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Depth of processing and memory organization

Asher Koriat[1] and Rachel Melkman[1]

[1] Department of Psychology, University of Haifa, Mount Carmel, Haifa 31999, Israel [1] Ben Gurion University, Beer Sheva, 84105 Israel

Summary. The study examined the idea that the organization of information in memory varies depending on the depth of processing during input, as well as on the conditions for retrieval. Two types of memory organization are distinguished: Conceptual organization implies a hierarchical structure in which items are grouped according to a principled taxonomic system (e.g., cow - horse). Associative organization, in contrast, is based on direct links among the members of a group (e.g., cow-milk). Two experiments examined the propositions that conceptual relations require more effort to be encoded during learning and more effort to be utilized during remenbering than associative relations. In Experiment 1 a list of 28 words was used, which could be grouped into 14 conceptual categories or, alternatively, into 14 associative categories of two words each. The words were presented under either shallow or deep encoding conditions. Increased depth of encoding resulted in increased conceptual clustering but had little effect on amount of associative clustering. Similar amounts of associative and conceptual clustering were observed during early output positions, but conceptual clustering tended to increase with recall trials, suggesting that it might depend on the establishment of a retrieval schema. In Experiment 2, after memorizing a list of words, subjects recalled the words either with or without the requirement to perform a secondary task while recalling. Relative to the undisturbed recall condition, the secondary task condition indicated stronger associative than conceptual clustering. The results were seen to support the idea that different types of memory organization may become salient under different attentional conditions.

Information that is committed to memory may be represented and organized in many alternate forms. It is of particular interest to determine what factors affect the choice of organization. Studies of clustering in free recall suggest that modes of grouping events change systematically with age (Denney & Ziobrowsky, 1972), and that adult subjects exhibit consistent individual differences in preferred modes of memory organization (Koriat &. Melkman, 1981). The present study examines the idea that when subjects are presented with information, its organization in memory may also vary depending on the depth of its processing during input. As Battig and Bellezza (1979) noted, the relationship between depth of processing and memory organization has received little attention in recent memory research, and the present paper may contribute to the rectification of this state of affairs.

We shall focus specifically on the distinction between the two types of memory organization, conceptual and associative, investigated by Koriat and Melkman (1981). Conceptual organization involves implicit set operations: Items are grouped according to a principled taxonomic system, so that the members of each grouping represent instances of the same class. For example: *cow, horse, dog; milk, wine, water; bucket, glass, barrel.* This form of grouping implies a hierarchical organization, in which the implicit superordinate concept (e.g., *animal)* serves as the mediating link. In associative organization, on the other hand, the members of a group are associalively related without constituting members of the same conceptual class. For example: *cow, milk, bucket; grapes, wine, barrel; horse, coach, whip.* Here the grouping is based on direct, pairwise associations among the members in a group. These associations may be of many different sorts, with no systematic principle of relatedness that cuts across the system of grouping as a whole.

Similar distinctions to that outlined above, between associative and conceptual organizations, have been proposed elsewhere. These have been casted in terms of contrasts such as syntagmatic vs. paradigmatic associations (see Nelson, 1977), horizontal vs. vertical relations (Wickelgren, 1977), successive vs. simultaneous synthesis (Das, Kirby, & Jarman, 1975, 1979; Jarman, 1978), and taxonomic vs. schematic organizations (Mandler, 1979; Rabinowitz, & Mandler, 1983). In Wickelgren's terminology, associative groupings are based on horizontal associations among the members of a set, whereas conceptual groupings are based, in addition, on vertical associations between each of the elements in a set and an intervening superordinate concept. Thus, associative groupings rest on direct links, whereas conceptual groupings rest on indirect, mediated links. Das et al. proposed a two-factor model of intelligence and suggested that in memory organizations of the associative type the relations are serial and sequence-dependent, whereas in memory organizations of the conceptual type the links are simultaneous and mutual. This distinction is somewhat similar to that discussed by Koriat (1981) in terms of the contrast between a priori and a posteriori types of word relationships. A similar empha-

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sis is implied in Mandler's distinction between schematic and taxonomic organizations. Schematic organization refers to the organization of events in terms of "stories", "scripts", "themes", or "scenes", in which the horizontal relations among elements are based on temporal proximity, spatial proximity, and cause-and-effect relationships. In taxonomic organization, on the other hand, the primary associations are vertical.

Both conceptual and associative groupings may represent concepts. A conceptual grouping represents the implicit superordinate concept that stands for the entire set, whereas an associative grouping may stand for a more vaguely defined composite idea (a "theme", a "scene") which is represented by the entire set of interconnected elements (Rabinowitz & Mandler, 1983; Wickelgren, 1977).

The present study examines the hypothesis that when verbal information is encoded shaliowiy, its organization in memory tends to be predominantly associative. As depth of encoding increases, memory organization tends to shift from associative to conceptual. This hypothesis is based on the assumption that dimensions of word meanings that underiy direct, horizontal associations suggest themselves more readily during encoding than the dimensions of meaning that underiy conceptual organization (see Lupker, 1984). Furthermore, even during recall associative relations may be activated more automatically, and may guide remembering even when attention is directed elsewhere. Conceptual relations, on the other hand, may require deliberate and planful search to be utilized during recall. Indeed, developmental studies indicate that memory organization in children is typically associative. It rests often on concrete, superficial attributes, and reflects more closely the spatial and temporal contiguities in daily experience (see Petrey, 1977). Conceptual organization on the other hand, requires some degree of mediation and abstraction, and emerges later in development (see Mandler, 1979; Moran, 1966; Nelson, 1977).

