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ABSTRACT

The present investigation studied the effectiveness of implicit analogies as advance organizers in children's learning. It was hypothesized that analogies which were structurally isomorphic to the target concept would facilitate learning of the latter even though linkages between components of the two concepts were not overtly specified. Ninety-six sixth graders from a rural Wisconsin Middle School served as subjects. Subjects in the experimental condition initially read an advance organizer describing an occupational hierarchy which was structurally isomorphic to the ecological hierarchy described in the experimental passage. One control condition received an irrelevant advance organizer containing significant terms from the job description embedded in a story. The second control condition received no advance organizer. Results of the study showed no significant effects of the advance organizer. Interpretation remains unclear, however, since a number of confounding factors may have been involved and several alternative explanations are plausible. (Author)

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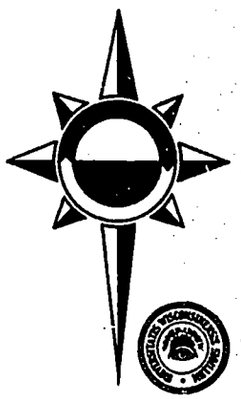

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HYPOSTATIZATION OF SELECTED ENVIRONMENTAL CONCEPTS IN ELEMENTARY SCHOOL CHILDREN

Report from the Project on Variables and Processes in Cognitive Learning

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STATEMENT OF FOCUS

The Wisconsin Research and Development Center for Cognitive Learning focuses on contributing to a better understanding of cognitive learning by children and youth and to the improvement of related educational practices. The strategy for research and development is comprehensive. It includes basic research to generate new knowledge about the conditions and processes of learning and about the processes of instruction, and the subsequent development of research-based instructional materials, many of which are designed for use by teachers and others for use by students. These materials are tested and refined in school settings. Throughout these operations behavioral scientists, curriculum experts, academic scholars, and school people interact, insuring that the results of Center activities are based soundly on knowledge of subject matter and cognitive learning and that they are applied to the improvement of educational practice.

This Technical Report is from the Project on Variables and Processes in Cognitive Learning in Program 1, Conditions and Processes of Learning. General objectives of the Program are to generate knowledge and develop general taxonomies, models, or theories of cognitive learning, and to utilize the knowledge in the development of curriculum materials and procedures. Contributing to these Program objectives, this project has these objectives: to ascertain the important variables in cognitive learning and to apply relevant knowledge to the development of instructional materials and to the programming of instruction for individual students; to clarify the basic processes and abilities involved in concept learning; and to develop a system of individually guided motivation for use in the elementary school.

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ABSTRACT

The present investigation studied the effectiveness of implicit analogies as advance organizers in children's learning. It was hypothesized that analogies which were structurally isomorphic to the target concept would facilitate learning of the latter even though linkages between components of the two concepts were not overtly specified.

Ninty-six sixth graders from a rural Wisconsin Middle School served as subjects. S's were randomly assigned to one of three treatment conditions. Subjects in the experimental condition initially read an advance organizer describing an occupational hierarchy which was structurally isomorphic to the ecological hierarchy described in the experimental passage. One control condition received an irrelevant advance organizer containing significant terms from the job description embedded in a story. The second control condition received no advance organizer.

Four measures of learning were employed: Two productive recall tasks, a free association task and a similarity rating scale. Productive recall data were analyzed by a multivariate analysis of variance. Free association scores and similarity ratings were each analyzed univariately.

Results of the study showed no significant effects of the advance organizer. Interpretation remains unclear, however, since a number of confounding factors may have been involved and several alternative explanations are plausible.

INTRODUCTION

The translation of abstractions into concrete entities, a cognitive process termed "hypostatization" (Davidson, 1970, 1971), appears in much of man's normal linguistic behavior through such techniques as metaphor or analogy. For example, an intellectual becomes an "egghead" whose domain is the "ivory tower"; time is represented as an old man with a long grey beard; foolishness is likened to "monkey business".

Without doubt man's most creative representatives have used hypostatization to enrich the human storehouse of understanding in science, poetry, literature, art and other areas of creative endeavor. Electromagnetic waves were conceived by Faraday as expanding and contracting rubber bands; Kekule represented the benzene ring as a snake swallowing its tail; and white corpuscles become an army of soldiers engaged in defense of the body against viral infection. Physical and mechanical models likewise represent abstract theoretical structures and relations. A particularly intriguing example is the modern computer which was developed as an analogue to the human brain in an effort to simulate and in some respects improve on human cognitive operations. The information processing, storage and retrieval capabilities of computers have reached such proportions, however, that one school of social scientists has come full circle and now investigates cognitive operations from the theoretical framework of computer technology.

Empirical investigation of the functional significance of hypostatization though scant nontheless points to the potency of this construct

in human linguistic functioning. On a literary level alone, hypostatization predominates in the expression of truths, of beauty, of relationships for which the poet is most admired. In a recent similes analysis (Davidson, 1970), for example, 100 nouns randomly selected from a similes dictionary and classified as either concrete (i.e. tangible) or abstract (intangible) were evaluated according to the kinds of comparisons in which they appeared. Eighty-eight percent of the similes containing concrete nouns were comprised of concrete-concrete relations in which one object is compared to another (e.g. "Her eyes are like stars"). For abstract nouns, however, eighty-seven percent of comparisons were hypostatizations in which the abstract term was related to something concrete (e.g. "My love is like a red, red rose"). It thus appears obvious that the hypostatization process is an important one.

A subsequent experimental study conducted within a paired associate paradigm (Davidson, 1971) investigated learning and retention of "experimental metaphors" consisting of subject and object nouns classified by the experimenter as human, concrete or abstract. All nouns were embedded pair-wise in sentences which were syntactically correct but some of which violated the selectional restriction rules of English (e.g., "Giggling freedom terrifies bashful courage"). In that experiment, the hypostatization condition for abstract words (e.g. "green ideas drink heavy dreams") outperformed the literally modified abstract condition (e.g. "abiding faith justifies complete determination"). That is to say, subjects learned hypostatized abstract nouns in rules violation sentences better than

nonhypostatized abstract nouns in semantically appropriate English sentences. Results of the study have since been replicated (Davidson, 1971) and thus strongly point to the efficacy of hypostatization as a learning device.

