

COGNITIVE STRUCTURE AND SYNONYMY: CLUSTERING
AS A MEASURE OF DIFFERENTIATION*¹

University of Maine, Orono

JOEL A. GOLD, NANCY L. COWLES, AND NINA WOUFFF

SUMMARY

A cognitive structural system based upon nonredundant meaning of attributes and assessed through derived measures of adjective clustering was proposed. Studies were carried out in order to determine (a) the factor structure of the properties and the differences between classes of stimulus objects on each property and (b) the stability of the measures. The results of the first study showed consistently more differentiated responding to political than to personal stimulus objects. An hypothesis of defensive simplicity based upon the idea of global and simple response styles toward those with whom individuals are socially bound was proposed to account for the findings. The second study involved two administrations of the system separated by an 11 week period. All of the stability coefficients were significant, indicating strong reliability over time.

It was also found that high and low dogmatic subjects differed on the measure of positive and negative evaluation (Bal) toward the political stimulus objects, as hypothesized.

A. INTRODUCTION

The assessment of the structure of cognitive experience is now an extensive area of psychological research (1, 4, 8, 10, 12). Most of the work in this area has been concerned with the manner in which individuals employ independent dimensions in the assessment or perception of objects. Many of the systems which have been developed have been based on the use of a series of bipolar adjective continua upon which individuals rated social objects. Such continua were chosen to reflect attributes of the objects being rated. Individuals were considered to be more complex: i.e., to have more independent

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dimensions available, to the extent that they employed many different points on the continua in rating any given object (9) or rated each of a series of objects differently on the same continua (8). The concept of independence then has referred to the differential application of the adjective continua in terms of the degree to which adjectives were applied to the objects.

The present paper takes a different approach. The basic rationale for the proposed system lies in the assumption that adjective dimensions are independent to the extent that they do not have synonymy of meaning. An individual who describes an object using a large number of adjectives, most of which are synonymous, is considered in the proposed system to have few independent dimensions and to be cognitively undifferentiated compared to the individual who uses even a few adjectives with quite different meanings.

This system is dependent upon an *a priori* knowledge of the synonymy of the adjectives used in rating objects. An empirical basis for synonymy has been established by Haagen (2) through his use of an associative clustering technique. This technique produced a list of 80 groups of six common two-syllable adjectives which were scaled according to similarity of meaning. For use in the presently proposed system, 10 groups of adjectives were chosen from this list, and one adjective lowest in similarity of meaning to the other five was eliminated, leaving a list of 50 words.² To the extent that an individual chooses adjectives from the same cluster to describe a stimulus object—i. e., a role figure such as mother or father—he is considered to have a less differentiated cognitive structure.

In order to measure differentiation with the use of the clustered word list, a formulation was developed on the basis of a theoretical approach proposed by Zajonc (11). He developed a system of cognitive structure which involved having the subject generate a list of attributes (adjectives or phrases) which described a single psychological object. The second part of the procedure was to group the attributes into categories or classes in terms of the perceived similarity. These broad classes were then to be broken down further until no additional subclass differentiations were possible.

One of the measures he developed, homogeneity, was obtained through the use of calculations based upon mathematical set theory. Basic to this measure was the notion that attributes grouped into common classes contained some common elements (i. e., some common basis for classification) and thus intersected. Thus if two attributes, A and B, were grouped together, they would have an intersection of common elements AB. Since the elements of attributes were not empirically available, all commonly coded attributes were assumed

² The final list of clustered adjectives is available upon request from the first author at the address shown at the end of this article.

to intersect totally. The generalized formula for the number of intersections of m commonly coded attributes was given as $2^m - 1 - m$ [formula 1]. Applying this formula to the attributes within each subclass and summing over the total number of subclasses (M) produced an absolute measure of homogeneity.

