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ABSTRACT

The effects of arousal on literal and inferential comprehension of text over short- and long-term retention intervals were studied using 369 elementary school children. Putative arousal manipulations were of two types: expectation and deviations from expectation as established by an advance organizer followed by text that for different experimental conditions varied in structure, and insertion of words varying in arousal value. It was found that expectancy had no significant effect on literal and inferential comprehension at either retention interval. There was also no significant effect of the advance organizer itself. Word arousal (positive affect) significantly aided long-term literal comprehension, in line with previous work, while long-term inferential comprehension was significantly facilitated by negative affect. (Author)

Technical Report No. 265

CHILDREN'S LEARNING FROM DISCOURSE: ADVANCE ORGANIZER, TEXT SEQUENCE, AND AROUSAL EFFECTS ON LITERAL AND INFERENTIAL COMPREHENSION

by

Frank H. Farley

Report from the Project on Motivation and
Individual Differences in Learning and Retention

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Statement of Focus

Individually Guided Education (IGE) is a new comprehensive system of elementary education. The following components of the IGE system are in varying stages of development and implementation: a new organization for instruction and related administrative arrangements; a model of instructional programing for the individual student; and curriculum components in prereading, reading, mathematics, motivation, and environmental education. The development of other curriculum components, of a system for managing instruction by computer, and of instructional strategies is needed to complete the system. Continuing programmatic research is required to provide a sound knowledge base for the components under development and for improved second generation components. Finally, systematic implementation is essential so that the products will function properly in the IGE schools.

The Center plans and carries out the research, development, and implementation components of its IGE program in this sequence: (1) identify the needs and delimit the component problem area; (2) assess the possible constraints—financial resources and availability of staff; (3) formulate general plans and specific procedures for solving the problems; (4) secure and allocate human and material resources to carry out the plans; (5) provide for effective communication among personnel and efficient management of activities and resources; and (6) evaluate the effectiveness of each activity and its contribution to the total program and correct any difficulties through feedback mechanisms and appropriate management techniques.

A self-renewing system of elementary education is projected in each participating elementary school, i.e., one which is less dependent on external sources for direction and is more responsive to the needs of the children attending each particular school. In the IGE schools, Center-developed and other curriculum products compatible with the Center's instructional programing model will lead to higher student achievement and self-direction in learning and in conduct and also to higher morale and job satisfaction among educational personnel. Each developmental product makes its unique contribution to IGE as it is implemented in the schools. The various research components add to the knowledge of Center practitioners, developers, and theorists.

Acknowledgments

Appreciation is expressed to Mr. Joseph Schmuller and Mr. Thomas Fischbach for their help in this work, and to the principals, teachers, and students in Adams and Lincoln schools in Janesville, Wisconsin, for contributing so greatly to the study.

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Abstract

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I
Introduction

A considerable amount of evidence has accumulated indicating that physiological arousal is an important factor in verbal learning and memory (Farley, in press; Weiner, 1966). The bulk of this work has shown that arousal is differentially related to short- versus long-term retention, such that high arousal during learning leads to poor immediate retention but superior long-term retention relative to the effects of low arousal during learning (Farley, in press). Thus arousal seems to be differentially involved in the process of short- versus long-term memory.

Most of the studies successfully demonstrating this effect have been list-learning studies, particularly paired-associate (PA) acquisition, in which on-going physiological measurements have been taken. Physiological responses, e.g., changes in galvanic skin response (GSR) or blood volume, have been time-locked to the presentation of specific items in the task. Items have been identified as associated with high arousal (marked physiological response) or low arousal (little or no physiological response), and the differential retention of these items at an immediate versus a long-term test has then been assayed. In some studies arousal has been experimentally manipulated through such operations as the introduction of white auditory noise during learning (Haveman & Farley, 1969) or the semantic properties of stimuli, i.e., the arousal potential of words (Farley, 1969). These studies have been less successful in demonstrating the cross-over effect of arousal level and retention interval, but have generally tended to show facilitating effects of arousal on long-term retention with no effects on short-term retention.