The general idea underlying Experiment 1 is that different levels of processing at input may result in qualitatively different memory organizations. The levels of processing model (Cermak & Craik, 1979; Craik & Lockhart, 1972) assumes that the way information is stored in memory is determined in large part by the type of encoding operations applied to it during input. Craik and Lockhart postulated a continuum of depth of processing operations extending from sensory analysis to semantic analysis and elaboration, and proposed that persistence of information in memory depends on depth of processing during learning. Much of the research motivated by this proposition addressed the quantitative prediction that people should recall more words that are processed deeply than words that are processed shaliowiy. The levels of processing approach, however, also allows for predictions regarding qualitative differences in memory. These are based on the assumption that what is stored is the result of the highest encoding operations applied. Thus, at the shallowest level, memory stores the transient by-products of sensory analysis, while at the deepest level it is the outcome of associative and semantic analysis that is retained. This assumption may account for the observation that depth of processing affects different measures of memory differently (e.g., Eagle & Leiter, 1964).

The distinction between automatic and controlled processes, central in current theorizing in cognition, also implies that a stimulus may give rise to qualitatively different consequences depending on whether or not attention is allocated to it (Posner & Snyder, 1975). Hasher and Zacks (1979) extended this distinction to the study of memory. They distinguished between stimulus features that require effort to be encoded into long term store and features that may be encoded automatically. The latter include spatial location, time, frequency of occurrence, and word meaning.

In the present paper we extend this idea further and propose that a similar distinction may be made within the semantic domain. We assume that words may be encoded in terms of a number of semantic dimensions, and that these dimensions differ in terms of the amount of attention or processing effort that is required for their encoding. Thus, dimensions of word meaning that are pertinent to associative organization may be encoded under relatively shallow levels of processing, whereas dimensions of word meaning that underlie conceptual organization become salient only under relatively deep levels of processing. As a consequence, the same list of words presented for learning may exhibit qualitatively different memory organizations under shallow encoding than under deep encoding conditions. Specifically, memory organization may shift from associative to conceptual organization with increasing depth of encoding.

This idea was examined in Experiment I. A list of 28 words was used, which could be classified into 14 conceptual categories or, alternatively, into 14 associative categories of two words each. An incidental memory paradigm was employed, using either one of two orienting tasks assumed to differ in terms of the level of processing they induce. The recall protocols were scored for both conceptual and associative clustering. It was expected that depth of processing should have a stronger effect on conceptual clustering than on associative clustering.

Experiment 1

Method

Stimulus materials. The memory list was composed of 28 common Hebrew nouns and adjectives. The list was constructed so that the words could be grouped into 14 mutually exclusive conceptual categories or, alternatively, into 14 mutually exclusive associative categories of two words each. The members of a conceptual category shared a common superordinate concept (e.g., metal, 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 statisfactory norms of word associations are available in Hebrew, intuition and three independent judgements were employed to evaluate associative strength. 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 28 words included in the final list (translated from Hebrew) are listed below, according, first, to their conceptual grouping, followed by their associative grouping:

Conceptual grouping: sweet, sour; gold, iron; rain, wind; pants, boots; oil, blood; ulcers, pox; track, path;

tailor, (gold)smith; vein, stomach; cake, matzah; dish, jug; lemon, ethrog; round, crooked; Passover, Succoth.

Associative grouping: lemon, sour; (gold)smith, gold; rai!(track), iron; path, crooked; dish, round; tailor, pants; jug, oil; rain, boots; stomach, ulcers; pox, wind; vein, blood; cake, sweet; Succoth, ethrog; Passover, matzah.[1]

Each of the 28 words was printed on a card using a 2-cm Letraset print.

Subjects. Seventy Hebrew speaking undergraduates at the University of Haifa participated in the study for course credit. There were 27 females and 8 males in the shallow-encoding group, and 25 females and 10 males in the deep-encoding group.

Procedure. Subjects were tested individually. Each subject was assigned to either of the two conditions according to a predetermined schedule. In the shallow-encoding condition subjects were told that they would be presented with a list of words, each word appearing on a separate card, and that they were to call out the number of syllables in each word. The required vocal response was simply a number. In the deep encoding condition subjects were told that they had to determine the gender of each word and to respond with masculine, femine, or "difficult to decide".[2] The words were presented by manually displaying the cards one at a time at a rate of approximately one card every 3 s. The subject's responses were tape-recorded. When presentation was completed, the subject was told: "I want you to say all the words you can remember from the list. The order is immaterial. You have 90 seconds." These responses were also tape-recorded.

This same procedure was repeated three more times. The order of the words in each trial was random except that the first and last two words in each trial did not occupy any of the four extreme positions (first, second, last, and penultimate) in any of the other trials.

