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ABSTRACT

It has been shown that incidental stimulus attributes are not utilized as much under conditions of high anxiety. It was hypothesized that the nature of this restricted encoding may be interpreted within a levels-of-processing framework. The physical attributes of verbal items (e.g., orthography, sound) may be thought of as shallow features, requiring relatively little processing compared to the semantic properties (i.g., meaning), which may be said to require deeper processing. It was hypothesized that high anxiety systematically reduces the depth of information processing which the subject does, so that the peripheral deep features may not be processed. A false recognition study and two free recall experiments are reported as tests of this notion. In general, the differential-depth hypothesis was not supported, though in retrospect the methodologies used probably did not involve processing at different levels. (Author/WR)

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SUBJECT DIFFERENCES IN BREADTH OF ENCODING IN MEMORY [1]

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Abstract

It has been shown that incidental stimulus attributes are not utilized as much under conditions of high anxiety. It was our hypothesis that the nature of this restricted encoding may be interpreted within a levels-of-processing framework. The physical attributes of verbal items (e.g., orthography, sound) may be thought of as shallow features, requiring relatively little processing compared to the semantic properties (i.e., meaning), which may be said to require deeper processing. It was our hypothesis that high anxiety systematically reduces the depth of information processing which the subject does, so that the peripheral deep features may not be processed, even if the core meaning is processed. A false recognition study and two free recall experiments are reported as tests of this notion. In general, the differential-depth hypothesis was not supported, though in retrospect the methodologies used probably did not actually involve processing at different levels.

While the past several years have witnessed a new peak of interest in human learning, particularly cognitive processes and information processing, little has been done to study individual differences in this area, aside from a certain amount of developmental research. A recent report by Hunt, Frost, and Lunneborg (1973) is perhaps a notable exception. While the search for some general laws should take precedence perhaps, the past justification for ignoring these effects, i.e., they are randomly distributed "error" or uninformative "noise," seems suspect (Hunt et al., 1973, p. 115; Sarason & Smith, 1971). In fact, as Hunt et al. note, "It is something of a tribute to the ingenuity of students of experimental design that cognition has been studied with little concern for the differences between people (p. 90)." The state of affairs was aptly described by Jenkins some years ago, in remarks which are still essentially true today:

> "From time to time those of us who march under the banner of the verbal learning army gird up our loins and, casting a glance over the activities of the field, we _talk_ about launching an attack against our collective ignorance at the point where it is most strongly defended. We loudly deplore the lack of _theoretically motivated_ [emphasis added] studies of individual differences in verbal learning, and suggest that _someone_ should do _something_ about it. ... Somehow, though, following these periodic forays, the army fails to march (1967, p. 90)."

Progress here will be made most rapidly, as Jenkins implies, only when there is a conceptual tie between (1) the interpretation of laboratory studies of memory and learning and (2) the nature of the individual difference dimension. That is, the underlying theory in the two areas would ideally contain some conceptual commonality. Otherwise, the two areas cannot meet, or they touch only in piecemeal fashion, with the result that all too much of the research is "exploratory" in nature. Work in our laboratory during the past two years has impressed upon us the importance of this problem, and suggested one theoretical link. The specific problem which we have become most involved in concerns the effect of motivational differences on stimulus encoding. The underlying theme of this work is that the encoding behavior or mediational activity of certain subjects will be more restrictive than for others. It is important to note that the argument here is not that individual differences will produce large effects in all cases, since in many or most cases they produce somewhat smaller effects than can be obtained by numerous environmental manipulations, but rather that we can account for additional amounts of variance by studying them, and thus produce more precise tests of our theories of learning and memory. Thus it has not been our intent to articulate these individual differences per se, but rather to study them as boundary conditions for theories postulating covert events.

The literature on the interaction between motivation and learning is considerable. One notable emphasis has been a concern with the energization or _activation_ of behavior which results when drive is increased (e.g., Goulet, 1968; Spence &

Spence, 1966). Another concern has been with the effect of arousal on the consolidation of memories (e.g., Kleinsmith & Kaplan, 1963; Levonian, 1972). However, we have instead been concerned with a slightly different question, one with an equally long history, namely the effect of anxiety on attention. For example, it was observed some time ago that high-anxiety subjects displayed less incidental learning than low-anxiety subjects (Easterbrook, 1959; Kausler & Trapp, 1960), provided that the intentional task was sufficiently difficult and motivation defined in terms of emotion rather than incentive. We have not used the incidental learning paradigm, but we have pursued this observation of a deficit in cue utilization. Of course, it is not our argument that energization and consolidation are not affected by anxiety, simply that differential stimulus encoding is another component of the overall result.

Given that high-anxiety subjects tend to utilize incidental stimuli less than low-anxiety sunjects, the question of an underlying mechanism arises. One possibility might be a smaller short-term memory capacity, or a difference in perceptual apparatus (lower capacity?). There are some findings that high anxiety reduces digit-span performance (e.g., Hodges & Spielberger, 1969), and also that arousal reduces sensitivity (in signal detection analyses; Bacon, 1974). Although somewhat different, the argument that high anxiety leads to a preoccupation with task irrelevant events (Mandler & Sarason, 1952) would be functionally equivalent, in that less general processing space would be available (cf. Biggs, 1968). However, there are demonstrations that while utilizing fewer peripheral cues, high-anxiety subjects actually perceive more (e.g., Solso, Johnson, & Schwartz, 1968). While this may be a component of the cue utilization deficit, it seems not to be the whole problem.

As an alternative (supplement) to reduced sensitivity or capacity in short-term memory, it seems possible that high-anxiety subjects may either process information less actively, or differently. The possibility of less activity seems counter to the idea of greater activation, but both possibilities seem to predict about the same thing at this point. However, we tend to think in terms of "kind" of processing instead, as follows.

We have used verbal items as the materials to be learned, and these items seem likely to possess a number of "attributes" (Underwood, 1969), e.g., meaning, appearance, etc. While subjects might encode all of these features, it seems likely that this encoding is more selective (Underwood, 1972). Our basic hypothesis is that one circumstance under which a more restrictive encoding occurs will be high anxiety. Craik and Lockhart (1972) have recently argued that memory might be understood in terms of a "depth of processing" analysis, where "deep" processing would involve the semantic attributes of a word and "shallow" processing would involve only physical properties (orthography, sound) of the word. Given sufficient time, and certain other contingencies, subjects would normally process deeply. However, suppose that some subjects did not do so. Suppose specifically that high-anxiety subjects do not process as deeply as low-anxiety subjects (or as a slight variant of this, that they encode only the core meaning, or some idiosyncratically salient attribute, perseverating on it at the expense of further deep processing, e.g., less common usages, etc.).

This suggests that high-anxiety subjects would show the cue-utilization deficit primarily for "deep" attributes, and not perhaps for shallow attributes. This conceptualization has guided our research of late. At this time, this perspective seems to make essentially the same predictions as Broadbent's (1971) notion of "pigeon-holing" as discussed by Schwartz (1973, 1974a, 1974b, 1974c), and "further processing" will be required to distinguish which is more appropriate. It is encouraging, however, that Schwartz' results may be interpreted as consistent with this differential-depth analysis.

Experiment I

Our first experiment to test this differential-depth hypothesis utilized the false recognition paradigm introduced by Underwood (1965). This procedure requires the subject to state for each word in a series whether it occurred before in the series or not, i.e., is it a repeated item, or occurring for the first time? If the subject says that a new word was presented before, that constitutes a false recognition. When the word falsely recognized is related in some way to a word actually shown before, e.g., JUMP--LEAP, that is taken as evidence that the subject initially attended to the feature(s) which the words share in common. Needless to say, the nature of the overlap can be varied, e.g., similar meaning as shown, similar sounds, etc.

