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A DIMENSIONAL ANALYSIS OF MANUAL EXPRESSION[1]

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A three-mode factor analysis was performed to investigate 78 subjects' ratings of 36 photographs of manual expression on 40 semantic-differential-type scales. Four scale factors were identified: (I) Activation, (II) Evaluation, (III) Dynamism, and (IV) Control. Similarly, four concept factors were found: (I) Grip, (II) Droop, (III) Cup, and (IV) Push. One major subject factor was found. It was discovered that Scale Factor I intercorrelated most highly with Concept Factor I, Scale Factor II with Concept Factor II, Scale Factor III with Concept Factor III, and Scale Factor IV with Concept Factor IV. The magnitude of these intercorrelations diminished according to the respective decrease in importance of the factor for describing the verbal and visual spaces.

The renewed interest in the study of emotional expression, sparked by the series of experiments done by Schlosberg, Engen, and Levy (Engen, Levy, & Schlosberg, 1958; Schlosberg, 1952, 1954), has centered around the problem of discovering and defining the dimensions and shape of an emotional expression solid, as opposed to earlier concern with the labeling and identification of discrete categories of emotion. Schlosberg (1954) concluded that there are three dimensions of emotional expression: pleasant-unpleasant (P-U), acceptance-rejection (A-R), and sleep-tension (S-T), likening his cone-shaped model to the Munsell color solid. As did the many investigators before him, Schlosberg used series of photographs of facial expression for his stimuli.

In the last several years, researchers have been primarily concerned with the number of dimensions needed to define the semantic space for emotional expression, with the label to be given to the dimension that Schlosberg dubbed A-R, and with whether or not Schlosberg's three dimensions are independent.[3] Concerned with the neglect of other media of emotional expression, Gitin (1965) conducted a "typical" Schlosberg experiment using hands for the stimuli instead of faces. She found: (*a*) Hands could be rated quite consistently using the same types of categorical and dimensional scales used to judge facial expression; (*b*) the order of importance of Schlosberg's dimensions as descriptive variables for emotional expression differed for hands and faces. Whereas Schlosberg found the P-U dimension to be most important for the description of facial expression and S-T the least, Gitin found that the opposite held true for hands; S-T was the most important dimension and P-U, the least important; (*c*) the shape of Schlosberg's emotion solid is different for manual expression than for facial expression, and the arrangement of the Woodworth (1938) categories of emotion on this solid is most definitely different for hands and faces (Gitin, 1965).

Ekman (1965) had three groups of subjects rate three series of photographs of spontaneous emotional expression drawn from five stress interviews. One set of stimuli showed only a person's head, another the body up to the neck, and the last, the whole person (head and body). Ekman concluded that there is a difference between the head and body as broad classes of nonverbal cue sources in the communication of information about affect. Head cues carry information primarily about what particular affect is being

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[3] For reviews of the literature see Bruner and Tagiuri (1954), Gitin (1965), Osgood (1966), and Woodworth and Schlosberg (1954).

experienced, but provide relatively little information about the intensity of the affect or the level of arousal; body cues reverse this pattern, communicating information primarily about the level of arousal or the degree of intensity of the affective experience, but providing relatively few cues about what particular affect is being experienced.

More recently, Ekman and Friesen (1967) reformulated the relationship between head and body cues. They proposed that information about the intensity of emotion is available from both head and body cues. Facial expression, as well as head orientations, can convey the full range of intensity of information. Body acts and positions, however, may show the extremes of intensity which are not permitted in the face and thus, at times, may be more relevant to perceptions of intensity. Furthermore, information about the nature of the emotion can also be ascertained from both head and body cues. Specific emotions, however, are generally perceived from facial expressions and from body acts, while both head orientations and body positions will most frequently allow only perception of gross affective states. Since the rate of facial expressions usually far exceeds the rate of body acts, perceptions of specific emotions can more frequently be made from head than from body cues.

Problem

The present experiment was designed (*a*) to discover the number of factors needed to define the semantic space for manual expression, to name these factors, and to determine their relative importance in describing the semantic space; (*b*) to attempt to code the stimulus characteristics of manual expression with, eventually, the aim of determining the features of hand movements which evoke high factor scores on a given scale dimension; and (*c*) to shed some light on the question of the number of subject factors that exist in human judgment situations using semantic-differential-type scales.

