johnson and Myers' scale were not among the 255 in the adjective checklist format. On the other hand, the subjects' acquiescence scores used in Eq. (2) for Thayer's (1967) General Activation Scale were a sum of responses to 248 items (255 adjectives less the seven items of the General Activation Scale).

The resulting acquiescence scores were relatively independent of emotional content, as evidenced by the correlations of acquiescence scores based on all 255 items with pleasure ($-.15$), arousal ($.22$), and dominance ($-.14$) scores.

*Regression analyses.* Multiple regression analysis was used to explore scores on each emotion scale (treated as the criterion variable) as a function of the main effects of pleasure, arousal, dominance, and acquiescence. To test the generality and stability of the relations obtained, a double cross-validation technique was employed. Within each data set (A and B) all variables were first standardized (mean $= 0$; $SD = 1$) and then, for each criterion variable, a set of $\beta$ weights was computed for Set A and separately for Set B. Next, for each criterion, the $\beta$ weights derived from Set A were used in a regression equation with the data from Set B, and vice versa. These analyses yielded two multiple correlation coefficients, which are the correlations of criterion scores actually obtained with those predicted by the equation. The two multiple correlation coefficients for each criterion were then averaged and the results are reported in Table 1 in the column labeled $R_1$.

These cross-validated multiple correlation coefficients were high, ranging from .51 to .88. Indeed, in every case the multiple correlation coefficient approached (and twice exceeded) the reliability coefficient for the emotion scale criterion. Because of the double cross-validation procedure used and because the measures of pleasure, arousal, and dominance also contained a degree of unreliability (which limits the possible magnitude of the multiple correlation coefficient), the multiple correlation coefficients obtained were as high as could have been expected. In short, the three content variables and the one response style variable accounted for almost all of the reliable variance in the various scales of emotion investigated.

The next set of analyses was concerned with obtaining weights for each of the predictor variables. In an analogous double cross-validation procedure, another multiple correlation coefficient was computed for each criterion variable by using unit weights ($\pm 1.0$) rather than $\beta$ weights, but of course with the same sign as the $\beta$ weights, in the regression equations. This analysis tested the stability of the $\beta$ weights since equations with unit weights generally produce higher cross-validated multiple correlations than do equations with $\beta$ weights when the sample size is insufficient to provide stable estimates of population $\beta$ weights (see the review in Dawes and Corrigan, 1974). The results of this analysis are given in Table 1 in the $R_2$ column and show that the multiple correlations for equations with unit weights, while moderately high (ranging from .35 to .77), were lower than the multiple correlations for equations with $\beta$ weights in every case, and in some cases were substantially lower. This analysis thus provided evidence that the individual $\beta$ weights were adequately reliable, and further analyses were thus carried out to obtain the best estimates of these $\beta$ weights.

For this purpose, a stepwise multiple regression analysis (Efroymson, 1960) was performed for each emotion scale using the data from both Set A and Set B; there were thus 400 observations (200 subjects × 2 situations per subject) for each equation. Scores on each emotion scale were expressed as a function of the main effect of the four predictor variables, pleasure (P), arousal (A), dominance (D) and acquiescence (Aq), and, for exploratory purposes, three interaction effects (P × A, P × D, and A × D). Terms representing each of these seven effects were entered into a regression equation in successive steps. At each step, a .01 level of significance test was conducted on the increment in the multiple correlation coefficient. If the term was significant, it was entered into the equation. The next term considered was the one accounting for the greatest amount of remaining variance in the criterion. When no additional term was found to be significant in this way, the analysis was terminated. All variables were standardized before performing the regression analyses, and thus the magnitudes of the coefficients in the resulting equations express the relative contribution of each term. The results for all the analyses are summarized in Table 1.

In all but one case [Johnson and Myers' (1967) Arousal Scale], acquiescence was a significant component of responses to the emotion scale. All coefficients for acquiescence in the equations were positive (ranging from .10 to .61), irrespective of scale content. This evidence supports our interpretation of these acquiescence scores as measures of a response bias rather than of a content factor.

The evidence also supports Bentler's (1969, 1973) view that acquiescence is a pervasive contributor to responses obtained with measures that

are in a single-adjective format. The acquiescence $\beta$ weights for the five Johnson and Myers scales, which were in a Thurstone-type format, were relatively low. They included one nonsignificant $\beta$ weight and the others ranged from .12 to .27. The Spielberger et al. (1970) scale and the three Zuckerman and Lubin (1965) scales, although in an adjective checklist format, employ negatively as well as positively keyed items. The acquiescence $\beta$ weights for these scales were also relatively low, although all were positive and significantly greater than zero; they ranged from .10 to .16. The remaining scales, those of Izard (1972), McNair and Lorr (1964), Nowlis (1965), and Thayer (1967), are in an adjective checklist format and employ only positively keyed items. Their acquiescence $\beta$ weights were high, ranging from .18 to .61. Thus, it is possible at least to minimize acquiescence bias in an adjective checklist by employing both positively and negatively keyed items.

The scales in Table 1 are grouped approximately by content. The first set of scales (numbers 1–10) includes states of neutral to high pleasure, neutral to high arousal, and neutral to high dominance. The similarity among these scales was also evident in their intercorrelations, which ranged from .08 to .96. The Nowlis (1965) Elation Scale, the Izard (1972) Enjoyment Scale, and the Johnson and Myers (1967) Happiness Scale were all similar in that they included a very high pleasure component and small but positive arousal and dominance components. The Vigor Scales of Nowlis (1965) and of McNair and Lorr (1964), the General Activation Scale of Thayer (1967), and the Arousal Scale of Johnson and Myers (1967) included approximately equal components of pleasure and arousal; perhaps vigor or enthusiasm is the most appropriate name for these scales.

Equations (12) through (15) refer to pleasant but unaroused states. Equation (16) shows that although concentration had a slightly pleasant connotation, it was unrelated to either arousal or dominance. Since only one measure was used, concentration may actually include a high arousal component, which, however, was not tapped with this particular measure.

Equations (17) through (28) refer to unpleasant but aroused states. These equations show that anger (hostility, aggression) involved a feeling of dominance, whereas anxiety (fear, tension) involved submissiveness. These results replicated previous findings (Plutchik & Landau, 1973; Russell & Mehrabian, 1974) and are especially important in establishing the necessity for the dimension of dominance–submissiveness for a comprehensive description of emotional states since this dimension helps make the important distinction between anger and anxiety.

