

Individual differences in memory organization as related to word-association, object-sorting, and word-matching styles

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The aims of the study were to examine the possibility of consistent individual differences in styles of clustering in free recall, and to relate these differences to styles of organization reflected in other tasks. Fifty-seven subjects were presented with seven repetitions of a list of 33 words which could be grouped into 11 conceptual categories or, alternatively, into 11 associative categories of three words each. Subjects were found to converge consistently upon one or the other mode of organization with successive presentations of the list. Number of words recalled was more strongly related to associative than to conceptual clustering. Individual differences in amount and style of clustering yielded complex relationships with variables derived from object-sorting, word-association, and word-matching tasks. The implications of the results to the idea of different modes of organizing events were discussed.

The study of the manner by which ideas come to be associated to one another has attracted the interest of psychologists for decades, manifesting itself in such topics as object-sorting behaviour, word associations, judgements of similarity, and more recently, the clustering of items in free recall. Leading among the questions posed in the first two areas of research were those pertaining to the possibility of different, alternative modes of relating events, and the psychological significance of these modes. Thus, in analyses of object-sorting behaviour (e.g. Bruner & Olver, 1965), a distinction has been proposed among concrete (perception-bound), functional, and abstract-categorical modes of grouping events, and a good deal of evidence on developmental changes and individual differences in the use of these modes has accumulated (McGaughan & Moran, 1956; Kagan *et al.*, 1963; Melkman & Deutsch, 1977). Similarly, in word-association studies, a distinction has been drawn between syntagmatic (e.g. *dog-barks*) and paradigmatic (e.g. *dog-cat*) modes of responding, and a developmental shift from syntagmatic to paradigmatic associations has been repeatedly demonstrated (see Nelson, 1977). Although the nature of this shift is not clearly understood, there are indications that the basic shift is from distant and syntactic responses to logical responses (such as coordinates and superordinates) which involve implicit set operations (Stoltz & Tiffany, 1972). With adults, Moran and his associates (Moran *et al.*, 1964; Moran, 1966) reported consistent individual differences in the preference for different types of word associations. Four characteristic styles or 'sets' were identified, which were defined in terms of the tendency to give predominantly coordinate-contrast, predicate, synonym-superordinate, or functional responses, respectively. In factor analyses, the first two sets emerged as two poles of a bipolar factor, while the remaining sets defined a second and a third factor. Moran (1966) interpreted these sets as representing four general bases for matching words which may be arranged in a hierarchy from the more concrete to the more conceptual and abstract modes of relating events.

The recent emphasis on organizational processes in memory (Tulving, 1968) provides a new perspective for the question of different modes of relating ideas. Studies of free recall indicated that the order in which subjects retrieve words from memory shows a systematic sequential organization, and that the extent of this organization is closely related to the amount of recall (Mandler, 1967; Shuell, 1969). In the light of the findings of consistent preferences for modes of object-sorting and word associations, it is of particular interest to examine the possibility that the sequential ordering of words in free recall reflects similar

systematic individual differences in modes of memory organization. If consistent modes of clustering are found, the study of their relationship to the modes of organization manifested in object-sorting and word-association behaviours may help to bring together these disparate areas of research. Furthermore, the study of individual differences in modes of organization in the context of a memory task may help to shed some light on the functional value of these modes for different individuals and on possible processes underlying their choice.

Despite the considerable work on organizational processes in free recall, little effort has been directed to the possibility of individual differences in preferred modes of organization (see Battig, 1975). This is probably because in the most widely used experimental paradigm - clustering - the list organization is experimenter determined. A second paradigm, that of subjective organization or inter-trial repetition (Tulving, 1962), allows in principle for the manifestation of individual differences in modes of organization. However, since this paradigm has been most advantageously used with 'unrelated' words, the inter-trial repetitions are not likely to reveal systematic differences in modes of organization.

The present study investigates the possibility that subjects prefer one mode of organization over another in a situation which permits a choice between them. A distinction between two types of memory organization is suggested by studies of clustering using experimenter-determined categories. Shuell (1969) classified these studies into those using a categorical clustering and those using an associative clustering paradigm, according to the principle that guided the organization of the stimulus list. In categorical clustering items within each category represent instances of the same conceptual-taxonomic class (e.g. horse, cow, chicken). In associative clustering they are associatively related without constituting members of the same conceptual class (e.g. horse, coach, whip). It would be interesting to examine the possibility that human subjects, like memory investigators, display similar differences in the predilection for either of these general modes of organization. Clearly, both modes are prevalent in human thought processes. Yet, as the above-mentioned studies of object-sorting and word-association behaviours suggest, subjects may differ in the relative reliance on each of these modes of memory organization. Furthermore, Denney & Ziobrowski (1972) have shown a developmental shift from syntagmatic to paradigmatic clustering in free recall.

Two recent formulations may provide a framework for distinguishing between the two types of organization. First, Wickelgren (1977) distinguished between two types of organization. Associative groupings are based on direct, horizontal associations among all pairs of elements in a set. Conceptual groupings are based in addition on vertical associations between each of the elements in a set and an intervening superordinate concept. In associative organization a complex idea is represented by a strongly associated set of elements, whereas in conceptual organization it is represented by a single concept which stands for the entire set. Second, a recent theory of mental abilities proposed by Das *et al.* (1975) distinguishes between two forms of memory organization, successive synthesis, where elements are organized in a serial, sequence-dependent form, and simultaneous synthesis, where elements are organized into composites which allow analysis of the relationship of multiple elements to one another. Jarman (1978) explicitly proposed that paradigmatic and syntagmatic clustering in free recall reflect simultaneous and successive types of processing, respectively.

Accordingly, the first aim of the present study was to examine the possibility that individuals display consistent preferences for either conceptual or associative modes of memory organization. A list of words was constructed which could be grouped into 11 mutually exclusive conceptual categories, or alternatively, into 11 mutually exclusive

associative categories of three words each. The list was presented for seven recall trials, and the recall protocols were scored for the extent to which each of the two modes of organization has been adopted. These data allow examination of the manner in which the preference for a particular mode of list organization develops with successive presentations, and assessment of the relative contribution of the two types of organization to recall.

