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Test Anxiety and Cue Utilization Deficit

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This study investigated the organizational cue utilization deficit as a function of test anxiety level. A 2 (cue)×3 (anxiety)×3 (testing mode) mixed factorial design employed the experimental material of phrase list developed from the main textbook of subjects' course. The deficit for high test-anxious subjects was generalized to related meaningful and, also, found clearly general occurring for all types of performance measures of the study: The mean performance of high test-anxious subjects tended to be inferior to that of less anxious subjects and their memory were less organized. The retrieval cue was effective only for those subjects who encode superficially and employ more repetitive and less elaboration of structural organization. The results were discussed from an attention as well as arousal-cue-untilization hypothesis.

High test-anxiety levels and performance decrements are generally related (e.g. McKeachie, Pollie, & Speisman, 1955; Mueller, 1976, 1979; Culler & Holahan, 1980). Test anxiety theory (e.g. Sarason, 1975) specifically attributes the deficit produced by anxiety to self-preoccupation during study. Monitoring of task-irrelevant events interferes with the study of task-relevant materials, making anxious subjects less attentive to the task to study, and, thus, leaving only limited amounts for task-relevant responeses, when evaluative stress is introduced. High-anxiety subjects may be reasonably characterized as more narrow and shallow in their encodings, less flexible in organizational strategies and simpler in cue selection. Such a characterization derives from a synthesis of the levels-of-processing (Craik & Lockhart, 1972) and cue-utilization (Easterbrook, 1959; Geen, 1979) positions. The synthesis assumes that the high-anxiety subjects encode fewer and narrower featural attributes and are less able to organize materials than low-anxiety subjects, because they are more restricted in encoding and cue-utilization. High anxiety induces repetitive maintenance rehearsal rather than elaboration. It seems reasonable to assume that performance differences on a task, particularly for meaningful prose material, depends to a great extent on the efficiency with which task-related stimuli and higher-order structural cues are attended to and utilized.

This study is concerned with whether encoding differences are associated with individual differences in anxiety level. Specifically, it is addressed to the investigation of generality of organizational cue utilization deficit as a function of test anxiety level. Most studies involving anxiety, however, have typically used multi-classifiable free recall lists (Schwartz, 1975; Mueller, 1979) or other direct associative serial lists (Geen, 1976), which are limited in the scope of organizational processing. As Battig and Bellezza (1979) suggest, we need to broaden the scope of organizational processing beyond the direct relationship between individual items

to include use of previously developed organized structure in memory within which newly memorized units can be incorporated. In reading textbooks and listening to lectures, learners must seek out and use cues to relationships between the concepts presented; they must process new materials in ways that facilitate its organization into meaningful relationships with previous learning already stored in memory; and they must retrieve needed concepts in test situations in which new cues are presented.

The present study is expanded to vertical organizational processing, involving the incorporation of individual words or events into some higher-order knowledge structure (Battig & Bellezza, 1979). A test of the hypothesis of organization deficit should be possible with meaningful textbook material better than one with single words. Moreover, the study considers the worry component of test anxiety only, since it appears that emotionality, either as indicated by physiological measures or by self-report, has little to do with impaired performance (Smith & Morris, 1976; Tryon, 1980).

Method

Subjects

60 subjects in the course of 'Psychology of Aging' at the University of Michigan were used as the subject of the experiment. Those subjects whose data were incomplete were eliminated and 5 subjects chosen randomly from cells with an excell were discarded in order to have equal cell sizes.

Design and Material

The study employed a 2 (uncued and cued retrieval group) $\times$3 (low, medium, and high anxiety group) $\times$3 (different testing mode of immediate recall, delayed recall, and delayed recognition test) mixed factorial design, with the latter as a repeated within-subjects variable. Low (L), Medium (M), and High (H) anxiety groups were categorized on the basis of test anxiety scores. Out of a possible score range of 4$\sim$20, subjects whose scores were 4, 5, or 6 were categorized as Group L, Ss of 7, 8, or 9 as Group M, and others having score of 10 or higher than that as Group H. This categorization system divided the total group into about one-third each, which also held true in its score distribution of 154 students including subjects for this experiment.