In a number of cases an interaction term was also found to be significant in the regression equations reported in Table 1. Table 2 provides the cell

TABLE 2

CELL MEANS FOR THE PLEASURE × AROUSAL INTERACTION EFFECT FOR THE JOHNSON AND MYERS HAPPINESS SCALE

|  | Arousal | |
| --- | --- | --- |
|  | Low | High |
| Pleasure |  |  |
| Pleasure | 6.5 | 9.4 |
| Displeasure | 3.1 | 3.2 |

*Note.* Higher scores indicate greater happiness.

means (using mean splits on pleasure and arousal) for the Pleasure × Arousal interaction of Johnson and Myers' (1967) Happiness Scale (Table 1, Eq. (1)). The equation for this scale, incidentally, indicated that since it includes not only pleasure but also arousal, it might more appropriately be labeled "Elation." The cell means in Table 3 show that there was a significant contribution of arousal to higher reports of happiness or elation only when pleasure was high; there was no effect due to arousal when displeasure was experienced. Thus, arousal does not necessarily contribute to happiness or elation, but pleasure is a necessary component of it, which is especially enhanced when the pleasure is combined with arousal. (The absence of an interaction effect would indicate that either pleasure *or* arousal alone is sufficient to contribute to the feeling of happiness or elation.)

A similar interpretation is applicable to all of the interaction effects reported in Table 1 since a similar pattern of cell means was obtained for all, with the sole exception of the interaction effect given for McNair and Lorr's (1964) Friendliness Scale. That is, for any pleasant emotion (one with a positive pleasure component), cell means for the interaction effect showed that the arousal effect (or the dominance effect where PD is reported) was greater when pleasure was experienced than when displeasure was experienced. In parallel fashion, for any unpleasant emotion (one with a negative pleasure component), cell means for the interaction effect showed that the arousal (or dominance) effect was greater when displeasure was experienced.

These results bear on an important issue in the definition of particular emotional states. Should each state be defined as requiring a specific combination of the three basic components (multiplicative definition) or as a weighted sum of the three components (additive definition)? Interaction effects are predicted by the first definition, whereas main effects are predicted by the second. The results of Table 1 show that although additive definitions are clearly adequate (since the main effects in the equations account for most of the variance in each criterion), more

precise definitions are obtained by combining main and interactive terms.

The sole exception to the pattern of interactions discussed above and represented in Table 2 was found with McNair and Lorr's (1964) Friendliness Scale. The cell means for that Pleasure × Arousal interaction are given in Table 3. These means show that when someone felt pleasant, his friendliness *increased* with increasing arousal; when he felt unpleasant, his friendliness *decreased* with increasing arousal. This interaction effect and the main pleasure effect reported in Eq. (13) of Table 1 replicated previous work on the emotional correlates of friendliness or affiliation (Mehrabian & Russell, 1975), work in which affiliation was considered a behavioral and conative dimension and was distinguished conceptually from emotional states. The pattern of cell means for friendliness obtained here is unlike that for any other emotion and suggests that, indeed, friendliness is more appropriately considered a behavioral or conative dimension, one that is nonetheless strongly associated with several emotional states, rather than a particular emotional state per se.

## STUDY TWO

A second study used a different methodology to complement Study One. In the present study, subjects were asked to "define" emotion-denoting terms directly by means of semantic differential-type scales of each of the three basic factors of pleasure, arousal, and dominance. In this way the relationships of these three basic factors with the other specific emotional states could be assessed without the use of correlations or samples of emotion-eliciting situations.

Furthermore, the list of 42 emotional states investigated in Study One overrepresented some emotional states (e.g., anxiety) and underrepresented others (e.g., relaxation or boredom). This second study therefore explored the basic emotional components of a more adequate list of 151 different terms denoting emotional states. This study thus provided not only a comparison to the results of the first study but also provided a

TABLE 3
CELL MEANS FOR THE PLEASURE × AROUSAL INTERACTION EFFECT
FOR THE MCNAIR AND LORR FRIENDLINESS SCALE

|  | Arousal | |
| --- | --- | --- |
|  | Low | High |
| Pleasure |  |  |
| Pleasure | 13.1 | 14.5 |
| Displeasure | 8.7 | 7.8 |

*Note.* Higher scores indicate greater friendliness.

preliminary dictionary of emotional terms, each defined on the basic emotional dimensions.

### Method

*Subjects.* Subjects were 300 University of California undergraduates who participated in the study to fulfill a course requirement.

*Materials.* A set of 151 terms (words or phrases) was selected to sample a wide range of emotion-denoting terms and is listed in Table 4. Mehrabian and Russell's (1974, Appendix B) three scales (with six 9-point semantic differential-type items per scale) of pleasure-displeasure, arousal-nonarousal, and dominance-submissiveness were used to assess the emotional components of each term.

*Procedure.* Each subject read instructions on how to use semantic differential scales. The instructions then continued with: "We want you to describe what it is like when you feel [a term denoting an emotional state was inserted here]. Pause to think just what this feeling is like. Then use the adjective-pair scales below to describe this feeling. Remember that each adjective of the scales below refers to how *you* might feel."

The subject then rated the emotion term on the 18 adjective pairs that assessed pleasure, arousal, and dominance. Depending on time limitations, each subject repeated this rating process for 10 to 20 different terms. The set of emotion terms rated by a subject was randomly selected from the total list of 151. However, all members of one group of 29 subjects rated the same 20 terms to provide reliability data.

### Results

For each emotion term, mean pleasure-displeasure, arousal-nonarousal, and dominance-submissiveness scores were computed across all subjects who rated that term. These means were transformed linearly to a scale ranging from −1 to +1 with a neutral value of 0. Table 4 provides these mean values, standard deviations on the −1 to +1 scale for the ratings of each term, and the number of subjects who provided the data for each term. (When a subject failed to complete his rating of a term, all his data for that term were excluded from calculations. Hence some terms were rated by fewer subjects.)

The reliability of the mean scores of pleasure, arousal, and dominance given in Table 4 was estimated with a technique described by Winer (1962, pp. 124–128). Data from the 29 subjects who had all rated the same 20 terms were analyzed and yielded reliability coefficients of .97 for pleasure, .89 for arousal, and .87 for dominance. These figures, which were quite satisfactory, are interpreted as estimates of the correlation of mean scores (e.g., the pleasure scores) across these 20 terms obtained from two different groups of subjects.

A two-tailed test based on the normal distribution was used to test the significance of each coefficient (mean score) in Table 4. All coefficients differing significantly from zero at the .01 level are marked with an asterisk (*). These tests were performed to provide a comparison with the results of Study One, even though the reliability estimates showed that all the coefficients in Table 4, including values of zero, can be meaningfully interpreted.