The second and third aims of the study involve possible relationships between the amount and type of clustering exhibited in the memory task and variables derived from object-sorting, word-association, and word-matching behaviours. Studies of objective-sorting behaviour (Clayton & Jackson, 1961; Gardner & Schoen, 1962; Sloan *et al.*, 1963) indicate that when asked to sort an array of objects into as many groups as they wish, subjects differ in the number of groupings they use, and these differences are relatively stable over time and consistent over a variety of content areas. Gardner & Schoen (1962) viewed preferred number of groupings as a measure of 'conceptual differentiation', and reported data which suggest that this variable may be part of a general cognitive style which combines differentiation and integration. They proposed therefore that although high conceptual differentiation implies emphasis on differences, it may lead to a better structuring of experience and may be expected to correlate with higher facility in integration and better recall. Indeed, Melkman (1975) found that subjects who formed a larger number of categories in free sorting exhibited superior recall of a list sorted into an experimentally determined number of categories. Accordingly, the second aim of the study was to examine the possibility that the amount of clustering (regardless of type) and recall evidenced in the memory task will be positively related to the number of groupings preferred in an object-sorting task.

The third aim concerned the generality of individual differences in preferred modes of organization. Curiously enough, despite repeated speculations regarding the possibility of different styles of relating events, little systematic effort has been directed to the examination of the generality of these styles over different tasks. In the present study, three tasks were employed in addition to the memory task, which convey information regarding preferred modes of organization. The first, a word-matching task, was specifically constructed to contrast conceptual and associative bases of similarity. A straightforward prediction may therefore be offered regarding its relationship to clustering. This is not the case with the other two tasks, object-sorting and word-association, which allow somewhat more complex distinctions. The styles of organization derived from these tasks, however, can be roughly arranged in terms of increasing abstraction and sophistication (Moran, 1966), and may therefore be expected to reveal a correspondingly increasing correlation with the preference for conceptual rather than associative clustering.

Method

Materials

Memory list. The memory list was composed of 22 common Hebrew nouns. The list was so constructed that the words could be grouped into 11 mutually exclusive conceptual categories or, alternatively, into 11 mutually exclusive associative categories of three words each. Conceptual grouping was defined in terms of membership in a common conceptual class: all members of a conceptual category shared a common superordinate concept (e.g. means of transportation, profession, etc.), but displayed low inter-item associations. The members of an associative category were related to one another on the basis of some principle other than membership in a common class. All words were of moderately high frequency of usage. Since no satisfactory norms of word associations are available in Hebrew, intuition and three independent judgements were employed to evaluate associative strength. None of the associative categories had more than a single word in common with any of the conceptual categories and vice versa. The list was repeatedly modified on the basis of several pretests in an attempt to minimize consistent clustering in recall of words from

disparate conceptual or associative categories. The 33 words included in the final list (translated from Hebrew) are listed below, first, according to their conceptual grouping, and then according to their associative grouping:

Conceptual grouping: bicycle, automobile, boat; cook, fisherman, shepherd; beret, kerchief, hat; silk, straw, wool; milk, soup, gasoline; knapsack, basket, net; infant, boy, old man; garage, kitchen, (play)pen; shock of hair, beard, mane; rifle, (walking)stick, whip; horse, worm, sheep.

Associative grouping: kitchen, soup, cook; boat, fisherman, net; shepherd, sheep, wool; knapsack, rifle, beret; old man, (walking)stick, beard; gasoline, garage, automobile; milk, infant, (play)pen; horse, mane, whip; boy, shock of hair, bicycle; kerchief, silk, worm; basket, straw, hat.

The 33 words were printed each on a 3 x 5 card using a 2 cm Letraset print.

Object-sorting test. A paper-and-pencil object-sorting test was used. The sorting list consisted of 50 Hebrew words designating common objects. This list was previously employed by Melkman (1975). The words were typed in two columns of a single page.

Word-association test. This test consisted of 30 Hebrew stimulus words, composed of 10 nouns, 10 adjectives, and 10 verbs. They were selected on the basis of preliminary results because they were found to elicit divergent responses in terms of the word-association sets found by Moran *et al.* (1964). The words were printed in two columns of a single page.

Word-matching test. A 20-item test, each item consisting of a pivot word and two response words, one related to it conceptually, the other related to it associatively. In all items the conceptually related word and the pivot word designated members of the same conceptual class while the associatively related word did not. Example of items (translated from Hebrew): violin-string, flute; pen-pencil, ink. The pivot words appeared along one side of the page, and on the other side, opposite each, were printed the two corresponding response words, one above the other. The order of the response words in each item was random. Written instructions directed the subject to choose for each pivot word the response word judged to be the most strongly related to it.

Procedure

The experiment was conducted in two sessions. In the first session subjects were administered the memory procedure and the word-matching test. In the second session they were administered the word-association and object-sorting tests.

In the first session each subject was tested individually. He was told that he was to learn a list of words, each word appearing on a separate card. The words were then presented by manually displaying the cards one at a time at a rate of approximately one card every two seconds. When presentation was completed, the subject was handed a blank sheet and asked to write his name on top of it (to reduce recency effects), and to list in a single column as many words as he could remember in any order in which they occurred to him. Ninety seconds were allowed, at the end of which the recall sheet was collected. This procedure was repeated for seven trials. Before each trial, the cards were thoroughly shuffled with the restriction that the first and last cards in any trial did not occupy either of the two extreme positions in the subsequent trial. Upon completion of the memory task, subjects were asked to rate on a five-point scale the extent to which they made use of imagery in attempting to recall the words. Following this, they were administered the word-matching test.

In the second session, which was conducted 2 to 3 days later, subjects were tested in small groups. All instructions were written and each subject worked at his own pace. The word-association test was administered first, with the instructions to respond with the first word that comes to mind. The object-sorting test followed. The subject received a sheet containing the list of 50 words, and was instructed to sort the words into groups in a way that 'seems most natural, most logical, and most comfortable' to him. He was also told that he was free to shift words around until he arrived at a satisfactory grouping, and that upon completion he was to label or otherwise describe each of the groupings established.

When the sorting task was completed, all material was collected and an unexpected recall test was administered; the subject was handed a sheet of paper, containing the instructions to write down as many words from the sorting list as he could remember. Two minutes were allowed for recall.

Scoring

Object sorting. The object-sorting task provided information regarding both the number of groupings preferred and, the modes of classification adopted. As far as the number of groupings used is concerned, Messick & Kogan (1963) found that the number of single-item categories represented a dimension distinct from the number of categories of two or more items. They interpreted the former as representing compartmentalization while the latter was seen as the proper measure of conceptual differentiation. Following their proposals, the sorting protocols of the present study were scored for conceptual differentiation - the number of categories of two or more items - and compartmentalization - the number of uncategorized items.