A related line of investigation explored the interrelationships between concreteness-abstractness and imagery in the semantic content of nouns (Davidson, 1971). Using a seven-point semantic differential, University of Wisconsin students rated single words and metaphors on imagery (ease with which a stimulus term arouses sensory images) and concreteness (how directly a word relates to a physical object or experience). Stimulus items consisted of twenty abstract nouns (e.g., "business"), twenty concrete nouns ("thumb"), twenty metaphors composed of the abstract nouns and a modifier ("monkey business"), and twenty metaphors composed of the concrete nouns plus a modifier ("green thumb"). Each of the metaphors constituted an English cliché (i.e., a commonly used expression) which would presumably be familiar to adult speakers of English. Clichés were selected which, in the estimation of the experimenters, would be either more concrete (modified abstract nouns) or more abstract (modified concrete nouns) than the same nouns without modification. As predicted, concrete nouns surpassed abstract nouns on both imagery and concreteness measures. Modified concrete nouns were rated lower on imagery than single concrete nouns but received higher imagery ratings than either single or modified abstract nouns. At the same time, the hypostatized group (modified abstract nouns) evoked higher imagery ratings than did abstract nouns alone. On the concreteness-abstractness dimension, predictions were upheld for concrete nouns and

phrases in that modified concrete nouns were clearly less concrete (more abstract) than single concrete nouns. However, hypostatized nouns (modified abstract nouns) failed to elicit higher concreteness ratings than did abstract nouns presented alone. While reasons underlying the failure to obtain expected results along this dimension remain unclear, it seems likely that some modifiers did not in actuality represent terms for which clear sensory referents were available. A second possibility is that subjects responded to some phrases literally rather than metaphorically, in which case responses should not have followed the predictions.

A third variation of the metaphorical studies employing printed textual materials likewise supports the notion that hypostatization represents an important cognitive process (Davidson, 1971). College-age subjects read the difficult "mat-maker" passage from Melville's Moby Dick in which the interworkings of fate, chance and necessity are compared to the operation of a sword-mat loom. Subjects in the hypostatization condition first read a pictorially illustrated explication of the loom's physical structure and operation. Other subjects read an irrelevant but structurally equivalent passage containing a diagram and description of a portable power and resistor unit. Here again, the hypostatized group clearly outperformed the nonhypostatized group on word association and recall measures as well as in recognition of valid and invalid propositions contained in the mat-maker passage.

The Moby Dick study clearly illustrates the facilitating effect of hypostatization induced by a relevant advance organizer. Two components of the investigation appear particularly relevant: (1) the diagramatic

representation of a sword-mat loom's operation, and (2) the link-by-link expression of the comparison between chance, fate and necessity and the loom.

Because the vehicle of the mat-maker analogy (the loom) is concrete and the tenor* (life) abstract, the analogy itself constitutes a form of hypostatization. Yet subjects reading only that comparison showed poorer learning and retention scores than did those initially provided with a descriptive illustration of the sword-mat loom's structural and functional properties. Thus although abstractness-concreteness does appear a potent dimension of analogical meaning, concreteness per se apparently does not facilitate concept attainment when the vehicle object is unfamiliar to the learner.

Recent investigation of linguistic operations suggests that such differential facilitation may be due in part to the role of imagery in the mediation of word meaning. Results of a number of studies strongly support a dual-process approach to verbal meaning in which both verbal and nonverbal mediators operate in information processing, storage and retrieval (Paivio, 1969; Davidson, 1971; and Rohwer, 1970). According to this view imagery constitutes the most effective mediator of concrete terms since they relate directly to sensory experience which can be reproduced in imaginal form. Abstract words represent concepts which

*I. A. Richards (1936) originally coined the terms tenor which refers to the principal idea in an analogy and vehicle, the idea to which the tenor is compared.

have no direct sensory referents and hence are dependent to a greater extent on verbal mediation. Within this theoretical framework verbal and nonverbal processes are assumed to operate either concomitantly (Davidson, 1971) or independently but with a rapid interchange function (Paivio, 1969, 1970). If, as the evidence suggests, concrete items are more easily learned and retained, and if imagery constitutes the prepotent mediator of concrete words, then transformation of abstractions into concrete entities may enhance learning by facilitating the activation of imaginal mediators rather than verbal processes alone. In that case such "adjunct aids" (Frase, 1971) as pictures, diagrams or relevant verbal material may function as advance organizers, perhaps by arousing an image or series of images on which the individual can "hang" the more abstract properties of the concept during learning (cf. Paivio, 1969 for discussion of the conceptual peg hypothesis).

The degree of concreteness necessary for optimal facilitation from advance organizing material remains unclear. Some investigators such as Pella and Ziegler (1967) have concluded that elementary school children can learn classificatory (concrete) concepts without physical models but that such models are necessary for the acquisition of theoretical (abstract) concepts. Physical models, of course, permit the ikonic (Bruner, Olver, Greenfield, et al., 1966) or imaginal representation of the attributes of theoretical concepts. Other researchers, however, have found verbal analogies to constitute powerful aids in the acquisition

of complex theoretical concepts both among elementary school children (Gordon, 1971) and high school students (Rosenshine, 1968).

In a related line of investigation into structural properties of concept formation, Ausubel (1960, 1962, 1963) has found the advance presentation of relevant substantive material to facilitate incorporation and retention of meaningful verbal material. Here advance organizers are viewed as "relevant subsuming concepts" which facilitate acquisition and retention of related but unfamiliar material. According to Ausubel, advance organizers facilitate because they mobilize existing relevant concepts which enhance the integration of novel material into an already partially formed structure of a general substantive area (e.g. physics or American History). This approach, however, addresses itself only to the use of organizers which are themselves an integral part of the subject matter being taught. It fails to consider the possible facilitating effect of material which may be indirectly related but which exists outside the formal substantive boundaries.