The assumption that high-anxiety subjects engage in a less extensive encoding suggests two things for this paradigm. First, the generally more restricted encoding which they make would lead to fewer false recognitions overall. [Since many of the relationships involve dominant associative connections, e.g., KING--QUEEN, the energization component would suggest the opposite, with a possible tradeoff on this point.] More importantly though, the depth hypothesis suggests that high-anxiety subjects would falsely recognize primarily along rather shallow dimensions. For example, one would expect them to make a preponderance of false recognitions involving acoustic similarity, while low-anxiety subjects would make relatively more semantic false recognitions (e.g., synonymity).

Materials

The list contained 6 instances of synonymity, 6 instances of antonymity, and 6 instances of associates without obvious semantic connection. These three types were equated in terms of average associative strength in the norms, with associative probability ranging from 0.20 to 0.82. Certain analyses involved pooling two items from each semantic type to get high, medium, and low associative strength groupings. In addition, 6 instances of homonymity were included, and while these could not be checked for associative relationships in the norms, such connections appeared minimal.

Each critical stimulus (CS) was repeated once, at a lag of about 12 items. The experimental (E) words followed the repetition of the CS at a lag of about 25 items. The control (C) words immediately preceded the E words half of the time, and followed them half the time. The C words were chosen so as to approximately match the E words in terms of frequency, number of syllables, etc. Filler items were added to the list, a third being repeated once, another third repeated twice, with the rest unrepeated, yielding a total list length of 160 items. Four different list forms were used.

Subjects

A large number of Introductory Psychology students (414) were administered the Taylor (1953) Manifest Anxiety Scale as a 75-item Biographical Inventory. The upper, middle, and lower thirds were used for final selection, with 8 males and 8 females ultimately run from each third. The high-anxiety subjects all had scores greater than 27 (mean = 34.9), middle-anxiety subjects had scores between 18 and 21 (mean = 19.9), and low-anxiety subjects had scores less than 11 (mean = 6.4).

Procedure

The continuous single-item presentation procedure was used, with each subject required to state for each word whether it had occurred before in the list, and to rate his confidence in his decision on a five-point scale. The list was presented at a 4-second rate on a memory drum. Following the last item, subjects were given the forward digit-span test from the WAIS, and then the state-anxiety scale (Spielberger, Gorsuch, & Lushene, 1970).

Results

Some of the results are shown in Table 1. The main effect of E vs. C-word false recognition was significant [F (1,24) = 75.05, p < .0001], as expected. The main effect of semantic type was significant [F (3,72) = 10.79, p < .01], as homonyms (and synonyms) produced somewhat greater false recognition rates. The anxiety main effect was not significant [F < 1], nor was the Anxiety X E/C-word interaction [F (2,24) = 1.53]. The Anxiety X Semantic Type interaction was significant [F (6,72) = 2.29, p < .05], as the intermediate anxiety levels produced more false positives for all types except homonyms. The analysis of confidence ratings revealed the same results.

The analysis by associative strength is shown in Table 2. There was no anxiety main effect, nor interactions with anxiety [Fs < 1.23]. The main effect of associative strength was not significant [F (1,48) = 1.41].

Insert Tables 1 & 2 about here

Discussion

This experiment gives little support to the initial expectations. It is true that high-anxiety subjects made more false positives to homonym lures, but so did low-anxiety subjects. For those who like to dwell on this sort of thing, the same pattern emerged for correlations of performance with the state anxiety scores as well. Nor did digit-span correlate with performance here (means = 7.6, 7.1, and 7.6, for high, medium, and low anxiety, respectively).

We think the problem here may lie in the methodology used. That is, each CS produced only one possible false recognition later. What would seem a better test would require that each CS produce both a possible shallow and a possible deep false recognition, e.g., the word URN as a CS would be followed by both EARN (shallow) and VASE (deep) as E words. This seems a more demanding test of the hypothesis, and we have such research under way. It may well be though, that the rate of false recognitions is simply too low for this paradigm to serve as an effective test of the differential-depth hypothesis, and other tasks may be required as tests.

Experiment II

We had been simultaneously investigating this problem using the free recall task as well. This task presents a set of words to the subject, with the subject required to reproduce them in any order he wants. If the word list includes related items, e.g., OAK, ELM, BIRCH, the subjects tend to cluster these related words together at the time of recall, even though they were separated during input. Presumably this organization of recall aids retention, and increased recall generally accompanies greater clustering.

Our previous work had shown that high-anxiety subjects clustered less for both associative and conceptual category definitions of relatedness (Mueller & Goulet, 1973; Mueller, 1974). Similar findings have been obtained by Hormann and Osterkamp (1966) with arousal and conceptual categories. We interpreted this as consistent with the possibility that high-anxiety subjects encoded more restrictively, and did not utilize all of the possible attributes which could have helped organize recall. However, since both of our bases for organization essentially required semantic comprehension, the results were indeterminate with regard to the depth hypothesis outlined above. We needed a basis for clustering which could be said to be "shallow" in the Craik and Lockhart sense.

Earlier research had shown that subjects will utilize acoustic similarity as a basis for clustering (e.g., Baddeley & Warrington, 1973; Bousfield & Wicklund, 1969; Forrester, 1973; Holborn, Gross, & Catlin, 1973; Laurence & Trotter, 1971; Long & Allen, 1973; Zupnick & Forrester, 1972). If physical attributes are in some sense shallower than semantic attributes, it seemed possible to argue that contrasting clustering based on acoustic relationships to that based on conceptual categories would pit shallow against deep encodings.

Materials

Two different 30-item lists were constructed. The semantic list consisted of five words from each of six conceptual categories in the Battig and Montague (1969) norms, using only the top seven instances for selection. The acoustic list consisted of 30 words involving six sounds, with five instances of each sound. [To preserve reputations, it is a good idea to construct such lists with your office door closed!] This list consisted of the following words: PAIR, CHAIR, WHERE, DARE, BLARE, YOUNG, LUNG, HUNG, TONGUE, STUNG, SPEAR, QUEER, CLEAR, PIER, NEAR, EIGHT, GREAT, FREIGHT, WAIT, GATE, PEACE, NIECE, FLEECE, LEASE, GEESE, POST, MOST, GHOST, COAST, and ROAST. Of course, there is considerable orthographic similarity in the latter list, but that should also be a shallow attribute; however, it will ultimately be necessary to compare acoustic and orthographic similarity. These two lists were arranged into four different orders for presentation such that each block of six items contained one instance from each category. Each of these orders was used about equally often as the starting order.

It is important to note that the semantic and acoustic lists are not directly comparable, since we have no way of knowing that the acoustic categories are as obvious as the conceptual categories, among other things. However, we did have all subjects rate all 12 groupings after the experiment, presenting the five-word groupings and a 9-point scale (see below), and there were no differences between the overall ratings. The acoustic groupings received a mean rating of 8.5 and the conceptual groupings a mean rating of 8.6; this suggests that both types of categories are fairly obvious when shown in a blocked manner, though random presentation was used for actual testing. The more critical comparison in any event is that between anxiety levels _within_ the same list.