For the analysis of the nature of the categories employed, a classificatory scheme developed by Melkman (1970) was used. Each of the categories of two or more items was classified into one of six types according to the relationships of the items to one another and to the category label provided by the subject. The six types of groupings are as follows:

(1) Conceptual or class inclusion. All items represent independent instances of a commonly used conceptual class designated by the label (sample: 'screwdriver, hammer: tools')

(2) Functional. The category label represents a concept (usually designating a function) to which all items are related. The relationship, however, is not necessarily one of inclusion, and not the same for all items (sample: "matches, ashtray, pipe: related to smoking").

(3) Relational. Usually two, sometimes three items which are related to one another without the mediation of a common concept, and the category label provided specifies this relationship (sample: 'vase, flower: you put flowers in the vase').

(4) Perceptual. The category label refers to a perceptual property shared by the items, which may be tangential to their identity (sample: 'pencil, nail, pipe: elongated objects').

(5) Thematic. Items grouped on the basis of idiosyncratic, personal association (sample: 'pencil, ashtray, . . . may be found on my desk').

(6) Loose. Badly formed, ill-defined categories.

Two judges independently rated the protocols. They concurred on all but a few of the responses, the scoring of which was determined after discussion. Six scores were then generated for each subject, consisting of the percentages of categories (out of the total number of categories of two or more items employed by him) classified as belonging to each of the six types.

In addition to the scores mentioned above, the number of words recalled from the sorted list (recall of sorted items) was used as a measure of memory for organized information.

Word association. The word-association test was scored for the 'idiodynamic' sets described by Moran (1966). Each of the 30 responses was classified as synonym, superordinate, contrast, coordinate, sensible predicate, abstract predicate, functional-concrete, functional-abstract, and unscored. Nine scores were then derived for each subject consisting of the frequencies of the nine types of responses. The intercorrelations among these scores yielded a similar pattern to that consistently found by Moran and his associates. Consequently, the nine scores were collapsed to yield four variables corresponding to the four word-association sets discussed by Moran (1966): synonym-superordinate, coordinate-contrast, functional and predicate.

Word matching. The word-matching test was scored for conceptual responses. The individual's score consisted of the number of conceptual responses (out of 20) exhibited.

Subjects

Fifty-seven Hebrew speaking undergraduates at the Hebrew University of Jerusalem, 12 males and 45 females, participated in the study as part of a course requirement. Six additional subjects had to be eliminated from the final sample because they failed to report for the second session.

Results

Conceptual and associative clustering

The mean number of words recalled in each of the seven trials is presented in the lower portion of Fig. 1. As can be seen, recall increased as a negatively accelerated function of

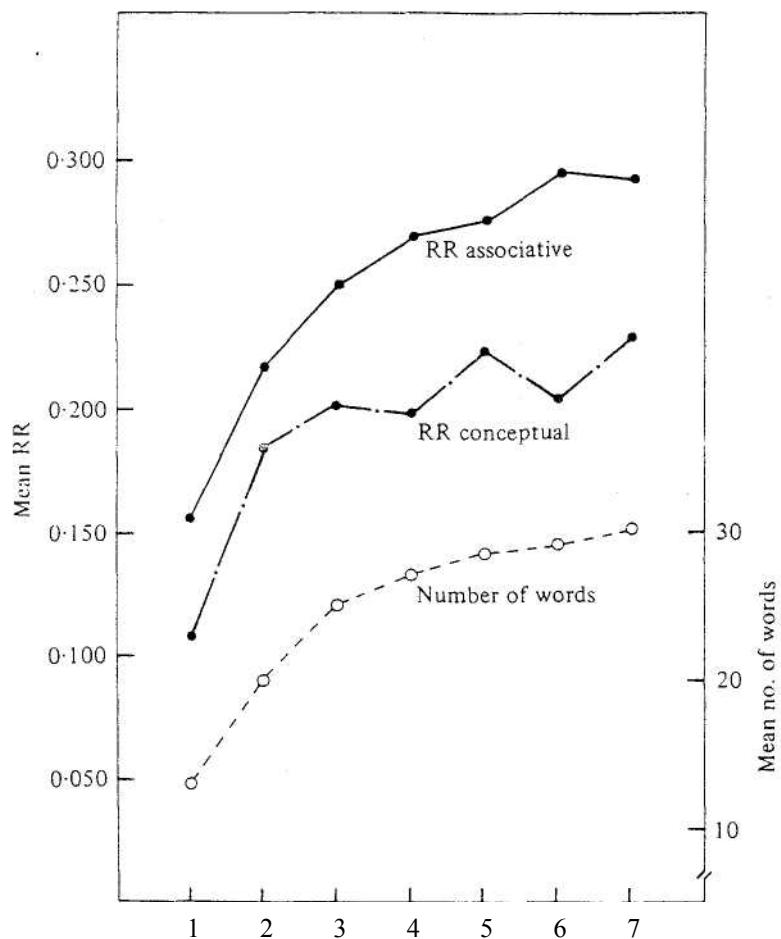


Figure 1. Mean recall, conceptual clustering, and associative clustering as a function of trials.

trials. Also represented in this figure are data on organization. The major variable in obtaining organization scores was the specification of the stimulus categories. Two ratio of repetition scores (RR; Bousfield, 1953) were calculated for each trial and for each individual by counting the number of times a word from one category was followed by a word from the same category, and dividing this number by $n - 1$, where n is the total number of words recalled. For the conceptual clustering (RRC) scores two words were defined as belonging to the same category if they were conceptually related, and for the associative clustering (RRA) scores they were so defined if they were associatively related. In calculating these scores, intrusions were disregarded, and items listed a second time were treated as new items. Fig. 1 presents mean RRC and RRA scores for each of the seven trials.

Two features of the clustering results presented in Fig. 1 are immediately apparent. First, both conceptual and associative clustering increase as a function of trials. Second, associative clustering is more prevalent than conceptual clustering. A 2×7 type of clustering by trial analysis of variance yielded significant effects for both type of clustering, $F = 13.94$, d.f. = 1, 56, $P < 0.01$, and trial, $F = 51.85$, d.f. = 6, 336, $P < 0.001$, and no significant interaction.