Hypotheses. The hypotheses proposed were that (*a*) Activation or Intensity will emerge as the most important factor or dimension of the semantic space for manual expression; (*b*) there will be at least three dimensions needed to define the semantic space for manual expression.

METHOD

Stimuli

The stimuli used in the present research were developed in a previous study (Gitin, 1965). An actor was seated in a straight-backed chair behind a suspended black cloth screen. Six-inch slits were cut, through which he extended his arms to a point halfway between his shoulders and elbows. Two methods of eliciting emotional expression were used: (*a*) The actor was instructed to try to experience and act out a specific emotional situation, and (*b*) the actor was instructed to position his hands according to his conception of what they should look like in a particular emotional situation or at a particular point on a Schlosberg dimension. The first method was generally used.

The emotions the actor was asked to express were chosen so as to encompass the Woodworth categories and to spread over all gradations and combinations of Schlosberg's three dimensions. A 16-millimeter motion picture camera was used with black and white film. The investigator selected 36 frames of this reel to be used as stimuli on the basis of two considerations: (*a*) that the photographs depict "natural" manual expression as opposed to "stylized" gesticulation. Ekman and Friesen (1969) suggested that behaviors earning the latter label (which they call "emblems") can be performed upon demand, are generally a deliberate effort to communicate, and have a direct, well-known verbal translation. Behaviors included in the former category (which they call "adaptors") are usually performed with little awareness and with no intent to communicate; (*b*) that the photographs comprise a broad and representative sample of hand positions, so as to closely approximate a "natural" repertoire of manual expression.

One limitation connected with using only single frames rather than film clips is that still photographs may not necessarily represent emotional expression unless, as Ekman and Friesen (1967) stated, they happen to "coincide with some point during the period of maximum activity rather than with the beginning or end point of an act [pp. 713–714]" thereby conveying "at least some impression of movement and perhaps by inference some of the relevant sequential cues [p. 714]."

Subjects

The 78 subjects were drawn from the introductory psychology subject pool at the University of Illinois. Both sexes were equally represented.

Procedure

The subjects were presented with a booklet of 36 pages, 1 page to be used for rating each stimulus photograph. Each page included the same 40 bipolar 7-point scales, and there were three different orders