Subjects

In this experiment, the subjects were scaled on test anxiety (Sarason, 1972). The subjects were all females, enrolled in Introductory Psychology, and selected from 448 who had taken the test anxiety scale. No high-anxiety subject had a score below 26 (mean = 28.5), and no low-anxiety subject had a score above 10 (mean = 7.9). The acoustic and semantic lists were each learned by 14 high- and 14 low-anxiety subjects. The experimenters were blind as to a subject's test anxiety score.

Procedure

Each subject performed for six trials on one of the two lists. The words were presented on a memory drum at a 2-second rate, with subjects pronouncing each word out loud one time as it was showing, followed by a 60-second written recall period. The sixth trial was followed by both the forward and backward digit-span tests from the WAIS.

As the final phase, all subjects completed a booklet which involved rating groups of words. The six acoustic groupings and the six conceptual groupings were arranged in the booklet, two of each per page. Beside each grouping of five words was a 9-point rating scale, which the subjects were instructed to use to indicate how clear the basis for grouping the words seemed to them. Thus, all subjects, regardless of which list they had just performed on for six trials, rated both types of categories. Although not statistically significant, the subjects who had learned the semantic list for some reason rated both the semantic and acoustic bases for grouping as less obvious, in spite of clustering highly on the conceptual basis.

Results

The average number of items recalled per trial is shown in Figure 1, with the average clustering scores per trial shown in Figure 2. The clustering score is the adjusted-ratio-of-clustering (ARC) measure discussed by Roenker, Thompson, and Brown (1971), and it is computed as follows: (observed - expected clusters) divided by (maximum - expected clusters).

High-anxiety subjects recalled less [F (1,52) = 6.95, p < .01], which has not always been the case in our earlier work, in spite of previous organization deficits. There was less recall for the acoustic list [F (1,52) = 112.40, p < .0001], and while it appears that the anxiety difference was present only for the acoustic list, the Anxiety X List interaction was not significant [F (1,52) = 2.57, p < .12]. There was a List X Trials interaction [F (5,260) = 7.03, p < .0001], as the differences between the lists increased over trials, the acoustic list being acquired more slowly.

Insert Figures 1 & 2 about here

In terms of recall organization, high-anxiety subjects clustered less [F (1,52) = 4.22, p < .05], and there was considerably more clustering in the semantic list [F (1,52) = 188.53, p < .0001]. While the anxiety difference was more pronounced in the acoustic list, the Anxiety X List interaction was not significant [F (1,52) = 1.74]. We had observed in earlier studies slightly greater recall and clustering for females, and since all subjects in this study were females, it seems likely that the reduced clustering difference in the semantic list can be attributed to a ceiling effect. However, the possibility also remains that this can be attributed to some difference in category potency between the semantic and acoustic list, such that the anxiety deficit appears only for weakly defined categories. The latter possibility certainly appears testable, with either type of organization, but perhaps more readily with the existing conceptual category norms.

Recall correlated significantly with ARC score (mean over Trials 1-5) in the acoustic list, r (26) = .45, p < .02, but not in the semantic list, r (26) = .21, p < .29. Digit-span performance seemed uncorrelated with recall in both lists, and uncorrelated with clustering in the acoustic list, but forward, backward, and total digit-span performance correlated positively with clustering by conceptual categories, rs (26) = .34, .36, and .47, ps < .08, .06, and .02, respectively. Digit-span again seemed uncorrelated with anxiety, with means of 6.11 and 6.57 for forward span, and 4.46 and 4.50 for backward span, for high and low anxiety respectively. Although Bartel, DuCette, and Wolk (1972) found that locus of control affected degree of category clustering, our post hoc correlations failed to reveal any effects of locus of control on either recall or clustering in either list. Since our subjects were selected on test anxiety though, this question remains open.

Discussion

The depth analysis of anxiety differences in recall organization would have expected that the deficit for high-anxiety might have been restricted to the acoustic (shallow) basis for organization. Instead, the deficit was present for both types of lists. With the benefit of hindsight again, it seems that this outcome is not that difficult to comprehend, nor necessarily contradictory to the hypothesis. Recall that the lists were presented in unblocked order, such that several words might intervene before a rhyming word was presented, and it thus becomes clear that the acoustic relationships which are clear enough when blocked are rather difficult to determine when ordered randomly. In other words, this basis for organization is peripheral, and thus requires considerable processing. For this reason, plus perhaps the visual presentation rather than auditory, it is not surprising that the organization deficit is more general.

Clearly, what is required is a methodology which gives each subject the option of organization by shallow or deep attributes. Having come to this realization on the basis of the two preceding studies, the third experiment was an initial attempt to examine what happens when subjects have a choice in their organization. Ideally this choice would involve equally potent classification schemes, but we know of no feasible way of doing that just now. It is possible though, to devise lists with alternative bases for organization.

Experiment III

The third experiment used what we will refer to as "ambiguous lists," or lists with multiple bases for organization. In terms of the differential-depth hypothesis, such a list should have one basis which involves a "shallow" dimension of encoding, and another basis which involves a "deep" encoding dimension. One possibility would be a list composed of words belonging to conceptual categories such that each category had one word which sounded like a word in each of the other categories (e.g., Long & Allen, 1973). Another possibility would be an ambiguous list such as has been used by Battig and his colleagues (e.g., Lauer & Battig, 1972; Mondani, Pellegrino, & Battig, 1973), and Hicks and Young (1973), where each conceptual category has a word beginning with the same letter. For example, the five instances in the five semantic categories all have one word beginning with A, C, M, S, W. In this case, subjects could cluster by either conceptual categories or by first-letters. We used this latter type of list initially because it seemed more directly amenable to the use of orienting tasks, a manipulation which we had not used to this point.

It would seem possible to influence the subject's encoding strategy in the manner used recently by Jenkins and his colleagues (e.g., Hyde & Jenkins, 1973). Briefly, this procedure involves giving a preliminary orienting strategy, followed by a free recall test. The common finding is that if the subjects are instructed by the orienting task to attend to semantic features, e.g., is it a pleasant word, greater recall and clustering result relative to an orienting task which might direct the subject's attention to just whether or not the first-letter is a vowel or consonant, for example. It seemed to us that this procedure ought to reduce the high-anxiety subject's deficit when the orienting task directed attention to semantic properties, but perhaps enhance it if the orienting task was nonsemantic. Thus this feature was added to the design.

Materials

A 25-item list was constructed by selecting five words from each of five conceptual categories in the Battig and Montague (1969) norms, within the constraint that each category have instances beginning with the same first-letters as the instances in other categories. Two slightly different forms of the list were used, with partial overlap of words, categories, and first-letters. Form A consisted of the following words: ANTELOPE, COW, MOUSE, PIG, SKUNK, ARMS, CHEST, MUSCLES, PANCREAS, SHOULDERS, ACCOUNTANT, CLERK, MINISTER, PLUMBER, SECRETARY, AUSTRALIA, CANADA, MEXICO, PERU, SWEDEN, ASH, CEDAR, MAPLE, POPLAR, SYCAMORE. Form B consisted of the following words: COW, FOX, MOUSE, PIG, TIGER, CHIN, FINGER, MUSCLES, PANCREAS, TONGUE, CANCER, FLU, MALARIA, POLIO, TYPHOID, CUBA, FRANCE, MEXICO, PERU, THAILAND, CLERK, FARMER, MINISTER, PLUMBER, TEACHER. Despite the overlap, it was felt that two forms would provide somewhat greater generality to the results. Although first-letters are shared, it should be noted that formal similarity is minimal otherwise; e.g., the first two letters uniquely define each word. These lists were arranged into five different random orders, with each block of five instances containing one member of each conceptual category and one member with each first-letter, and with each specific instance appearing in each block over the five orders. Each order was used approximately equally often as the starting order.