The latter result deserves a comment in view of Marshall's (1967) finding of higher clustering in pairs of words that share a common superordinate than in pairs where the words are related but do not share a common superordinate. Clearly, neither the results of the present study nor those reported by Marshall can allow any general conclusions

regarding the relative dominance of the two modes of organization. To allow such conclusions, the strength of the pre-experimental associations pertaining to each of the alternative modes must be properly evaluated or controlled. This task does not appear feasible at the present state of the art, since it requires that the two modes of organization be reduced to one common basis. In Marshall's study for example, the categorized and non-categorized pairs were equated in terms of the mutual relatedness (MR) index of association. However, there is, at the present, no sound justification for attributing to the MR index the status of a common denominator. Indeed, many of Marshall's results, j valuable as they are, may be seen to reflect the fact that the MR index is biased towards the associative mode of organization. In sum, all that can be concluded on the basis of the results reported above is that, with the list of words and with the procedure employed in the present study, associative relations are a more powerful determinant of clustering than conceptual relations.

Individual differences in modes of clustering

Two analyses were carried out to examine the proposition that subjects demonstrate consistent preferences for the conceptual or the associative modes of clustering. In the first analysis, the intercorrelations among the seven RRC and seven RRA scores were calculated. These intercorrelations will not be presented but they can be summarized in terms of two general trends. First, the conceptual and associative RR scores tended to form two distinguishable clusters. Thus, the median within-mode correlation was 0.44 for the RRC scores and 0.49 for the RRA scores, whereas the median between-mode correlation was -0.16. Second, the conceptual and associative scores tended to diverge with successive trials, with the final degree of divergence reached by trials 3 or 4.

These conclusions were further substantiated in the second analysis which was based on j difference scores. In this analysis, seven scores were derived for each subject, one for each trial, consisting of the difference between the number of associative repetitions and the number of conceptual repetitions that appeared in the recall protocol. The intercorrelations among the seven difference scores yielded two main findings: First, all of the 21 correlations were positive, ($P < 0.001$ by a sign test), indicating that the subjects' preference of one mode over the other is consistently maintained throughout the seven trials. Second, the pattern of intercorrelations suggested that the preference for a given I mode of organization gradually developed during the first three or four trials and was maintained thereafter. Thus, the difference score for trial 7 displayed the following j correlations with the difference scores for trials 1-6, respectively: 0.13, 0.38, 0.64, 0.66, 0.60 and 0.77.

A trial-by-trial examination of individual learning protocols indicated that the adoption of a systematic mode of ordering is not the result of the maintenance of once-achieved pairings and the gradual addition of words or pairs consistent with the predominant mode of organization. Rather, in many instances a word would appear as part of a conceptual cluster in one trial and as part of an associative cluster in the subsequent trial and vice versa. This tendency to vacillate between different sequential strategies from one trial to another appears inconsistent with Buschke's (1976) recent work, which indicates that clusters once formed remain intact in subsequent trials. This apparent inconsistency will be discussed later.

It might have been expected that the imagery ratings provided by the subjects at the end of the memory task will be higher for subjects who show preference for associative clustering. The results, however, indicated no relationship between these ratings and the preference for either conceptual or associative clustering.

On the basis of the results presented above, three summary indices of individual

differences will be retained for the analyses to follow. The first index, designated recall, consists of the mean number of words recalled on each of the last three trials. The other two indices involve clustering and are designated conceptual clustering (CC) and associative clustering (AC). These consist of the mean RRC and mean RRA scores, respectively, on the last three trials. Examination of the last two indices in conjunction permits conclusions regarding individual differences in both the kind and the amount of organization imparted on the stimulus list. Several analyses were also carried out using number of word triples rather than word pairs; they yielded results similar to those obtained with the CC and the AC indices and will not be reported. Also, alternative indices of mode of organization based on the rate of increase in conceptual and associative clustering with successive trials were explored, but they were found to be too highly related to the AC and the CC indices to merit a separate analysis.

Figure 2 presents, for illustrative purposes, the recall and clustering data of two selected subjects, who displayed divergent preferences for the two modes of clustering.

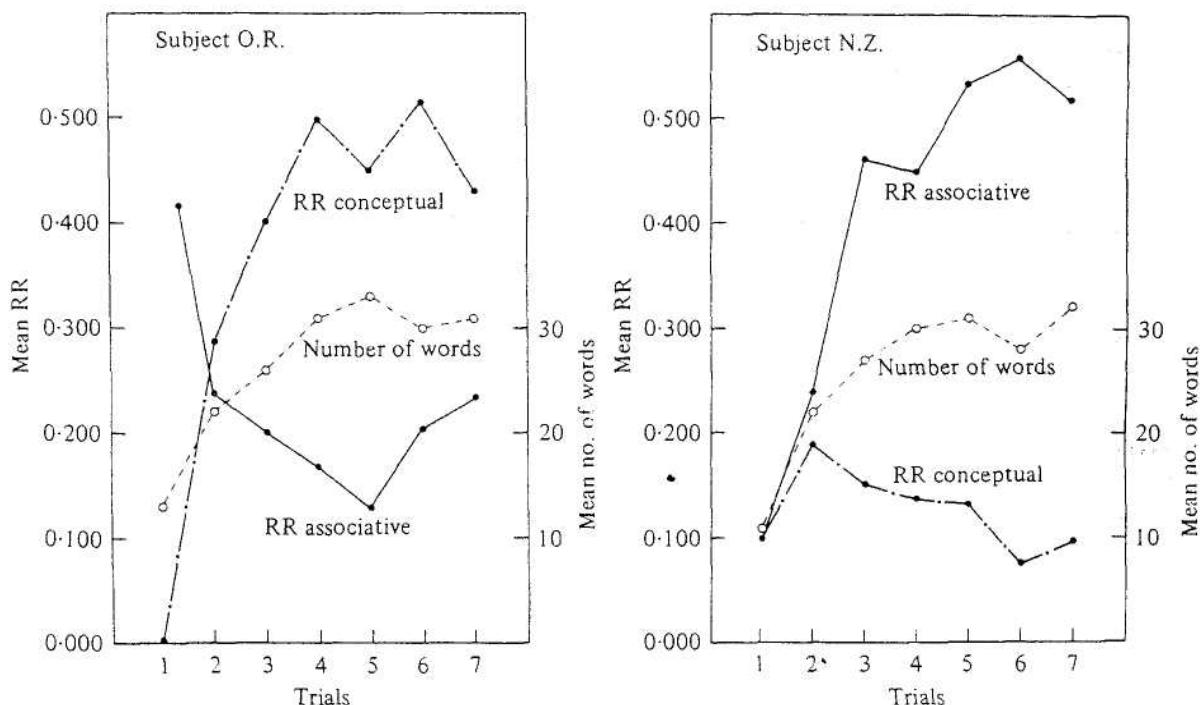


Figure 2. Mean recall, conceptual clustering, and associative clustering as a function of trials for two selected subjects.

