

## Affective Space is Bipolar

James A. Russell

University of British Columbia, Vancouver, Canada

Numerous previous studies found monopolar rather than bipolar dimensions of affect (defined as emotion represented in language), but may have included methodological biases against bipolarity. The present study of self-report data ( $N = 150$ ) on 11 affect scales showed that response format and acquiescence response style significantly shifted correlations between hypothesized opposites away from showing bipolarity. When these biases were taken into account, pleasure was found to be the bipolar opposite of displeasure and arousal of sleepiness. In turn, pleasure-displeasure and degree of arousal formed a two-dimensional bipolar space that accounted for almost all of the reliable variance in Thayer's four factors of activation plus a measure of depression. Dominance and submissiveness factors were also included in the study, but invalidity of the scales used precluded any conclusions regarding their bipolarity.

Early work on affect (emotion as represented in language) was based on the assumption that its descriptive dimensions would be bipolar: "An affective scale is a bipolar one" (Guilford, 1954, p. 264). Nowlis (e.g., Nowlis & Nowlis, 1956) similarly began his factor-analytic work on affect by hypothesizing four bipolar dimensions: pleasantness-unpleasantness, activation-deactivation, positive-negative social orientation, and control-lack of control. He gathered adjectives to measure each dimension and, in a series of studies, factor-analyzed the intercorrelations among responses to those adjectives. "How [did] these results relate to our original hypotheses? First, we had assumed that each factor would be bipolar. Actually, bipolarity was almost nonexistent in the obtained axes" (Nowlis, 1965, p. 358). His hypothesized opposites had tended to form two separate, in-

dependent monopolar factors instead of single bipolar ones.

Borgatta (1961), Clyde (1963), and McNair and Lorr (1964) subsequently reported the results of additional factor-analytic studies on affect in which monopolar, as opposed to bipolar, factors were consistently obtained. Thayer (1967) investigated what had originally been hypothesized to be a single, bipolar affective dimension, degree of activation or arousal, and obtained four independent monopolar factors, which he termed *general activation*, *high activation*, *deactivation-sleep*, and *general deactivation*. Indeed, most investigators of affect now argue against the existence of bipolar affective dimensions (e.g., Bradburn, 1969; Hall, 1977; Izard, 1972; McLachlan, 1976; Westbrook, 1976).

In other words, considerable research has tended to indicate that a person can feel, for example, both happy and unhappy or both aroused and sleepy at the same time. Based on these results, the affect scales most commonly used today were constructed to assess monopolar factors (e.g., Izard, 1972; McNair, Lorr, & Droppleman, 1971; Nowlis, 1965; Thayer, 1967), although several scales continue to be based on bipolar dimensions (e.g., Mehrabian & Russell, 1974; Spiel-

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I am grateful to Lesley Walton, Klaus Schroeder, Nicole Clement, and Doreen Ridgeway for their help in carrying out this study, to James H. Steiger and A. Ralph Hakstian for their help in data analysis, and to Jerry S. Wiggins and Auke Tellegen for helpful comments on an earlier version of this article.

Send reprint requests to James A. Russell, Department of Psychology, University of British Columbia, Vancouver, British Columbia, Canada V6T 1W5.

berger, Gorsuch, & Lushene, 1970; Zuckerman & Lubin, 1965).

### *Bipolarity of Semantic Space*

Interestingly, a similar controversy arose in the semantic differential literature. Osgood, Suci, and Tannenbaum (1957) found that the affective meaning of words could be adequately summarized by three bipolar dimensions: evaluation, activity, and potency. Since each of these dimensions was defined by adjective-pair scales such as good-bad, fast-slow, and strong-weak, respectively, Green and Goldfried (1965) argued that bipolarity had been assumed, indeed had been forced onto the results, by the rating procedure employed. Green and Goldfried then attempted to empirically test the assumption of bipolarity by constructing a single-adjective version of Osgood's semantic differential scales and examining the actual correlation between alleged opposites. If evaluation, say, were indeed bipolar, one would expect a high negative correlation between responses to negative evaluation words such as *bad* and those to positive evaluation words such as *good*. In fact, Green and Goldfried generally failed to find such correlations and concluded that semantic space should *not* be conceptualized as bipolar. If accepted, such a conclusion would have important implications not only for the widely used semantic differential technique but for the area of affect as well, in that the semantic differential factors have been interpreted as reflecting basic dimensions of human affect (Osgood, 1969).