Results

Recall. The number of words correctly recalled increased as a negatively accelerated function of trials for both conditions. The means for Trials 1-4, respectively, were 7.3, 12.6, 16.3, and 19.4 for the shallow encoding condition, and 11.8, 15.9, 19.0, and 20.8 for the deep encoding condition. A two-way, Condition by Trial analysis of variance (ANOVA) yielded significant effects for trial F(3,2O4) = 25I.93, /><0.0001, for condition, *F(*\,68) = 15.26; *P* < 0.0002, and for the interaction, F(3,2O4) = 5.I3; *P* <0.005. The effect of condition on recall is consistent with previous findings on the effects of depth of processing, and may be considered as supporting the validity of the manipulation employed. The interaction apparently reflects the fact that the difference between the conditions is strongest on the first trial and decreases gradually with repetitions.

It should be noted that the mean number of extralist intrusions was somewhat higher for the shadow encoding condition than for the deep encoding condition. For the shallow encoding condition the means were 0.51, 0.43, 0.14, and 0.25 for Trials 1-4, respectively. The respective means for the deep encoding condition were 0.17, 0,14, 0.17, and 0.23.

Clustering. We shall turn now to the memory organization data. The major variable in obtaining organization scores was the specification of the stimulus categories. Two ratio of repetition (RR) scores (Bousfield, 1953) were calculated for each trial and for each subject 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 scores two words were defined as belonging to the same category if they were conceptually related, and for the associative clustering scores they were so defined if they were associatively related in accordance with the predefined grouping. In calculating these scores, intrusions and items listed a second time were disregarded (i.e., skipped over). Figure 1 presents mean conceptual and associative RR scores for the two conditions for each of the four trials.

A three-way, Condition by Trial by Mode of Clustering ANOVA yielded significant effects for condition, F(l,68)=16.7; P<0,0002, for trial, *F*(3,204) = 26.01; *P* < 0.0001, for mode of clustering, *F(* 1,68) = 9.37; *P*< 0.005, and for the Condition by Mode of Clustering interaction, F(l,68)= 13.10; /•< 0.001.

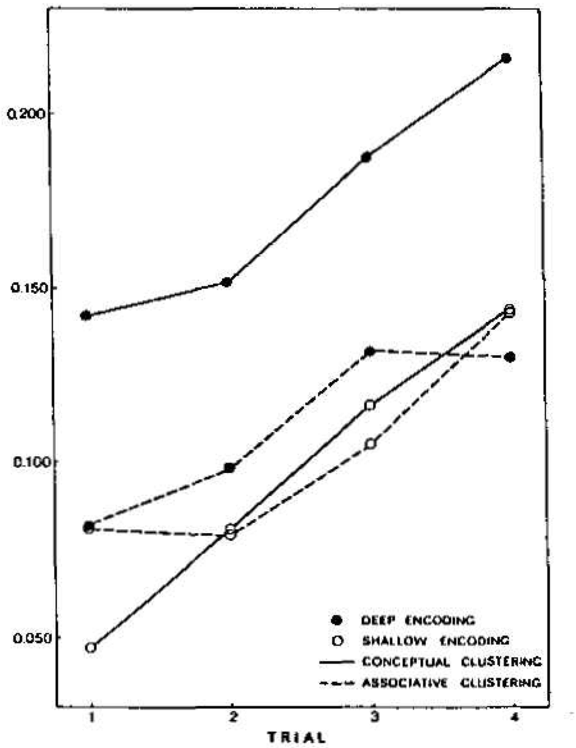

Fig- 1. Mean associative and conceptual clustering as a function of trial for the shallow and deep encoding conditions

[1] In Hebrew, railroad is literally "iron-track" (cf. French *chemin defer.* German *Eisenbahn;* the Hebrew word for chicken-pox is literally "wind-pox" {cf. German *Windpocken);* ethrog (or citron) is a lemon-like citrus fruit used for ceremonial purposes on the Succoth holiday

[J]In Hebrew, nouns have a gender, either masculine or femine. (Tliere is no neuter gender.) Although gender may sometimes be determined on the basis of word endings, this was possibly true for only four of the words used

Two features of the results of Figure 1 are immediately apparent. First, both associative and conceptual clustering increase monotonically with number *of* trials for both conditions. Second, as excepted, increasing depth of processing resulted in increased conceptual organization but had little effect on associative organization. Thus, when the clustering scores were averaged over the four trials, mean associative clustering for the shallow and deep encoding conditions were 0.102 and 0.111, respectively. The respective means for conceptual clustering were 0.097 and 0.174.

Separate Condition by Trial ANOVAs were carried out for conceptual and associative clustering. Conseptual clustering evidenced significant effects for both trial, F(3,204)-17.62; *P*< 0.0001, and condition, F(l,68) = 26.73; *P*<0.0001. Associative clustering, on the other hand, evidenced a significant effect for trial, F(3,204) = 7.44; /><0.000l, but no significant effect for condition *{F*< I). Thus, although amount of associative clustering increased systematically and significantly with trial, it was insensitive to depth of encoding.

It is interesting to note the pattern observed in the first trial. For the deep encoding condition mean conceptual clustering is higher than mean associative clustering [0.142 vs. 0.082; *t*(34) = 3.02; *P* <0.005], whereas for the shallow encoding condition mean conceptual clustering is actually lower than mean associative clustering [0.047 vs. 0.081; / (34) =1.26; *ns]*.