Clustering and recall

Some of the recent research on memory organization centres around the proposition that organizational processes affect, even determine, the amount of information recalled (Tulving, 1962; Mandler, 1967). In the present study, the relationship between recall and organization was examined for each mode of clustering separately. For each memory trial, product moment correlations were calculated over subjects, between the number of words recalled on that trial, on the one hand, and RRC and RRA scores on the other hand. The median correlation between RRC and number of words recalled was 0.09 (range: -0.09 to 0.18). The median correlation between RRA and number of words recalled was 0.40 (range: 0.31 to 0.46). On the basis of these results, it appears that recall is more strongly related to associative than to conceptual clustering.

This trend is perhaps best seen when analysis is confined to the last three trials, in which both organization and recall are highest. Recall correlated 0·10 (n.s.) with CC and 0·44 ($P < 0\cdot001$) with AC. The correlation between CC and AC was -0·36 ($P < 0\cdot005$).

The results presented above may be interpreted as reflecting a causal, intra-subject relationship between organization and memory: associative clustering facilitates recall more than does conceptual clustering. However, since the type of organization was subject determined, the results may alternatively be seen to reflect a between-subject effect, i.e. a positive correlation between recall ability and the preference for an associative mode of memory organization. Further research is needed to distinguish between these two interpretations.

Object-sorting: Conceptual differentiation

Several analyses were carried out to investigate the relationships between the object-sorting variables and the memory task variables. In the present section, the results pertaining to conceptual differentiation, compartmentalization, and recall of sorted items will be *I* reported. In the next section, the results involving modes of classification will be examined. The data of the present study generally confirmed Messick & Kogan's (1963) proposition I regarding the independence of conceptual differentiation and compartmentalization, the correlation between the two variables being 0·09. In addition, consistent with Messick & Kogan's interpretation of the two measures, conceptual differentiation was found to relate to recall and clustering, as will be reported below. On the other hand, no relationship was found between compartmentalization and either the number of words recalled on the memory list or the amount of conceptual or associative clustering used.

The relationship between conceptual differentiation and the memory variables was evaluated as follows. Subjects were divided into three groups, according to their conceptual differentiation scores: low (7 or less categories), medium (8-11), and high (12 or more).

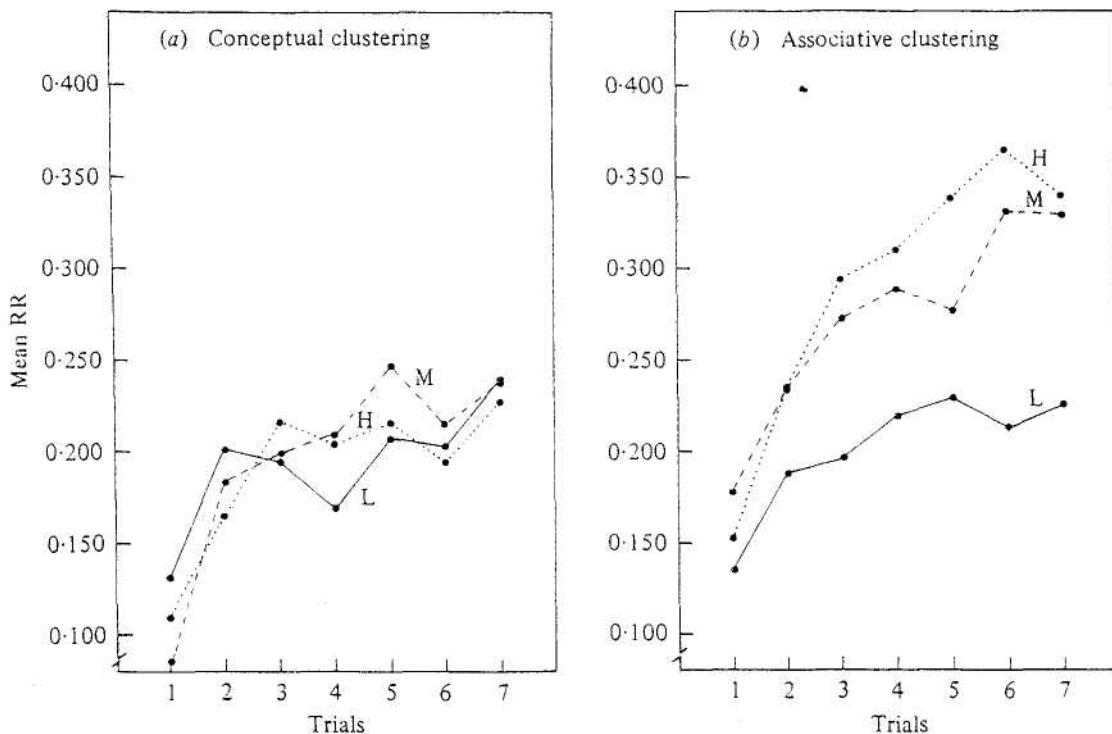


Figure 3. Mean conceptual clustering, and associative clustering for subjects scoring high, medium and low on conceptual differentiation. •—•, low; •---•, medium; •····•, high.

The number of subjects in each of the three groups was 16, 21, and 20, respectively. Fig. 3 presents mean RRC and RRA scores as a function of trials for each of the three groups. These results suggest that the three groups do not differ in conceptual clustering, but do reveal systematic differences in amount of associative clustering, with high categorizers displaying the highest degree of associative organization, and low categorizers the lowest. A one-way analysis of variance comparing the three conceptual differentiation groups with regard to AC scores yielded $F = 13.06$, d.f. = 2, 56, $P < 0.001$. A similar analysis carried out on CC scores yielded $F = 0.449$, d.f. = 2, 56, which is not significant.

Inspection of Fig. 3 indicates that the differences among the conceptual differentiation groups in associative clustering increase with successive trials. Indeed, separate one-way analyses of variance for each of the seven trials revealed no significant effects of conceptual differentiation on associative clustering in trials 1 and 2, but significant effects from the third trial on. Conceptual differentiation then appears to predict the tendency to develop associative clustering with repeated presentations. This effect is also clearly evident when the correlations between conceptual differentiation and the RRA scores for each trial are examined. These correlations were 0.05, 0.14, 0.31, 0.39, 0.35, 0.50 and 0.42 for trials 1 through 7, respectively.