Green and Goldfried's (1965) argument against bipolarity of semantic space did not go unchallenged, however. Bentler (1969) argued that high negative correlations indicative of bipolarity might have been obscured in their study by acquiescence, which is an individual-difference variable in the tendency to agree or disagree with an item regardless of its content. That is, if acquiescence were a factor in Green and Goldfried's data, it would have shifted all observed correlations between words in a positive direction and hence away from showing bipolarity ( $r = -1.0$ ). Bentler tested his hypothesis by constructing a single-adjective version of the

semantic differential and using a partial correlation technique to control acquiescence. The results provided striking evidence for his hypothesis. For example, a composite of positive evaluation words correlated only .03 with a composite of negative evaluation words—before acquiescence was taken into account. After acquiescence was partialled out, these composites correlated  $-.76$ , thus giving strong evidence for the bipolarity of semantic space.

### *Bipolarity of Affective Space*

In the domain of affect, Meddis (1972) has recently defended the notion of bipolar dimensions. He noted two potential sources of bias in the response format used by Nowlis (1965), and subsequently by Thayer (1967), that could account for their failure to obtain bipolar dimensions. The response rating scale used by Nowlis and Thayer, shown in Table 1, assigns 1 point to "No (definitely not)," 2 points to "? (cannot decide)," 3 points to "V (feel slightly)," and 4 points to "VV (definitely feel)." First, Meddis noted, this scale is asymmetric, in that there are two categories of acceptance (V and VV) but only one of rejection (No), and, second, the option "? (cannot decide)" may preclude even ordinal data, since a response to that option could mean a variety of things other than a feeling whose intensity is somewhere between the two neighboring categories.

Meddis (1972) empirically contrasted the results obtained using Nowlis's and Thayer's response format with results obtained using a format that was more symmetric and that excluded the "cannot decide" alternative. (This last format is shown in Table 1 as the "Meddis" format.) Responses to affective adjectives were gathered with each of these formats separately and factor-analyzed. As predicted, predominantly monopolar factors tended to emerge from the data gathered with Nowlis's and Thayer's format, whereas bipolar factors tended to emerge from the data gathered with the Meddis format. When, for example, responses to 38 adjectives similar to those studied by Thayer (1967) were gathered with the Meddis format, bipolar factors were obtained: general activation ver-

sus deactivation-sleep and high activation versus general deactivation. In Meddis's (1972) words, "Whether or not we obtain bipolar factors appears to depend upon the kind of rating scale we use" (p. 183).

#### *Additional Factors Operating Against Bipolarity*

Many of the studies supporting monopolarity reviewed above did not employ Nowlis's and Thayer's response format and therefore are not subject to Meddis's specific criticisms. The conclusion of monopolarity in these additional studies may be questioned on the grounds of other methodological problems, however, such as the possibility of alternate rotations and of the influence of difficulty factors (unequal response distributions of the variables involved) in factor-analytic solutions. More importantly, these studies may also have included biases specifically against bipolar factors. First, to the extent that the sample of emotion words studied underrepresents one end of a bipolar continuum, bipolar factors are less likely to emerge. Second, if the instructions ask subjects how they felt over an extended period of time (such as over a week; e.g., Bradburn, 1969; Hall, 1977), they may describe several, perhaps opposite, emotional experiences. Finally, the correlation between two items of a scale has been shown to be spuriously inflated in proportion to the proximity of the items to each other in time or space (Guilford, 1954; Stockford & Bissell, 1949). This phenomenon, known as proximity error, would be expected to result in an overall shift toward more positive correlations among a set of items—irrespective of content—to which subjects responded within a short period of time, which of course is standard practice (and, it would seem, a necessity) when measuring affect.

In short, although numerous empirical studies of affect have concluded against bipolarity, results from these studies may have been biased by one or more of the following: an acquiescence response bias; a response format that fails to yield ordinal data; an asymmetric response format; inadequate

sampling of affect terms; instructions to describe feelings during a time period long enough that several, possibly opposite, feelings might have occurred; and a proximity error, which is the tendency to respond similarly to items that are nearer in time or space.

#### *Overview of the Present Study*

In the present study, subjects described their current affective state on separate scales assessing opposite ends of hypothesized bipolar dimensions so that correlations between these scales could be empirically established. Four response formats (shown in Table 1) were employed: Meddis's (1972) format plus three others that have been extensively used in studies obtaining monopolar factors of affect, Nowlis's (1965) and Thayer's (1967), McNair and Lorr's (1964), and a true-false format.