Whereas in Zajonc's system attributes were generated and grouped by the subject yielding a phenomenological set of dimensions, the present system, while borrowing Zajonc's notions dealing with groupings of attributes, considers an independent dimension an empirically derived coding category or cluster. It seemed to the authors that since in Zajonc's system the elements upon which intersections were based were unmeasurable, the entire set theoretical scheme was inappropriate. If three adjectives A, B, and C were grouped together, four intersections were produced: AB, AC, BC, ABC. All of the common elements of the ABC intersection were contained in each of the two-way intersections, and all of the elements contained within every intersection including ABC were contained within at least two of the individual attributes, A and B, A and C, or B and C. Thus in terms of common elements, the simple calculation of the total number of intersections produced redundancy. If the elements were measurable, then the actual number of elements common to the three attributes could be directly assessed by solving for the number of elements contained in the intersection ABC. In the present system, as in Zajonc's system, the elements of attributes were not empirically measurable, and thus the notions of intersections based upon set theory were not relevant.

For the proposed system, the only assumptions necessary were that adjectives from the same cluster were connected in some fashion by similarity of meaning, and all clusters were independent. The calculation of the degree of clustering then was based simply upon counting the number of connections between chosen adjectives. The total number of connections between adjectives from a common cluster is given as $(m^2 - m)/2$ [formula 2] where m is defined as in formula 1 above.

In addition to measuring differentiation, the proposed system also provided for a measurement of positive and negative evaluation by having the subject indicate the favorability or unfavorability of each adjective chosen.

B. MEASURES OF COGNITIVE STRUCTURE

The proposed system produced two structural measures. Differentiation Within Roles (*DWR*) was derived directly from the theoretical notions of clustered attributes. *DWR* is obtained by calculating the number of connections produced by the adjectives chosen from common clusters, summing these values over the clusters chosen, and dividing by the total possible

number of connections, given the number of words chosen. The formula is as follows:

$$DWR = 1 - \frac{\sum_{i=1}^M (m_i^2 - m_i)/2 - K}{\sum_{i=1}^{m_{\min}} (m_{\max}^2 - m_{\min}^2)/2 - K}, \quad [3]$$

where M = the number of clustering categories,

m_i = the number of attributes chosen from category i ,

m_{\min} = the theoretical minimum number of categories possible given N attributes chosen,

m_{\max} = the theoretical maximum number of attributes possible in category i given N attributes chosen and m_{\min} categories possible.

K = correction term. A correction term is necessary when $N > M$, since under this condition a minimum amount of clustering must occur. If $NC < N \leq 2NC$, $K = N - M$. If $2NC < N \leq 3NC$, $K = 2N - 3M$. Since, in the studies described in this paper, a subject could choose a maximum of 25 words and since 10 clustering categories were used, the correction term has only been derived for values of N up to this limit.

An example may help to illustrate the nature of the formula. If a subject chose 12 adjectives to describe a given role figure, and four of the adjectives were from one cluster, four from a second, and four from a third, DWR would be as follows:

$$1 - \frac{[(4^2 - 4)/2 + (4^2 - 4)/2 + (4^2 - 4)/2] - 2}{[(5^2 - 5)/2 + (5^2 - 5)/2 + (2^2 - 2)/2] - 2} = .16. \quad [4]$$

Since each cluster contains five adjectives, the maximum score possible, given that 12 adjectives were chosen, would be five of the 12 from one cluster, five from the second, and the remaining two from a third cluster. This is the denominator of formula 3.

The second structural measure, Balance (Bal), reflects the degree to which the adjectives chosen were given positive or negative valences by the subject. The assumption heré was that commonality existed between attributes valenced alike, and thus all positive attributes were connected and all negative attributes were connected. The balance score is simply the number of connections between positive minus the number of connections between negative adjectives over the larger number of connections, positive or negative.

In the case where all adjectives are positively valenced, Bal is equal to +1.00, and where all adjectives are negatively valenced Bal is equal to -1.00. Equal numbers of positive and negative words yield a Bal score of zero.

$$\text{Bal} = \frac{(NP^2 - NP)/2 - (NN^2 - NN)/2}{(NL^2 - NL)/2}, \quad [5]$$

where NP = number of positive valences,
 NN = number of negative valences,
 NL = number of valences positive or negative, whichever is larger.