To examine the relationship between conceptual differentiation and recall on the memory list, a one-way analysis of variance was carried out, comparing the three groups on recall (i.e. number of words reproduced on the last three trials). Mean recall for low, medium and high categorizers were 27.8, 29.6, and 30.8, respectively, $F = 4.28$, d.f. = 2, 56, $P < 0.02$. Examination of the correlations between conceptual differentiation and number of words recalled on each of the memory trials suggests that conceptual differentiation is correlated with the improvement in recall with repeated presentations of the list. Thus, the correlations between conceptual differentiation scores and number of words recalled were 0.01 and 0.04 for trials 1 and 2, respectively, and 0.31 and 0.33 for trials 6 and 7, respectively.

It should be noted that these correlations, as well as the results of the analyses of variance suggest that conceptual differentiation is more predictive of associative clustering than it is of recall. In fact, the partial correlation between conceptual differentiation and AC with recall partialled out was 0.40, whereas that between conceptual differentiation and recall, with AC partialled out, was only 0.13. Since the correlations between recall and associative clustering are rather high for the last memory trials, this pattern of results may be seen to indicate that conceptual differentiation is primarily related to extent of associative organization, and that its correlation with recall is mediated by this relationship.

The number of words recalled from the sorting list yielded a correlation of 0.21 with conceptual differentiation and -0.23 with compartmentalization. Recall of sorted items was also found to correlate with the memory task variables in a manner similar to that of conceptual differentiation. That is, it was unrelated to conceptual clustering but was related to both recall and associative clustering. The correlations between recall of sorted items and number of words recalled from the memory list were 0.13 and 0.45 for trials 1 and 7, respectively. The respective correlations with RRA scores were -0.10 and 0.39. These results suggest that recall of sorted items is a measure of memory for organized information, and that its relationship to recall and associative clustering cannot be entirely accounted for by its correlation with conceptual differentiation.

Object-sorting: Modes of classification

The results pertaining to the modes of classification adopted in the sorting task will be examined next. Across all subjects, the distribution of the six types of groupings was as

follows: 26 per cent conceptual, 27 per cent functional, 7 per cent relational, 13 per cent perceptual, 22 per cent thematic, and 4 per cent loose. Certain modes of classification were found to be more prevalent among high than among low categorizers. Thus conceptual differentiation was found to correlate 0·48 with relational groupings, 0·41 with conceptual, 0·15 with functional, 0·02 with perceptual, —0·34 with loose, and —0·56 with thematic.

To evaluate the relationship between the modes of classification and the memory variables, subjects were divided into high (above-median) and low (below-median) scorers on each of the modes of classification separately, and their CC, AC, and recall scores were compared by means of *t* tests. The results are summarized in Table 1. As can be seen, no relationship emerged between conceptual clustering and any of the classification modes. Associative clustering, on the other hand, was positively related to the use of functional and relational groupings, and negatively related to the use of perceptual and (with $P < 0\cdot10$) thematic groupings. The results for recall paralleled in part those obtained for associative clustering.

Table 1. Mean CC, AC, and recall for subjects scoring low and high on each of the modes of classification in the object-sorting test

Mode of classification	Group	<i>n</i>	CC		AC		Recall	
			Mean	<i>t</i>	Mean	<i>t</i>	Mean	<i>t</i>
Conceptual	Low	29	0·207	1·07	0·288	1·08	29·5	0·56
	High	28	0·231		0·290		29·0	
Functional	Low	27	0·225	0·48	0·255	2·92**	28·0	2·89**
	High	30	0·214		0·321		30·4	
Relational	Low	38	0·224	0·55	0·269	2·50*	28·9	1·23
	High	19	0·209		0·330		30·0	
Perceptual	Low	29	0·226	0·67	0·314	2·10*	30·2	2·26*
	High	28	0·211		0·264		28·3	
Thematic	Low	28	0·228	0·74	0·309	1·66	30·5	2·92**
	High	29	0·210		0·270		28·1	
Loose	Low	46	0·218	0·19	0·290	0·09	29·1	0·95
	High	11	0·223		0·287		30·1	

* $P < 0\cdot05$; ** $P < 0\cdot01$.

As was indicated above, the number of categories used by the subject was not independent of the mode of classification adopted. Consequently the contribution of one of these variables to the prediction of memory and clustering may be partly redundant over that of the other variable. At the present, it cannot be determined whether modes of classification should be conceptualized as the primary dimension of individual differences, which in turn affects the number of categories employed in sorting a given list, or whether it should be conceptualized as a by-product of the latter. A third possibility, of course, is that the two variables represent two facets of a single dimension.

Word-associations

As expected from the results of Moran and his associates (Moran *et al.*, 1964; Moran, 1966), the four variables derived from the word-association test were not entirely independent of one another. The intercorrelations among them suggested a polarization

between coordinate-contrast and synonym-superordinate on the one hand, and functional and predicate on the other. The first two sets have been designated by Moran (1966) dimension-referent and concept-referent, respectively. They have been assumed to reflect abstract modes of associating, and may be seen to capture the general mode of organization underlying conceptual clustering as defined in the present study. The predicate and functional sets were designated as perceptual-referent and object-referent, respectively. They were assumed by Moran to reflect relatively concrete modes of relatedness, and may be expected to correlate more strongly with associative than with conceptual clustering.

To examine the relationships between the four associative sets and the memory variables, subjects were divided at the median on each of the associative sets. Table 2 presents the means of CC, AC, and recall scores for the low and high groups, as well as the results of *t* test comparisons.

Table 2. Mean CC, AC, and recall for subjects scoring low and high on each of the word-association sets

Set	Group	<i>n</i>	CC		AC		Recall	
			Mean	<i>t</i>	Mean	<i>t</i>	Mean	<i>t</i>
Synonym-superordinate (SS)	Low	31	0.213	0.53	0.278	1.00	28.1	3.06**
	High	26	0.225		0.303		30.7	
Contrast-coordinate (CC)	Low	30	0.192	2.51*	0.291	0.16	28.5	1.90
	High	27	0.248		0.287		30.1	
Functional (F)	Low	27	0.229	0.86	0.306	1.29	30.4	2.58*
	High	30	0.209		0.275		28.2	
Predicate (P)	Low	29	0.223	0.38	0.300	0.88	30.2	2.13*
	High	28	0.214		0.279		28.3	

**P* < 0.05; ** *P* < 0.01.

As can be seen, all four sets tend to correlate with recall, with high coordinate-contrast and high synonym-superordinate subjects exhibiting superior performance on the recall test, and high functional and high predicate subjects exhibiting inferior performance. Thus, superior recall seems to be related to the adoption of abstract rather than concrete modes of word association. These differences cannot be entirely accounted for in terms of the amount or type of clustering employed: the only significant relationship observed was between coordinate-contrast and conceptual clustering. As expected, high coordinate-contrast subjects displayed stronger conceptual clustering than low subjects.