To ensure an adequate sample of affect terms, items were chosen for the questionnaire that appeared on a priori grounds to assess primarily opposite ends of pleasure-displeasure, arousal-sleepiness, and dominance-submissiveness, since these dimensions have been suggested by a variety of sources of evidence as basic dimensions of affect (see Russell, 1978, for a brief review of this evidence). All adjectives from Thayer's (1967) four scales of activation were also included in order to explore the activation/arousal dimension more thoroughly. Thayer (1970) showed his scales to be significantly related to physiological indexes of arousal, and the relation of his four factors to the entire affective space is thus of considerable theoretical importance. Moreover, evidence provided by Russell and Mehrabian (1977) indicated that it was possible to subsume Thayer's four dimensions within a more general, three-dimensional theory of affect defined by pleasure-displeasure, degree of arousal, and dominance-submissiveness. The present study provided further evidence on that notion and tested Meddis's (1972) hypothesis that Thayer's general activation is the bipolar opposite of deactivation-sleep and that high activation is the bipolar opposite of general deactivation. Finally, a set of adjectives that

Table 1  
*Response Probability for Each Category of Four Response Formats*

Format	Label			
Meddis (1972)	XX (definitely do not feel) .17	X (do not feel) .41	V (slightly feel) .34	VV (definitely feel) .08
Nowlis (1965) & Thayer (1967)	No (definitely do not feel) .45	? (cannot decide) .15	V (feel slightly) .32	VV (definitely feel) .08
McNair & Lorr (1974)	1 (not at all) .41	2 (a little) .36	3 (quite a lot) .18	4 (extremely) .05
True-false	N (no, I do not feel) .63	Y (yes, I do feel) .37		

*Note.* Probabilities were calculated across 58 items and 150 subjects for each response format.

appeared to assess depression was included, since on inspection of Thayer's items, depression seemed more likely to be the actual bipolar opposite of his general activation scale.

## Method

### Subjects

Subjects were 71 female and 79 male University of British Columbia undergraduates. These were students from two different psychology classes who responded to a series of four questionnaires during class time, each questionnaire on a separate day, approximately 2 weeks apart. One class responded in the fall of 1976, the other in the following spring. Ten additional subjects began, but failed to complete the study, and their data were excluded from analysis.

### Materials

Eleven sets of adjectives, a total of 58 items, were used. The first 4 sets are Thayer's (1967) factors of activation, and the remaining 7 were constructed a priori to measure pleasure, displeasure, arousal, sleepiness, dominance, submissiveness, and depression. The sets were the following:

1. *General activation* (Thayer): lively, active, full of pep, energetic, peppy, vigorous, activated.
2. *High activation* (Thayer): clutched up, jittery, stirred up, fearful, intense.
3. *General deactivation* (Thayer): at rest, still, leisurely, quiescent, quiet, calm, placid.
4. *Deactivation-sleep* (Thayer): sleepy, tired, drowsy.

5. *Pleasure*: contented, happy, satisfied, pleased, joyful.

6. *Displeasure*: discontented, unhappy, dissatisfied, displeased, joyless.

7. *Arousal*: wide awake, aroused, aflame, impassioned, alert, roused.

8. *Sleepiness*: inactive, half asleep, slow, unaroused.

9. *Dominance*: dominant, controlling, influential, important, autonomous.

10. *Submissiveness*: submissive, controlled, influenced, awed, guided.

11. *Depression*: depressed, discouraged, gloomy, sad, blue, sluggish.

Four questionnaires were formed by intermixing these 58 items in two random orders and then counterbalancing each. Each questionnaire began with directions stating, "On this sheet you will find a list of words or phrases that describe different kinds of moods and feelings. Please use this list to describe your feelings *today*."

Next followed one of the four response formats (shown in Table 1). The true-false format allows two response alternatives; the remaining three formats allow four response alternatives and differ only in the verbal label attached to each alternative. For convenience, these three formats were labeled in the table by the name of investigators who introduced, or at least have used, that format in studies of affect.

### Procedure

Each subject responded to the 58-item questionnaire at the beginning of class and returned it to an envelope; all envelopes were collected. Altogether, each subject responded four times, once to each of the four response formats in random order. Each subject responded only once, again in random order, to each of the four orders of presentation of the 58

items. In other words, all possible combinations of response format with order of item presentation were employed and randomly assigned to subjects. No feedback from their data was given to subjects until after the last questionnaire had been completed.

## Results and Discussion

### *Response Format*

Table 1 shows the mean probability of a response to each category of each response format. The Meddis format resulted in a roughly even, symmetric distribution of responses. The Nowlis and Thayer format, in contrast, resulted in a bimodal distribution, because subjects avoided the category labeled "? (cannot decide)"—a finding that supports the view that this category may preclude ordinal data. The McNair and Lorr format resulted in a skewed distribution, because the modal response was to the first category, "not at all." Thus, of the four formats studied, the Meddis format provided the best distribution of responses and may be preferred on these grounds alone.

