CODING OF FACIAL AND VERBAL EXPRESSIONS OF EMOTION: A METRIC MULTI-DIMENSIONAL SCALING ANALYSIS

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ABSTRACT

The study of coding is fundamental to communication inquiry, particularly as it pertains to the identification of relations between verbal and nonverbal information. The expression of emotion is especially relevant with regard to this broad area of inquiry. Scholars frequently employ examples of affective expression in order to illustrate the complementarity and, in some cases, interchangeability of facial, gestural, and linguistic sign vehicles having a common referent (Ekman & Friesen, 1969; Nolan, 1975; Littlejohn, 1978). As code elements, verbal and nonverbal signs are presumed to internally organized such that the meaning or significance of any given element derives, in part, from its relation to other elements in the code complex.

Considerable research has focused on (a) categorical correspondence between certain facial expressions and words denoting common emotional referents, and (b) the internal structure and dimensionality of facial and linguistic affective codes, respectively. Surprisingly little is known, however, about the comparative aspects of verbal and nonverbal code organization. Neurophysiological studies of hemispheric specialization suggest that the perception and cognitive organization of facial and linguistic stimuli may differ (Rizzolatti, Umilta, & Berlucci, 1971). Some cognitive psychologists, on the other hand, suggest that, following initial reception, verbal and nonverbal sign vehicles are processed via a more generalized common semantic code (Cotton & Klatzky, 1978).

This study focuses on comparing the structures of facial and linguistic

affect codes in order to determine if the two are fundamentally organized differently or similarly. The "coding" of sign vehicles of emotion is conceptualized as a cognitive process of multi-dimensional organization; rather than being placed in one of numerous unrelated categories (as distinguished in the vernacular), verbal and nonverbal affective stimuli are arrayed along a set of more basic attributes or dimensions. The resulting configuration of spatial relations among code elements constitutes the structure of the code. The method of metric multidimensional scaling analysis is especially useful for assessing and comparing facial and linguistic affective code structures. Accordingly, the following experiment was conducted.

Fifty undergraduates enrolled at a large southwestern university participated as respondents. The respondents were randomly assigned to one of two groups. Each group was asked to make ratio judgments of separation among all possible non-redundant pairs of the following emotions: fear, surprise, sadness, anger, interest-excitement, disgust, and happiness. The scaling procedure employed was a variant of the ratio judgment of separation procedure in which, rather than reporting numerical estimates, the respondents indicate a point along a meter stick which is proportionate to the magnitude of the difference or dissimilarity between the judged pair. Based on a pilot study, "fear" and "surprise" were set at 10 centimeters difference, and served as the criterion pair for all judgments. All respondents reported individually to scheduled sessions, and performed the judgment task independently and at a pace comfortable for each. The only difference in procedures for the two groups was that one made paired comparisons among unlabeled facial expressions of the selected emotions (still photographs), while the other made paired comparisons among words expressing these emotions.

The data were analyzed using the RPI version of the metric multi-dimensional scaling program GALILEO. All analyses were conducted at the Rensselaer Polytechnic Institute computing center. Options selected included statistics, normal eigenvectors,

rotated coordinates, regenerated distance matrices, and row and column correlations. These analyses provide the bases for the results summarized below.

The results indicate that (a) the spaces for both groups (facial expressions versus words) are basically Euclidian (Warp Factors equal to 1.09 and 1.17 for facial expression and word groups, respectively), (b) a two-dimensional solution is basically appropriate for each space, accounting for at least 65% of the variance in each case, and (c) the structure and dimensionality of both spaces are essentially the same. Table 1 presents the rotated coordinates of both spaces on the first two dimensions. The zero-order correlation between Space 1 - first dimension coordinates and Space 2 - first dimension coordinates is .932 ($p < .01$). The zero-order correlation between Space 1 - second dimension coordinates and Space 2 - second dimension coordinates is .968 ($p < .01$). The comparability of the two structures is graphically illustrated in Figure 1.

Granting that this is an initial investigation employing emotional referents for which the categorical correspondence between facial and linguistic signs has been well-established, these findings are nonetheless provocative. While no firm interpretation of the dimensionality of affective code structures obtained here can be offered, it appears that the data are arrayed from relatively pleasant to unpleasant along the first dimension, while a spontaneity-constraint continuum seems to describe the array of the facial and linguistic indicators of emotion along the second dimension. Both continuua have been used to interpret factor structures and MDS results in many previous studies (see Harper, Wiens, & Matarazzo, 1978; 77-92). Future research will examine the replicability of these findings utilizing alternative emotions and persons, as well as make attempts to obtain measures of the degree to which the various affective stimuli are seen as manifesting pleasantness and spontaneity, in order to provide an empirical basis for our currently tentative interpretation of the dimensionality of affective space.

In terms of the central research question, we have presented initial evidence of the structural comparability of facial and linguistic affective codes. As such, these data support a "common-code" explanation of the perception and coding of verbal and nonverbal expressions of emotion. We hasten to add, however, that none but tentative conclusions are warranted in the absence of additional inquiry.