The retrieval cue variable was manipulated by providing 9 names of chunks, each chunk containing three of 27 phrases, at the retrieval test. The cued (C) group received response sheets which had 9 names of chunks printed on the left side, and was instructed, "Some concepts are given on the left side of the paper. You may use them as cues if you think they are helpful in remembering the phrases." The uncued (UC) group had neither the names of chunks on the responsesheets nor additional instruction related to it. However, in the study phase, Group UC and Group C had identical material.

Nine conceptual chunks were selected from last two chapters of Stevens-Long (1979), which was the main textbook of the course. Three short phrases (generally with three to five words), defining each of these higher-order conceptual chunks, were generated (e.g. three phrases defining the higher-order conceptual chunk of 'dying' were 'inevitable and universal', 'fear of dying', 'stage model of dying'). These phrases were essentially from the textbook material. Thus, the phrase list developed consisted of 27 phrases defining 9 chunks. Phrases defining the same chunk were adjacent and generally followed the presentation order in the textbook. However first three phrases were uesd as primacy buffer and the last three as a recency

buffer. Thus, only the remaining 21 phrases of 7 chunks were analyzed for the study.

The Test Anxiety Scale was administered during another class period separate from the experiment. The scale consisted of 4 Worry items selected from the Worry Scale of the Worry-Emotionality Questionnaire (Liebert & Morris, 1967). For each item, subjects were requested to respond on a five-point scale from "the statement does not describe my feeling, condition, etc. during the test" to "the feeling, condition, etc. is very strong".

Procedure

One week before the experiment, the instructor specially reminded the subjects to review the two chapters from which the phrase had been developed. The experiment was list performed during a scheduled class hour. Ss were provided the phrase list including written instruction, "Following are some key phrases covering the last two chapters of your textbook. Please try to remember as many of them as you can". The instructional statement was the same for each of the experimental conditions. After soliciting questions, the experimenter allowed subjects four minutes of study trial, which was followed by an immediate recall test of three minutes. Afterward, the normal classroom session was resumed for 30 minutes and a delayed recall test was then given for another three minutes. Its format was exactly same as that of immediated test. Finally, the delayed recognition test followed immediately for two minutes. The delayed recognition test included an additional 21 phrases derived from another two chapters of the same textbook as well as the 21 study phrases, in addition to the 3 primacy buffer and the 3 recency buffer phrases. These two chapters were covered in the classroom session already, but their content was not directly related to the study phrases.

Among the data analyzed were (1) the number of phrases recalled, (2) the number of chunks formed, (3) the organizational index, (4) the number of phrases recalled in delayed recall test but missed in the immediate test, (5) percent-loss of phrases, (6) percent-loss of chunk, and (7) the number of phrases recognized. The organizational index (OI) is a measure of the degree to which phrases from the same chunk tended to be recalled near one another. The value of 1 was assigned if the phrase was the first phrase recalled in a chunk. For the remaining two phrases of each chunk, the following formula was used to assign a value for each phrase, if next phrase retrieved: 1-(number of phrases recalled between phrases)/(total number of phrases recalled after the preceding phrase). The ratio is thus used as a modifying factor to indicate the organizational relationship between the preceding phrase and the next phrase. The greater the distance between two phrases, the greater the ratio and the smaller the value is assigned to the next phrase. If all three phrases were recalled consecutively, then each phrase will be scored 1 with a maximum of 3 for each chunk. The organizational index for each subject is an average of sum of scores for each phrase recalled by the number of chunks used. Thus, OI's score range came to be, when counted all of phrases of 7 chunks, 0 to 3. However, practically, the OI score ranges from 1 to 3, assuming at least one phrase recalled.

Results

The mean performance of each group of a 2 (cue) $\times$3 (anxiety) $\times$3 (testing mode) mixed factorial design on measures analyzed is summarized in Table 1.