It had been hypothesized that in comparison with the Meddis format, the other formats would shift correlations among items in the positive direction. A sign test was thus used in which each interitem correlation from the Meddis format was compared with its counterpart from each of the other three formats. As expected, correlations based on the other formats did tend to be greater than their counterparts based on the Meddis format: In the Nowlis and Thayer format data, 649 correlations were smaller and 1,004 were greater ( $z = 8.71, p < .01$ ); in the McNair and Lorr format data, 684 were smaller and 969 greater ( $z = 6.98, p < .01$ ); and in the true-false format data, 500 were smaller, and 1,153 greater ( $z = 16.04, p < .01$ ). In addition, the true-false format resulted in more correlations that were greater than their counterparts not only from the Meddis format but from the others as well; Compared with the Nowlis and Thayer format data, 559 were smaller and 1,094 were greater ( $z = 13.13, p < .01$ ); and compared with the McNair and Lorr format data, 641 were smaller

and 1,012 were greater ( $z = 9.10, p < .01$ ). There was no significant difference between correlations from the Nowlis and Thayer format and those from the McNair and Lorr format (864 smaller and 789 larger,  $z = 1.82, ns$ ). In sum, when compared with the Meddis format, the three formats commonly used in studies of affect resulted in correlations shifted in the positive direction—away from evidence of bipolarity.

### *Content Scales*

*Reliability.* Since 7 of the 11 scales were constructed ad hoc for this study, their internal consistency was unknown. Rather than use an extensive item-selection process, however, it was decided to simply eliminate any item from a scale if it failed to correlate positively with each of the other items on that scale. Based on data gathered with the Meddis format ( $N = 150$ ), only one item—"controlled" on the submissiveness scale—failed this criterion, and that item was excluded from further analyses. Measures of internal consistency reliability (coefficient alpha, Cronbach, 1951) were then calculated for all 11 scales, separately for each format. (Values for 5 scales are reported later in Table 3.) Three scales showed only moderate reliability: high activation (.59 to .69), dominance (.68 to .73), and submissiveness (.56 to .65). But, all other scales showed adequate reliability (.70 to .95), and at this point, all scales were retained for further analysis.

*Product-moment correlations.* Table 2 gives zero-order correlations of 6 scales with hypothesized bipolar opposites, separately for each response format. Correlations between pleasure and displeasure ranged from  $-.43$  with the true-false format to  $-.71$  with the Meddis format. Similarly, correlations between arousal and sleepiness ranged from  $-.45$  with the true-false format to  $-.62$  with the Meddis format. Correlations between dominance and submissiveness were considerably lower and mostly positive, ranging from .27 with the true-false format to  $-.05$  with the McNair and Lorr format. Correlations between Thayer's high activation and its hypothesized opposite, general

Table 2  
*Association Between Scales and Their Hypothesized Opposites*

Scale	Hypothesized opposite	Meddis (1972)			Nowlis (1965) & Thayer (1967)			McNair & Lorr (1964)			True-false		
		<i>r</i>	Partial <i>r</i>	AQ	<i>r</i>	Partial <i>r</i>	AQ	<i>r</i>	Partial <i>r</i>	AQ	<i>r</i>	Partial <i>r</i>	AQ
Pleasure	Displeasure	-.71*	-.78*	#	-.66*	-.80*	#	-.66*	-.78*	#	-.43*	-.71*	#
Arousal	Sleepiness	-.62*	-.71*	#	-.62*	-.76*	#	-.55*	-.72*	#	-.45*	-.66*	#
Dominance	Submissiveness	.12	.05		.13	.02	#	-.05	-.19	#	.27*	.06	#
General activation	Deactivation-sleep	-.53*	-.50*		-.58*	-.66*	#	-.50*	-.55*	#	-.38*	-.52*	#
General activation	Depression	-.58*	-.60*		-.42*	-.50*	#	-.39*	-.56*	#	-.20	-.43*	#
High activation	General deactivation	-.31*	-.36*	#	-.16	-.30*	#	-.16	-.25*	#	-.14	-.34*	#

Note. *r* refers to zero-order correlations between the two scales listed. Partial *r* refers to a partial correlation with acquiescence partialled. The column AQ indicates (by the appearance of a number sign, #) that acquiescence correlated significantly ( $p < .01$ ) with the first scale listed partialing the hypothesized opposite.  $N = 150$ .