C. STUDY 1.

1. *Introduction*

The generality of the measures of cognitive structure is an important question in the derivation of any new system. To determine whether or not individuals show consistency in terms of structural properties across varying domains of objects, political figures, personal figures (parents and acquaintances), and self were employed as stimulus objects in the present study. If consistent differences were found between but not within these three classes of objects, then generality would exist only within any given domain.

In order to provide some external validity for the measures, the Dogmatism Scale (7) was administered. It was expected that differences between groups of high and low dogmatic subjects would occur most strongly on Bal for the political figures, since it has been shown that political bias exists in the Dogmatism scale (6).

2. *Method*

a. Subjects. One hundred thirty-eight students enrolled in courses in introductory, social, and educational psychology served as subjects.

b. Measurement Apparatus. The measure of structural properties consisted of a nine page booklet containing nine role figures (each presented on a separate page) along with the randomized list of 50 adjectives. The nine role figures included self, four personal stimuli (mother, father, female acquaintance, male acquaintance), and four political figures (Spiro Agnew, Richard Nixon, George McGovern, Edward Kennedy). Six random orderings of the role figures were used.

The 40 item form of the Dogmatism Scale (7) was also administered to each subject.

c. Procedure. The instructions to the subject given on the cover sheet of the booklet were as follows:

Choose those adjectives from the attached list that describe each of the following individuals. You may choose as many as you like to describe each one and may use the same adjective to describe more than one individual. Indicate, by writing a plus

or a minus beside each adjective you list whether you consider it a positive or negative attribute.

After completion of the structural measure subjects were asked to complete the Dogmatism scale.

3. Results

The two structural measures were calculated through the use of a computer program written by the senior author.

Principal factor analyses with varimax rotations were carried out between all stimulus objects for both of the properties. Factoring was discontinued when eigenvalues dropped below 1.00. The factor loadings for the two properties are presented in Table 1 along with the means and standard deviations. When some subjects either failed to respond to selected stimulus objects or chose only a single adjective to describe some stimuli, these omissions were treated as missing data. Since missing data resulted in listwise deletions in the data matrix, all of the reported factor loadings and means and standard deviations were based upon $N = 82$.

a. DWR. Four factors were extracted for this property with Factor I accounting for 57.6% and Factor II for 18.6% of the common factor variance. Factor I seemed to be a personal dimension in that the stimulus objects self, mother, father, and male acquaintance all loaded above .30. Factor II was a parental factor with the variables mother and father both loading above .45 on this factor. Factors III and IV accounted for only 13.7 and 10.2% of the variance, respectively, with no clear pattern emerging.

Mean DWR scores ranged from .74 (McGovern) to .58 (female acquaintance). The mean DWR score for all political stimulus objects was .72, while that for the personal objects was .63, indicating more differentiated responding to the political figures.

In order to gain a better understanding of the differences between stimulus objects or DWR, *t* tests for correlated samples were calculated between all pairs of stimulus objects. This procedure was also carried out for each of the remaining properties. In general, the results confirmed the finding of greater differentiation for political figures as opposed to personal stimulus objects. Of the 16 possible differences between political and personal stimulus objects, 11 were significant (five at $p < .001$, four at $p < .01$, and two at $p < .05$) and all were in the direction of greater differentiation for the political figures. The *t* values for these comparisons are reported in Table 2.