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TABLE 1

Rotated Coordinates for Nonverbal and Verbal Spaces

		I	II
NONVERBAL - SPACE ONE	1) Fear	4.149	9.478
	2) Surprise	- 9.259	9.098
	3) Sadness	8.457	- 3.894
	4) Anger	12.623	- 0.817
	5) Interest-Excitement	- 9.323	1.953
	6) Disgust	2.770	- 9.777
	7) Happiness	- 9.416	- 6.042
VERBAL - SPACE TWO	1) Fear	5.072	9.813
	2) Surprise	- 7.980	5.689
	3) Sadness	13.502	- 3.155
	4) Anger	14.244	- 1.107
	5) Interest-Excitement	- 9.279	1.586
	6) Disgust	11.013	-11.435
	7) Happiness	-26.571	- 3.604

TABLE 2

Mean Dissimilarities Among Facial Expressions of Emotion

	1	2	3	4	5	6
1 Fear						
2 Surprise	11.25					
3 Sadness	14.72	27.60				
4 Anger	*18.17	26.56	22.92			
5 Interest-Excitement	17.64	15.84	23.68	*25.79		
6 Disgust	20.24	22.48	21.04	17.80	22.64	
7 Happiness	23.92	17.20	*24.50	*21.79	*13.08	19.72

* Indicates that the mean dissimilarity was calulated based on 24 rather than 25 cases, because an individual estimate exceeding the sum of the mean plus three standard deviations was encountered and deleted.

TABLE 2

Mean Dissimilarities Among Words Expressing Emotion

	1	2	3	4	5	6
1 Fear						
2 Surprise	*12.37					
3 Sadness	*16.50	*19.46				
4 Anger	16.08	17.92	17.36			
5 Interest-Excitement	*18.83	5.56	*30.63	*20.29		
6 Disgust	24.32	23.48	12.80	10.88	*24.96	
7 Happiness	35.52	13.60	44.76	42.76	10.68	39.84

* Indicates that the mean dissimilarity was calculated based on 24 rather than 25 cases, because an individual estimate exceeding the sum of the mean plus three standard deviations was encountered and deleted.

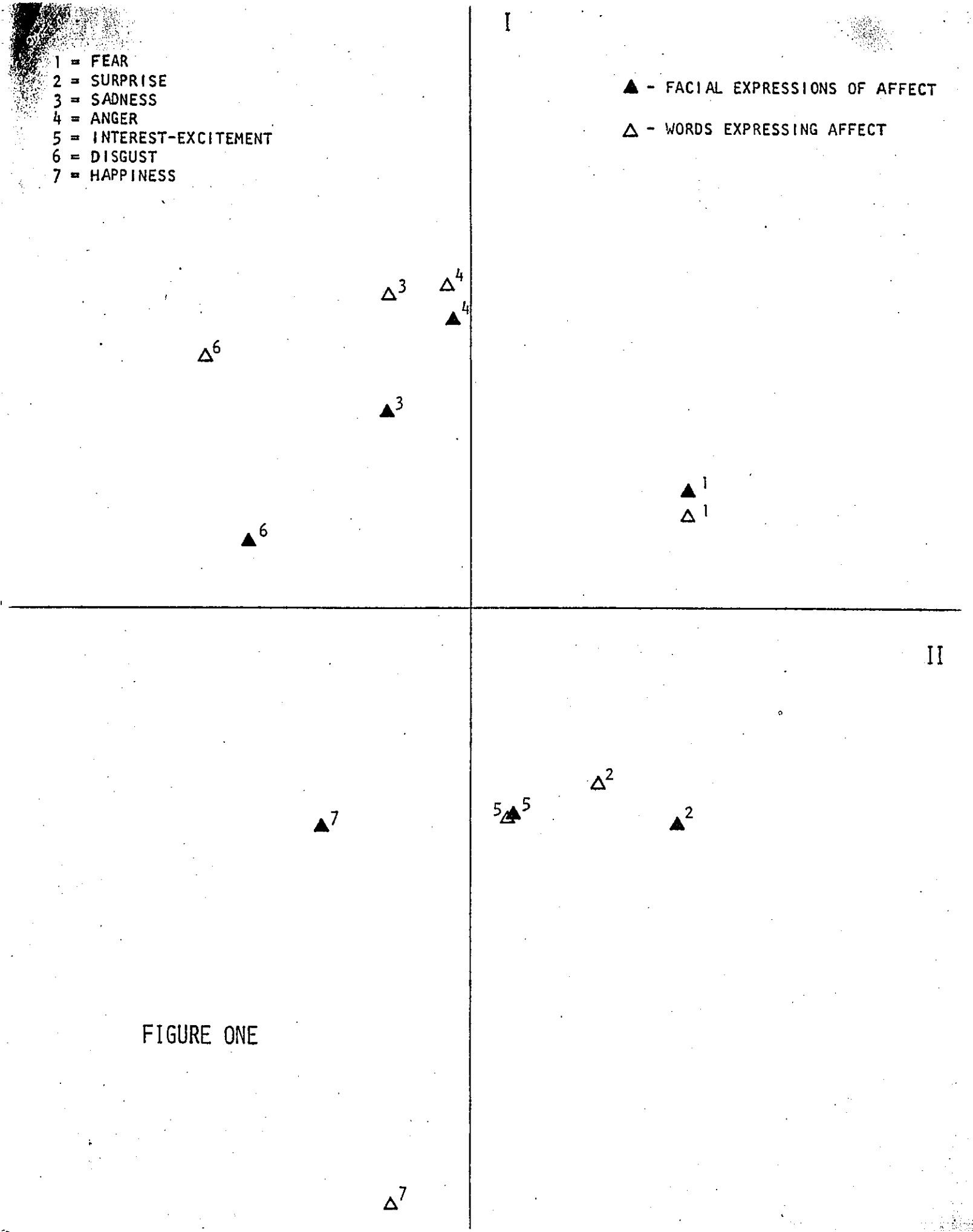
1 = FEAR
2 = SURPRISE
3 = SADNESS
4 = ANGER
5 = INTEREST-EXCITEMENT
6 = DISGUST
7 = HAPPINESS
▲ - FACIAL EXPRESSIONS OF AFFECT
△ - WORDS EXPRESSING AFFECT
I
II