Several additional analyses suggested that, if anything, the associative sets, unlike the sorting variables, are more strongly related to conceptual than to associative clustering. Thus, high AC and low AC subjects did not differ on any of the nine types of associative responses. High CC subjects (above median, *n* = 29) on the other hand, gave significantly more coordinate responses (*t* = 2.66, *P* < 0.01), more contrast responses (*t* = 2.55, *P* < 0.02), less sensory predicate (*t* = 2.97, *P* < 0.01), and less functional-abstract responses (*t* = 2.60, *P* < 0.02) than low CC subjects. These differences are consistent with expectations.

Word-matching

The mean of the word-matching scores over all subjects was 4.86 with a standard deviation of 3.47. This result indicates that associative relatedness was a stronger determinant of the matching responses than conceptual relatedness. Cronbach's alpha for the test as a whole was 0.76, indicating that subjects were fairly consistent in responding either in terms of associative or in terms of conceptual relatedness.

Word-matching scores failed to correlate significantly with any of the memory-task variables or with any of the measures derived from the object-sorting task. The only significant relationships were found with the word-association variables: a correlation of 0.24 ($P < 0.05$) with coordinate-contrast set, and a correlation of -0.38 ($P < 0.002$) with functional set. These relationships are consistent with predictions since in the construction of the word-matching test conceptual relatedness was defined in terms of coordination relationships, and associative relatedness was defined in terms of relationships most appropriately classified as functional in the context of the word-association task. The correlations reported above may thus be seen to provide some support for Moran's (1966) contention that individual differences in word-association sets reflect different conceptions of word relationships.

Modes of classification and word-association sets

Moran also proposed that there may be parallels between the bases for matching words manifested in word-association responses, and the bases for matching objects revealed in object-sorting behaviour. In the present study, the variables derived from the sorting task are not entirely comparable to the word-association variables. Still, certain relationships between some of the sorting variables and some of the word-association sets may be definitely expected if the two sets of variables tap the same dimensions of individual differences in matching events. Table 3 presents the intercorrelations among the six modes of classification and the four associative sets.

As it may be readily observed, all of the inter-task correlations are rather low, and their pattern is not consistent with the proposition that the same dimensions of individual differences underlie responses to both tasks. These results are intriguing in view of the observation that word-association sets and modes of object-sorting appear to display similar developmental sequences (Moran, 1966).

Table 3. Intercorrelations among modes of object-sorting and word-association sets

Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
<i>Object-sorting</i>										
(1) Conceptual	—	—	—	—	—	—	—	—	—	—
(2) Functional	-0.32	—	—	—	—	—	—	—	—	—
(3) Relational	0.03	-0.05	—	—	—	—	—	—	—	—
(4) Perceptual	-0.11	-0.29	-0.06	—	—	—	—	—	—	—
(5) Thematic	-0.26	-0.35	-0.38	-0.17	—	—	—	—	—	—
(6) Loose	-0.27	-0.12	-0.13	-0.04	-0.12	—	—	—	—	—
<i>Word-association</i>										
(7) Synonym-superordinate	0.12	0.06	-0.03	-0.24	0.09	-0.12	—	—	—	—
(8) Contrast-coordinate	0.07	-0.02	0.19	-0.08	-0.23	0.04	0.02	—	—	—
(9) Functional	-0.02	0.01	-0.10	0.21	0.02	-0.02	-0.24	-0.86	—	—
(10) Predicate	-0.09	0.04	-0.16	0.09	0.24	-0.07	-0.32	-0.86	0.66	—

Discussion

The present study focused on individual differences in the type of organization imparted on verbal stimuli in a free recall task. It explored the relationships of these individual differences to memory performance, on the one hand, and to other measures of style of information organization, on the other. The discussion will focus on three issues: (a) the possibility of consistent individual differences in clustering; (b) the generality of styles of organization over different tasks, and (c) the relationship between these styles and memory performance.

Let us first consider the issue of consistent styles of clustering. The results of the present study suggest that when a choice of mode of organization is available, individuals tend to diverge in their preference for conceptual or associative clustering in free recall. This preference developed during the first three or four trials and was maintained thereafter. Examination of individual recall protocols for the earlier trials indicated that subjects tended to vacillate frequently between the two modes of organization before their consistent overall organization was established. It seems that the majority of subjects try out relationships of both kinds, finally retaining the ones which fit best together or which offer a better overall organization of the entire list. These observations suggest that the stylistic preferences evident in clustering do not reflect differences in the availability of different bases of organization, but may rather reflect differences in the functionality of their use for the individual's performance. A similar view has been expressed recently by Nelson (1977) who suggested that age differences in word associations represent differences in the utilization rather than in the availability of particular word relationships.

The observation that for the same individual particular words frequently appeared once in the context of a conceptual cluster and once in the context of an associative cluster in two successive trials appears inconsistent with results presented by Buschke (1976).

According to his results clusters once formed remain intact in subsequent trials, other items being added to these clusters. In contrast to the list used in the present study, however, Buschke's list consisted of 'unrelated' words. It may be speculated that with such a list the clusters formed are primarily based on organizational cues generated *ad hoc* by the subject. Since competing organizational cues are absent these clusters are more resistant to change than the clusters formed with the type of list employed in the present study. The latter type of clusters are based on the utilization of pre-experimentally available associations which may be readily abandoned when alternative organizational cues offer themselves.

Consistent with these speculations is an observation reported by Abramczyk & Bousfield (1967). They found more pronounced changes in sequential ordering strategies from one trial to another when the list contained words with a certain degree of inter-item associative strength (as measured by free associational norms) than when it contained unrelated words. Battig (1975) has also presented evidence for within-individual shifts in the use of different bases of organization even when some degree of individual consistency was present.