The only significant difference shown between political figures was that between McGovern and Nixon with greater differentiation being shown

TABLE I
MEANS, SDs, AND FACTOR LOADINGS FOR THE TWO STRUCTURAL PROPERTIES

Object	DWR				Bal					
	Mean	SD	Factors		Mean	SD	Factors			
			I	II			III	IV	I	II
Self	.68	.18	.71	.23	.19	.64	-.03	.51	-.10	.07
Mother	.62	.20	.31	.58	.29	.51	-.03	.45	.12	-.07
Father	.67	.20	.33	.46	.28	.48	.03	.06	-.20	-.04
Female acquaintance	.58	.26	.08	.12	.20	.52	.06	.32	.70	.01
Male acquaintance	.65	.20	.48	.12	.14	.34	.02	.44	-.02	.05
Nixon	.67	.21	.05	.02	.28	.83	.63	-.01	-.08	-.06
Agnew	.73	.23	.01	.27	.00	.88	.92	-.05	.03	.01
McGovern	.74	.23	.17	.08	.72	.56	-.18	-.08	.24	.26
Kennedy	.72	.23	-.04	.41	-.03	.73	.10	.10	.05	.71

Note: DWR = Differentiation Within Roles; Bal = Balance.

TABLE 2
t VALUES FOR COMPARISONS BETWEEN POLITICAL AND PERSONAL STIMULUS OBJECTS ON DWR^a AND BAL

Personal stimulus objects	Nixon		Agnew		Political stimulus objects		McGovern		Kennedy	
	<i>t</i>	<i>df</i>	<i>t</i>	<i>df</i>	<i>t</i>	<i>df</i>	<i>t</i>	<i>df</i>	<i>t</i>	<i>df</i>
Mother										
DWR	1.93*	123	2.40**	114	4.77***	97	3.07**	112		
Bal	5.86***	123 R	5.50***	114 R	-.97	97 C	2.12*	112 R		
Father										
DWR	1.08	119	1.61	110	3.46***	94	1.96*	108		
Bal	6.54***	118 R	6.53***	110 R	.10	94 R	2.83**	108 R		
Male acquaintance										
DWR	.99	118	1.24	110	3.82***	93	1.56	109		
Bal	8.08***	118 R	7.17***	110 R	1.06	93 R	3.66***	109 R		
Female acquaintance										
DWR	2.93**	123	3.23**	116	5.43***	96	3.63***	112		
Bal	6.00***	123 R	5.84***	116 R	-.31	96 C	1.98*	112 R		

Note: R = row stimulus figure is larger than column stimulus figure; C = column stimulus figure is larger than row stimulus figure.

^a Mean DWR scores were higher for the political stimulus objects in all of the comparisons.

* $p < .05$.

** $p < .01$.

*** $p < .001$.

toward McGovern ($t = 3.03$, $df = 116$, $p < .01$). Within the personal stimuli the only significant differences found were those between female acquaintance and father ($t = 2.44$, $df = 121$, $p < .01$) and female acquaintance and male acquaintance ($t = 2.33$, $df = 121$, $p < .01$), with less differentiated responding occurring to female acquaintance in both cases. In comparing self with the personal stimuli, significant differences were found between self and mother ($t = 3.20$, $df = 125$, $p < .01$) and self and female acquaintance ($t = 3.73$, $df = 125$, $p < .001$) with more differentiated responding being shown toward self in both cases. In the remaining two comparisons, self with father and self with male acquaintance, the differences, although nonsignificant, again showed greater differentiation toward self.

b. Bal. Four factors emerged with Factors I and II accounting for 39.9 and 28.5% of the common factor variance, respectively. Factor I was a pure political preference variable with Agnew and Nixon being the only high loadings (.92 and .63, respectively). Factor II was a personal factor with the objects self, mother, female acquaintance, and male acquaintance all loading above .32. Factors III and IV accounted for 17.4 and 14.3% of the variance, respectively, with no consistent pattern emerging.

Average Bal scores ranged from .13 (Nixon) to .86 (male acquaintance) with standard deviations ranging between .88 (Agnew) and .34 (male acquaintance). The t tests for dependent samples showed strong and consistent differences between the personal and political figures. The comparisons between the political and personal figures showed significantly higher mean Bal scores for all of the personal figures with the exception of McGovern, where no significant differences appeared. The t values for the comparisons on Bal between the personal and political stimuli are also found in Table 2.