\*  $p < .01$ .

deactivation, were negative, but low and mostly nonsignificant. There were two hypothesized opposites for Thayer's general activation scale: Thayer's deactivation-sleep scale and the depression scale. Correlations between high activation and these two hypothesized opposites were negative and mostly significant, but again modest in size.

To test the hypothesis that response format influenced the correlation between hypothesized opposites, each of the six correlations from the Meddis format was compared with its counterpart from each of the other three formats.<sup>1</sup> Two pairs of correlations were found to be significantly different: (a) The correlation between pleasure and displeasure ( $-.71$ ) from the Meddis format differed from that ( $-.43$ ) from the true-false format ( $z = 3.85$ ), and (b) the correlation between general activation and depression ( $-.58$ ) from the Meddis format differed from that ( $-.20$ ) from the true-false format ( $z = 4.08$ ). Thus, the true-false response format resulted in two significant differences, both in the expected direction of a more positive correlation than that produced by the Meddis format. In the other four comparisons between these two formats, the differences were in the same direction, although not significant. The Meddis format did not, however, produce any significantly more negative correlations between opposites in comparison with either the Nowlis and Thayer or the McNair and Lorr formats.

Indeed, as shown in Table 2, although 9 of these 12 comparisons were in the expected direction, there were no large differences among corresponding correlations from the four-place formats. Contrary to Meddis's (1972) hypothesis, these results suggest that the Nowlis and Thayer format contributes at most a modest bias against obtaining bipolar dimensions.

#### *The Role of Acquiescence*

*Partial correlations.* A clearer picture of the relationship between hypothesized opposites emerged when acquiescence was taken into account through partial correlation. For each pair of scales within a given format, an acquiescence score was calculated for each subject by summing his or her responses to all items (many of them antonyms), except those items constituting the pair of scales to be correlated. For example, the acquiescence score partialled from the correlation between

<sup>1</sup> A separate test was carried out for each of the six pairs of scales listed in Table 2 for a total of 18 comparisons. Each test was conducted at the .001 level (one-tailed) so that the probability of a single spuriously significant result would be kept to approximately .018 ( $18 \times .001$ ). The test used here for the difference between two correlations based on the same sample is discussed in Olkin (1967), but the formula is misprinted there. The correct equation was supplied by James H. Steiger through personal communication.

pleasure and displeasure consisted of responses to 48 items, which were all the items except those for pleasure or displeasure. A partial correlation was then calculated between each pair of hypothesized opposites, partialing the appropriate acquiescence score. These results are also shown in Table 2.

In all but one case (general activation/deactivation, Meddis format), partialing acquiescence shifted the correlation in the expected, negative direction, that is, in the direction supporting bipolarity. In order to assess whether acquiescence contributed significantly to the variance in the content scales, another partial correlation was calculated: the correlation of acquiescence with the first scale listed in the table, partialing its hypothesized opposite. A number sign (#) is shown in Table 2 in the column labeled AQ (acquiescence) whenever this partial correlation was significant at the .01 level, which occurred in 21 of the 24 cases. Interestingly, all three exceptions occurred with the Meddis-format data, suggesting that this format is less subject to acquiescence bias than the others. In contrast, the results for the true-false format were not only significant but sizable, suggesting that this format is particularly subject to acquiescence bias.

*Pleasure and arousal.* Returning to the partial correlations between content scales, we can see from Table 2 that for pleasure and displeasure, these partial correlations were quite substantial—negative and large in magnitude, ranging from  $-.71$  to  $-.80$ . This was the case even for the data from the true-false format, in which was seen the most dramatic change due to partialing acquiescence. Similar results were obtained for arousal and sleepiness, for which the partial correlations ranged from  $-.66$  to  $-.76$ . Thus, for these two dimensions, strong evidence of bipolarity was obtained by partialing acquiescence—regardless of which response format was involved.<sup>2</sup>

*Dominance.* Partialing acquiescence from the correlations between dominance and submissiveness shifted these correlations in the expected negative direction. Nevertheless, the final results, ranging from  $.06$  to  $-.19$ , did not differ significantly from zero and pro-

vided no evidence of bipolarity. In light of the results for pleasure and displeasure and for arousal and sleepiness, this finding is puzzling. Its explanation seems to be that there was little valid variance in either of the two scales, but especially submissiveness. First, reliabilities for these scales were low. Second, a substantial proportion of the reliable variance appears to have been actually acquiescence response style: Correlations of dominance with an acquiescence score (based on all items except dominance or submissiveness ones) ranged from  $.20$  (Meddis format) to  $.42$  (true-false format); correlations of submissiveness with the same acquiescence score ranged from  $.32$  (McNair and Lorr format) to  $.52$  (true-false format). In short, a considerable proportion of the variance in each scale was either unreliable or invalid, leaving so little valid variance that meaningful conclusions are precluded.