The distinction between associative and conceptual (or categorical) clustering has been discussed by several authors (e.g. Cofer, 1965, 1966; Tulving, 1968), particularly in connection with the question of the mechanism underlying the organization of verbal responses in free recall. The issue has been raised whether clustering can be entirely explained in terms of direct inter-item associations, or whether it is necessary to invoke an additional principle such as superordination, coding or mediation. It is an open question whether the results of the present study should or should not have a bearing on this issue, since there is little in the data that can directly point to the mechanism involved. Still the emergence of the two types of clustering as alternative ordering strategies as far as individual differences are concerned suggests that the distinction between them is useful in some contexts. These results suggest that individual differences in the preference for the two

modes of organization must be taken into account in any attempt to evaluate the relative priorities of these modes in determining ordering in free recall.

It would be interesting to examine the possibility that the tendencies to adopt associative or conceptual clustering are related to the abilities underlying successive synthesis and simultaneous synthesis, respectively, in the model of mental abilities proposed by Das *et al.* (1975). Such a relationship, if demonstrated, might call for a search for the origin of preferred styles of organization in the individual's pattern of cognitive abilities or cognitive limitations (see Melkman, 1975).

The second issue concerns the generality of individual differences in styles of organization. The low correlations found between the modes of organization displayed in the object-sorting, word-association, and word-matching tasks present serious difficulties for a conception of styles of organization as a unitary dimension which is manifested in a variety of situations. Such a conception is often implied in some of the discussions of cognitive development by the use of such general terms as 'modes of analysing events', 'bases of organization', and the like (see Denney, 1974). It is important, however, to examine the results of the present study from the point of view of this conception.

Before taking up this examination, it should be pointed out that although the analyses of the clustering data were presented in terms of the amount of each type of clustering separately, measures of the relative preference of one type of clustering over the other did not yield better results. Thus, the difference between CC and AC, a variable reflecting the relative preference for conceptual over associative modes of clustering, yielded no significant correlation with any of the object-sorting modes or the word-association sets.

One possible reason for the low consistency among the various measures of style of organization is that the individual measures themselves are not reliable. In the present study, reliability, in a narrow sense, was demonstrated for word-matching and clustering only. In both test situations, subjects were found to display systematic preferences for the conceptual or the associative modes of word relationships. It is not known, however, to what extent these differences are stable over time. Kagan *et al.* (1963), for example, reported a moderate test-retest reliability over a 1-year period in the tendency to match figures according to analytic, inferential, or relational principles. Moran (1966) reported adequate test-retest reliabilities over a 3-month period for the word-association sets. With regard to object-sorting behaviour, Gardner & Schoen (1962) found level of abstraction, denoted as the proportion of conceptual groupings, to be stable over a relatively brief period of time, but to fluctuate greatly over longer periods. On the whole, these scattered observations appear to suggest that the low correlations among the various measures of styles of organization cannot be entirely accounted for in terms of the unreliability of the individual measures.

A key to the understanding of the interrelationships between the various measures may be found in the analysis of the task in terms of the cognitive processes they involve and in terms of the overall task attitude they may tend to elicit. A high reliability over a brief period of time combined with a low reliability over longer periods may suggest that the individual's mode of responding is affected by his momentary attitude towards the task. Task attitude may result in the adoption of a consistent style of responding to the stimuli of one test situation, but may change from one situation to another depending on the nature of the task presented and on the individual's momentary set. Moran (1966), for example, found systematic changes in the subject's habitual set of word associations as a result of time pressure instructions, and the extent of these changes varied for individuals with different associative sets. These results suggest a way in which individual variability over different situations (particularly over situations likely to elicit different attitudes on the part of the subject), may be accounted for without entirely rejecting the possibility of a

common, generic dimension. In such an account, the contribution of the individual's general style of organization, the contribution of the task at hand, and their interaction must be considered in the explanation of the organizational strategy chosen. The importance of task attitude or task interpretation has also been emphasized by Nelson (1977) in her attempt to account for the systematic age changes in word-associations. The third issue pertains to the relationship between styles of organization and memory performance. Despite the lack of generality of styles of organization over different tasks, the results of the present study indicated several significant relationships between recall on the one hand, and styles of clustering, object-sorting, and word-associations, on the other.

Conceptual differentiation on the object-sorting task was found to correlate with amount of associative clustering: subjects who preferred a larger number of groupings in the object-sorting task displayed stronger associative clustering and better recall than subjects who preferred a smaller number. These differences were stronger for later than for earlier trials, suggesting that conceptual differentiation is related to the capacity or tendency to develop an effective organization of the list with repeated presentations. This result is consistent with Gardner & Schoen's (1962) proposition that conceptual differentiation combines both analysis and synthesis: 'The categorizing of *Ss* high in conceptual differentiation may be an organized structuring of experience that also leads to synthesis of heterogeneous items into meaningful units when this is required' (p. 15).

The number of words recalled from the sorted list may be seen as another index of the degree to which the elements sorted have been structured or organized. This index was found to be positively related to conceptual differentiation, and like the latter, was found to predict the increase in associative clustering and recall from earlier to later trials of the memory task.

The positive relationships between clustering, recall, conceptual differentiation, and recall of sorted items are unlikely to be accounted for by individual differences in a general ability factor; Melkman (1970) found no relationship between preferred number of groupings and a vocabulary measure of intelligence among college students. These relationships, however, may reflect a common underlying dimension of individual differences similar to that investigated by Earhard (1967) and Earhard & Endicott (1969). Using subjective organization rather than clustering of pre-categorized items, they identified a dimension of individual differences in amount of memory organization, which was interpreted as the ability to form and maintain inter-item associations. The superior associative clustering and recall of high conceptual differentiation subjects may be assumed to reflect a similar ability. If this assumption is correct, the lack of relationship between conceptual clustering and conceptual differentiation may be interpreted as indicating that conceptual clustering results from the development of a general retrieval plan rather than from the strengthening of specific inter-item associations (Slamecka, 1972).

The remaining correlations present a complex pattern which is difficult to interpret. Both associative clustering and recall on the memory task were positively correlated with the use of functional and relational groupings and negatively correlated with the use of perceptual and thematic groupings in the object-sorting task. For the word-association task, on the other hand, a positive relationship was found between conceptual clustering and the tendency to give coordinate and contrast responses, whereas associative clustering was unrelated to any of the word-association sets. The word-association responses yielded the most consistent relationships with the number of words recalled: superior recall was correlated with the tendency to give abstract-type rather than concrete-type word-association responses.

In conclusion, the present study has succeeded in demonstrating the existence of consistent individual differences in styles of clustering in free recall. It failed, however, to

demonstrate the generality of these styles over a variety of cognitive tasks. The pattern of correlations observed between measures of style of organization on the one hand, and memory performance on the other, may provide promising clues about the nature and origin of individual differences in memory functioning.

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