In addition to studies either manipulating arousal or simply monitoring arousal changes during learning, a recent series of studies have attempted to treat arousal as an individual difference (ID) variable (Farley & Gilbert, 1970; Osborne & Farley, 1971). This approach has viewed arousal level in a learning situation as a characteristic quality of the person; that is, as a stable ID variable not unlike such "classic" ID variables as IQ. This notion of arousal, which has been labelled "intrinsic arousal," (Farley, Osborne & Severson, 1970) suggests the possibility of stratifying Ss as to their level of intrinsic arousal, and investigating their learning in short- and long-term retention paradigms.

Two list-learning studies have been reported using this approach (cf. Farley & Gilbert, 1970; Osborne & Farley, 1971) and both have demonstrated the significant cross-over interaction of intrinsic arousal and retention interval in the determination of recall performance. The intrinsic arousal measure used was salivary response to controlled lemon juice stimulation. This arousal measure is based on hypothesized differences in effector responsivity between Ss at different intrinsic arousal levels. It has been explicated by Farley, Osborne, and Severson (1970) who have also demonstrated its reliability and validity.

One problem in the above-cited research lies in the tasks used. Most of the experiments have focused on list learning. However, a learning problem of greater significance to education is children's learning and comprehension of text or prose. Given the powerful role of motivation as operationalized in arousal processes where verbal list learning is concerned, the likely role of such processes in reading and comprehension seems worthy of investigation. Clearly, any teacher will underscore the importance of attention and activity level in children's reading and resultant learning.

Recent extensions of the arousal and verbal learning research to children's reading and processing of prose have been undertaken (Farley & Eischens, 1971). On the hypothesis that adjunct questions inserted into text would have arousal-attention effects, the effects of such

questions on short- and long-term retention was studied. It was found that questions generally facilitated both short- and long-term retention. In addition, a text complexity by grade interaction was suggested. Subsequent research (Farley, in press; Farley & Schmuller, in press) has demonstrated strong effects of single-word arousal on learning from text, particularly long-term factual or literal comprehension.

One approach to studying arousal and attention effects on the processing of prose might be through the use of expectation and uncertainty manipulations. If a reader is led to expect certain things to occur in the text, certain information to be presented, and a certain organization and sequencing of text to take place, then it might be hypothesized that slight deviations from confirmation of this expectation would be arousing and would therefore facilitate long-term retention. Evidence that uncertainty or slight discrepancies from expectation are arousing has been reported by Berlyne (1960).

The present study attempted to manipulate certainty and expectation by using an advance organizer (Ausubel, 1968) which was followed, depending on the experimental condition, by a passage varying in the degree to which it seemed to follow from or agree with the advance organizer. In addition, both immediate and long-term retention tests were given. It was expected that slight discrepancies from expectation (as "set" by the advance organizer) would be optimally arousing, leading to more active memory processing and thus better learning than other experimental conditions. A further condition involving manipulation of the arousal value of the passages was included. That is, passages differed by the presence in a given passage of ten high positive-arousal words, ten high negative-arousal words, or ten low-arousal words. This manipulation was based on previous work (Farley, in press; Farley & Schmuller, in press), using the same passages, which has demonstrated significant effects on retention of such arousal variables. Thus the present design allowed for the study of the interaction and separate effects of the two methods of influencing arousal in text: word-produced arousal and structurally-produced arousal.

II
Method

Subjects

Three hundred and sixty-nine Grade 3, 4, 5, and 6 students participated in the study. All Ss were obtained from two predominantly white, middle-class elementary schools in a small Midwestern city of 40,000.