Since Koriat and Melkman (1981) found consistent individual differences in the tendency to cluster items in memory on the basis of conceptual or associative links, it is important to examine the data for individual subjects. As far as the first trial is concerned, 17 subjects in the shallow encoding condition and 13 subjects in the deep encoding condition evidenced identical associative and conceptual RR scores. For the remaining subjects, 7 in the shallow encoding group evidenced stronger conceptual than associative clustering compared to 11 who evidenced the reverse pattern. The respective numbers for the deep encoding group were 16 and 6. A Chi-square analysis of these data indicated x^2 = 4.64; ^<0.05. A similar analysis on mean clustering scores across all four trials indicated that in the shallow encoding condition 14 subjects exhibited stronger conceptual clustering and 20 evidenced stronger associative clustering, whereas in the deep encoding condition the respective numbers were 24 and 10; *%* =5.96; /•<0,02.

Finally, we should note that there was a very slight trend suggesting that words receiving the same response in the orienting task (e.g., "masculine") tended to be clustered together in recall. Several analyses indicated, however, that this tendency could not account for the differential effects of the two types of orienting tasks on associative and conceptual organization.

Changes in clustering during recall. Previous studies of clustering in free recall found that the degree of clustering changes systematically as a function of the stage of recall, being strongest in the middle of the output period (Bous-

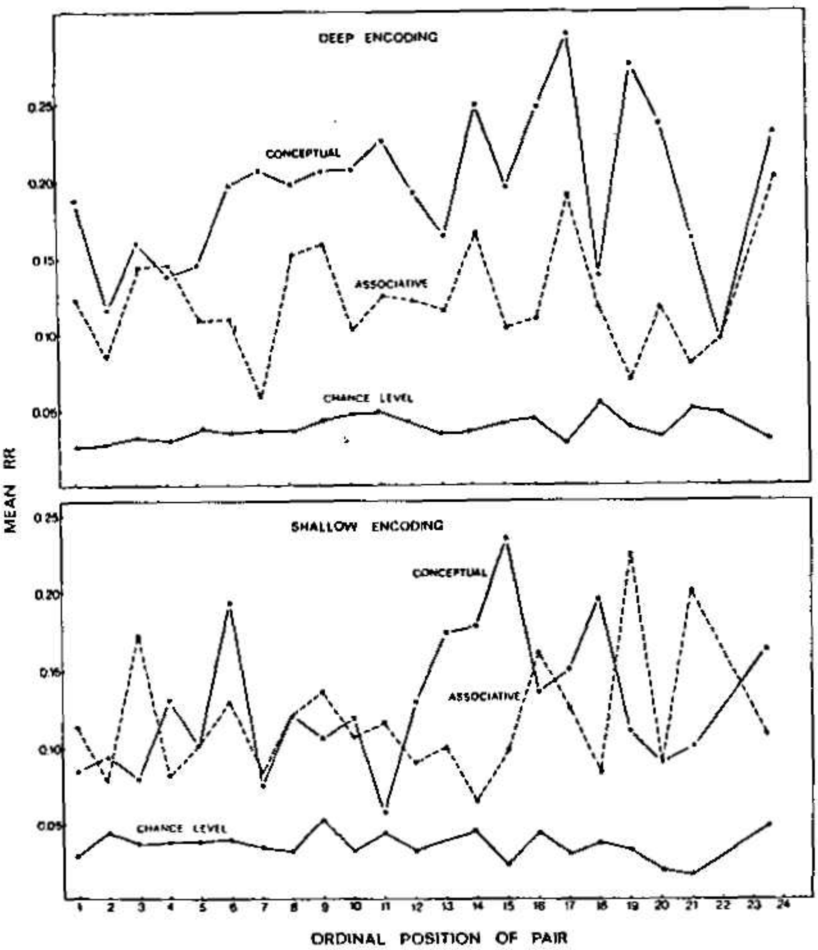

Fig. 2. Mean associative and conceptual clustering as a function of output recall position for the shallow and deep encoding conditions. The results are averaged over the four learning trials

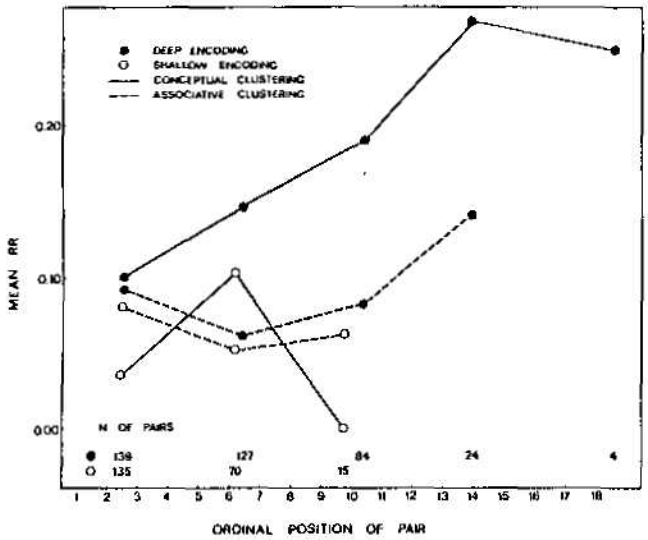

Fig. 3. Mean associative and conceptual clustering Tor the first learning trial as a function of output recall position for the shallow and deep encoding conditions (see text for explanation)

field, 1953; Bousfield & Cohen, 1953). The progressive increase in clustering from the early phase to the middle phase of the recall sequence may reflect the gradual establishment of an organized, controlled retrieval scheme. We may assume that early recall attempts tend to be dominated by a haphazard search, which is receptive to accessible items as they suggest themselves. These may include, for example, items occupying late output positions. This relatively passive and associative recall phase gives way to a more organized and directed search, which takes advantage of the structure of the list. The drop in clustering towards the end of the recall period may reflect the abandoning of the controlled search when the supply of recallable words seems to be depleted.