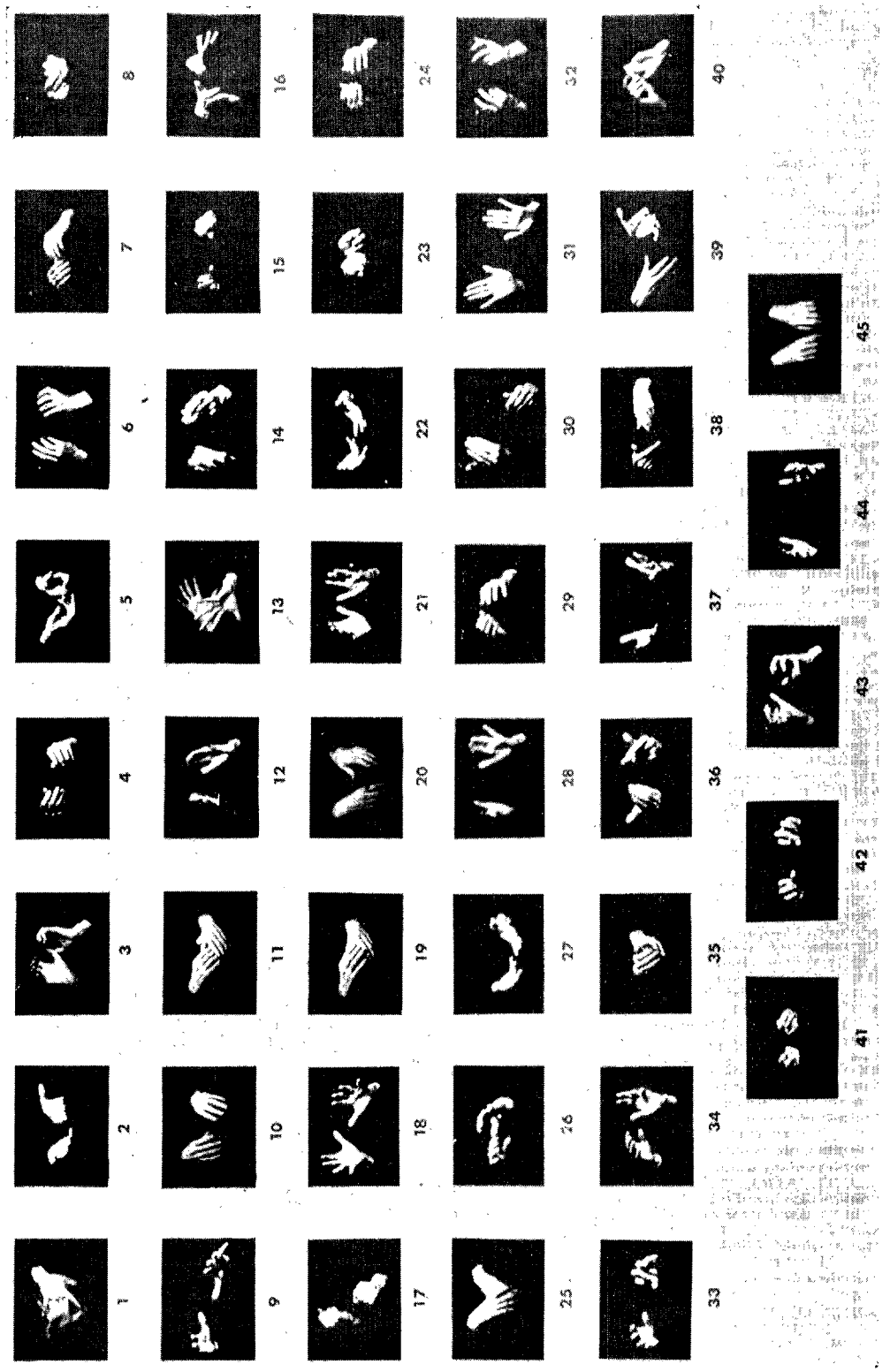

FIG. 1. Examples of manual expression. (Pictures 7, 8, 11, 13, 24, 27, 32, 40, and 42 were omitted in this study.)

TABLE 1

ROTATED FACTOR MATRIX OF SCALES

Scales	Factors			
	I	II	III	IV
active-passive	9.4		5.6	
sharp-dull	9.2		4.5	
interesting-uninteresting	8.7			
tense-sleepy	8.7	4.8		
exciting-boring	8.7			
curious-indifferent	8.1			
meaningful-senseless	7.7			6.3
intentional-unintentional	7.6			5.2
pleasant-unpleasant		10.6		
friendly-unfriendly		10.6		
good-bad		9.8		
beautiful-ugly		9.7		
submissive-dominant	4.6		9.1	
weak-strong	4.6		8.9	
unarmed-armed		4.7	8.5	
doubtful-certain			8.1	5.2
shy-brave	4.4		7.5	
slow-fast	6.6		7.5	
controlled-uncontrolled				8.4
mature-immature				7.4
deliberate-impulsive				6.7
functional-superfluous	5.6			6.4
meaningful-senseless	7.7			6.3

of these scales presented alternately (12 times each). The scales were chosen from three sources: (*a*) from earlier studies for their success in labeling emotional expression in general, (*b*) from Osgood's semantic differential, and finally, (*c*) from judgments of their particular appropriateness for manual expression. The subjects were instructed to rate all scales for each picture, and the meaning of the 7 points was explained. The photographs were projected by a 35-millimeter Carousel slide projector. Each frame or stimulus picture remained on the screen until all subjects had completed their ratings.[4]

Method of Analysis

Previous solutions to the problem of analyzing multimode data (i.e., multiway classification tables) were based on some system which reduced the data to a two-way table. Semantic differential studies generally used a standard Scale × Concept analysis, collapsing the subject dimension. This approach assumes that the perceptual processes of the judges are similar and does not allow for individual differences in semantic structure (Wiggins & Fishbein, 1969). Thus, in order to determine simultaneously the factor structure for scales, concepts, and subjects, the technique of three-mode factor analysis was employed (Levin, 1965; Tucker, 1964, 1966). Three-mode factor analysis is an extension of classical factor analysis which can be applied to three-way classification data. This procedure utilizes a matrix of sums of squares and cross-products, so that the numbers in a three-mode factor analysis can only be considered in relation to each other and do not represent the usual factor loadings or scores. Nevertheless, a three-mode factor analysis extracts a similar type of information to that of classical factor analysis. The output of three-mode factor analysis also includes a core matrix which represents intercorrelations between the factors of the different modes.