Subjects

The subjects were selected from 188 males and 253 females who had taken the test anxiety scale (as well as the locus of control and introversion-extraversion scales). The 60 high-anxiety subjects all had scores greater than 19 (mean = 26.4), and the 60 low-anxiety subjects all had scores less than 14 (mean

= 9.8); men and women were equally represented at each level and in each condition.

Procedure

One-third of the subjects received a preliminary orienting task which required them to check for each word as it was projected on the screen whether or not the first letter was a vowel or a consonant. Another third of the subjects were required to check whether or not the word was pleasant or unpleasant. It was expected that the former would induce a shallow processing, and the latter a deeper encoding. The words were presented at a 1-second rate, with an interslide interval of about one second. The remaining subjects received no orienting task.

Five immediate free recall trials were then given. The list was presented at a 2-second rate using a Carousel projector, with a 60-second written recall period each trial. It should be noted that this procedure means that the subjects with orienting tasks did not recall the words until after essentially two study trials, and throughout have the one trial "advantage" over the control subjects.

Each subject returned to the laboratory 48 hours later for delayed recall tests. This session consisted of three parts, an unpaced and uncued recall, a cued test using the first-letters as cues, and finally a cued test using the conceptual category labels as cues. The two cued tests involved projecting the cue on the screen for about 12 seconds apiece. These tests were always administered in this order, since a recall test can be a further study phase, and it was expected that alphabetic cueing would produce less recall and thus less opportunity for incidental study to confound the subsequent cued test.

These delayed tests were included for a number of reasons. First, it seems of interest to relate the results of our procedures to the consolidation-arousal literature (e.g., Farley, 1973; Levonian, 1972; Uehling, 1972; Zubrzycki & Borkowski, 1973), which requires at least an immediate and a delayed test. Secondly, it seems of interest to determine whether the orienting effects which Jenkins and others have observed are maintained over longer time periods. In addition, it seems of interest to determine whether the clustering deficit which characterizes high-anxiety subjects persists over a delay period. Finally, it seems of interest to determine whether or not clustering during immediate tests, which seems to lead to greater recall on the immediate test, actually leads to greater retention in general, i.e., does immediate organization facilitate long-term retention?

Results

Figure 3 presents recall performance by anxiety level and orienting task in each phase. During the initial five trials, high-anxiety subjects recalled less than low-anxiety subjects [$F(1,114) = 2.91$, $p < .09$], but anxiety did not interact with trials or orienting task [Fs < 1.98]. The main effect of orienting task was significant overall [F (2,114) = 3.25, p < .04], as the pleasantness orientation led to greater recall than the control, and the first-letter orientation led to worse recall. These effects were more pronounced for high-anxiety subjects, but the Anxiety X Orienting Task interaction was not significant [F (2,114) = 1.98]. An Orienting X Trials interaction [F (8,456) = 2.67, p < .007], however, seemed to indicate that this ordering and most differences were more pronounced on the early trials, with only the high-anxiety control and first-letters groups showing reduced recall later.

Separate analyses of each of the delayed tests revealed only significant main effects due to anxiety [Fs (1,114) = 5.08, 3.38, and 6.06, ps < .03, .07, and .02, for the uncued, alphabetic cueing, and label cueing respectively]. Of course, these differences may only reflect a carryover of the difference present at the end of acquisition (Underwood, 1964), but at least there was no evidence of long-term superiority for high-anxiety, contrary to the consolidation literature. Orienting produced no significant main effects for these three tests [Fs < 1.71], and there were no Anxiety X Orienting interactions [Fs < 1]. However, it seems worth pointing out the striking decline between Trial 5 and the uncued delayed test for the high-anxiety pleasantness-orienting group.

Insert Figure 3 about here

Each subject's protocol was scored twice, once with conceptual categories defining clusters, and once with alphabetic categories defining clusters, computing the ARC score as before in each case. The results of the conceptual classification are shown in Figure 4, and the alphabetic classification is shown in Figure 5.

Insert Figures 4 & 5 about here

The conceptual classification indicated that high-anxiety subjects clustered slightly less than low-anxiety subjects on Trials 1-5 [F (1,114) = 3.54, p < .06], but anxiety did not interact with either trials or orienting task [Fs < 1.81]. The main effect of orienting task was not significant [F (2,114) = 1.16], though the letters condition was worse than the control which was worse than the pleasantness task, as has been previously found. Conceptual clustering on the uncued delayed trial revealed a significant anxiety effect [F (1,114) = 7.08, p < .009], but no orienting main effect or interaction with anxiety [Fs < 1].

The results for the alphabetic classification may be summarized very briefly: no effects were significant for either Trials 1-5 or on the delayed test [Fs < 1.22].

Inspection of the recall protocols revealed that what little alphabetic clustering occurred seemed to occur at specific points, namely whenever there was a transition from one conceptual category to another. Thus subjects seemed to be using alphabetic clustering to bridge the "gaps" between other units of organization, with the last word of conceptual category _i_ beginning with the same first letter as the first word of conceptual category _i_+1. Thus we observed the total number of alphabetic clusters for a subject, and divided that into the number of alphabetic clusters which occurred at transition points. For purposes of defining the latter, a conceptual cluster had to both precede and follow the transition, else it is unclear whether any alphabetic cluster actually bridged other organizational units. The proportion of all alphabetic clusters which occurred adaptively at these transition points is shown in Figure 6.

Insert Figure 6 about here

While the data do not look that clean, high-anxiety subjects did use this higher-order strategy less often than low-anxiety subjects over Trials 1-5 [F (1,114) = 4.39, p < .04]. There was no orienting task main effect or interaction with anxiety [Fs < 1]. There were no significant effects on the delayed trial [Fs < 1].

The mean ARC score for conceptual clustering on Trials 1-5 was highly correlated with recall performance on Trials 1-5, r (118) = .57, p < .0001, on the uncued delayed recall test, r (118) = .45, p .0001, and the two cued delayed tests, rs (118) = .34 and .57, for the letters and labels cues, respectively. The mean ARC score for alphabetic clustering on Trials 1-5 was significantly negatively correlated with recall on Trials 1-5, r (118) = -.21, p < .03, but not with recall on the various delayed tests, rs (118) = -.05, .10, and -.10, respectively. The ratio of alphabetic clusters at transition points averaged over Trials 1-5 was also positively correlated with the uncued delayed test performance, r (118) = .42, p < .0001, and it also correlated with performance on Trials 1-5, r (118) = .50, p < .0001. All in all, it appears that the better organized recall was also greater in amount.

Discussion

The results of this experiment were not supportive of the idea that high-anxiety subjects would show a clustering deficit only on the deeper attributes, and not with regard to organization based upon the shallower dimension of first-letters. Of course, this particular definition of shallow may also be criticized, and while it is true that this definition fitted nicely with the use of the orienting procedure, it must be admitted that this basis for organization is also not particularly obvious when one considers the subject's task in identifying this basis. Still, the data on the use of alphabetic clusters to bridge transitions between conceptual clusters does suggest that it was discovered to some extent, and used by at least some subjects.

The results for the orienting tasks were disappointing, and in view of earlier findings using these tasks, further analysis and research seems indicated. It may be that our procedures were at fault, namely the rapid pacing of the orienting phase, and the interpolation of a further study trial before testing for recall. The latter factor, essentially giving the orienting subjects an extra study trial, may explain why the letters task did not lead to substantially worse recall and organization than the control group, but to accept that means that the failure of the pleasantness group to show greater facilitation is even more puzzling.