Immediate Recall: The result of the immeidiate recall test may principally provide information

Table 1. *Mean Performance on Several Measures as a Function of Retrieval Cue and Anxiety*

	Retrieval Cue		Anxiety		
	Uncued	Cued	Low	Medium	High
			Immediate Recall		
Phrase	9.93	9.46	10.40	9.60	9.10
Chunk	5.47	5.46	5.80	5.50	5.10
OI	1.63	1.64	1.73	1.66	1.51
			Delayed Recall		
Phrase	7.57	8.03	8.75	7.40	7.25
Chunk	4.67	5.07	5.15	4.75	4.70
OI	1.54	1.53	1.72	1.54	1.36
New phrase	0.93	1.67	1.30	1.25	1.35
Percent-loss (phrase)	33.77	34.40	28.55	34.45	39.25
Percent-loss (chunk)	18.37	15.20	12.50	16.70	21.10
			Delayed Recognition		
Phrase	17.27	17.80	19.20	17.25	16.15

about difference in short-term memory capacity as a function of anxiety level, attenuating the effect of treatment differences of organizational cue utilization. The number of phrases recalled, chunks formed, and OI were analyzed. A 2 (cue) × 3 (anxiety) ANOVA showed neither the main effect of cue or anxiety variable nor their interaction effects significant, as hypothesiezd. However, careful examination of the data in Table 1 shows that there are systematic and consistent performance differences particularly as a function of test anxiety level, even though not large enough to be significant. Throughout analysis, the mean performance of anxious subjects was consistently inferior to that of less anxious subjects and the low-anxiety group performed most effectively.

Delayed Recall: A 2(cue) × 3(anxiety) ANOVA for the phrases recalled showed neither main effects nor the interaction effect significant. However, direction of the effect was as expected, with means of Groups L, M, and H, 8.75, 7.40, and 7.25, and those of Groups UC and C, 7.57, 8.03, respectively. Similar analysis with number of chunks formed and employed in retrieving material revealed no significant main

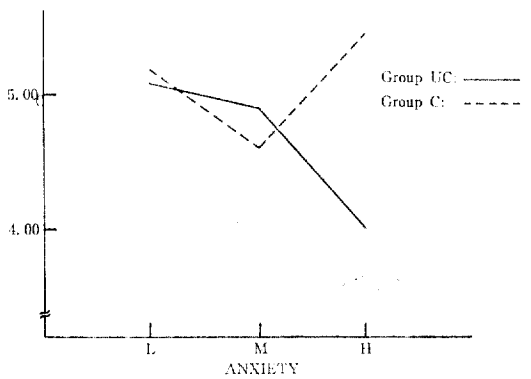

Figure. 1. Number of Chunks Stored as a Function of Cue and Anxiety.

effect of cue or anxiety variable. However, the Cue × Anxiety interaction effect was significant, $F(2, 54) = 2.67, p < .07$, even though somewhat marginal. As shown in Figure 1, the interaction effect was very interesting. Performance means of Groups L, M, and H in uncued retrieval conditions were 5.10, 4.90, 4.00, and those in cued retrieval conditions were 5.20, 4.60, and 5.40, respectively. Further analysis indicated that Group UC and Group C differed significantly only at high-anxiety level, $t = 2.59$, $p < .01$. The result suggests that high-anxious subjects benefit reliably more by having retrieval cues than low-anxious subjects.

The Organizational Index showed a clear anxiety main effect, $F(2,54)=3.59$, $p<.05$, and no other significant effects. The Organizational Index (OI) means of groups Low, Medium, and High in uncued- and cued-retrival conditions were 1.7, 1.6, 1.4, and 1.7, 1.5, and 1.3.