The second component of interest in the Moby Dick study concerns the degree of specificity linking terms in the matmaker analogy itself. It has already been noted that the concrete-abstract relationship per se between a sword-mat loom and life apparently had no facilitating effect on learning. Where the vehicle of an analogy is already familiar to subjects, however, learning of the tenor is enhanced. Moreover, where both terms in an analogy are meaningful, each can be used to increase understanding of the other (Gordon, 1971).

It thus appears likely that some degree of meaningfulness or familiarity with at least one term in the analogy rather than specification of conceptual links per se is necessary for hypostatization to occur. A complete lack of familiarity would, of course, preclude the arousal of sensory images and hence the activation of imaginal mediators presumed to function in the hypostatization process. If, in addition, the mobilization of substantive structures is involved as Ausubel suggests, some degree of structural isomorphism between vehicle and tenor may be requisite for the establishment of conceptual links between two seemingly disparate ideas. In that case a critical question becomes whether knowledge of formal structural relations is sufficient to bridge the conceptual gap or whether analogical relations must be overtly specified.

The present study seeks to determine whether implicit, i.e., structurally isomorphic but unspecified, analogies will facilitate learning of complex relational concepts. More specifically, will a familiar relational concept which is structurally isomorphic with a second unfamiliar relational concept facilitate learning of the latter? Perleman (1969) has noted that rich analogies can be created with double hierarchies, as these are characterized by horizontal and vertical relations. Such hierarchical structures, according to Perlman, are normally directly or inversely proportional or at least express a term-to-term relation between two ideas and hence strengthen the individual's structure of reality for each of them. One hierarchically structured concept should thus enhance understanding of another.

In addition to structural implications for hypostatization it appears likely that abstract concepts which already possess meaning for the learner do so at least in part because they are associated with concrete examples and hence are partially subject to imaginal mediation. For this reason, hypostatization is thought possible even where both concepts under consideration are comprised of abstract componential features.

The present investigation in effect extends the Moby Dick study to the structural level. Of primary concern is whether isomorphism between an advance organizer and the experimental concept is sufficient to facilitate learning of the latter in the absence of overtly specified relations. Although the mat-maker analogy per se failed to enhance learning in the Davidson study, it is suggested that lack of familiarity with the vehicle may have been a confounding factor. As noted earlier, other studies utilizing analogies show decided facilitating effects.

Because of its social relevance, relational character and probable unfamiliarity to sixth grade children, the ecological concept of "niche" was selected for inclusion in the present research. Niche is defined as the function performed in an ecosystem of an organism, a population, or a group of mixed species which have the same role. The term as it is primarily used by ecologists thus stresses the function or role of each organism in the community rather than its physical place in the habitat (Darling and Milton, 1964). In this respect, a niche in the natural community is analogous to a job in the human community. Moreover, the niche is a subset of the ecosystem which in turn is subsumed under the