GENERAL DISCUSSION

Overall, the results of Experiments II and III provide additional demonstrations of the general deficit in organization of recall for high-anxiety subjects, for further definitions of anxiety and bases of organization. The free recall task indeed seems to have marked advantages for the study of this matter, particularly when organizational measurements are considered.

However, the differential-depth hypothesis was not supported by these data. Several interpretations seem possible, and for the moment these seem preferable to discarding the general idea. Our preferred interpretation is as follows. First, the locus of the deficit may be located somewhere at the deeper levels. This being the case, the deficit may involve the <u>peripheral</u> deep attributes, with high-anxiety subjects not processing beyond the very <u>core</u> meaning of the words, perseverating upon that. Additionally, our manipulations may have been ineffective in some way. For example, the manipulations may not have induced truly shallow processing as noted above, or perhaps our conceptualization of those dimensions as shallow is simply inappropriate. One possibility here may well be the method of presentation. Inspection of the literature (e.g., Schwartz, 1974b, 1974c) suggests that blocking of similar items at input does lead to results more consistent with the differential-depth hypothesis (and pigeon-holing/filtering). Perhaps blocking of instances, or simultaneous presentation of the list, within the other procedures we used, would be more productive, as that might avoid the extended processing subjects must go through to identify the acoustic or alphabetic dimension with random presentation.

Essentially then, rather than a general deficit for shallow and deep levels of encoding, our analysis based on the present results tends toward the assumption of an inflexible encoding at the deeper levels, processing restricted to the core meaning. We will put aside for the moment any conclusion about whether there is any deficit at the shallower levels, pending the development of techniques for better defining that notion in free recall with unblocked presentation sequences. Further research should allow us to better choose among these alternatives, and the use of orienting tasks with ambiguous lists seems especially fitted to those questions.

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FOOTNOTES

1. The author would like to gratefully acknowledge the diligent efforts of several people involved in the data collection for the experiments reported here: Trent Hall (Experiment I), Char Adkins and Ray Coffman (Experiment II), and Calvin Longhibler (Experiment III).

Table 1

Average Number of False Positives by Type of Semantic Relationship, Experimental (E) or Control (C) Word, and Manifest Anxiety Level in Experiment I.

	Anxiety Level			
	High	Medium	Low	All Subjects
Synonyms:				
E-words	0.69	0.75	0.56	0.67
C-words	0.19	0.31	0.19	0.23
Antonyms:				
E-words	0.19	0.38	0.13	0.23
C-words	0.19	0.25	0.25	0.23
Homonyms:				
E-words	1.44	0.63	1.19	1.09
C-words	0.07	0.13	0.31	0.17
Associates:				
E-words	0.38	0.50	0.31	0.40
C-words	0.19	0.19	0.06	0.15
All Types:				
E-words	2.70	2.26	2.19	2.39
C-words	0.64	0.88	0.81	0.78
(E - C)	2.06	1.38	1.38	1.61

Note: Maximum for the individual semantic types is 6; maximum for combined types is 24.

Table 2

Average Number of False Positives by Associative Strength, Experimental (E) and Control (C) Word, and Manifest Anxiety Level in Experiment I.

	Anxiety Level			
	High	Medium	Low	All Subjects
Strong:				
E-words	0.56	0.44	0.25	0.42
C-words	0.25	0.44	0.25	0.31
Intermediate:				
E-words	0.25	0.69	0.50	0.48
C-words	0.25	0.25	0.19	0.23
Weak:				
E-words	0.44	0.50	0.25	0.40
C-words	0.06	0.06	0.06	0.06
Combined:				
E-words	1.25	1.63	1.00	1.30
C-words	0.56	0.75	0.50	0.60
(E - C)	0.69	0.88	0.50	0.70

Note: Homonyms were excluded from this analysis.

FIGURE CAPTIONS

Figure 1. Average recall per trial by test anxiety level for each type of list in Experiment II.

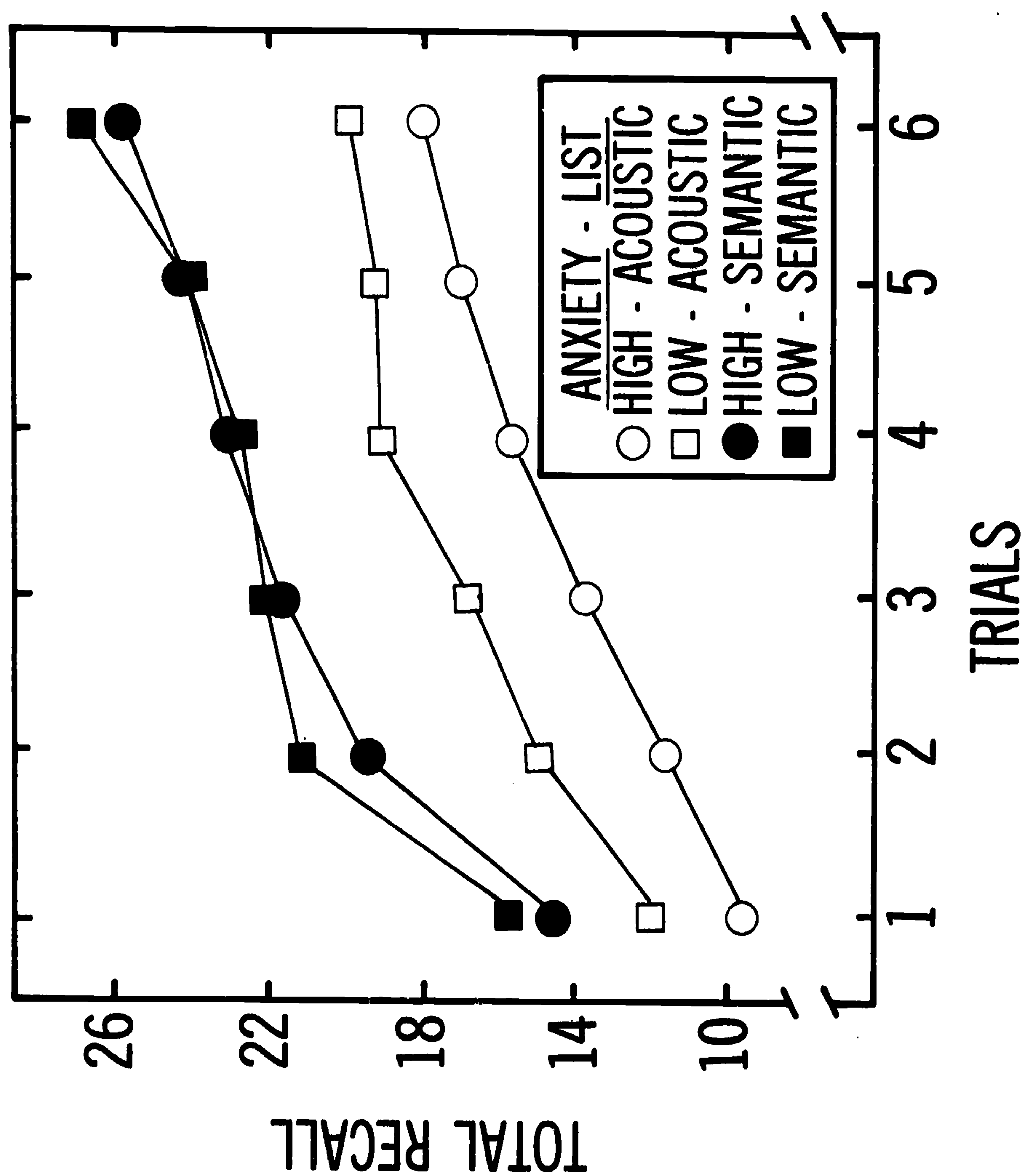
Figure 2. Average clustering score (adjusted ratio of clustering, ARC) per trial by test anxiety level for each type of list in Experiment II.