Materials

The prose passage used was the same as that employed by Farley (in press) and Farley and Schmuller (in press). It was 230 words (26 sentences) in length. Within the passage, every 21st word was an "arousal event," i.e., it varied as to arousal properties [high arousal positive, high arousal negative, and low arousal (neutral)]. There were ten such words or arousal events in the passage. The high- and low-arousal words were taken from the Di Vesta and Walls (1970) list in which fifth graders rated 487 words on a number of semantic dimensions. Dimensions of friendly-unfriendly, good-bad, and nice-awful scaled from 1 to 7 points were used in constructing the present lists. Words rated between 1.00 and 2.60 on two out of three dimensions were used as high-arousal (positive direction) words, words rated between 3.50 and 4.50 on two out of three dimensions were used as low-arousal (neutral) words, and words rated between 5.40 and 7.00 on two out of three dimensions were used as high-arousal (negative direction) words. Thus, high-arousal words were extreme in either the positive or negative direction on the continuum used, while the low arousal words were neutral on the continuum. The three word lists were equated with respect to such major verbal-learning variables as Thorndike-Lorge frequency, but had nonoverlapping distributions on the "arousal" dimension. In addition to the foregoing considerations, the passage with the ten high-arousal positive words, the passage with the ten high-arousal negative words, and the passage with the ten low-arousal words were equated by cloze procedure such that on a sample of children comparable to that of Di Vesta and Walls it was found that with every 21st word missing, the probability of guessing a high- or low-arousal word at each location was equal. Thus, within the context of the passage used, the probabilities of occurrence of the high- or low-arousal word at each location was equal. Thus, within the context of the passage used, the probabilities of occurrence of the high- or low-arousal words, by cloze technique, were equivalent. The low-arousal words were: slow, hunter, door, tobacco, habit, thirsty, nail, boss, esteem, backward. The high-arousal (positive) words were: gentle, priest, light, lamb, practice, strong, flower, head, approval, generous. The high-arousal (negative) words were: bad, robber, noise, slavery, crime, mean, lion, thief, jealousy, ignorant. The passage concerned a fictitious primitive tribe (the Wahoos) in a fictitious country (South Langu).

The advance organizer was 54 words in length and followed Ausubel's (1968) general requirements for the definition of an advance organizer.

Each of the three texts outlined above was varied in three ways in an attempt to render the organization of the text disparate from the expectation presumably established by the advance organizer. The basic text was reorganized in the following three ways: every eighth sentence (R_8) was randomly interchanged, every fourth sentence (R_4) was randomly interchanged, or all sentences were randomly interchanged (R complete [R_C]). Two versions of each randomization were prepared.

The comprehension test consisted of ten literal and ten inferential items in a four-choice multiple-choice format with the order of items randomized.

Procedure

A 2 x 3 x 4 design was used consisting of advance organizer vs. no-advance organizer, high-arousal positive vs. high-arousal negative vs. low arousal, and original passage vs. R_g vs. R_i vs. R_c. In addition, an immediate vs. long-term (one-week) retention test comparison was made (repeated measure) as well as a comparison on the retention test of literal vs. inferential comprehension.

The materials were presented in booklets. On the first administration, the booklets consisted of a cover page, followed by either a page containing the advance organizer or a page simply informing the S not to proceed further until told to do so, followed by a page containing the passage, followed by three pages containing the comprehension test items. Two minutes were allowed for reading the advance organizer (or control), five minutes for reading the passage, and eight minutes for completing the comprehension test. One week later, at the same time of day and in the same room as the first session, the Ss were again administered the comprehension test, with an eight-minute time limit.

Ss were randomly assigned to conditions within classrooms.

III
Results

The mean comprehension scores for the various groups for the two retention intervals are presented in Table 1.

The mean comprehension scores for the advance organizer and passage randomization conditions are presented in Table 2.

The mean comprehension scores for the advance organizer effect only are presented in Table 3.

The mean comprehension scores for the passage randomization effect only are presented in Table 4.

The mean comprehension scores for the advance organizer and word arousal conditions are presented in Table 5.

The mean comprehension scores for the word arousal and passage randomization conditions are presented in Table 6.

The mean comprehension scores for the word arousal variable only are presented in Table 7.