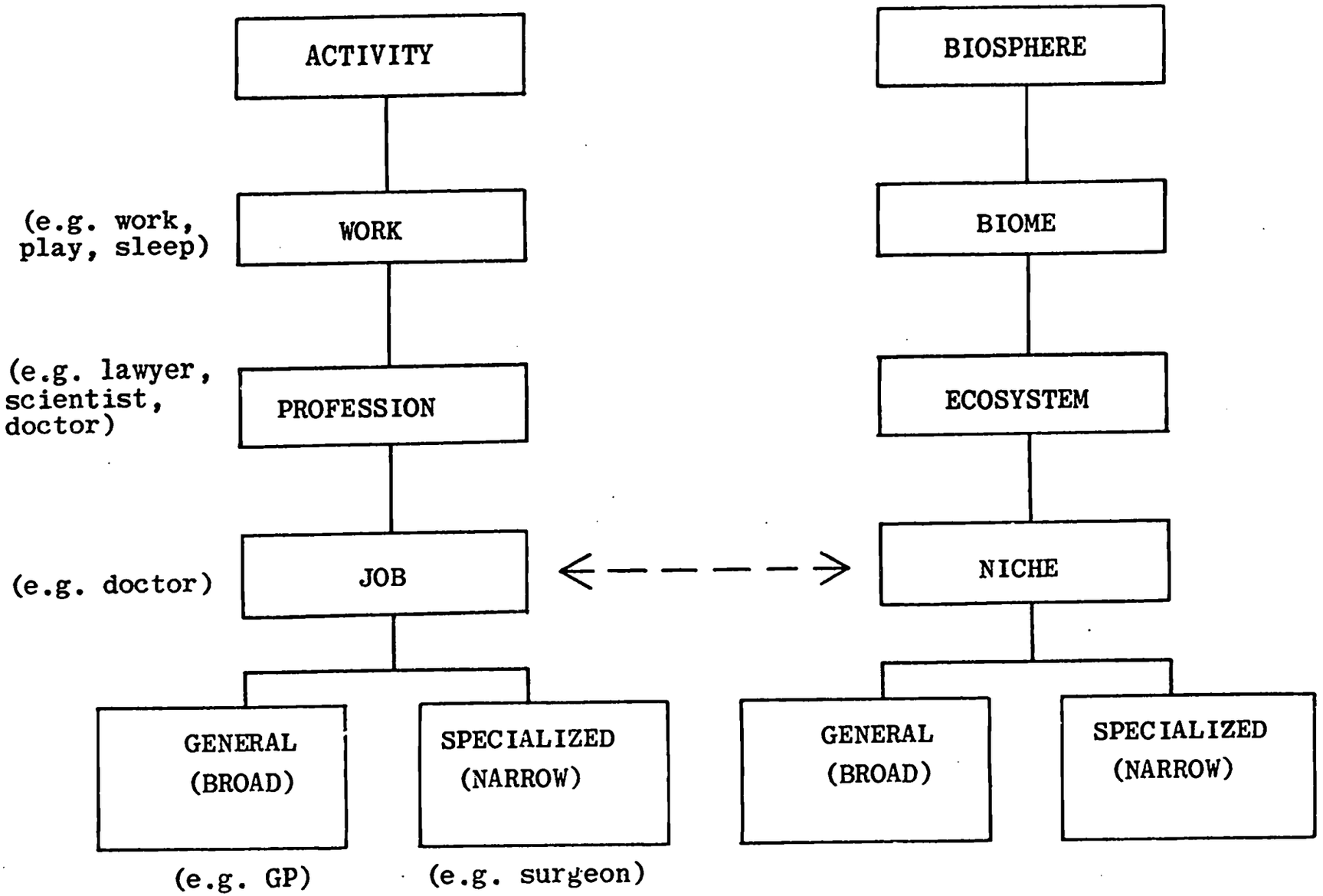

Figure 1. Structural Organization of the Ecological and Occupational Hierarchies

biome and finally the biosphere; a job constitutes a subset of the class "profession" which is further subsumed under "work" and "human activity." In addition to isomorphism along the subordinate-superordinate (vertical) dimension, "niche" and "job" share immediate structural characteristics. Both may be broad and general or narrow and specific. An organism's niche is further composed of its activities, its habitat and the other organisms with which it interacts. An individual's job consists of his activities, his place of work and his interaction with other people (see figure 1).

Selection of the concept of "job" as an advance organizer to facilitate learning of the ecological concept is further indicated by its probable familiarity to sixth grade children. Since children of this age have presumably been exposed to people in different occupations, they should be able to relate their concrete examples to the structural hierarchy presented in a paragraph and thus readily integrate it into their existing cognitive structures. It is hypothesized that concrete examples provided by both the paragraph and the child's previous experience will enable the abstract job hierarchy to function in much the same way as a totally concrete concept to facilitate learning.

METHODS

Subjects

Ninety-six sixth grade science students from the Kennedy Middle School in Germantown, Wisconsin, served as subjects. This sample comprised approximately 68% of sixth graders in the primarily rural school.

Procedures and Measures

Subjects were randomly assigned to one of three treatment groups: an experimental and two controls. Subjects in the experimental (hypostatization) condition or Job Group initially read a relevant advance organizer describing the job hierarchy presented above. One control condition, the Story Group, received an irrelevant advance organizer containing significant terms from the job description which were embedded in a story. That story bore no structural similarity to the hierarchy provided the hypostatized group. Both organizers contained approximately the same number of syllables and were judged to be of approximately comparable reading difficulty. A second control, the Blank Group, was given no advance organizer but received a blank page on which to doodle or draw while other subjects were reading.

The two advance organizers read as follows:

Relevant Advance Organizer: Job Description

> Human beings have many kinds of activity including eating, playing and working. The term "work" includes such large groups of jobs as unskilled, skilled and professional occupations. Each of these large groups contains smaller groups of jobs. "Professional Occupations," for instance, include lawyers, scientists and doctors.

Each individual profession has its own type of work to do: a doctor does not do a lawyer's job and a lawyer does not do a doctor's job. Within the doctor's profession, however, there are many specific jobs which are filled by different kinds of doctors. These individual jobs may be general such as that of the general practioner or specialized such as that of the brain surgeon. Each doctor's job includes what he does, where he does it and the other people (such as nurses, other doctors and patients) with whom he works.

Irrelevant Advance Organizer: Story

"What a crummy deal," grumbled Tony. Though the hospital bustled with activity, there was nothing for him to do but eat and play cards with the patient in the next bed. Tony considered himself skilled at poker, but Jim was totally unskilled so the game usually ended in boredom. Only his short daily discussions with the nurses and doctors who popped in and\out of his room kept Tony from "completely cracking up" as he called it. He was grateful that these busy people so often took time from their work to spend a few minutes with him. Although Tony had decided to become a scientist or lawyer, he still enjoyed learning about their profession from the general practioners and specialists who visited him as part of their jobs. Most of all, he realized these were people who cared that he get well and who knew how to help. That knowledge alone made the hospital seem less lonely.

This study was conducted as a group experiment. All subjects were tested during their regular science class in their usual room. All three groups performed identical tasks simultaneously except during presentation of the advance organizers which constituted the differential treatment under investigation.

Immediately following presentation of the organizers, the experimental paragraph, mounted on a 2" x 2" slide, was projected onto a screen at the front of the room. This paragraph defined subordinate-superordinate and horizontally parallel relationships within the ecological hierarchy.

To control for intersubject pronunciation and reading skills, the experimenter read the paragraph aloud while Ss read it silently. A 2 1/2 minute recall interval followed presentation of the slide, during which time Ss were instructed to write down verbatim as much of the paragraph as they could remember. The slide-recall sequence was then presented a second time following identical procedures (See Appendix A: Instructions to Subjects).

The experimental paragraph read as follows:

> All organisms live in a part of the biosphere. The biosphere contains a number of large areas known as biomes. Each biome includes many different ecosystems. The ecosystem includes individual niches which are filled by separate species. These niches may be broad and general or narrow and specialized. Each organism's niche includes its activities, its habitat and the other inhabitants of the ecosystem with whom it interacts.

Two additional measures involving a free association task and similarity ratings of critical word pairs in the ecological and occupational hierarchies were obtained for all subjects.

In the free association task, subjects were presented with 16 words at 45-second response intervals. Stimulus items consisted of critical components of the environmental and job hierarchies to which subjects had already been differentially exposed. It was hypothesized that subjects receiving prior relevant organizing information in the description of a job hierarchy would integrate the test passage into their existing cognitive structures more readily than would subjects

receiving irrelevant or no advance information. The hypostatization group should then yield a response distribution characterized by a greater occurrence of other stimulus items. The stimulus items included the following structurally significant terms from the ecological and job hierarchies arranged in two separate random orders: organism, biosphere, biome, ecosystem, niche, species, habitat, general, specialized, interaction, activity, work, profession, job, doctor, surgeon. Stimulus items were presented one to a page followed by a response blank with each word occuring 15 times on the page (See Appendix B: Instructions to Subjects and stimulus materials).