If this view is correct, we may speculate that, in the early phase of recall (and probably in the late phase as well), order of retrieval may reveal greater reliance on associative than on conceptual organization, and that conceptual organization gains dominance as the retrieval process becomes controlled and directed.

To examine this possibility we calculated the proportion of associatively related and conceptually related words for successive positions in the recall protocol. Intrusions and repetitions were ignored. The analysis was carried out across all subjects and all four trials. The results are presented in Figure 2 for the two conditions separately. Also plotted in this figure is the proportion of related pairs expected by chance. This was obtained by a computer simulation in which for each trial and for each subject *n* words were drawn from the list, without replacement, *n* being the number of words recalled by the subject on that trial.

The results for the deep encoding condition indicate about the same amounts of associative and conceptual clustering for the first six output positions. For the remaining positions, associative organization remains relatively low (though above chance level), whereas conceptual organization tends to increase gradually until about the 18th position. For the shallow encoding condition, amount of clustering remains practically the same across all positions, with the strongest advantage of conceptual over associative clustering obtained in the middle positions.

A similar analysis was carried out using the data for the first trial only, where recall was presumably unanticipated by the subjects. The results for this trial were grouped over each set of four successive pairings. Figure 3 presents mean RR scores for these groups as a function of average ordinal position (at the bottom are the number of pairs on which the respective average was based). The pattern is generally similar to that found for all four trials combined.

In sum, the changes in clustering during recall are consistent with the idea that associative organization may govern the retrieval of information during the initial output phase, with the strength of conceptual clustering gradually increasing with the development of an organized retrieval scheme.

Discussion

The results of Experiment 1 are consistent with the idea that dimensions of word meanings that are pertinent to conceptual-taxonomic organization are better encoded under deep than under shallow levels of analysis, whereas the encoding of semantic dimensions that are pertinent to associative, horizontally-based organization is equally efficient under both conditions.

In most studies in which depth of processing was manipulated, deeper processing was taken to mean more semantic analysis. Furthermore, it has generally been assumed that the encoding of word relationships requires semantic analysis (e.g., Craik & Lockhart, 1972), and relatively effortful memory processes (Hasher & Zacks, 1979). The results of Experiment 1, in contrast, are consistent with the idea (see Anderson & Reder, 1979) that semantic processing itself may vary along a continuum from shallow to deep processing, and that even relatively shallow encoding may afford some degree of organization, one that is based on direct associative links among the verbal elements.

The finding that in the deep encoding condition the advantage of conceptual over associative clustering increases gradually from the beginning to the middle phases of the recall sequence supports the hypothesis that conceptual clustering depends not only on deep encoding during input but also on the operation of a directed, organized retrieval plan during output. Experiment 2 was designed to explore this possibility more directly.

Experiment 2

The results of Experiment 1 are consistent with the idea that the organization of information in memory may vary depending on the depth of its processing during input. It should be clear, however, that information may be simultaneously stored and organized in memory in many different forms. The relative contribution of these forms to output organization may depend not only on the conditions for encoding but also on the conditions for remembering. The changes in clustering during recall observed in Experiment I are consistent with this idea. They suggest that deep processing at input is not sufficient to guarantee conceptual clustering. Presumably, retrieval must be relatively deliberate and organized to take advantage of conceptual links that have been stored in memory.

This suggests the possibility that even if the conditions for encoding favor conceptual organization, the sequential organization of recall may reveal greater reliance on associative links under conditions that interfere with intentional, planful remembering. This proposition rests on the idea that associative links suggest themselves rather automatically during recall, and may guide retrieval even when conditions do not allow sufficient allocation of attention (effort, processing) to the search and retrieval operations. Conceptual relations, on the other hand, may require that a relatively effortful and deliberate memorizing strategy be utilized during recall. Mandler (1979) advanced a similar proposition concerning the distinction between schematic and categorical organizations, claiming that schematic organization may serve as a more automatic vehicle for remembering than categorical organization.

In Experiment 2 two groups of subjects were asked to memorize a list of words. During the recall phase one group was asked to perform an additional task while attempting to recall the words. This was assumed to interfere with the formation and maintenance of an organized retrieval scheme, and to favor output organization along associative lines.

Method

Stimulus materials. A second list of Hebrew words was constructed in exactly the same manner as the list used in Experiment 1. The 28 words (translated from Hebrew) are listed below according to their conceptual and associative groupings.