In the present study, the scale dimension was factored first, followed by the concept and subject dimensions. The same number and identification of factors is expected regardless of the order of factoring, but the actual factor loadings will differ due to computer limitations. It is not possible to carry more than 10 factors from one mode to the next; hence, all variance associated with factors past 10 is lost in subsequent analyses.

RESULTS AND DISCUSSION

Mode 1 (Scales)

A principal-components analysis was performed on the cross-products among scales across subjects and concepts. No communality estimation was attempted. Inspection of the distribution of eigenvalues revealed a break in the distribution occurring after the fourth latent root, differences among remaining roots approaching a small arbitrary constant. The first 4 factors in this mode account for approximately 50% of the total variance among scales. This finding thus supports the second hypothesis, and, therefore, Osgood (1966). Although it was decided only to interpret the first 4 factors, 10 factors were included in rotation to avoid possible underextraction and to provide a more representative context for interpretation. Accordingly, the first 10 factors were rotated to a Varimax criterion of simple structure (Kaiser, 1958).

The first four rotated factors appear in Table 1. Because the component analysis was based on cross-products rather than on correlations, the "factor loadings" cannot be interpreted in terms of the conventional metric. To facilitate interpretations, factor loadings less than the arbitrary value of 4 have been omitted, and the scales have been rearranged in such a manner as to emphasize the factor structure.[5]

[4] A complete listing of the 40 scales and the three orderings employed may be found in Gitin (1968).

[5] Copies of the complete rotated and unrotated scale factor matrices may be found in Gitin (1968).

TABLE 2
ROTATED FACTOR MATRIX OF CONCEPTS

Concepts	Factors			
	I	II	III	IV
15	8.6			
17	8.5			
33	8.3			
41	8.0			
9	7.3	4.8		
43	7.1			
10		8.4		
45		8.3	4.5	
25		8.1		
20		7.7		
19		6.9		
2			9.2	
30			8.3	
36			8.2	
44			7.3	
31				7.2
18				7.1
21				6.1

Factor I definitely appears to be an Activation dimension, with high loadings on such scales as tense-sleepy, active-passive, interesting-uninteresting, etc. This finding clearly supports the first hypothesis, thus corroborating the earlier findings of Gitin (1965) and Ekman (1965, 1967).

Factor II is most definitely Osgood's Evaluation dimension of connotative meaning, or Pleasantness, with high loadings on such scales as good-bad, friendly-unfriendly, and beautiful-ugly, etc. This finding supports all of the factor-analytic work with facial expressions and also Ekman's (1965) work with body cues.

Factor III appears to be a Dynamism factor, or a fusion of the residues of Osgood's Potency and Activation dimensions, with high loadings on such scales as shy-brave, slow-fast, weak-strong, etc. The isolation of this factor is a fairly common one, being found also by Triandis and Osgood (1958) and Levin (1965).

Factor IV is Osgood's (1966) Control dimension, with high loadings on deliberate-impulsive and controlled-uncontrolled.

Although these factors are the same or similar to those found, at various times, by investigators of facial expression, it is important to note that the order of importance of these factors is not the same for the two media of emotional expression. It is generally the Pleasantness factor that is most important for facial expression, and it is the Activation dimension that is most important for manual expression. Osgood (1966) found that for facial expression, the dimensions were ordered as follows: (*a*) Pleasantness, (*b*) Control, (*c*) Activation. Ekman (1967) presents some interesting hypotheses as to why this is so.