Similarity ratings along a seven-point scale were obtained for pairs of words existing in various vertical and horizontal relationships within the ecological and occupational hierarchies. Because of time limitations not all permutations of word pairs in the matrix could be rated. The thirteen word pairs retained thus represent those relationships judged most crucial to the hierarchical structures . These stimulus items included terms representing vertically adjacent relationships (biosphere-biome, activity-work, specialist-surgeon, niche-specialist), horizontally adjacent relationships (ecosystem-profession, niche-job, biosphere-activity, biome-work), vertically distant relationships (activity-surgeon, biome-niche, work-job, job-surgeon) and a horizontally distant relationship (biosphere-specialist). See Appendix C: Instructions to Subjects and stimulus materials.

Scoring

Productive Recall Data

Productive recall data obtained from the first part of the experiment were subjected to two scoring procedures. First the number of critical words recalled was tabulated for each subject. Critical words were defined as those substantive terms necessary to the structure of the concept and included the following 10 items: biosphere, biome, ecosystem, niche, general, specialized, organism, species, habitat and interaction. An individual score assigned each subject was composed of the number of critical words recalled from the paragraph. Spelling was not considered in the tabulation so long as words were recognizable.

The measure described above provides a useful index of a youngster's componential understanding of a complex concept. At this level, however, the analysis constitutes no more than a laundry list of separate elements included in the concept. To investigate children's comprehension of relational components, the number of correctly recalled subordinate-superordinate and parallel relations in the paragraph was also ascertained. Such functional words or phrases as "contains," "includes," "is in," "is part of," etc. were assumed to reflect subordinate-superordinate relationships in the youngster's conceptual structure. As in the first productive recall measure, each subject's score consisted of the number of critical subordinate-superordinate or parallel relationships recalled from the total presented. Because this was a test of recall, only those relationships specified in the experimental paragraph were accepted as correct. For example, if a subject wrote "Niches are in the biosphere" the response was scored as incorrect since that relationship, while valid, was not

explicitly specified in the paragraph. The total score for each individual reflects only the proportion of correctly recalled relationships: errors were disregarded. This scoring procedure was determined a priori and did not actually enter into tabulations of the data since subjects either gave a correct relationship or omitted it entirely. That is, very few incorrect responses were produced by subjects in the experiment. It should also be noted that this type of scoring procedure measures only factual recall. It does not tap inferences or interrelationships beyond a single attribute span.

Nine relationships were specified in the experimental paragraph. These included five immediately adjacent subordinate-superordinate relationships (biosphere-biome, biome-ecosystem, ecosystem-niche, niche-habitat, niche-activities, niche-inhabitants), and one generally inclusive relationship (organism-biosphere).

Free Association Data

Free association data was scored for number of critical associates. An individual score for each subject reflecting the proportion of critical to total associates was obtained. The measure was defined as

$$P = \frac{\text{obtained critical associates}}{\text{Total associates}}$$

Similarity Data

Responses on the similarity scale, a seven-point semantic differential, ranged from 1 (unlike) to 7 (like). Mean values for each word pair were computed for each of the treatment groups.

Analysis

The analysis was designed to test the Null Hypothesis

H_o: The use of implicit analogies as advance organizers has no effect on learning.

Data were analyzed in a 2 x 3 design with two levels of sex and three levels of treatment: (1) Relevant advance organizer (Job Group), (2) Irrelevant advance organizer (Story Group), and (3) No advance organizer (Blank Group).

Four different measures from three separate tasks were employed:

(1) Number of critical words recalled (productive recall task)

(2) Number of critical relationships recalled (productive recall task)

(3) Proportion of critical associates given (free association task)

(4) Similarity ratings

Each of the four measures was used to test a different null subhypothesis (e.g., the use of implicit analogies as advance organizers has no effect on the number of critical words recalled). The two measures from the productive recall task were tested jointly. Univariate analyses were employed for free recall and similarity measures. An α level of .05 was established for all tests.

Because three treatment groups have two degrees of freedom two orthogonal comparisons were formed. The first such comparison was between Control 1 (irrelevant advance organizer) and Control 2 (no advance organizer). The second contrast was the average of these two

groups combined versus the experimental group (relevant advance organizer). Thus

$$\hat{\psi}_1 = \text{Control 1 vs Control 2}$$

$$\hat{\psi}_2 = \frac{\text{Control 1 + Control 2}}{2} \text{ vs Experimental}$$

RESULTS AND DISCUSSION

Results

Means scores on each of the dependent variables are summarized in Tables 1 through 4 and shown in Figures 2 through 5.

Productive Recall Scores

Critical words and relations recalled from the experimental paragraph were analyzed by a multivariate analysis of variance. Results of this analysis are summarized in Table 5. No significant main effects for sex were revealed. The treatment contrast between Control 1 and Control 2 was likewise nonsignificant as was the contrast between the experimental group and the mean of the two control groups. The sex x treatment interaction was also nonsignificant for productive recall scores.