TABLE 4
THE DEFINITION OF TERMS DENOTING EMOTIONS IN TERMS OF
PLEASURE, AROUSAL, AND DOMINANCE

| Term | N | Pleasure Mean | SD | Arousal Mean | SD | Dominance Mean | SD |
|---|---|---|---|---|---|---|---|
| 1. Bold | 27 | .44* | .32 | .61* | .24 | .66* | .30 |
| 2. Useful | 27 | .70* | .20 | .44* | .28 | .47* | .40 |
| 3. Mighty | 27 | .48* | .37 | .51* | .28 | .69* | .31 |
| 4. Kind | 27 | .73* | .22 | .19* | .32 | .57* | .27 |
| 5. Self-satisfied | 27 | .86* | .10 | .20 | .40 | .62* | .31 |
| 6. Admired | 29 | .81* | .21 | .44* | .30 | .51* | .34 |
| 7. Proud | 29 | .77* | .21 | .38* | .34 | .65* | .33 |
| 8. Interested | 29 | .64* | .20 | .51* | .21 | .17 | .40 |
| 9. Arrogant | 29 | .00 | .51 | .34* | .44 | .48* | .34 |
| 10. Inspired | 29 | .71* | .30 | .63* | .21 | .34* | .55 |
| 11. Excited | 29 | .62* | .25 | .75* | .20 | .38* | .29 |
| 12. Influential | 28 | .68* | .23 | .40* | .33 | .75* | .18 |
| 13. Aggressive | 28 | .41* | .30 | .63* | .25 | .62* | .24 |
| 14. Strong | 28 | .58* | .24 | .48* | .30 | .62* | .30 |
| 15. Dignified | 28 | .55* | .27 | .22* | .40 | .61* | .30 |
| 16. Powerful | 28 | .54* | .26 | .45* | .36 | .73* | .25 |
| 17. Elated | 28 | .50* | .47 | .42* | .14 | .23* | .36 |
| 18. Hopeful | 29 | .51* | .30 | .23* | .33 | .14 | .41 |
| 19. Triumphant | 29 | .69* | .23 | .57* | .19 | .63* | .26 |
| 20. Joyful | 29 | .76* | .22 | .48* | .26 | .35* | .31 |
| 21. Capable | 29 | .70* | .24 | .28* | .27 | .61* | .31 |
| 22. Lucky | 30 | .71* | .19 | .48* | .30 | .37* | .29 |
| 23. Responsible | 30 | .35* | .29 | .38* | .26 | .49* | .37 |
| 24. Friendly | 30 | .69* | .23 | .35* | .28 | .30* | .27 |
| 25. Masterful | 30 | .58* | .25 | .44* | .27 | .69* | .25 |
| 26. Free | 30 | .81* | .14 | .24* | .38 | .46* | .33 |
| 27. Devoted | 30 | .49* | .25 | .17* | .27 | .10 | .37 |
| 28. Domineering | 27 | .23* | .37 | .40* | .21 | .58* | .26 |
| 29. Aroused | 30 | .24* | .28 | .57* | .26 | .22* | .33 |
| 30. Concentrating | 28 | .42* | .25 | .28* | .27 | .39* | .34 |
| 31. Happy | 29 | .81* | .21 | .51* | .26 | .46* | .38 |
| 32. Egotistical | 29 | .24* | .34 | .32* | .25 | .50* | .31 |
| 33. Carefree | 29 | .78* | .21 | .25* | .39 | .41* | .31 |
| 34. Affectionate | 29 | .64* | .26 | .35* | .34 | .24* | .40 |
| 35. Vigorous | 30 | .58* | .22 | .61* | .23 | .49* | .24 |
| 36. Activated | 30 | .42* | .26 | .58* | .21 | .38* | .28 |
| 37. Alert | 30 | .49* | .25 | .57* | .20 | .45* | .26 |
| 38. Alone with responsibility | 30 | .33* | .34 | .34* | .37 | .48* | .36 |
| 39. Controlling | 30 | .47* | .26 | .34* | .23 | .66* | .25 |
| 40. Proud and lonely | 27 | .01 | .43 | .02 | .32 | .26* | .40 |
| 41. Enjoyment | 30 | .77* | .17 | .44* | .26 | .42* | .29 |
| 42. Serious | 30 | .27* | .22 | .24* | .22 | .42* | .27 |
| 43. Cooperative | 31 | .39* | .32 | .13* | .27 | .03 | .34 |
| 44. Thankful | 27 | .61* | .25 | .10 | .34 | -.13 | .35 |

TABLE 4 (Continued)