Conceptual grouping: horse, cow; milk, wine; driver, doctor; car, cart; red, yellow; Egypt, Lebanon; karate, sailing; triangle, pyramid; sea, swamp; eucalyptus, cedar; coat, belt; winter, autumn; chrysanthemum, squill; teeth, ribs (also sides).

Associative grouping: horse, cart; milk, cow; car, driver; wine, red; Lebanon, cedar; sailing, sea; Egypt, pyramid; doctor, teeth; yellow, chrysanthemum; eucalyptus, swamp; squill, autumn; karate, belt; coat, winter; triangle, sides.[3]

Subjects. Sixty Hebrew-speaking undergraduates at the University of Haifa participated in the study. Thirty were randomly assigned to the counting condition and thirty to the no-counting condition. Nine of the subjects had participated in Experiment 1, and were randomly divided between the two conditions of the present experiment.

Procedure. Subjects were assigned to the counting and no-counting conditions according to a predetermined schedule. The procedure was similar to that of Experiment I except for the following. In the counting condition the experiment began with a practice task in which subjects had to alternate between counting and recall. They were asked to count from I to 10, and to recite the Hebrew alphabet interlacing numbers and letters.

The instructions for the memory task indicated that recall would be tested. No orienting task was used. The words were presented at a rate of one word every 2 s. When presentation was over subjects were instructed to recall the words in any order they wanted. Subjects in the counting condition were asked to do this by counting from 1 on, and recalling one word after each number. Ninety seconds were allowed for recall. The list was presented for three trials. After the third recall test, a filler task was administered for 5 min, requiring the circling of even numbers below 50 in a list of two-digit numbers. Following the filler task, subjects were asked to recall the words for the fourth time.

Results

Recall. Mean number of words correctly recalled for the no-counting condition was 14.4, 20.5, 23.0, and 23.0, for trials 1 to 4, respectively. The respective means for the counting condition were 12.2, 19.1, 22,2, and 22.8. Counting seemed to reduce the number of words recalled, but only appreciably so on the first two trials. A two-way Condition by Trial ANOVA yielded, F(3,l 74) = 342.17; /•<0.000l for trial, F(l,58) = 2.51; *P*< 0.15 for condition, and F(3,174) = 2.83; *P* < 0.10 for the interaction. A similar analysis including only the first two trials indicated F(l,58) = 5.11, *P*< 0.05 for condition.

Clustering. Figure 4 presents mean associative and conceptual RR scores by condition and trial. The results suggest that the requirement to count during recall increases the extent of associative organization, but has little effect on the extent of conceptual organization. A two-way Condition by Trial ANOVA for associative clustering yielded significant effects for trial, F(3,174) = 19.64; *P<0.000*, and for condition /=•(!,58) = 4.08; *P*< 0.05. The interaction approached significance, *F*(3,174) = 2.21; *P* <0.10. The respective analysis for conceptual clustering indicated a

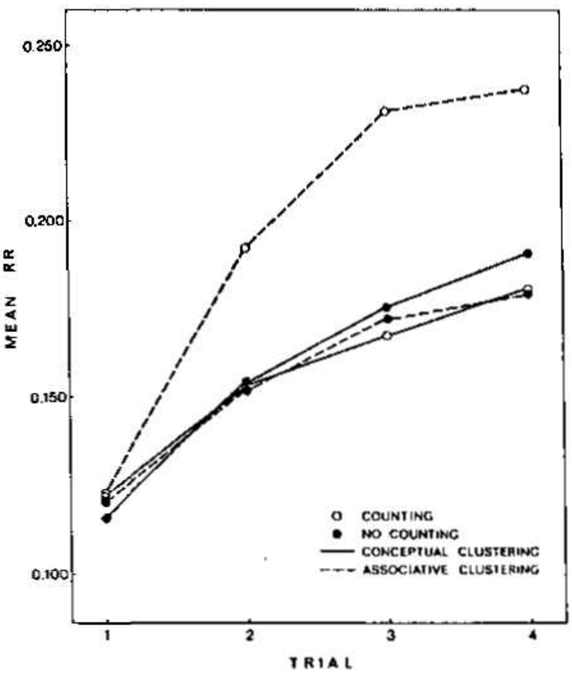

Fig. 4. Mean associative and conceptual clustering as a function of trials for the counting and no-counting conditions

[3] In Hebrew dentist is literally "a tooth doctor" (cf. German *Zahnarzi)* in Israel the eucalyptus tree has been traditionally used to dry swamps; squill is a very common wildflower in Israel whose flowering symbolizes the coming of autumn; the word for ribs also signifies the sides of a polygon

significant effect for trial, /"(3.I74) = 9.69; *P*< 0.0001, and no other effects. It may be seen (Figure 4) that in the counting condition associative organization is superior to conceptual organization, f(29) = 3.85; /^>^<0.001, whereas in the no-counting condition the two types of organization are of about the same magnitude, /(29) = 0.28; ns.

Examination of the data for individual subjects revealed great variability in the clustering scores. When RR scores were averaged across the four trials 18 subjects in the counting condition and 13 subjects in the no-counting condition evidenced higher associative than conceptual clustering, while the remaining subjects revealed the reverse pattern. This difference was not significant in a Chi-Square analysis.