*Thayer's scales and depression.* Thayer's (1967) four scales yielded intermediate results. The partial correlations for general activation and its two hypothesized opposites, depression and deactivation-sleep, ranged from  $-.43$  to  $-.66$ , indicating a consistently negative relationship, although not a substantial one. The partial correlations for high

<sup>2</sup>Since my concern was with the bipolarity of theoretical dimensions rather than with practical prediction problems, a correction for attenuation (unreliability) provided a useful estimate of what these partial correlations would be if the two scales correlated were perfectly reliable. The pleasure-displeasure partial correlation from the Meddis-format data ( $-.78$ ) was thus corrected for unreliability (as estimated by alpha coefficients) in both the pleasure and displeasure scales; the result was  $-.88$ . A similar procedure for the arousal-sleepiness partial correlation ( $-.71$ ) yielded an estimate of  $-1.02$ . Such corrected correlations must be interpreted with caution, because the use of coefficient alpha as an estimate of reliability can overcorrect the correlation (as obviously happened in the case of arousal-sleepiness). Also, it is not a common practice to disattenuate *partial* correlations, although doing so would appear to be biased on the conservative side, since after partialing reliable variance, error variance would constitute a relatively greater proportion of the remainder. Nevertheless, these results at least reinforce the view that as various sources of bias and error are removed, the correlation between these hypothesized opposites approaches  $-1.00$ .

Table 3  
*Multiple Regression Results and Reliability Coefficients for Thayer's Four Scales and Depression*

Criterion	Response format	Standardized regression weight			R	Reliability for criterion
		Pleasure	Arousal	Acquiescence		
General activation	Meddis <sup>a</sup>	.32	.67	.08	.84	.91
	Nowlis <sup>b</sup> & Thayer <sup>c</sup>	.19	.75	.16	.84	.92
	McNair & Lorr <sup>d</sup>	.30	.72	.16	.87	.95
	True-false	.15	.67	.24	.80	.93
High activation	Meddis	-.64	.38	.32	.68	.65
	Nowlis & Thayer	-.39	.40	.37	.57	.59
	McNair & Lorr	-.52	.37	.35	.68	.69
	True-false	-.42	.35	.55	.72	.66
General deactivation	Meddis	.43	-.69	.14	.57	.78
	Nowlis & Thayer	.35	-.58	.33	.49	.76
	McNair & Lorr	.27	-.60	.34	.48	.71
	True-false	.28	-.59	.34	.47	.81
Deactivation-sleep	Meddis		-.66	.23	.66	.88
	Nowlis & Thayer		-.83	.29	.77	.90
	McNair & Lorr		-.80	.29	.71	.92
	True-false		-.81	.42	.74	.88
Depression	Meddis	-.82	-.16	.22	.90	.88
	Nowlis & Thayer	-.79	-.22	.33	.87	.84
	McNair & Lorr	-.74	-.28	.40	.84	.90
	True-false	-.69	-.23	.51	.81	.84

*Note.* Each regression equation was based on 150 cases. All values of regression weights and multiple correlations that are entered were significant at the .01 level. Reliability of each criterion was estimated by Cronbach's (1951) coefficient alpha measure of internal consistency.

<sup>a</sup> 1972.

<sup>b</sup> 1965.

<sup>c</sup> 1967.

<sup>d</sup> 1964.

activation and its hypothesized opposite, general deactivation, ranged from  $-.25$  to  $-.36$ , indicating a more modest but still negative relationship. Thus, although inversely related, Thayer's scales did not form exact bipolar opposites as Meddis (1972) had predicted.

#### *A Bipolar Affective Space*

*Regression analyses.* The results so far were far clearer for pleasure and displeasure and for arousal and sleepiness than for Thayer's four scales and depression. A series of multiple regression analyses helped to clarify the relationships among the latter five scales and their relationship to pleasure-dis-

pleasure and arousal-sleepiness as well. Multiple regression analysis was used specifically to test the hypothesis that pleasure-displeasure and arousal-sleepiness can adequately account for Thayer's four scales and depression.