Free Association Scores

Proportion of critical associates was subjected to a univariate analysis of variance, results of which are presented in Table 6. No significant main effects for sex were ascertained. Treatment main effects were likewise nonsignificant both for the first contrast, Control 1 vs. Control 2 and for the second contrast, Experimental vs. mean

Table 1

Observed Cell Means:
Number of Critical Words Recalled

	Relevant Advance Organizer	Irrelevant Advance Organizer	No Advance Organizer	Mean
Male	6.11	6.55	5.19	5.95
Female	6.21	7.19	6.25	6.55
Mean	6.16	6.87	5.72	

Table 2

Observed Cell Means:
Number of Critical Relations Recalled

	Relevant Advance Organizer	Irrelevant Advance Organizer	No Advance Organizer	Mean
Male	1.44	1.18	1.44	1.35
Female	1.58	3.05	1.25	1.96
Mean	1.51	2.12	1.35	

Table 3

Observed Cell Means:
Proportion of Critical Associates

	Relevant Advance Organizer	Irrelevant Advance Organizer	No Advance Organizer	Mean
Male	.23	.17	.15	.18
Female	.22	.22	.15	.16
Mean	.23	.20	.15	

Table 4

Observed Cell Means:
Similarity Ratings

	Relevant Advance Organizer	Irrelevant Advance Organizer	No Advance Organizer	Mean
Male	3.59	3.54	3.64	3.59
Female	3.40	3.67	3.50	3.52
Mean	3.50	3.11	3.57	

Table 5

Multivariate Analysis of Variance of Productive Recall Scores
(Number of Words Recalled, Number of Relations Recalled)

SOURCE	F	d.f.	F
Sex	1.62	2,89	<.20
Treatment			
Control 1 vs. Control 2	1.52	2,89	<.22
Experimental vs. Mean of Two Control Groups	.63	2,89	<.54
Sex x Treatment	1.27	4,178	<.28

Table 6

Univariate Analysis of Variance of Free Association Scores
(Proportion of Critical Associates)

SOURCE	F	d.f.	MS	P
Sex	.23	1,90	.00	<.64
Treatment				
Control 1 vs. Control 2	2.01	1,90	.03	<.16
Experimental vs. mean of two control groups	3.72	1,90	.06	<.06
Sex x treatment	.70	2,90	.01	<.50

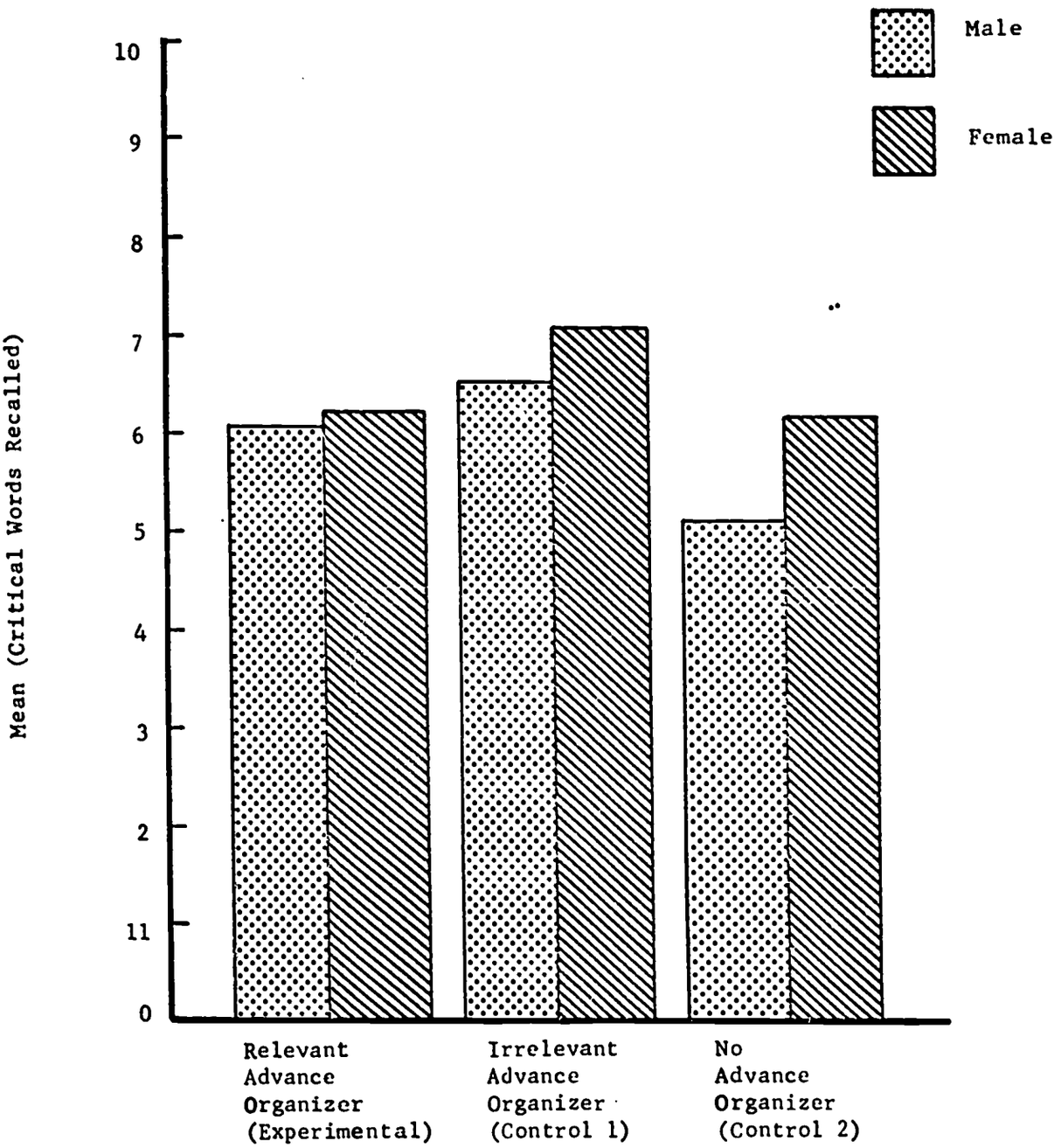

Figure 2. Mean values for number of critical words recalled (productive recall task)