The delayed recall test, even though more relevant to an analysis of organizational processing than immediate recall test, might still reflect a carryover of differences from the immediate recall test. So, the data were further analyzed as percent-loss from the immediate recall test, in regard to number of phrases recalled and chunks established to store phrases. Analysis of percent-loss of phrases revealed that anxiety main effect was significant, $F(2,54)=2.53$, $p<.08$, even though marginal. Again, there were systematic and consistent differences among Groups L, M, and H as well as between Group UC and Group C, as noted in Table 1. Moreover, analysis of percent-loss of chunks showed a very interesting Cue× Anxiety interaction effect, $F(2,54)=3.58$, $p<.05$. Mean performances of Groups L, M, and H either in uncued or cued retrieval condition were 10.50, 15.40, 29.20, and 14.50, 18.00, and 13.10, respectively. The picture of the interaction effect is graphed in Figure 2. Again, the difference of Group UC and Group C was statistically significant only at the high anxiety level, $t=2.47$, $p<.05$. The result revealed herewith was basically identical with what was found in the analysis of chunks formed and used in retrieving.

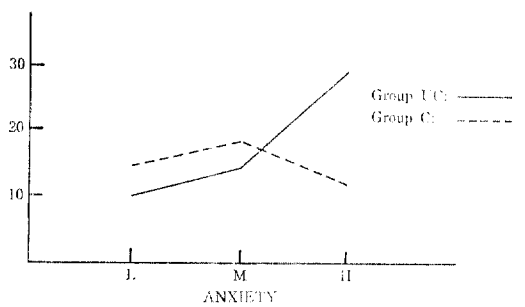

Figure 2. Percent-loss of Chunks in Delayed Recall Test.

Delayed Recognition: The number of phrases recognized correctly was analyzed, with the anxiety main effect significant, $F(2,54)=3.41$, $p<.05$. Cue variable main effect and Cue× Anxiety interaction effect were not significant. As shown in Table 1, high-anxious subjects showed the greatest performance decrement.

Discussion

The present results are generally concordant with those earlier reported of a deficit in organizational cue utilization for high-anxiety subjects. The deficit was generalized to related meaningful prose material and, also, found clearly general, occurring for almost all types of performance measures of the study. It appears that high-anxiety induces a deficit in selective strategies and flexible utilization of organizational cue to incoporate individual materials into higher-order conceptual structure. Specifically, first, high-anxious subjects tended to recall less on both immediate and delayed tests. Even though the direction of the effect of organization cue deficit was consistently with disadvantages for high-anxious subjects, the magnitude of the difference of the effect was not large enough to be significant. However, the magnitude of the organizational cue effect was significant on the delayed recognition. These results are in accord with that of Battig and Einstein(1977), who found a significant differences for delayed recognition but not for recall task. Nonetheless, they may appear conflict with other claims indicating a large organizational effect on recall performance with relatively small effects on recognition (Battig & Bellezza, 1979). Actually, we have some evidence showing that high-anxiety has debilitating effect on free recall

performance (Eysenck, 1977). The present findings on the decremental effect of organizational cue for high-anxious subjects can be reported as restricted cue utilization for high-anxious subjects; that is, anxious subjects do not proceed to select cues broadly and utilized them flexibly in encoding. This explanation is consistent with prediction from an attention hypothesis; the performance difference of high- and low-anxiety subjects lies in the different attentional focuses, with the test-anxious subjects dividing attention between self-preoccupied worry and task cues and the less anxious person focusing more fully on task-relevant variables (Wine, 1971). This explanation can also be advanced from Easterbrook's (1959) arousal-cue-utilization hypothesis predicting that, as applied to test anxiety, the range of task cues utilized in performance will become progressively narrower or smaller as the level of test anxiety rises. Also, only a modest effect on recall task seem to deserve our attention. It is generally believed that recall involves both adequate storage and retrieval whereas recognition involves less active searching. It could mean that the recognition is more sensitive to the subtle treatment effect than the recall. The insignificant magnitude of the effect of cue utilzation deficit on recall task, found in the present study, may reflect (1) overloaded information that subject cannot handle well enough in the time available (Underwood & Zimmerman, 1973), (2) low organizational cue saliency to induce weak treatment effect on encoding and retention, (3) masking by other memory subprocesses and task demands, (4) or all of some combinations of them. Apparently, there is no basis in the present data for definite test of them.