To define variables for the equations, scores on all scales were first standardized ( $M = 0$ ;  $SD = 1$ ). Displeasure scores were then subtracted from pleasure scores, and sleepiness from arousal, to form pleasure-displeasure and degree-of-arousal predictor variables. For the third predictor variable, a separate acquiescence score was computed for each regression equation by summing scores on all items other than the items of those scales already part of that equation.

Separate multiple regression equations were then computed from data for each response format for five criterion variables: each of Thayer's four scales plus depression. The results are shown in Table 3.

Multiple correlation coefficients were "shrunk" to provide estimates of the correlations in the population between the scores on the criterion predicted from the equation and those actually obtained. These multiple correlations were substantial and significant ( $p < .01$ ) in every case. Since unreliability in either the criterion or the predictors limits the possible magnitude of the multiple correlation coefficient, the last column of Table 3 provides reliability estimates for each criterion variable. As can be seen, the multiple correlations for all scales except Thayer's general deactivation generally approached the limit set by the reliabilities.

*A reinterpretation of Thayer's activation dimensions.* The standardized regression weights shown in Table 3 provided definitions for the five criterion variables that considerably clarified their meaning. Approximately the same information is also shown graphically in Figure 1, which presents loadings of the 11 affective scales on their first two principal components, since these components

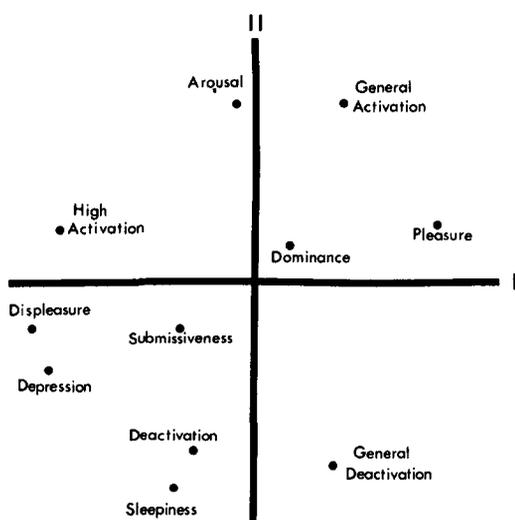


Figure 1. First two principal components of the 11 affective scales, based on data gathered with the Meddis (1972) response format ( $N = 150$ ), after an orthogonal varimax rotation.

were readily interpretable as pleasure-displeasure and degree of arousal. Both analyses showed Thayer's high activation and general activation to contain the expected high degree of arousal. The difference between these two scales, however, was as much the amount of pleasure as it was the degree of arousal, with general activation involving pleasure and high activation involving displeasure. Similarly, Thayer's deactivation-sleep and general deactivation scales contained the expected low arousal, but again the two scales differed on pleasure, with general deactivation involving pleasure but deactivation-sleep involving only arousal. In short, Thayer's (1967, 1970) factor-analytic results were multidimensional not because the arousal continuum is multidimensional but because (among other things) his items varied on the pleasure dimension as well as on arousal.

In Figure 1, general activation is shown to be the *approximate* bipolar opposite of both deactivation-sleep and depression (as was suggested by the partial correlations of Table 2). General activation fell within the high pleasure/high arousal quadrant. Its hypothesized opposites, deactivation-sleep and depression, both fell within the opposite quadrant (displeasure/low arousal), but neither fell exactly opposite general activation. The regression equations of Table 3 similarly showed deactivation-sleep to involve too little, and depression too much, displeasure to be the precise bipolar opposite of general activation, thus explaining the moderate magnitude of their negative correlations shown in Table 2.

Similarly, Thayer's high activation fell within the displeasure/high arousal quadrant, and its hypothesized opposite, general deactivation, fell within the opposite quadrant, high pleasure/low arousal. These two scales were only slightly negatively correlated rather than exact bipolar opposites, however, because each is maximally saturated with a different factor: High activation is mainly displeasure with a moderate component of arousal; general deactivation is mainly low arousal with a moderate component of pleasure.

Even though Thayer's four scales did not form exact bipolar opposites, the results summarized in Figure 1 and Table 3 show that they are part of a bipolar space. Presumably, their exact bipolar opposites could be found if adequate terms were included in the sample of terms studied. From this point of view, Thayer's scales are considerably mislabeled. Since both general activation and general deactivation involve pleasure, "general" could be more precisely replaced with "pleasant." More specifically, general activation assesses high pleasure combined with high arousal and, with items such as *lively* and *vigorous*, could be relabeled "vigor" or "excitement." General deactivation assesses high pleasure combined with low arousal and, with items such as *calm* and *placid*, could be relabeled "calmness" or "relaxation." Deactivation-sleep (with items *sleepy*, *tired*, *drowsy*) is appropriately labeled, but high activation assesses displeasure combined with high arousal and, with items such as *jittery* and *clutched up*, could be relabeled "distress."