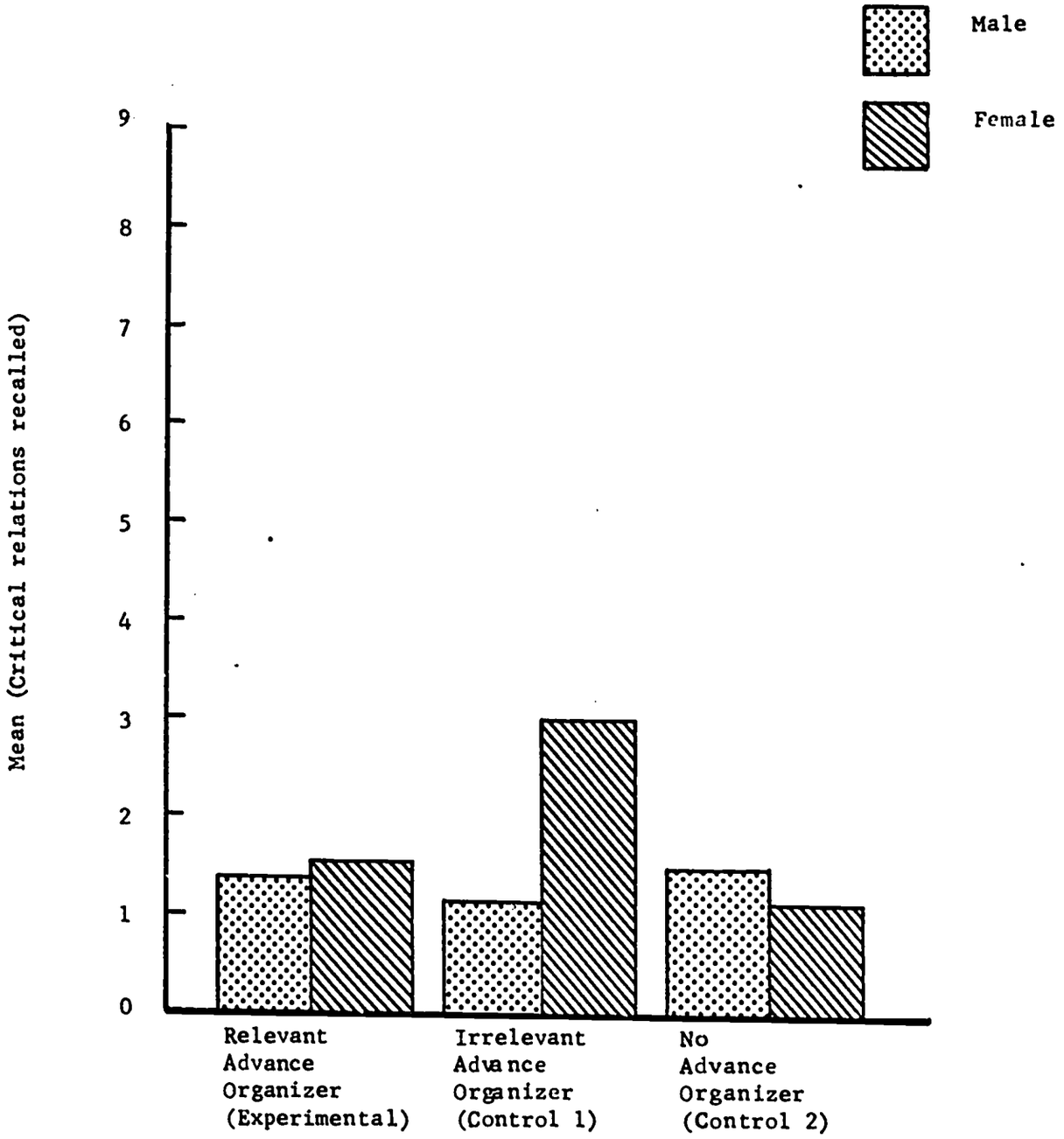

Figure 3. Mean values for number of critical relationships recalled (Productive recall task)

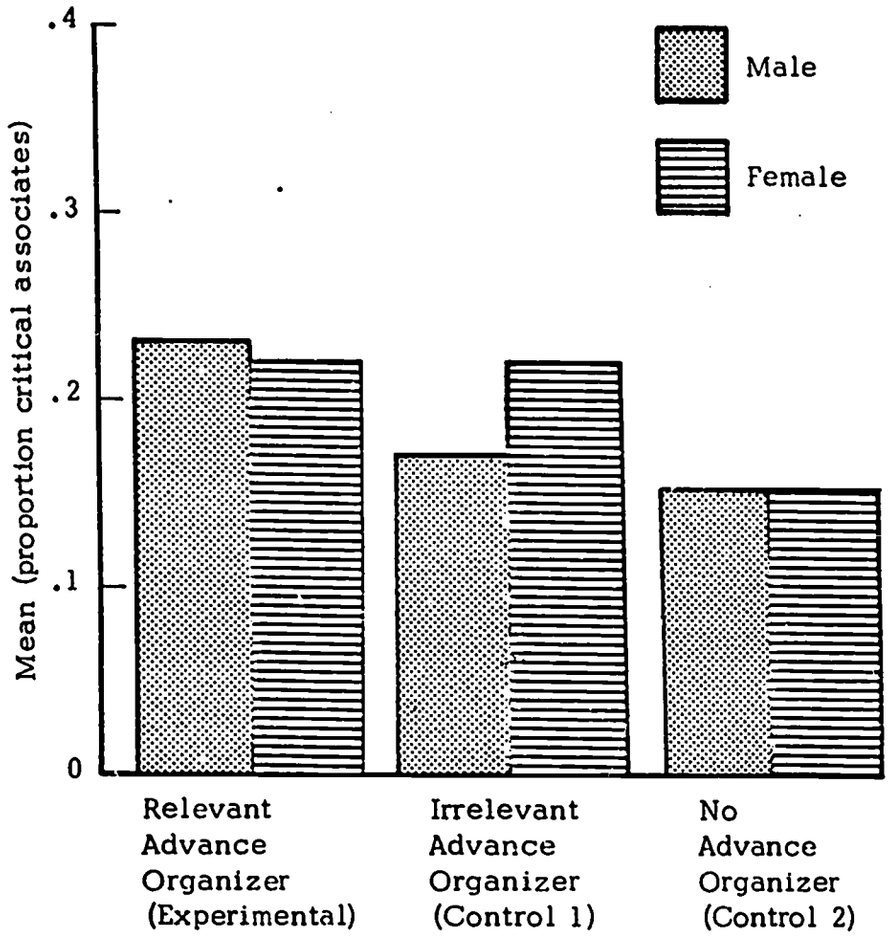

Figure 4. Mean values for proportion of critical associates (Free Association task)