Second, overall conceptual clustering occurred in all groups, but it was lower in high-anxiety subjects. Specifically, even though high-anxious subjects may recall as many phrases, their recall was less organized; there is less clustering of phrases on the organizational basis of conceptual relationship than low-anxiety subjects. The present study involves embedded cues within task materials that were directly relevant to effective performance. Thus, subjects need to attend to cues, possibly through broader flashlight beam (Watchel, 1967), and utilize them to mediate from one phrase to another. One possible explanation of the organizational cue utilization deficit for high-anxiety subjects is that states of high-arousal may induce attention constriction, attenuate selective spotlighting to differentiate the integral and peripheral part of the task, or weaken persistent attention-focusing to the integral cues to conceptually interrelate materials into a higher whole. In any case, high-anxiety subjects seem to engage in a more restricted and inflexible encoding and retention.

Third, another interesting and drastic evidence for the organizational cue utilization deficit was the significant interaction of cue and anxiety for delayed recall. Unlikely on immediate recall, high-anxious subjects showed a performance decrement under the uncued retrieval condition, and benefited the most from retrieval cues on delayed recall task. As noted already, the immediate recall test may basically provide information about differences in short-term memory capacity as a function of anxiety level, attenuating the effect of treatment differences, whereas the delayed recall test might better reflect qualitative differences in encoding. The present result is clearly in accord with the notion of greater benefits for qualitative differences in encoding as the demands on memory increases with a longer retention interval. The qualitative differences in high- and low-anxiety subjects may be understood by considering the organizational cue utilization deficit,

again. To the extent that structural properties of phrases can provide a basis for acquisition, they should permit to a faster transition to deeper (or conceptual) levels of processing and, also, to the development of a structural retrieval plan. This type of explanation implies the rigidity in self-monitoring for high-anxious subjects, with deficit in selective attention as well as in elaboration of structural organization. To the disadvantage for high-anxious subjects, direct associative relationship seem to be used as a primary basis for encoding and no effective organizational encodings seem to have resulted.

Fourth, on delayed recall, high-anxious subjects recalled more phrases missed on the immediate recall than low-anxious subjects. This result further evidences the above argument and is consistent with disadvantages deriving from the qualitative differences between organizational encoding and direct associative encoding.

Fifth, high-anxious subjects' less organized memory traces and rigid processing of structural cues were further noted in the analysis of percent-loss of phrases retained and chunks formed. They lost a greater portion of information stored, thus retaining relatively fewer phrases than low-anxiety subjects. Their percent-loss was rather drastic when no retrieval cue was provided. Traces, based on these superficial and less organizing processing, should become increasingly weaker over time and the retrieval process will be greatly retarded. Their perfo-rmance level will be correspondingly hindered, as the retention interval increases. The result confirms the importance of hierarchical structures in acquisition (e.g. Bower, Clark, Lesgold, & Winzenz, 1972). This finding carries with it particular implications for the natural situation, which has immensely diverse and complex materials and an undetermined retention interval.

Finally, retrieval cues were not effective for immediate and delayed recall as well as for recognition. The Cue × Anxiety interaction effect revealed that only the high-anxious subject shad benefited significantly by having the retrieval cues. This result generally seems to confirm Tulving's encoding specificity principles (Tulving & Thomson, 1973) stating that a retrieval cue provided by the experimenter can be effective only when it is the one attended to by the subject during encoding. However, a retrieval cue provided by the experimenter only in the retrieval phase appears to be effective for those subjects who encode superficially on the basis of direct associative relationship of phrases and employ more repetitive and less elaboration of structural organization.

It may be that anxiety is so pervasive as to restrict the subject's ability to perform well enough; on the other hand, it may be that subjects become highly anxious because they are ill-equipped. Adequate interpretations can be advanced only after more analytic research has localized differences. However, whatever the causal sequences are, the overall findings of the study appear to suggest that more adequate learning emphasizing understanding and structural organization may turn out beneficial for helping high-anxious subjects. It may lead to better knowledge of the material and, also, indirectly to reduced attention rigidity and worry responses which might derive from the insufficient confidence in the material.

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