| Term | N | Pleasure Mean | SD | Arousal Mean | SD | Dominance Mean | SD |
|---|---|---|---|---|---|---|---|
| 45. Respectful | 27 | .38* | .39 | .13 | .29 | -.08 | .49 |
| 46. Appreciative | 27 | .55* | .26 | .07 | .30 | -.14 | .35 |
| 47. Loved | 28 | .87* | .17 | .54* | .26 | -.18* | .30 |
| 48. Grateful | 28 | .64* | .23 | .16 | .22 | -.21* | .34 |
| 49. In love | 28 | .82* | .17 | .65* | .24 | -.05 | .37 |
| 50. Anxious | 28 | .01 | .45 | .59* | .31 | -.15 | .32 |
| 51. Impressed | 28 | .41* | .26 | .30* | .25 | -.32* | .34 |
| 52. Surprised | 29 | .40* | .30 | .67* | .27 | -.13 | .38 |
| 53. Sexually excited | 29 | .58* | .26 | .62* | .20 | -.01 | .43 |
| 54. Wonder | 30 | .27* | .37 | .24* | .35 | -.17* | .26 |
| 55. Fascinated | 29 | .55* | .22 | .51* | .23 | -.07 | .35 |
| 56. Awed | 30 | .18* | .34 | .40* | .30 | -.38* | .21 |
| 57. Overwhelmed | 30 | .14 | .39 | .45* | .34 | -.24* | .32 |
| 58. Curious | 28 | .22* | .30 | .62* | .20 | -.01 | .34 |
| 59. Relaxed | 27 | .68* | .30 | -.46* | .38 | .06 | .49 |
| 60. Untroubled | 27 | .79* | .25 | -.01 | .46 | .33* | .39 |
| 61. Modest | 29 | .27* | .34 | -.06 | .30 | .12 | .39 |
| 62. Secure | 29 | .74* | .22 | -.13 | .32 | .03 | .37 |
| 63. Nonchalant | 30 | .07 | .35 | -.25* | .31 | .11 | .33 |
| 64. Aloof | 30 | .16 | .35 | -.01 | .30 | .25* | .32 |
| 65. Leisurely | 30 | .58* | .35 | -.32* | .33 | .11 | .33 |
| 66. Reserved | 30 | .01 | .37 | -.19* | .28 | .02 | .37 |
| 67. Protected | 27 | .60* | .35 | -.22* | .37 | -.42* | .40 |
| 68. Consoled | 27 | .29* | .50 | -.19* | .33 | -.28* | .38 |
| 69. Quiet | 27 | .19 | .57 | -.40* | .21 | -.04 | .39 |
| 70. Sheltered | 29 | .14 | .53 | -.36* | .32 | -.44* | .24 |
| 71. Humble | 28 | .23* | .39 | -.28* | .24 | -.27* | .35 |
| 72. Solemn | 29 | .03 | .39 | -.32* | .26 | -.11 | .33 |
| 73. Reverent | 28 | .31* | .35 | -.08 | .26 | -.29* | .34 |
| 74. Astonished | 30 | .16* | .26 | .88* | .19 | -.15* | .26 |
| 75. Disgusted | 29 | -.60* | .20 | .35* | .41 | .11 | .34 |
| 76. Insolent | 28 | -.26* | .43 | .21 | .44 | .20* | .31 |
| 77. Cruel | 29 | -.45* | .35 | .48* | .32 | .42* | .32 |
| 78. Irritated | 29 | -.58* | .16 | .40* | .37 | .01 | .40 |
| 79. Defiant | 28 | -.16* | .30 | .54* | .37 | .32* | .42 |
| 80. Hate | 28 | -.56* | .16 | .59* | .29 | .13 | .34 |
| 81. Hostile | 29 | -.42* | .31 | .53* | .36 | .30* | .32 |
| 82. Angry | 29 | -.51* | .20 | .59* | .33 | .25* | .39 |
| 83. Mildly annoyed | 29 | -.28* | .16 | .17* | .28 | .04 | .31 |
| 84. Enraged | 29 | -.44* | .25 | .72* | .29 | .32* | .44 |
| 85. Contempt | 29 | -.23* | .39 | .31* | .33 | .18* | .29 |
| 86. Selfish | 29 | -.34* | .31 | .09 | .33 | .31* | .43 |
| 87. Reprehensible | 24 | -.09 | .36 | .11 | .24 | .06 | .32 |
| 88. Contemptuous | 25 | -.24* | .26 | .31* | .31 | .21* | .32 |
| 89. Scornful | 28 | -.35* | .21 | .35* | .27 | .29* | .32 |
| 90. Suspicious | 29 | -.25* | .23 | .42* | .21 | .11 | .32 |
| 91. Skeptical | 29 | -.22* | .28 | .21* | .25 | .03 | .33 |

TABLE 4 (Continued)

| Term | N | Pleasure | | Arousal | | Dominance | |
|---|---|---|---|---|---|---|---|
| | | Mean | SD | Mean | SD | Mean | SD |
| 92. Burdened with responsibility | 30 | −.08 | .41 | .28* | .31 | .19 | .47 |
| 93. Cold anger | 30 | −.43* | .29 | .67* | .27 | .34* | .44 |
| 94. Hostile but controlled | 30 | −.24* | .31 | .42* | .35 | .09 | .38 |
| 95. Crushed | 27 | −.69* | .50 | .03 | .47 | −.50* | .23 |
| 96. Frustrated | 27 | −.64* | .18 | .52* | .37 | −.35* | .30 |
| 97. Distressed | 27 | −.61* | .17 | .28* | .46 | −.36* | .21 |
| 98. Insecure | 27 | −.57* | .34 | .14 | .42 | −.42* | .29 |
| 99. Humiliated | 27 | −.63* | .18 | .43* | .34 | −.38* | .30 |
| 100. Hungry | 29 | −.44* | .26 | .14 | .33 | −.21* | .27 |
| 101. Fearful | 29 | −.64* | .20 | .60* | .32 | −.43* | .30 |
| 102. Terrified | 29 | −.62* | .20 | .82* | .25 | −.43* | .34 |
| 103. Embattled | 27 | −.37* | 24 | .40* | .42 | −.02 | .39 |
| 104. Helpless | 29 | −.71* | .18 | .42* | .45 | −.51* | .32 |
| 105. Troubled | 28 | −.63* | .16 | .16 | .40 | −.40* | .24 |
| 106. Startled | 28 | −.09 | .34 | .65* | .29 | −.33* | .32 |
| 107. Anguished | 29 | −.50* | .30 | .08 | .46 | −.20* | .34 |
| 108. Shamed | 29 | −.57* | .23 | .01 | .46 | −.34* | .30 |
| 109. Displeased | 29 | −.55* | .21 | .16 | .34 | −.05 | .41 |
| 110. Embarrassed | 29 | −.46* | .30 | .54* | .26 | −.24* | .40 |
| 111. Upset | 30 | −.63* | .20 | .30* | .39 | −.24* | .24 |
| 112. Defeated | 30 | −.61* | .24 | .06 | .39 | −.32* | .23 |
| 113. Pain | 29 | −.58* | .21 | .41* | .31 | −.34* | .28 |
| 114. Quietly indignant | 26 | −.28* | .35 | .04 | .36 | −.16 | .40 |
| 115. Repentant | 25 | −.06 | .55 | .06 | .32 | −.12 | .43 |
| 116. Sinful | 28 | −.30* | .36 | .22* | .33 | −.01 | .41 |
| 117. Shy | 29 | −.15 | .33 | .06 | .30 | −.34* | .28 |
| 118. Guilty | 29 | −.57* | .19 | .28* | .38 | −.34* | .28 |
| 119. Weary with responsibility | 30 | −.27* | .34 | .02 | .28 | −.01 | .35 |
| 120. Angry but detached | 30 | −.42* | .22 | .28* | .41 | −.03 | .33 |
| 121. Confused | 30 | −.53* | .20 | .27* | .29 | −.32* | .28 |
| 122. Dissatisfied | 30 | −.50* | .22 | .05 | .28 | .13 | .32 |
| 123. Regretful | 30 | −.52* | .24 | .02 | .32 | −.21* | .28 |
| 124. Tense | 30 | −.33* | .35 | .58* | .32 | −.11 | .39 |
| 125. Disdainful | 25 | −.32* | .32 | −.11 | .27 | .05 | .29 |
| 126. Depressed | 27 | −.72* | .21 | −.29* | 44 | −.41* | .28 |
| 127. Despairing | 27 | −.72* | .21 | −.16 | .34 | −.38* | .25 |
| 128. Lonely | 29 | −.66* | .35 | −.43* | .36 | −.32* | .30 |
| 129. Meek | 29 | −.19 | .58 | −.25* | .32 | −.41* | .42 |
| 130. Burdened | 29 | −.66* | .21 | −.03 | .41 | −.26* | .36 |
| 131. Timid | 28 | −.15 | .41 | −.12 | .37 | −.47* | .31 |
| 132. Bored | 28 | −.65* | .19 | −.62* | .24 | −.33* | .21 |
| 133. Feeble | 29 | −.42* | .35 | −.20 | .42 | −.46* | .31 |
| 134. Nauseated | 29 | −.61* | .25 | −.01 | .28 | −.36* | .33 |
| 135. Inhibited | 30 | −.54* | .26 | −.04 | .40 | −.41* | .23 |
| 136. Fatigued | 30 | −.18 | .48 | −.57* | .29 | −.29* | .29 |
| 137. Rejected | 29 | −.62* | .24 | −.01 | .38 | −.33* | .27 |
| 138. Subdued | 29 | −.17 | .35 | −.26* | .25 | −.18* | .34 |