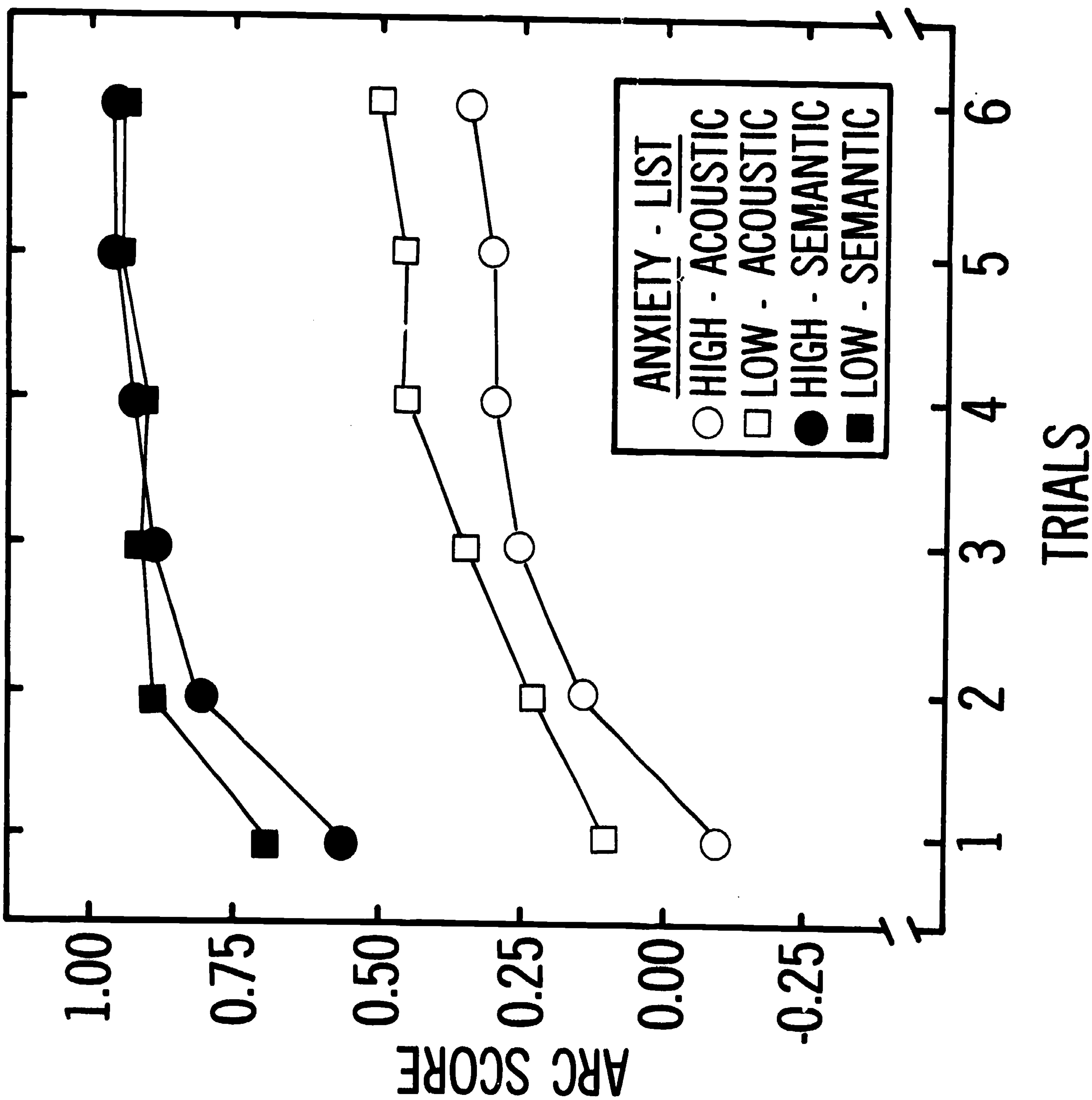
Figure 3. Average recall per trial in each phase of Experiment III, by test anxiety level and orienting task.

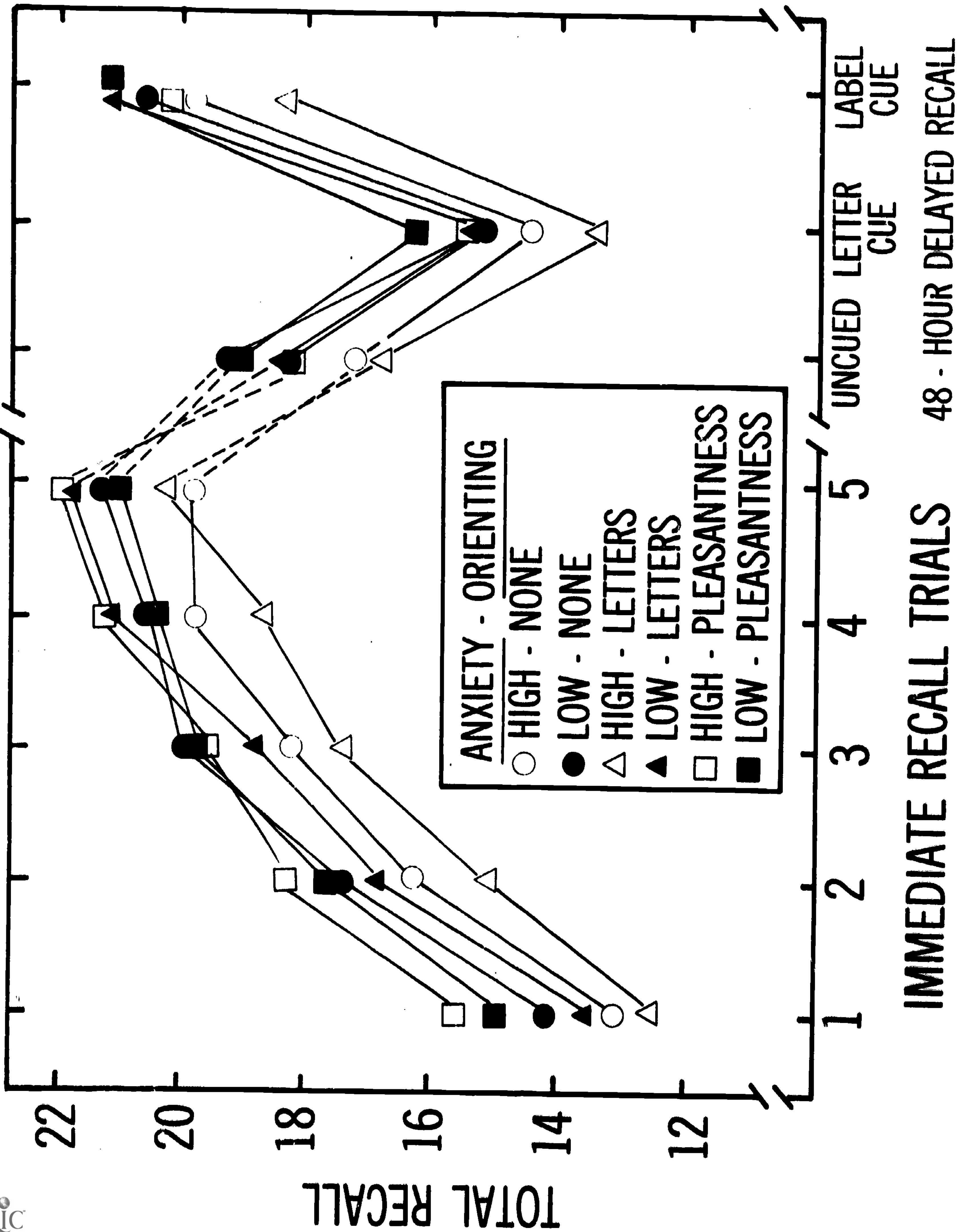
Figure 4. Average conceptual clustering score (ARC) for Trials 1-5 (immediate recall) and on the 48-hour uncued delayed test, by test anxiety level and orienting task.