The data summarized in Tables 1-7 were subjected to analyses of variance. These results are summarized in Table 8.

It is clear from Table 8 that the only significant effects on comprehension are those due to word arousal. To determine where the significant arousal differences were, *t* tests were computed. The results of this analysis are summarized in Table 9.

From Table 9 and inspection of the relevant means in Table 7, it is clear that high arousal (both positive and negative) had a significant facilitatory effect on long-term literal comprehension relative to low arousal. However, only the high-arousal negative condition had a significant facilitatory effect on inferential processing.

TABLE 1
MEAN COMPREHENSION SCORES ON THE SHORT- AND LONG-TERM TESTS
IN THE VARIOUS EXPERIMENTAL CONDITIONS

Experimental Condition		Retention Interval and Comprehension Type			
		Short-term		Long-term	
Advance Organizer	N	Literal	Inferential	Literal	Inferential
High arousal positive, normal passage	14	7.255	5.084	6.790	4.882
High arousal positive, R_8	15	6.634	4.871	6.171	4.849
High arousal positive, R_4	16	6.924	4.532	6.676	4.437
High arousal positive, R_c	15	6.876	4.683	6.570	4.595
High arousal negative, normal passage	16	7.148	5.780	6.950	5.262
High arousal negative, R_8	13	6.527	5.568	6.331	5.228
High arousal negative, R_4	15	6.817	5.229	6.836	4.816
High arousal negative, R_c	15	6.769	5.380	6.730	4.974
Low arousal (neutral), normal passage	16	6.994	5.449	6.270	4.884
Low arousal (neutral), R_8	15	6.373	5.236	5.650	4.851
Low arousal (neutral), R_4	14	6.663	4.897	6.156	4.439
Low arousal (neutral), R_c	15	6.615	5.048	6.050	4.596
No Advance Organizer					
High arousal positive, normal passage	16	7.196	5.304	7.073	4.906
High arousal positive, R_8	17	6.575	5.091	6.453	4.873
High arousal positive, R_4	16	6.865	4.753	6.959	4.461
High arousal positive, R_c	15	6.817	4.903	6.853	4.619
High arousal negative, normal passage	18	7.072	5.792	6.492	5.460
High arousal negative, R_8	13	6.451	5.579	5.872	5.426
High arousal negative, R_4	19	6.741	5.241	6.378	5.014
High arousal negative, R_c	17	6.693	5.391	6.272	5.172
Low arousal (neutral), normal passage	14	6.982	5.076	6.243	5.110
Low arousal (neutral), R_8	15	6.361	4.863	5.623	5.077
Low arousal (neutral), R_4	15	6.652	4.525	6.129	4.665
Low arousal (neutral), R_c	15	6.604	4.675	6.022	4.822

TABLE 2
MEAN COMPREHENSION SCORES ON THE SHORT- AND LONG-TERM TESTS
FOR THE ADVANCE ORGANIZER AND PASSAGE RANDOMIZATION CONDITIONS ONLY

Experimental Condition	N	Retention Interval and Comprehension Type			
		Short-term		Long-term	
		Literal	Inferential	Literal	Inferential
Advance organizer, normal passage	46	7.132	5.438	6.670	5.009
Advance organizer, R_8	43	6.511	5.225	6.051	4.976
Advance organizer, R_4	45	6.801	4.886	6.556	4.564
Advance organizer, R_c	45	6.754	5.037	6.450	4.722
No advance organizer, normal passage	48	7.083	5.390	6.602	5.159
No advance organizer, R_8	45	6.462	5.178	5.983	5.125
No advance organizer, R_4	50	6.752	4.839	6.488	4.713
No advance organizer, R_c	47	6.705	4.990	6.382	4.871