Within the political figures, both McGovern and Kennedy received significantly more positive evaluations than either Agnew or Nixon. Bal scores toward McGovern were significantly higher than those toward Kennedy, while no difference was found between Agnew and Nixon. Thus the strongest negative evaluations were toward Agnew and Nixon and to about the same degree, with Kennedy receiving more positive evaluations than either Agnew or Nixon but less positive evaluations than any of the personal figures. McGovern tended to be seen more like the personal than the political figures in terms of positive evaluation. The t values for the comparisons between the political figures are found in Table 3.

No significant differences were found between any of the personal figures. Thus differences in positive or negative evaluation tended to manifest themselves between the personal and political figures and between the various political figures rather than between the personal figures.

TABLE 3
t VALUES FOR COMPARISONS BETWEEN POLITICAL STIMULUS OBJECTS ON BAL

Political stimulus objects	Nixon	Agnew	McGovern
Agnew	.15 (<i>df</i> = 115) R		
McGovern	6.16* (<i>df</i> = 97) R	5.16* (<i>df</i> = 93) R	
Kennedy	3.81* (<i>df</i> = 109) R	3.78* (<i>df</i> = 107) R	-2.51* (<i>df</i> = 93) C

* $p < .001$.

Note: R = row stimulus figure is larger than column stimulus figure; C = column stimulus figure is larger than row stimulus figure.

Subjects were classified as high and low dogmatics on the basis of whether their scores on the dogmatism scale fell in the upper or lower 50% of the dogmatism distribution. The two dogmatism groups were then compared for all nine stimulus objects for both structural properties through a series of *t* tests for independent samples.

As hypothesized, the groups did differ on the political objects. The high dogmatic subjects showed more complex responding toward Agnew on DWR ($t = 2.61$, $df = 118$, $p < .01$). This was the only difference in differentiation shown. Low dogmatic subjects responded in a significantly less favorable manner on Bal toward both Agnew ($t = 3.02$, $df = 118$, $p < .01$) and Nixon ($t = 3.33$, $df = 126$, $p < .01$), and significantly more favorably on Bal toward McGovern ($t = 2.10$, $df = 98$, $p < .05$).

4. Discussion

The results tend to show that individuals possess more differentiated cognitions of nonpersonally rather than of personally known stimulus objects. DWR is a measure of the relative number of denotatively independent dimensions upon which judgments of stimulus figures are made. The less redundancy or synonymy which exists among the attributes upon which a cognition is based, by definition, the more differentiated that cognition becomes. In terms of the political *versus* personal figures, less redundancy occurred in the cognitions of the political figures. Thus a simpler and more global structure was shown in the cognitions of individuals' close social contacts—specifically friends and parents. This finding makes sense in that in order to interact on a constant basis, individuals must not scrutinize too closely the other members of the interaction. The high Bal scores toward friends and parents also reflected a nondifferentiated style of responding toward those persons. In other words, the hypothesis posited here is one of defensive simplicity: i. e., a nondifferentiated functioning toward those persons with whom one is intimately socially bound.

In contrast to the results of the present study and to the hypotheses presented are the findings of previous studies in the area dealing with the effect of amount of information on cognitive structure. Zajonc (11) using his own structural system found that in describing a painting, art school students showed significantly more differentiated cognitive structure than nonart school students.

Scott (8) reported a series of studies, some directly manipulating amount of information, in which positive relationships existed between amount of information and various structural measures. All of these studies (with one exception) dealt with nonpersonal domains of objects—specifically nations and psychological tests. The single study which dealt with personal objects found that subjects showed more differentiated structure with respect to well known rather than casually known acquaintances.

However, these findings may in fact not contradict the results of the present study. In Zajonc's study and in all of Scott's, with the exception mentioned, nonpersonal objects were used, and thus the results reflected differences only with respect to those domains. In the study dealing with acquaintances, more differentiated cognitions existed toward well known rather than casually known acquaintances, presumably reflecting differences in amount of information. The idea of defensive simplicity does not imply that individuals hold more complex cognitions toward persons whom they encounter only briefly and about whom little information is known.