TABLE 4 (Continued)

| Term | N | Pleasure | | Arousal | | Dominance | |
|---|---|---|---|---|---|---|---|
| | | Mean | SD | Mean | SD | Mean | SD |
| 139. Impotent | 30 | −.53* | .35 | −.13 | .40 | −.29* | .32 |
| 140. Ennui | 16 | −.45* | .39 | −.43* | .36 | −.17 | .42 |
| 141. Blasé | 26 | −.29* | .33 | −.51* | .25 | −.16* | .30 |
| 142. Haughty and lonely | 27 | −.47* | .28 | −.24* | .34 | −.13 | .26 |
| 143. Listless | 27 | −.45* | .41 | −.59* | .28 | −.24* | .28 |
| 144. Deactivated | 28 | −.46* | .32 | −.43* | .41 | −.46* | .27 |
| 145. Weary | 29 | −.18 | .38 | −.33* | .42 | −.24* | .35 |
| 146. Snobbish and lonely | 30 | −.62* | .26 | −.19* | .34 | −.14* | .28 |
| 147. Uninterested | 30 | −.47* | .26 | −50* | 22 | −.08 | .24 |
| 148. Detached | 30 | −.37* | .34 | −.26* | .28 | −.14* | .29 |
| 149. Discontented | 30 | −.53* | .19 | −.16 | .41 | −.26* | .30 |
| 150. Discouraged | 30 | −.61* | .25 | −.15 | .32 | −.29* | .32 |
| 151. Sad | 30 | −.63* | .23 | −.27* | .34 | −.33* | .22 |

Note. N is the number of subjects who rated the term; Mean is the mean rating transformed to a −1 to +1 scale; SD is the standard deviation on the same scale.
* The mean differs significantly ($p < .01$) from 0.0.

## GENERAL DISCUSSION

The numerical results from the two studies cannot be precisely compared since the coefficients obtained in the first study were $\beta$ weights, whereas those obtained in the second study were mean ratings. Moreover, standardized measures were used in the first study, whereas single terms were used in the second. Nevertheless, a general comparison can be made by considering the extent to which both studies showed a given emotional state to include displeasure or pleasure, low or high arousal, and submissiveness or dominance. That is, did coefficients for each emotional state differ significantly from zero in the same direction on each of the three dimensions in both studies?

For example, happiness was shown to include high degrees of pleasure, arousal, and dominance both in Table 1 (Eq. (1)) and in Table 4 (Eq. (31)). Similar replications on each of the three components were obtained in the following equations of Table 4: aroused (29), vigorous (35), angry (82), fearful (101), and depressed (126). Some results in Table 1 yielded less than three significant components, and the following equations of Table 4 replicated what was significant in Table 1 and occasionally showed significance for an additional term: interested (8), elated (17), concentrating (30), egotistical (32), enjoyment (41), disgusted (75), hostile (81), contemptuous (88), skeptical (91), shy (117), guilty (118), sad (151). For example, enjoyment was defined in Table 1 (Eq. (6)) as including pleasure and arousal; Table 4 (Eq. (41)) confirmed this and showed that enjoyment also includes a feeling of dominance.

Another set of equations in Table 4 only partially replicated the equations in Table 1. That is, all coefficients for the following equations in Table 4 were in the same direction as in Table 1, but some coefficients did not attain significance: surprised (52), nonchalant (63), tense (124), and fatigued (136).

Comparisons of results from the two studies were not possible in some cases. The term "surgency" was not included in Study Two. Thayer (1967) used the word "activation" in two of his scale titles, and he used the word "deactivation" in his two other scale titles. The term "activated" connotes pleasure, arousal, and dominance (Table 4, Eq. (36)) and is thus an appropriate label for Thayer's General Activation Scale (Table 1, Eq. (2)), which consistently replicated the components of "activated". Because of its pleasant connotation, "activated" is *not* an appropriate title for Thayer's High Activation Scale, however, which measures unpleasant arousal with the items jittery, intense, stirred-up, fearful, and clutched-up.

The term "deactivated" (Table 4, Eq. (144)) is the exact opposite of "activated" and was rated as an unpleasant, unaroused, and submissive state. It is thus an appropriate title for, and replicates the results of, Thayer's Deactivation Scale (Table 1, Eq. (39)). But, "deactivated" is inappropriate for Thayer's General Deactivation Scale, which consists of low arousal and submissiveness, but high pleasure (Table 1, Eq. (15)).

So far we have considered all but 5 of the 42 equations in Table 1. Discrepant results were obtained between the two studies for these five cases. In the first study, friendliness and social affection (Eqs. (13) and (14) of Table 1) both contained small, negative arousal components, whereas in the second study, "friendly" and "affectionate" (Eqs. (24) and (34) of Table 4) both contained high arousal components. Note, however, that the pleasure components of both these feelings were replicated. The discrepancies on arousal imply that friendliness does not necessarily involve high or low arousal, but can occur with either.