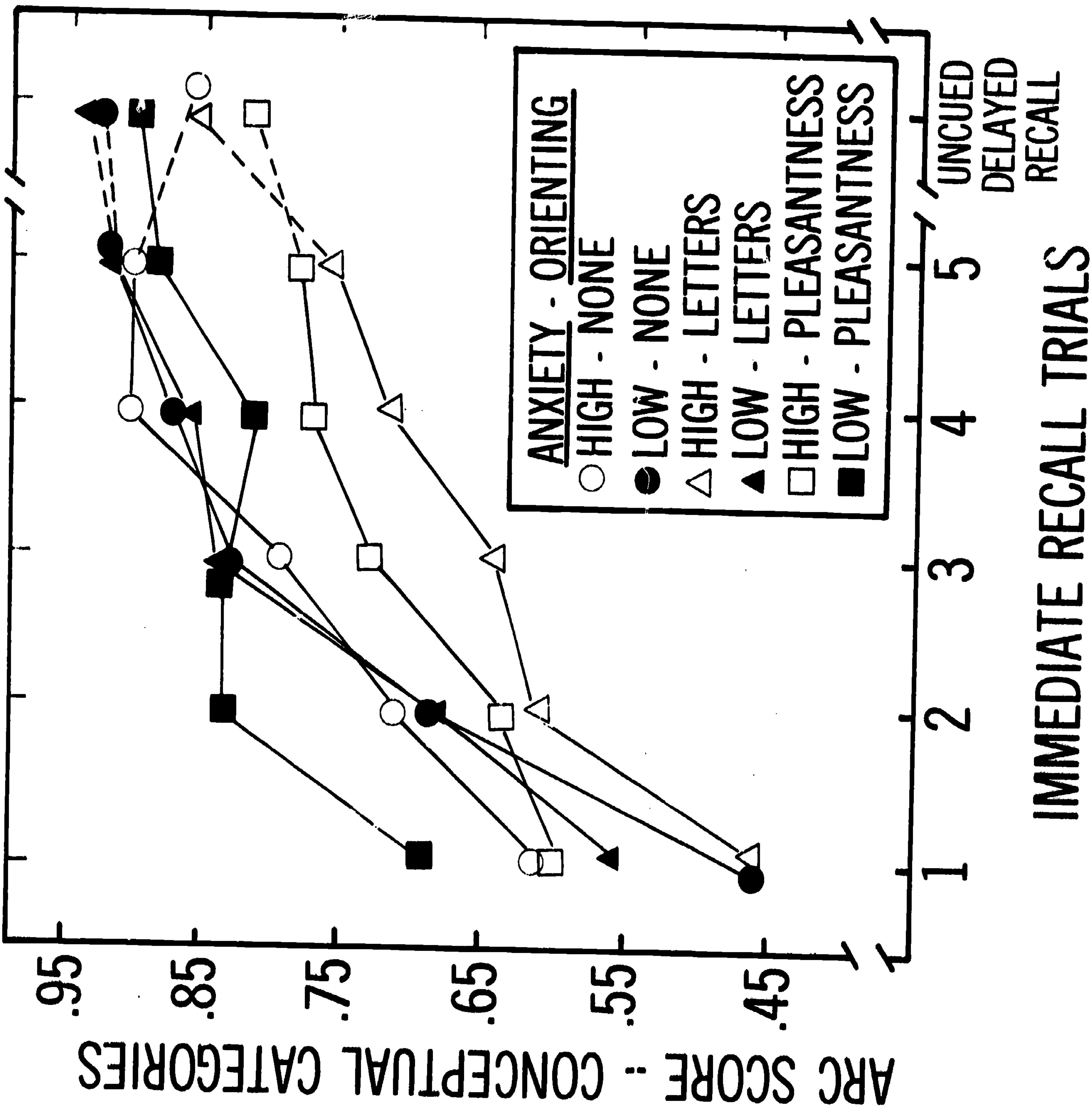
Figure 5. Average alphabetic clustering score (ARC) for Trials 1-5 (immediate recall) and on the 48-hour uncued delayed test, by test anxiety level and orienting task.

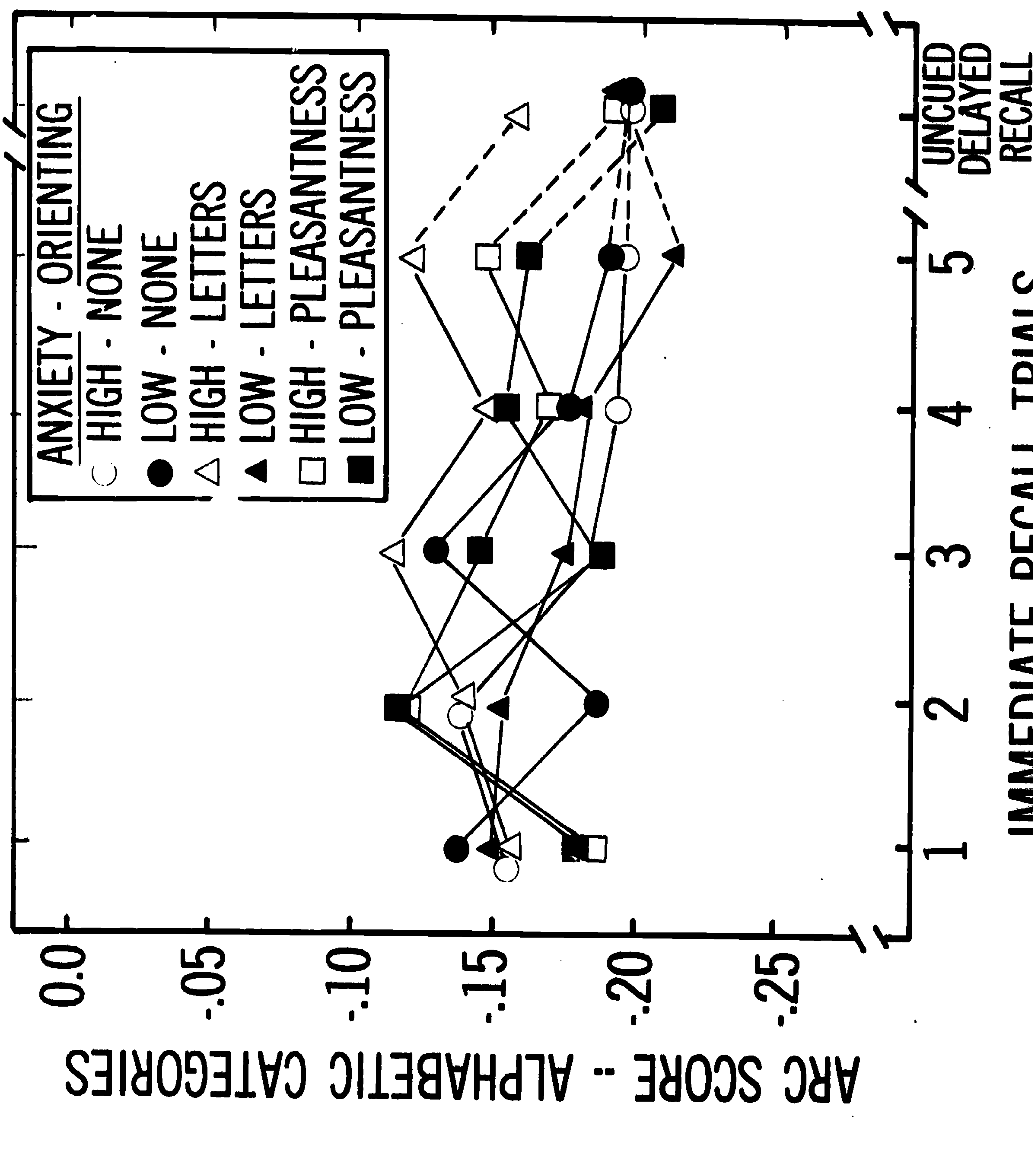
Figure 6. Proportion of all alphabetic clusters which occurred at transitions between conceptual clusters, for the five immediate tests and the uncued delayed test, by test anxiety level and orienting task.