### Implications

As the obscuring influence of methodological biases was reduced in this study, it could be seen that a *bipolar affective space*, defined by pleasure-displeasure and degree of arousal, was able to represent the relationships among scales of pleasure, displeasure, arousal, sleepiness, depression, and Thayer's (1967) four factors of activation. Evidence from a previous study (Russell & Mehrabian, 1977) showed that an even greater range of affective states could be represented in the same way. In a series of regression analyses similar to those shown in Table 3, pleasure-displeasure and degree of arousal were found to account for almost all of the reliable variance in a sample of 42 commonly used scales of affect (e.g., scales of happiness, elation, anger, fear, anxiety, and depression). In another study (Russell, 1978), it was shown that the same dimensions of pleasure and arousal have emerged as the two major dimensions of affect from studies of verbal self-report, semantic differential ratings, successive-intervals scaling, and multidimensional scaling of affect terms. In other words, diverse

sources of evidence are converging on a representation of affect similar to that depicted in Figure 1.

This proposed bipolar affective space may appear incomplete, however, because it is characterized by only two dimensions. Indeed, evidence has consistently confirmed the existence of dimensions of affect independent of pleasure and arousal. For example, in the Russell and Mehrabian (1977) study, dominance-submissiveness accounted for a significant proportion of the variance in scales of affect beyond that accounted for by pleasure and arousal. In the Russell (1978) study, multidimensional scaling of affect terms was used to examine more closely the dimensions of affect beyond pleasure and arousal. Results provided evidence for at least three such dimensions, interpreted as dominance/potency/control, depth or importance, and locus of causation.

Nevertheless, I would argue against the use of more than two orthogonal dimensions in a conceptualization of affect. The dimensions beyond pleasure and arousal have consistently been found to differ from pleasure and arousal in several important ways. In the Russell and Mehrabian (1977) study, pleasure and arousal accounted for by far the major proportion of variance in affect scales, with dominance accounting for a quite small amount. In the Russell (1978) study, the dimensions beyond pleasure and arousal (a) were found to be components of some, but not all, affect terms and (b) were interpretable as referring to the antecedents and consequences of the emotional state rather than to the emotion per se.

An examination of the proposed bipolar affective space as represented in Figure 1 indicates that this space lacks "simple structure." The various affective states do not all cluster about the axes, but appear to fall meaningfully (except for dominance and submissiveness) around the perimeter of the space. This observation is supported by the regression results of Table 3 and by those of Russell and Mehrabian (1977), in which affective states were typically found to be defined as *combinations* of pleasure-displeasure and degree of arousal. It may be arbitrary,

therefore, where the axes are located within this space. For example, a 45° rotation of the axes shown in Figure 1 would yield two bipolar axes that could be labeled "excitement-depression" and "distress-relaxation." More generally, the placement of the various affective states in relation to each other within the space appears to be more meaningful than the placement of the axes within the space.

The proposed bipolar affective space raises another issue concerning the conceptualization of affect. The proposed space is based on a definition of the domain of affect that includes low arousal states, such as sleepiness and relaxation, which are not commonly included on psychologists' lists of the emotions. For example, Tellegen<sup>3</sup> defines affect as *aroused feelings*. His proposed conceptualization of affect, which involves two dimensions, positive affect and negative affect, would therefore be expected to fall solely within the high arousal quadrants of Figure 1. And, indeed, his two dimensions appear to roughly correspond to the rotated dimensions of excitement and distress, respectively, defined above. The bipolar opposites of Tellegen's dimensions, however, fall outside the domain of aroused feelings. Tellegen's dimensions therefore ought *not* to be bipolar within that domain, and this appears to be his conclusion.

The present evidence showed that an empirical relationship exists between high and low arousal states and, therefore, that it is meaningful to group the two together within the same domain. The Russell and Mehrabian (1977) study suggested the same conclusion by showing that low arousal states were definable by the same pleasure and arousal dimensions required to define the high arousal states. From my point of view, a fully adequate description of a person's affective state at any moment in time therefore must include the possibility of these more mundane, but frequently encountered, low arousal states as well as the more dramatic emotions.

<sup>3</sup> Tellegen's conceptualization is described in Hall (1977) and was further elaborated through personal communication. Needless to say, only the roughest approximation to his conceptualization is presented here.

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Received March 9, 1978 ■