A more surprising discrepancy was obtained between the definition of aggression in Eq. (18) of Table 1, where it included displeasure, and in Eq. (13) of Table 4, where it included a high degree of pleasure. Other terms relating to aggression, however, were consistently defined in Study Two as including displeasure (e.g., angry, hostile, and cruel). More importantly, the Nowlis (1965) Aggression Scale does not use the term "aggressive," and those items of the Nowlis Aggression Scale that were included in Study Two (defiant, Eq. (79); angry, Eq. (82)) were indeed shown to involve displeasure. Thus, the word "aggression" is an inappropriate label for the emotional state of anger, probably because of the bold and assertive qualities sometimes associated with the term "aggression" (e.g., an aggressive leader).

The fourth case of discrepant results was similar to the preceding one. "Anxious," which was defined in Study One as including displeasure (Table 1, Eqs. (26), (28), and (29)), was rated as neutral on pleasure in Study Two (Table 4, Eq. (50)). Study Two did show, however, that other terms commonly employed in measures of anxiety did, as expected, include displeasure: fearful (Table 4, Eq. (101)), tense (Eq. (124)), terrified (Eq. (102)), and upset (Eq. (111)). Hence, as in the case of the word "aggressive," "anxious" is an inappropriate label for the emotion tapped by anxiety scales, probably because of its more positive meaning of being eager (e.g., "I am anxiously awaiting the arrival of good news." "I am anxious to see you.").

The final discrepancy involved the definition of "distress." In Study One, Izard's (1972) Distress Scale included low arousal (Table 1, Eq. (34)), but in Study Two this term involved moderately high arousal (Table 4, Eq. (97)). This discrepancy is explained by examining the three items, downhearted, sad, and discouraged, on Izard's Distress Scale. The last two items were rated in Study Two (Table 4, Eqs. (150) and (151)), and both were shown to involve low arousal. Hence, "distress" is an inappropriate label for Izard's scale, which might better be labeled "sadness."

Besides the terms used to replicate the results of Study One, Table 4 includes many terms that have not been previously explored in other studies of emotional states. One group of terms, given in Eqs. (59) through (66), refers to states that involve pleasure, low arousal, and dominance (e.g., relaxed, leisurely). Another group, in Eqs. (67) through (73), is similar to the "relaxed and leisurely" group in terms of its pleasure and nonarousal components, but differs from them in that it involves submissiveness rather than dominance. Examples are "sheltered," "reverent," and "protected." The measures of emotional states examined in Study One also failed to provide any instances combining displeasure, low arousal, and dominance. Table 4 (Eq. (125)) shows that "disdainful" describes such a state, although the magnitudes of the components were small.

## CONCLUSION

The present two studies provided evidence in support of the thesis that the three dimensions of pleasure–displeasure, arousal–nonarousal, and dominance–submissiveness are both necessary and sufficient to describe a large variety of emotional states. Evidence from both studies showed that these three dimensions are reliably measured. Considerable previous evidence showed the necessity for the pleasure and arousal dimensions in defining emotional states. Study One showed that arousal, independent of the contribution of pleasure, accounts for a significant proportion of the

variance in the various emotional states. Moreover, pleasure and arousal must be defined as independent dimensions since no more than 5% of the variance in pleasure scores could be accounted for by a combined linear and curvilinear function of arousal.

Evidence provided here showed the necessity for dominance–submissiveness as a basic factor as well. Only dominance makes it possible to distinguish angry from anxious, alert from surprised, relaxed from protected, and disdainful from impotent [the first word in each pair involves dominance; the second involves submissiveness (Table 4)]. Study Two, moreover, showed that all eight possible combinations of high and low values along each of the three dimensions actually occur as components of various emotional states. That is, dominance co-occurred with both high and low values of arousal and with both high and low values of pleasure; submissiveness similarly co-occurred with both high and low values of arousal and with both high and low values of pleasure. Nevertheless, Study One yielded a significant positive correlation between dominance and pleasure scores. In that same study, however, dominance contributed significantly to the prediction of the various emotional states even after this overlapping contribution of pleasure had been partialled out in the multiple regression analyses. Moreover, previous research with these same measures yielded considerably smaller correlations between pleasure and dominance. In short, even though the evidence is weaker than in the case of pleasure and arousal, and even though pleasure and dominance covary somewhat across some sets of situations, dominance cannot be accurately defined as some combination of pleasure and arousal and should therefore be considered a dimension logically independent of the other two. In contrast, other dimensions, such as anger and anxiety, could accurately be defined as combinations of pleasure, arousal, and dominance.

In sum, the evidence shows that all three dimensions are *necessary* for an adequate description of emotions. But are these three dimensions *sufficient* to define all the various emotional states? The question of sufficiency was clarified by the regression equations of Study One where scores on a wide sample of measures of emotional states were predicted from scores on the pleasure, arousal, and dominance dimensions. The multiple correlation coefficients in Table 1 show that pleasure, arousal, and dominance values (along with a response bias factor) accounted for almost all of the reliable variance in the 42 scales studied. Such results provide strong evidence for the sufficiency of these three dimensions.

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TABLE 1 (Continued)

| Scale | Number of items in scale | Standardized regression weights | | | | | $R_1$ | $R_2$ | Internal consistency |
|---|---|---|---|---|---|---|---|---|---|
| 27. Fear (Izard) | 3 | −.31P | +.22A | −.08D | −.10PA | +.47Aq | .70 | .66 | .94 |
| 28. Anxiety (Spielberger et al.) | 19 | −.75P | +.36A | | | +.13Aq | .85 | .74 | .94 |
| 29. Anxiety (Zuckerman & Lubin) | 21 | −.74P | +.25A | −.07D | −.08PA | +.16Aq | .86 | .74 | .95 |
| 30. High activation (Thayer) | 5 | −.33P | +.40A | | | +.52Aq | .82 | .74 | .78 |
| 31. Depression (Zuckerman & Lubin) | 40 | −.82P | −.10A | −.09D | | +.10Aq | .87 | .70 | .97 |
| 32. Depression–dejection (McNair & Lorr) | 13 | −.58P | | −.11D | +.05PD | +.51Aq | .88 | .74 | .94 |
| 33. Depression (Johnson & Myers) | 2 | −.66P | | | | +.22Aq | .72 | .58 | .70 |
| 34. Distress (Izard) | 3 | −.65P | −.09A | | | +.45Aq | .83 | .71 | .88 |
| 35. Fatigue–inertia (McNair & Lorr) | 6 | −.41P | −.43A | | | +.44Aq | .72 | .69 | .90 |
| 36. Fatigue (Nowlis) | 4 | −.36P | −.52A | | +.10PA | +.40Aq | .71 | .67 | .84 |
| 37. Fatigue (Izard) | 3 | −.30P | −.53A | | | +.41Aq | .69 | .65 | .83 |
| 38. Sadness (Nowlis) | 3 | −.59P | −.08A | | | +.43Aq | .77 | .65 | .86 |
| 39. Deactivation (Thayer) | 3 | −.28P | −.55A | | | +.39Aq | .65 | .60 | .81 |
| 40. Skepticism (Nowlis) | 3 | −.41P | | | | +.54Aq | .73 | .58 | .79 |
| 41. Guilt (Izard) | 3 | −.27P | | −.12D | | +.53Aq | .59 | .48 | .74 |
| 42. Shyness (Izard) | 3 | | | −.20D | +.09PA | +.44Aq | .51 | .41 | .77 |