Mode 2 (Concepts)

A principal-components analysis was performed on the cross-products among concepts across scales and subjects. As with Mode 1, no communality estimation was attempted. Inspection of the distribution of eigenvalues revealed that a break in the distribution occurred, as in Mode 1, after the fourth latent root, with differences among remaining roots approaching a small arbitrary constant. The first 4 factors in this mode account for approximately 50% of the total variance among concepts. Again, the first 10 factors were included in rotation to a Varimax criterion of simple structure. The first 4 rotated factors appear in Table 2.[6]

Factor I, with high loadings on such expressions as depicted by Photographs 9, 15, 17, 33, 41, and 43, is characterized by aggressive grabbing and/or clenching movements. This could, perhaps, be dubbed a "grip" dimension, as all high-loading pictures depict clenched fists or hands that look as if they were about to grip something. The aggressive tone of these pictures (tense muscles) is crucial, for other pictures looking close-fisted (4, 29, 35) do not load highly on this factor.

Factor II is principally loaded by Pictures 10, 19, 20, 25, and 45. In these photographs, the hands are all hanging together limply. Thus, this might be some sort of "droop" dimension.

Factor III, identified by Pictures 2, 30, 36, and 44, appears to be a "cup" dimension, but all hands in a cupped position do not load

[6] Copies of the complete rotated and unrotated concept factor matrices may be found in Gitin (1968).

TABLE 3

UNROTATED CORE MATRIX: SCALES × CONCEPTS FOR SUBJECT FACTOR I

Scales	Concept			
	I	II	III	IV
I	24.9	−7.1	4.7	−2.3
II	−12.5	−16.1	4.6	.9
III	−2.4	7.4	9.1	.4
IV	−3.4	1.3	−5.0	−7.1

as highly as these photographs on this factor —only those that are "high up" in relation to the body (about the shoulders or the face). Those pictures with medium loadings are cupped about the waist or lower in relation to the body.

Factor IV, with high loadings on the expressions represented by Pictures 18, 21, and 31, is described by hands that are together and up in front of the face with palms out, as though shielding the eyes, or pushing something away. This might be dubbed a "push" dimension.

Perhaps the most significant point to be made about these four concept factors is that the dimensions are all unipolar. There are virtually no large (and only two medium) negative loadings on any factor. Apparently, there are no "opposites" to these factors, or, if so, the appropriate stimuli to represent the opposites were not present in this sample of photographs.

Mode 3 (Subjects)

A principal-components analysis was performed on the cross-products among subjects across scales and concepts. Again, no communality estimation was attempted. In this mode, there was one major factor accounting for 52% of the total variance and another three factors accounting for an additional 10%. Due to the magnitude of the first factor, it was decided not to rotate this mode, but to espouse the prevailing notion that subjects do tend to use the semantic differential scales similarly (Osgood, Suci, & Tannenbaum, 1957). It is still highly possible, however, that with further analysis and rotation, other factors would become more apparent. Wiggins and Fishbein (1969), for example, found the possibility of two subject factors in Levin's (1965) analysis and three subject factors in Litt's (1966) unpublished study.

Core Matrix (Scales × Concepts)

The section of the unrotated core matrix which represents the intercorrelations between the 4 scale factors and the 4 concept factors for Subject Factor I appears in Table 3. Although this matrix is based on the unrotated principal components for scales and concepts, examination of these factors indicated that the rotated factor names would be appropriate here as well, except that Factors II and III for concepts are reversed. The unrotated Factor II seems to be equivalent to the rotated Factor III, that is, a "cup" factor, and the unrotated Factor III is equivalent to the rotated Factor II, that is, a "droop" factor.

The strongest relationship in this matrix appears to be between Factor I for scales (Activation) and Factor I for concepts (Grip). Subjects tended to rate gripping or grabbing hands as active. The next largest relationship is between Scale Factor II and Concept Factor II. Hands that are cupped (begging or passively receiving) are negatively evaluated as are gripping or aggressive hands. Cupped, and especially, drooping, hands (Factor III for concepts) are seen as weak, submissive, and shy (Factor III for scales). Finally, Factor IV for scales (Control) was most highly correlated with Concept Factor IV. Pushing hands are perceived as immature, uncontrolled, and impulsive.

In general, then, the four scale and concept factors are systematically related; visual meaning is consistently and appropriately coded verbally by subjects using semantic-differential-type scales. Scale Factor I correlates most highly with Concept Factor I, Factor II with Factor II, etc. Furthermore, the magnitude of the relationship diminishes, accordingly, as does the importance of the factor in describing the respective verbal and visual spaces.

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