TABLE 3
MEAN COMPREHENSION SCORES ON THE SHORT- AND LONG-TERM TESTS
FOR THE ADVANCE ORGANIZER VARIABLE ONLY

Experimental Condition	N	Retention Interval and Comprehension Type			
		Short-term		Long-term	
		Literal	Inferential	Literal	Inferential
Advance organizer	179	6.780	5.146	6.432	4.818
No advance organizer	190	6.751	5.099	6.364	4.967

TABLE 4
MEAN COMPREHENSION SCORES ON THE SHORT- AND LONG-TERM TESTS
FOR THE PASSAGE RANDOMIZATION VARIABLE ONLY

Experimental Condition	N	Retention Interval and Comprehension Type			
		Short-term		Long-term	
		Literal	Inferential	Literal	Inferential
Normal passage	94	7.108	5.414	6.636	5.084
R_8	88	6.487	5.201	6.017	5.051
R_4	95	6.777	4.863	6.522	4.639
R_c	92	6.729	5.014	6.416	4.796

TABLE 5
MEAN COMPREHENSION SCORES ON THE SHORT- AND LONG-TERM TESTS
FOR THE ADVANCE ORGANIZER AND WORD AROUSAL CONDITIONS ONLY

Experimental Condition	N	Retention Interval and Comprehension Type			
		Short-term		Long-term	
		Literal	Inferential	Literal	Inferential
Advance organizer, high arousal positive	60	6.922	4.793	6.552	4.591
Advance organizer, high arousal negative	59	6.815	5.489	6.712	5.070
Advance organizer, low arousal (neutral)	60	6.661	5.158	6.031	4.693
No advance organizer, high arousal positive	64	6.863	5.013	6.834	4.715
No advance organizer, high arousal negative	67	6.739	5.501	6.254	5.268
No advance organizer, low arousal (neutral)	59	6.650	4.785	6.004	4.919

TABLE 6
MEAN COMPREHENSION SCORES ON THE SHORT- AND LONG-TERM TESTS
FOR THE WORD AROUSAL AND PASSAGE RANDOMIZATION CONDITIONS ONLY

Experimental Condition	N	Retention Interval and Comprehension Type			
		Short-term		Long-term	
		Literal	Inferential	Literal	Inferential
High arousal positive, normal passage	30	7.225	5.194	6.932	4.894
High arousal positive, R_8	32	6.604	4.981	6.312	4.861
High arousal positive, R_4	32	6.894	4.643	6.818	4.449
High arousal positive, R_c	30	6.847	4.793	6.712	4.607
High arousal negative, normal passage	34	7.110	5.786	6.721	5.361
High arousal negative, R_8	26	6.489	5.573	6.102	5.327
High arousal negative, R_4	34	6.779	5.235	6.607	4.915
High arousal negative, R_c	32	6.731	5.386	6.501	5.073
Low arousal (neutral), normal passage	30	6.988	5.262	6.256	4.997
Low arousal (neutral), R_8	30	6.367	5.049	5.637	4.964
Low arousal (neutral), R_4	29	6.657	4.711	6.142	4.552
Low arousal (neutral), R_c	30	6.609	4.862	6.036	4.709

TABLE 7
MEAN COMPREHENSION SCORES ON THE SHORT- AND LONG-TERM TESTS
FOR THE WORD AROUSAL VARIABLE ONLY

Experimental Condition	N	Retention Interval and Comprehension Type			
		Short-term		Long-term	
		Literal	Inferential	Literal	Inferential
High arousal positive	124	6.893	4.903	6.693	4.703
High arousal negative	126	6.777	5.495	6.483	5.169
Low arousal (neutral)	119	6.655	4.971	6.018	4.806