*Note.* P is pleasure, A is arousal, D is dominance; PA and PD refer to interaction terms; Aq is acquiescence. All variables were standardized before performing the regression analyses. $R_1$ is the averaged multiple correlation coefficient resulting from the double cross-validation procedure using $\beta$ weights. $R_2$ is the averaged multiple correlation coefficient from the double cross-validation procedure using unit weights. The internal consistency of each scale was assessed with the Kuder and Richardson (1937, Formula 20) reliability coefficient.

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ly. For example, Zuckerman and Lubin's (1965) Hostility Scale correlated .84 with both their Anxiety and their Depression Scales; the latter two intercorrelated .85. This finding is consistent with previous evidence (Lubin & Zuckerman, 1967).

The observed redundancy among the 42 scales shows that there is a need for a description of emotions that predicts these relationships and that a relatively simple description should be possible. Parenthetically, this redundancy should also caution investigators concerned with assessing an individual's emotional state. Since an anxious person, for example, would tend to score high on a variety of scales listed in Table 1, scales whose labels range from anger to depression, assessment with these scales would not easily and unambiguously determine a single emotional state for that person.

*Interrelations among the pleasure, arousal, and dominance scales.* The pleasure and arousal scales intercorrelated .03, the pleasure and dominance scales intercorrelated .40, and the arousal and dominance scales intercorrelated .15. In addition, a possible curvilinear relation between pleasure and arousal was assessed since some investigators (e.g., Berlyne, 1960) hypothesized that pleasure is an inverted-U shaped function of arousal level. A quadratic regression coefficient of −.16 was obtained in a regression analysis with standardized pleasure and arousal variables and data (400 observations) from both Set A and Set B, showing a small though significant curvilinear (inverted U) relationship. This relationship, together with the .04 linear correlation between pleasure and arousal, however, accounted for less than 5% of the variance in pleasure scores. These results imply that it is incorrect to equate pleasure with intermediate arousal and to equate displeasure with extremes of arousal. Rather, pleasure and arousal must be defined as independently varying dimensions.

The intercorrelations obtained among the measures of pleasure, arousal, and dominance are not incompatible with their assumed independence. Generally, across any particular sample of emotional states, nonzero linear or curvilinear relationships may be seen among the pleasure, arousal, and dominance measures. For instance, previous studies that employed a different set of emotion-eliciting situations yielded some results opposite to those reported here: Pleasure was a U-shaped function of arousal and, in addition, the correlation between the pleasure and dominance scales, unexpectedly high in the present data, was considerably lower, though still positive (Mehrabian & Russell, 1974, Table 8.8).

The correlations among the measures of pleasure, arousal, and dominance were sufficiently low to permit the regression analyses reported below since the multiple regression method used employs a technique similar to partial correlation. That is, in testing the contribution of domi-

nance to each emotional state, the analysis first partialled out the overlapping contribution of pleasure.

*Acquiescence.* A separate acquiescence score was computed for each, subject's response to each emotion scale listed in Table 1. For a given scale, the subject's responses to all items on the adjective checklist, irrespective of content or scoring direction, were summed, excluding those items that were part of that scale. For example, the subjects' acquiescence scores used in Eq. (1) (Table 1) for Johnson and Myers' (1967) Happiness Scale employed responses to all 255 items of the adjective checklist since the items for Johnson and Myers' scale were not among the 255 in the adjective checklist format. On the other hand, the subjects' acquiescence scores used in Eq. (2) for Thayer's (1967) General Activation Scale were a sum of responses to 248 items (255 adjectives less the seven items of the General Activation Scale).

The resulting acquiescence scores were relatively independent of emotional content, as evidenced by the correlations of acquiescence scores based on all 255 items with pleasure ($-.15$), arousal ($.22$), and dominance ($-.14$) scores.

*Regression analyses.* Multiple regression analysis was used to explore scores on each emotion scale (treated as the criterion variable) as a function of the main effects of pleasure, arousal, dominance, and acquiescence. To test the generality and stability of the relations obtained, a double cross-validation technique was employed. Within each data set (A and B) all variables were first standardized (mean $= 0$; $SD = 1$) and then, for each criterion variable, a set of $\beta$ weights was computed for Set A and separately for Set B. Next, for each criterion, the $\beta$ weights derived from Set A were used in a regression equation with the data from Set B, and vice versa. These analyses yielded two multiple correlation coefficients, which are the correlations of criterion scores actually obtained with those predicted by the equation. The two multiple correlation coefficients for each criterion were then averaged and the results are reported in Table 1 in the column labeled $R_1$.

These cross-validated multiple correlation coefficients were high, ranging from .51 to .88. Indeed, in every case the multiple correlation coefficient approached (and twice exceeded) the reliability coefficient for the emotion scale criterion. Because of the double cross-validation procedure used and because the measures of pleasure, arousal, and dominance also contained a degree of unreliability (which limits the possible magnitude of the multiple correlation coefficient), the multiple correlation coefficients obtained were as high as could have been expected. In short, the three content variables and the one response style variable accounted for almost all of the reliable variance in the various scales of emotion investigated.

The next set of analyses was concerned with obtaining weights for each of the predictor variables. In an analogous double cross-validation procedure, another multiple correlation coefficient was computed for each criterion variable by using unit weights ($\pm 1.0$) rather than $\beta$ weights, but of course with the same sign as the $\beta$ weights, in the regression equations. This analysis tested the stability of the $\beta$ weights since equations with unit weights generally produce higher cross-validated multiple correlations than do equations with $\beta$ weights when the sample size is insufficient to provide stable estimates of population $\beta$ weights (see the review in Dawes and Corrigan, 1974). The results of this analysis are given in Table 1 in the $R_2$ column and show that the multiple correlations for equations with unit weights, while moderately high (ranging from .35 to .77), were lower than the multiple correlations for equations with $\beta$ weights in every case, and in some cases were substantially lower. This analysis thus provided evidence that the individual $\beta$ weights were adequately reliable, and further analyses were thus carried out to obtain the best estimates of these $\beta$ weights.