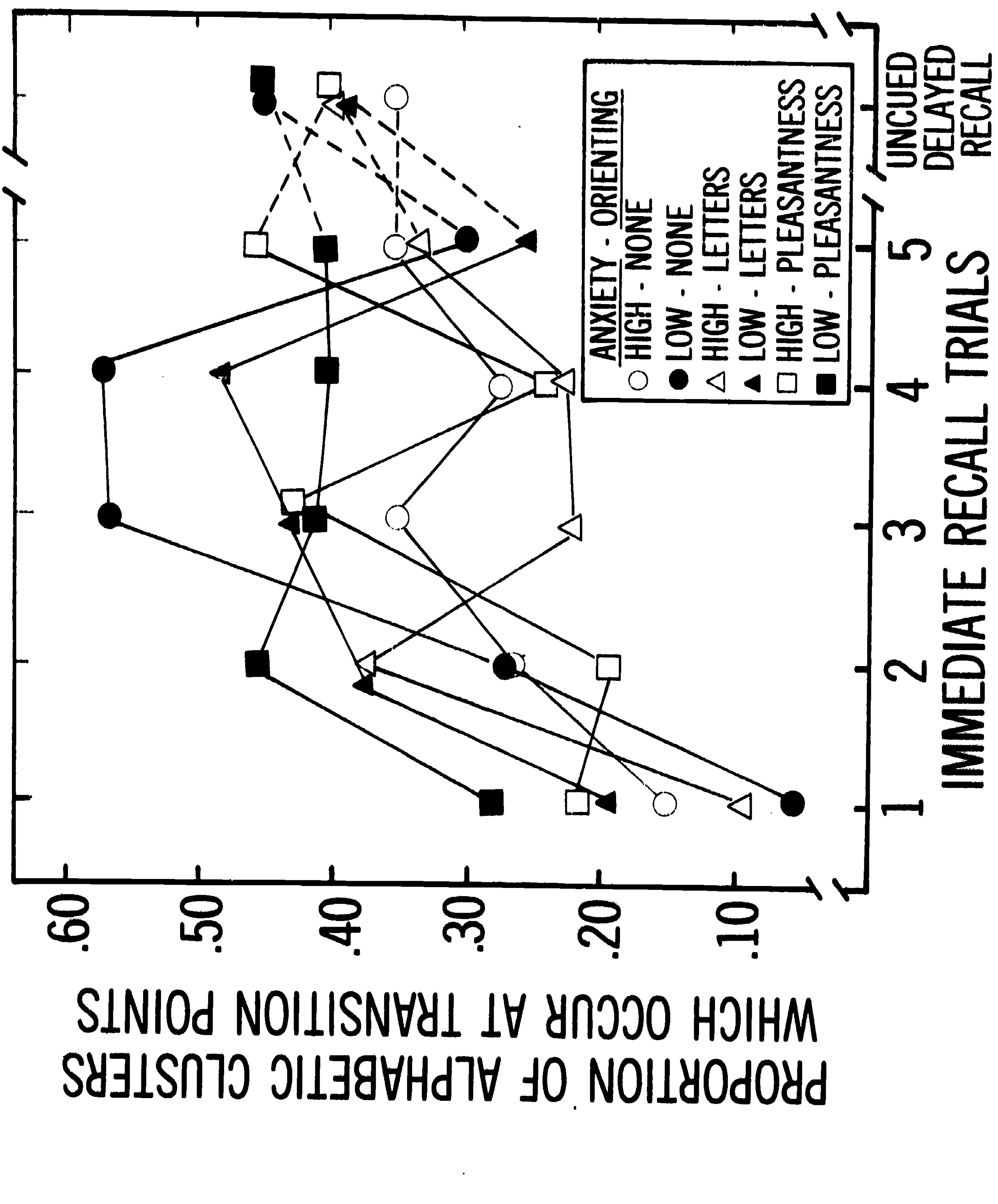

ANXIETY - LIST
HIGH - ACOUSTIC
LOW - ACOUSTIC
HIGH - SEMANTIC
LOW - SEMANTIC
TOTAL RECALL
26
22
18
14
10
TRIALS
1
2
3
4
5
6


ARC SCORE
1.00
0.75
0.50
0.25
0.00
-0.25
TRIALS
1
2
3
4
5
6
ANXIETY - LIST
HIGH - ACOUSTIC
LOW - ACOUSTIC
HIGH - SEMANTIC
LOW - SEMANTIC


TOTAL RECALL
22
20
18
16
14
12
1
2
3
4
5
IMMEDIATE RECALL TRIALS
UNCUED
LETTER CUE
LABEL CUE
48 - HOUR DELAYED RECALL
ANXIETY - ORIENTING
HIGH - NONE
LOW - NONE
HIGH - LETTERS
LOW - LETTERS
HIGH - PLEASANTNESS
LOW - PLEASANTNESS


ARC SCORE -- CONCEPTUAL CATEGORIES
.95
.85
.75
.65
.55
.45
IMMEDIATE RECALL TRIALS
1
2
3
4
5
UNCUED DELAYED RECALL
ANXIETY - ORIENTING
HIGH - NONE
LOW - NONE
HIGH - LETTERS
LOW - LETTERS
HIGH - PLEASANTNESS
LOW - PLEASANTNESS


ANXIETY - ORIENTING
HIGH - NONE
LOW - NONE
HIGH - LETTERS
LOW - LETTERS
HIGH - PLEASANTNESS
LOW - PLEASANTNESS
0.0
-.05
-.10
-.15
-.20
-.25
ARC SCORE -- ALPHABETIC CATEGORIES
1
2
3
4
5
UNCUED DELAYED RECALL
IMMEDIATE RECALL TRIALS


PROPORTION OF ALPHABETIC CLUSTERS WHICH OCCUR AT TRANSITION POINTS
.60
.50
.40
.30
.20
.10
1
2
3
4
5
IMMEDIATE RECALL TRIALS
UNCUED DELAYED RECALL
ANXIETY - ORIENTING
HIGH - NONE
LOW - NONE
HIGH - LETTERS
LOW - LETTERS
HIGH - PLEASANTNESS
LOW - PLEASANTNESS