FIGURE ONE

(8 F10.4)

#3

TABLE 3

Mean Dissimilarities Among Facial Expressions: Type of Scale – Numerical

	1 6	2 16	3 26	4 36	5 46	6 56	7 66	8 76	9 6	10 16
1 Fear	0.0	14.667	15.120	15.840	25.600	15.417	11.417	14.792	18.333	12.360
2 Surprise	*14.667	0.0	19.640	19.417	24.750	16.720	11.960	19.000	12.760	19.760
3 Hate	15.120	19.640	0.0	8.583	9.480	16.292	16.167	9.083	23.640	11.760
4 Sadness	15.840	*19.417	* 8.583	0.0	11.333	20.960	21.042	11.625	22.200	5.217
5 Anger	25.600	*24.750	9.480	*11.333	0.0	19.125	21.000	12.167	22.333	11.542
6 Love	*15.417	16.720	*16.292	20.960	*19.125	0.0	8.083	11.080	8.042	18.417
7 Excitement	*11.417	11.960	*16.167	*21.042	*21.000	* 8.083	0.0	20.120	6.792	15.750
8 Disgust	14.792	19.000	* 9.083	*11.625	*12.167	11.080	20.120	0.0	13.560	9.739
9 Happiness	*18.333	12.760	*23.640	22.200	*22.333	* 8.042	* 6.792	13.560	0.0	22.240
10 Confusion	12.360	19.760	11.760	** 5.217	*11.542	*18.417	*15.750	** 9.739	22.240	0.0

* Indicates that the mean dissimilarity was calculated based on an n of 24 (an individual estimate exceeding the sum of the mean plus +3 standard deviations was deleted).

** Indicates that the mean dissimilarity was calculated based on an n of 23 (two individual estimates exceeding the sum of the mean plus +3 standard deviations were deleted).

Sample size for all other mean dissimilarities was 25.

$\frac{28}{25 \times 45} = .02$

(8F10.4)

#4

TABLE 4 FEAR & SURPRISE 10.0

Mean Dissimilarities Among Words: Type of Scale – Numerical

	1 6	2 16	3 26	4 36	5 46	6 56	7 66	8 76	9 6	10 16
1 Fear	0.0	28.458	19.320	19.458	27.880	40.435	40.000	24.167	33.652	15.240
2 Surprise	*28.458	0.0	45.760	53.560	37.667	32.800	9.800	27.083	15.320	23.280
3 Hate	19.320	45.760	0.0	23.920	6.440	164.800	38.391	10.440	98.680	39.333
4 Sadness	*19.458	53.560	23.920	0.0	42.640	49.292	61.875	23.000	107.640	26.240
5 Anger	27.880	*37.667	6.440	42.640	0.0	40.261	58.240	14.417	54.000	30.320
6 Love	**40.435	32.800	164.800 **110.209	*49.292	**40.261	0.0	10.792	43.261	6.696	33.043
7 Excitement	40.000	9.800	**38.391	*61.875	58.240	*10.792	0.0	46.360	14.400	47.080
8 Disgust	*24.167	*27.083	10.440	*23.000	*14.417	**43.261	*46.360	0.0	66.292	33.565
9 Happiness	**33.652	15.320	98.680 ***48.95	107.640 **69.17	**54.000	** 6.696	14.400	**66.292	0.0	66.120
10 Confusion	15.240	23.280	39.333	26.240	30.320	**33.043	47.080	**33.565	66.120	0.0

* Indicates that the mean dissimilarity was calculated based on an n of 24 (an individual estimate exceeding the sum of the mean plus +3 standard deviations was deleted).

** Indicates that the mean dissimilarity was calculated based on an n of 23 (two individual estimates exceeding the sum of the mean plus +3 standard deviations were deleted).

** N=22

Sample size for all other mean dissimilarities was 25.

30/25x45 1125 = .03