For this purpose, a stepwise multiple regression analysis (Efroymson, 1960) was performed for each emotion scale using the data from both Set A and Set B; there were thus 400 observations (200 subjects $\times$ 2 situations per subject) for each equation. Scores on each emotion scale were expressed as a function of the main effect of the four predictor variables, pleasure (P), arousal (A), dominance (D) and acquiescence (Aq), and, for exploratory purposes, three interaction effects (P $\times$ A, P $\times$ D, and A $\times$ D). Terms representing each of these seven effects were entered into a regression equation in successive steps. At each step, a .01 level of significance test was conducted on the increment in the multiple correlation coefficient. If the term was significant, it was entered into the equation. The next term considered was the one accounting for the greatest amount of remaining variance in the criterion. When no additional term was found to be significant in this way, the analysis was terminated. All variables were standardized before performing the regression analyses, and thus the magnitudes of the coefficients in the resulting equations express the relative contribution of each term. The results for all the analyses are summarized in Table 1.

In all but one case [Johnson and Myers' (1967) Arousal Scale], acquiescence was a significant component of responses to the emotion scale. All coefficients for acquiescence in the equations were positive (ranging from .10 to .61), irrespective of scale content. This evidence supports our interpretation of these acquiescence scores as measures of a response bias rather than of a content factor.

The evidence also supports Bentler's (1969, 1973) view that acquiescence is a pervasive contributor to responses obtained with measures that

Another set of equations in Table 4 only partially replicated the equations in Table 1. That is, all coefficients for the following equations in Table 4 were in the same direction as in Table 1, but some coefficients did not attain significance: surprised (52), nonchalant (63), tense (124), and fatigued (136).

Comparisons of results from the two studies were not possible in some cases. The term "surgency" was not included in Study Two. Thayer (1967) used the word "activation" in two of his scale titles, and he used the word "deactivation" in his two other scale titles. The term "activated" connotes pleasure, arousal, and dominance (Table 4, Eq. (36)) and is thus an appropriate label for Thayer's General Activation Scale (Table 1, Eq. (2)), which consistently replicated the components of "activated". Because of its pleasant connotation, "activated" is *not* an appropriate title for Thayer's High Activation Scale, however, which measures unpleasant arousal with the items jittery, intense, stirred-up, fearful, and clutched-up.

The term "deactivated" (Table 4, Eq. (144)) is the exact opposite of "activated" and was rated as an unpleasant, unaroused, and submissive state. It is thus an appropriate title for, and replicates the results of, Thayer's Deactivation Scale (Table 1, Eq. (39)). But, "deactivated" is inappropriate for Thayer's General Deactivation Scale, which consists of low arousal and submissiveness, but high pleasure (Table 1, Eq. (15)).

So far we have considered all but 5 of the 42 equations in Table 1. Discrepant results were obtained between the two studies for these five cases. In the first study, friendliness and social affection (Eqs. (13) and (14) of Table 1) both contained small, negative arousal components, whereas in the second study, "friendly" and "affectionate" (Eqs. (24) and (34) of Table 4) both contained high arousal components. Note, however, that the pleasure components of both these feelings were replicated. The discrepancies on arousal imply that friendliness does not necessarily involve high or low arousal, but can occur with either.

A more surprising discrepancy was obtained between the definition of aggression in Eq. (18) of Table 1, where it included displeasure, and in Eq. (13) of Table 4, where it included a high degree of pleasure. Other terms relating to aggression, however, were consistently defined in Study Two as including displeasure (e.g., angry, hostile, and cruel). More importantly, the Nowlis (1965) Aggression Scale does not use the term "aggressive," and those items of the Nowlis Aggression Scale that were included in Study Two (defiant, Eq. (79); angry, Eq. (82)) were indeed shown to involve displeasure. Thus, the word "aggression" is an inappropriate label for the emotional state of anger, probably because of the bold and assertive qualities sometimes associated with the term "aggression" (e.g., an aggressive leader).

The fourth case of discrepant results was similar to the preceding one. "Anxious," which was defined in Study One as including displeasure (Table 1, Eqs. (26), (28), and (29)), was rated as neutral on pleasure in Study Two (Table 4, Eq. (50)). Study Two did show, however, that other terms commonly employed in measures of anxiety did, as expected, include displeasure: fearful (Table 4, Eq. (101)), tense (Eq. (124)), terrified (Eq. (102)), and upset (Eq. (111)). Hence, as in the case of the word "aggressive," "anxious" is an inappropriate label for the emotion tapped by anxiety scales, probably because of its more positive meaning of being eager (e.g., "I am anxiously awaiting the arrival of good news." "I am anxious to see you.").

The final discrepancy involved the definition of "distress." In Study One, Izard's (1972) Distress Scale included low arousal (Table 1, Eq. (34)), but in Study Two this term involved moderately high arousal (Table 4, Eq. (97)). This discrepancy is explained by examining the three items, downhearted, sad, and discouraged, on Izard's Distress Scale. The last two items were rated in Study Two (Table 4, Eqs. (150) and (151)), and both were shown to involve low arousal. Hence, "distress" is an inappropriate label for Izard's scale, which might better be labeled "sadness."

Besides the terms used to replicate the results of Study One, Table 4 includes many terms that have not been previously explored in other studies of emotional states. One group of terms, given in Eqs. (59) through (66), refers to states that involve pleasure, low arousal, and dominance (e.g., relaxed, leisurely). Another group, in Eqs. (67) through (73), is similar to the "relaxed and leisurely" group in terms of its pleasure and nonarousal components, but differs from them in that it involves submissiveness rather than dominance. Examples are "sheltered," "reverent," and "protected." The measures of emotional states examined in Study One also failed to provide any instances combining displeasure, low arousal, and dominance. Table 4 (Eq. (125)) shows that "disdainful" describes such a state, although the magnitudes of the components were small.

## CONCLUSION

The present two studies provided evidence in support of the thesis that the three dimensions of pleasure–displeasure, arousal–nonarousal, and dominance–submissiveness are both necessary and sufficient to describe a large variety of emotional states. Evidence from both studies showed that these three dimensions are reliably measured. Considerable previous evidence showed the necessity for the pleasure and arousal dimensions in defining emotional states. Study One showed that arousal, independent of the contribution of pleasure, accounts for a significant proportion of the