In absolute terms, the degree of differentiation toward both the well known and the casually known acquaintances may have been low if both were compared with a domain of objects about which information was readily available but with which no personal involvement existed. If, indeed, cognitions of acquaintances were less differentiated than those of nations or of political figures (as in the present study), then the simplicity hypothesis would be supported. A study by Irwin, Tripodi, and Bieri (3) found higher complexity scores for negatively than for positively evaluated persons. Here the distinction in domains was not one of information but rather one of value. Little social contact would exist between an individual and those he dislikes, and thus he would be free to actively scrutinize the characteristics of those persons and form differentiated impressions of them.

Even if subjects were defensively simple toward parents and close friends, why were they more differentiated toward the political figures? The answer to that question may be found in both the nonpersonal involvement and in the amount of information possessed about the political figures. In the present study, nationally known political figures were used as stimulus objects. These

were all persons about whom a great deal of information had been disseminated via the press and television. Detailed portraits had been produced by the media in order to convey the characteristics of these individuals to the American people. In a sense, mass-media produced cognitions, highly differentiated and sophisticated, had been transmitted to the reading and viewing audience. Under these circumstances, it is readily conceivable that complex cognitions would be formed.

If professional information dealing with parents and close friends were systematically made available to individuals, it could be expected that more differentiated cognitions of these persons would appear as a result of this bombardment. Defensive simplicity refers to a passive process: i.e., a process of not deliberately seeking information or carefully organizing the already available information. It should be noted that most therapies attempt to counteract the effects of defensive simplicity on the individual; i.e., they attempt both to provide information about the objects of a person's social world and to organize his existing information in a less global and more differentiated manner.

The comparisons between DWR scores on self and on the other stimulus objects showed that in general the cognitions of self were more differentiated than those of parents and friends. Again, the cognitions of those upon whom one is socially dependent were simpler than the cognitions of one's self. Mischel (5) in a review article cited evidence to show that individuals perceive more consistency in others than in themselves. His argument was that in viewing others we form global cognitions, while in viewing ourselves situational aspects are taken into account. This discrepancy produces structures reflecting more differentiated cognitions of self as opposed to others.

Although the results reported in this paper support the hypothesis of defensive simplicity, more work needs to be carried out directly testing this idea through both experimental and nonexperimental studies. The structural measure, DWR, which developed out of the main theoretical basis of this paper seems to offer the possibility of a potentially useful variable in terms of structural research.

D. STUDY 2.

1. *Introduction*

In order to determine the stability of the measures over time, a test-retest procedure was undertaken.

2. Method

a. *Subjects.* The final sample of subjects with scores from both administrations included 85 students from three classes at the University of Maine distributed in the following manner: Mental Hygiene, $N = 20$; Abnormal Psychology, $N = 51$; Political Science, $N = 14$.

b. *Measurement Apparatus.* The measure of structural properties was the same as that administered in Study 1 with the exception that the stimulus objects included only self, mother, and father.

c. *Procedure.* The structural measure was administered during the second week and again during the thirteenth week of the semester to the three classes mentioned above. It should be noted that since on the first administration for the Mental Hygiene and Abnormal classes and on both administrations for the Political Science class, students were allowed to complete the instrument on their own time and return it via the campus mail, the final sample was quite a select subset of the larger set of enrolled students.

3. Results

The reliabilities for self, mother, and father, respectively, were .50, .41, .39 on DWR; and .44, .88, .64 on Bal. All coefficients were significant at $p < .001$.

E. GENERAL DISCUSSION

In general then, the reliability of the system has been supported, and some evidence for validity has been found (Study 1). Work based upon the synonymity conception of complexity aimed at developing more refined measures needs to be carried out. Parallel form clustered word lists and a parallel form clustered behavior list are two possibilities that are currently being explored.

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Department of Psychology
University of Maine at Orono
Orono, Maine 04473

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