Discussion

Experiment 2 examined the idea that once a list of words has been learned, its output organization may vary depending on the conditions operative during retrieval. Specifically, conceptual output organization may require a relatively effortful and guided search on the part of the subject. When the conditions interfere with deliberate search, output organization may drift to reliance on direct, inter-item, associative links that suggest themselves readily.

The results of Experiment 2 are generally consistent with this hypothesis, though the differences found were only marginally significant. For the counting condition associative organization was significantly higher than conceptual organization, compared to the control, no-counting condition, which evidenced little differences. The exact pattern of the results is somewhat puzzling. We would have expected counting to reduce conceptual organization rather than increase associative organization. In fact, counting yielded a somewhat unusual pattern of effects: It reduced the number of words recalled but increased associative clustering. Clearly, we must await further replications and extensions before we can make definite conclusions.

The methodology of Experiment 2 may be contrasted with that of other studies in which comparisons were made between different memory tests assumed to differ in terms of their demands on the subject's use of conscious, deliberate search (e.g., Eagle & Leiter,1964; Eich, 1984; Koriat & Feuerstein, 1976). Koriat and Feuerstein examined the idea that incidentally acquired information is best recovered under conditions that minimize the active-selective intention to remember. Intention to recall was manipulated by using different measures of memory. A free-recall measure, which is assumed to involve deliberate search, evidenced a very strong superiority of intentional over incidental learning. On the other hand, no difference was found for a word-association measure assumed to tap unintentional, automatic priming. Similarly, in Eich's study, unattended information was found to affect performance on a spelling test of retention that does not require deliberate remembering, although it had no effects on a recognition memory test.

In the present study, in contrast, we attempted to reduce the amount of attention allocated to the search and retrieval operations by adding a secondary task rather than by changing the nature of the memory measure itself. The secondary task was assumed to interfere with the intentional, deliberate exploitation of lawful modes of organization, and to encourage reliance on associative links that suggest themselves. This methodology has the advantage that it allows one to compare performance on the same measure of memory. However, it is also problematic in at least two respects. First, it is not clear what other effects a secondary task induces apart from taxing one's attentional resources. To illustrate, it may be hypothesized that the use of imagery is more benficial for associative than for conceptual organization. If this is true, then the effects of a concurrent secondary task may be expected to differ when this task induces imagery encoding than when it interferes with it. In fact, in the exploratory experiments that preceded Experiment 2, some of the more difficult secondary tasks we used appeared to change the nature of the recall task itself in significant ways. Second, the recent work by Baddeley, Lewis, Eldridge, and Thomson (1984) raises doubts regarding the assumption that retrieval operations require attention. An added concurrent task during recall was found to increase recall latency but not to reduce the number of words remembered. This was interpreted to suggest that an attention-demanding concurrent task does not interfere with accessing information in long-term memory, but may affect response selection. Further research is needed to determine whether this view may be reconciled with the idea that different modes of memory organization become salient under different attentional conditions.

General discussion

The present study was concerned with the distinction between associative organization and conceptual organization. This distinction has received some attention in a variety of experimental contexts, notably cognitive development (e.g., Nelson, 1977), cognitive styles (e.g., Koriat & Melkman, 1981; Moran, 1966), and hemispheric differences (Das, Kirby, & Jarman, 1979). It is also prominent in theories of semantic representation in the contrast between network models that stress hierarchical-conceptual links (e.g., Collins & Quillian, 1969) and spread of activation models that stress associative links (e.g., Collins & Loftus, 1975). See Johnson-Laird, Herrmann, & Chaffin, 1984). The present study adds another perspective, namely the demands that each type of organization make on information processing. We propose that conceptual relations require more effort (attention, processing) to be encoded during learning and utilized during recall than associative relations. Consequently, as processing mode becomes less controlled and more automatic, the type of memory organization should shift from conceptual to associative grouping.

Clearly, more work is needed to refine the distinction between associative and conceptual organization and to specify the cognitive demands that each organization makes on encoding and retrieval. This distinction (see Koriat & Melkman, 1981) has much in common with distinctions proposed by others, but also differs in certain respects. Descriptively speaking, conceptual and associative organizations, as used in the present paper, differ in two respects. First, conceptual organization is based on class membership, and presumably involves the mediation of a superordinate concept, whereas associative organization is apparently based on direct links among the items. Second, in conceptual organization the elements are grouped together in terms of a systematic principle of relatedness that occurs throughout the entire list. In associative organization, on the other hand, the elements are grouped together on the basis of several loosely defined principles of relatedness that may vary in an unsystematic manner The former difference has been stressed by Nelson (1977) and Wickelgren (1977), among others. In Wickelgren's terminology, associative grouping may be said to rely on horizontal, direct links, whereas conceptual grouping relies, in addition, on vertical links that exist between each element and an implict superordinate concept. If conceptual organization depends on the indentification of the intervening superordinate concepts, then deeper encoding should indeed be more favorable for conceptual organization than for associative organization.

The second difference was stressed in Mandler's (1979) distinction between the categorical-taxonomic organization of objects and words and the schematic organization of scenes and events. In categorical organization there is a rule that governs the relationship among items, whereas in schematic organization (e.g., a story) items are connected on the basis of contiguities that have been experienced in space or time. In fact, schematic structures represent well-integrated organizations in which elements are directly related to each other, whereas in categorical-hierarchical structures the organization specifies only the vertical relationships.