TABLE 8
SUMMARY OF ANALYSIS OF VARIANCE OF COMPREHENSION SCORES
ON THE SHORT- AND LONG-TERM TESTS

Source	df	p for multivariate F	p for univariate F	
			Literal	Inferential
Short-term Test[a]				
Advance organizer	2,344	.953		
Passage organization	6,688	.102		
Arousal (linear & quadratic)	4,688	<u>.024</u>	.568	<u>.015</u>
linear	2,344	<u>.008</u>	.598	<u>.008</u>
quadratic	2,344	.434	.353	.239
Organizer x organization	6,688	.721		
Organizer x arousal	4,688	.692		
Organization x arousal	12,688	.429		
Organizer x organization x arousal	12,688	.489		
Long-term Test[a]				
Advance organizer	2,344	.524		
Passage organization	6,688	.047	.126	.291
Arousal	4,688	<u>.002</u>	<u>.014</u>	.089
linear	2,344	<u>.013</u>	.331	<u>.037</u>
quadratic	2,344	<u>.018</u>	<u>.006</u>	.570
Organizer x organization	6,688	.175		
Organizer x arousal	4,688	.393		
Organization x arousal	12,688	.503		
Organizer x organization x arousal	12,688	.699		

[a]Significant p values are underlined.

TABLE 9
SUMMARY OF t TEST COMPARISONS BETWEEN WORD AROUSAL GROUPS
WHERE SIGNIFICANT EFFECTS ON COMPREHENSION WERE OBTAINED

Comprehension Type and Retention Interval	Arousal Comparisons		
	High Positive vs. High Negative	High Positive vs. Low	High Negative vs. Low
Literal long-term	-0.905	-2.872***	1.987*
Inferential short-term	2.691*	0.304	2.350**
Inferential long-term	2.080*	0.454	1.606

* = p < .05.
** = p < .02.
*** = p < .001.

IV
Discussion

The present results are clearly negative where the putative manipulations of expectancy and set are concerned. Not only did these manipulations have no significant effect on comprehension, but neither the main effect of the advance organizer nor the text-scrambling effect was significant. The latter finding is not too surprising in light of the large number of studies, primarily from a programmed learning orientation, that have failed to demonstrate scrambling effects. The advance organizer, however, should have facilitated learning. At least two reasons for this lack of effect may be offered. First, it is possible that the basic principles of tribal life, etc., as presented in the advance organizer were already known to most of the children, thus attenuating any facilitating effects of the organizer. However, this seems unlikely, at least for the younger children (Grades 3 and 4), on the basis of questioning of teachers by the experimenter. It might be hypothesized that advance organizer effects with such material as used in this study would interact with grade level, being more effective in earlier than later grades. Another possible reason for the lack of a significant advance organizer effect may lie in the length of passage and amount of information presented. Although somewhat related to the other possibility discussed above, this suggestion would hold that organizer effects increase either gradually or in a quantum fashion with increased length and complexity of the ensuing passage (or perhaps density in Rothkopf's [1972] terminology). The present passage may have been too short, may have been too simple, and so on. An alternative interpretation to both of the above considerations where the lack of an advance organizer effect is concerned is simply that perhaps advance organizers do not aid children's learning. Relevant to this point is the fact that most research on advance organizers has used college or high school students as Ss. This is one of the first large-scale studies using elementary school children.

Where the lack of expectancy-uncertainty-set effects is concerned, one explanation may be that the basic logical structure of the text was not systematically developed or otherwise sufficient. That is, it is possible that with a narrative passage such as used here, with no explicitly logical structure, no uncertainty effects of organization would be obtained. This is possibly reinforced by the lack of organizational effects even on inferential processing, which required the relating of different parts of the text. We are currently undertaking, with Charles Clark, the extension of this study to include a more logical and systematic structure to discourse, as well as the measurement of individual differences in intrinsic arousal (Farley, Osborne, & Severson, 1970).

The long-term facilitating effects of high (word) arousal on literal comprehension is in line with previous findings (Farley, in press). This previous work found no long-term facilitating effects on inferential comprehension as indicated here, but included only high-arousal positive and low-arousal conditions. When these two conditions are compared in the present data, a similar lack of effect on inferential comprehension is observed. Thus, it would seem that the facilitating effects of arousal on inferential processing are restricted to high-arousal negative words as used here. The direction of high-arousal connotation clearly bears further investigation.

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