Mandler proposed that a schematic organization may be automatically activated both during encoding and during remembering. It is spontaneously adopted as an effective mechanism for "natural" or incidental remembering. A categorical organization, on the other hand, is less automatically applied and seems to come about only as a deliberate memorizing strategy. Even young children who do not uncover the structure of a categorized list (Worden, Mandler, & Chang, 1978) have no difficulty organizing story-like materials in terms of familiar schemata.

Associative organization, as defined in the present paper, is similar to Mandler's schematic organization in that, tike schematic structures, associative relations appear to have a more deeply ingrained basis in the temporal and spatial contiguities of daily experience in comparison to hierarchical-conceptual relations. In this sense associative relations seem to represent primitive abstractions from daily occurring scenes and episodes (see also Petrey, 1977). On the other hand, as Mandler noted, schematic structures are well integrated to the extent that they may be used as top-down processing mechanisms to guide remembering. This is not true of associative groupings. Thus, compared to Mandler's schematic organizations, both conceptual and associative groupings, as defined in the present paper, are less tightly integrated such that in neither type of grouping is there a sufficient specification of the particular units that will be included in each group.

In the present study we focused on two related propositions regarding the distinction between associative and conceptual organizations. First, the organization of information in memory varies with the depth of processing during learning. Second, the nature of output organization depends in addition on the extent to which the recall conditions permit the establishment of a deliberate and organized retrieval scheme.

The result of Experiment 1 supported the first proposition: Increased depth of processing resulted in increased conceptual clustering but had little effect on the magnitude of associative clustering. The evidence in favor of the second proposition comes from two observations. First, the changes in clustering during recall (Experiment I) are consitent with the idea that an organized retrieval scheme favors conceptual organization rather than associative organization. Second, the differential effects of an added secondary task on conceptual and associative organization (Experiment 2) are also consistent with the view that a high level of attention during recall is less critical for associative than for conceptual output organization. The first observation, however, is only suggestive, and the second is statistically weak. More research is needed before we can draw more definitive conclusions on the effects of attentional variables during retrieval.

The results of Experiment 1 imply that different aspects of semantic organization differ in the amount of attention and deli be rat en ess that is necessary for their encoding during learning and for their utilization during recall. This assumption may help resolve an apparent disagreement in the literature. On the one hand, in most studies of depth of processingsemantic analysis was generally assumed to be synonymous with deep processing. On the other hand, in some of the work on the automatic-controlled distinction it is assumed that the perception of word meaning is automatic (e.g., Hasher & Zacks, 1979; Posner & Synder, 1975). The view advanced in the present paper may be seen to imply an intermediate position. We assume that semantic processing itself varies along a continuum from shallow to deep processing (see also Anderson & Reder, 1979; Mistier-Lachman, 1972; Schallert, 1976). Semantic attributes underlying conceptual organization require deeper processing in encoding than semantic attributes that underly associative organization. This view implies that when automatic semantic priming is observed (see Posner & Snyder,l975), it is likely to depend on direct, associative links rather than on links that underlie the more abstract conceptual organization. This possibility is worth exploring (see e.g., Becker, 1980; Fischler, 1977; Koriat, 1981; Lupker, 1984).

Since deep processing appears to encourage conceptual organization, this organization might be expected to lead to better long-term retention than associative organization. Surprisingly, however, associative organization appears to yield more superior memory performance than conceptual organization (Koriat & Melkman, 1981). A similar result has been reported by Rabinowitz and Mandler (1983) who found superior memory for schematically organized than for categorically organized material.

Turning now to our second proposition, it was argued that output memory organization depends in addition on "depth of processing" during retrieval: This opportunity for deliberate and planned memory search may be critical for conceptual output organization, whereas associative organization may be relatively indifferent to the amount of effort that may be invested in remembering. As noted above, a similar proposition has been advanced by Mandler (1979) for the distinction between categorical and schematic organization. She proposed that categorical organization is generally the result of a deliberate memory strategy, whereas schematic organization may be activated spontaneously and automatically.

The idea that there exist different types of memory organization that achieve salience under different psychological conditions ("states of consciousness") has received much attention by psychoanalytically-oriented workers. Two types of memory organizations have been distinguished: drive organization and conceptual organization. Drive-organized memories have been said to underly primary-process operations, whereas secondary process operations were assumed to rely on conceptually and logically organized memories (see Rapaport, 1957). It has also been claimed that primary process operations best emerge under conditions that minimize voluntary, effortful control, whereas conceptually organized secondary process operations are more characteristic of conscious and deliberate thought (e.g., Kubie, 1958). This idea underlies, for example, the practice in psychoanalysis of treating patients in a reclining position, *a* position assumed to favor the patient's surrender to free associations, and to the emergence of primary process, drive-organized contents into consciousness (see Klein,1956). In view of the assumed relationship between the primary process and unconscious functioning on the one hand, and the secondary process and controlled-conscious functioning, on the other hand, it is somewhat puzzling that the modern investigation of the automatic-controlled distinction has not been extended to examine its implications for the nature of memory organization. Such an extension might prove profitable, since it may suggest that different models of semantic organization are appropriate for different modes of cognitive functioning.

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