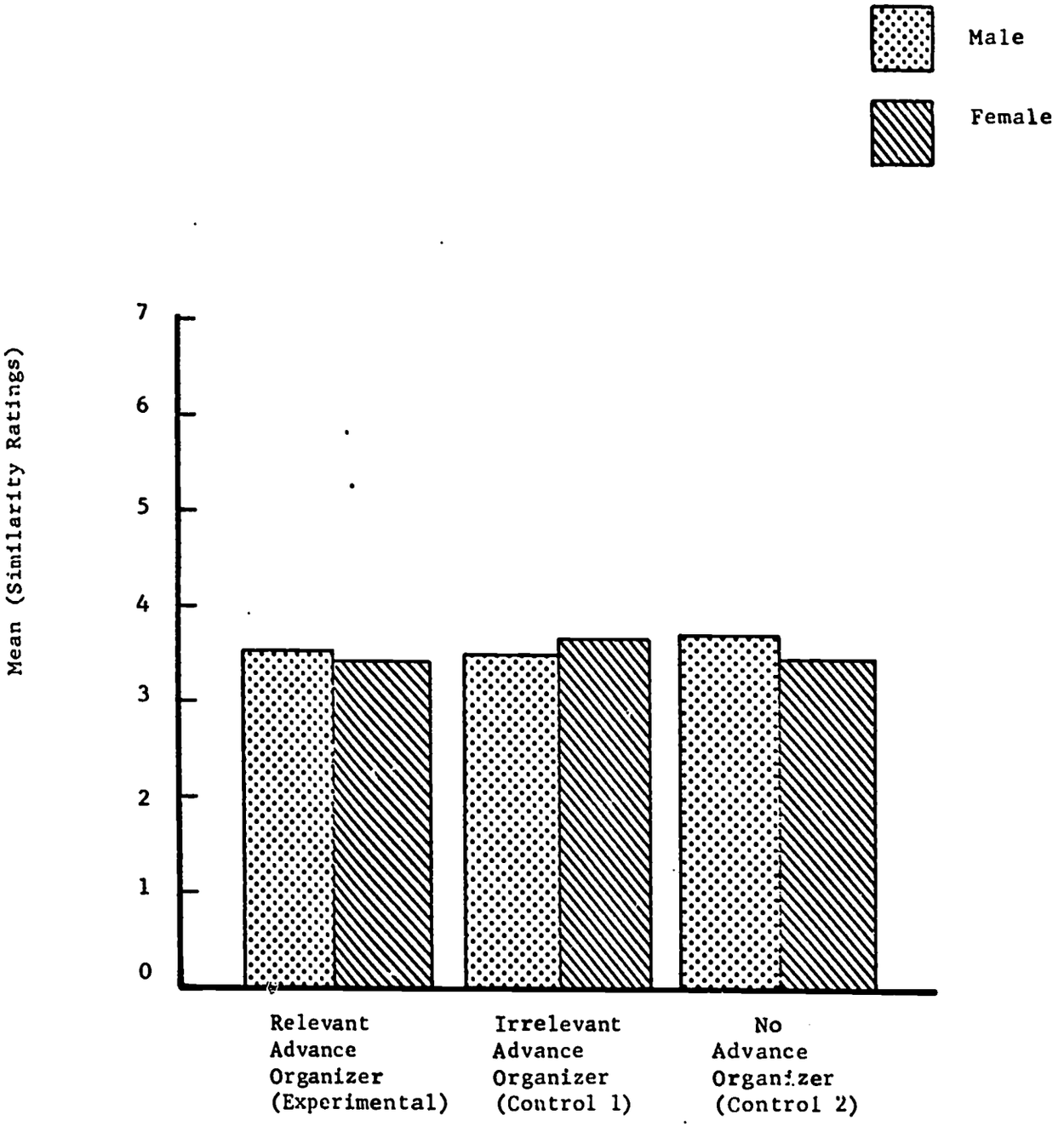

Figure 5. Mean values for similarity ratings.

of two control groups. The second contrast, however, approached significance in the predicted direction. The sex x treatment interaction for free association scores was similarly nonsignificant.

Similarity Ratings

Similarity ratings were analyzed by a univariate analysis of variance. Results of that analysis are summarized in Table 7. No significant main effects for sex were revealed for the similarity measure. The first treatment contrast between Control 1 and Control 2 was insignificant as was the contrast between the experimental group and the average of both controls. The sex x treatment interaction was also nonsignificant for this measure.

Discussion

Neither main nor interaction effects of sex approached significance. As shown in Figures 2-5, girls performed consistently better than boys but not significantly so. That sex does not constitute a predominate factor in this study is, of course, a positive result. In the development of teaching strategies one would not ordinarily employ methods which differentially facilitate learning on the basis of sex.

Effects of treatment were more surprising. As shown in Figures 2-5, no significant differences occurred between the three groups on any measure. When the experimental condition is tested against the average of the two control groups differences become even smaller.

Of crucial significance to the interpretation of these findings is the apparent reversal of direction shown in Figure 2-5. Whereas the

Table 7

Univariate Analysis of Variance of Similarity Ratings

SOURCE	F	d.f.	MS	P
Sex	.31	1,90	.07	<.58
Treatment				
Control 1 vs. Control 2	.19	1,90	.04	<.67
Experimental vs. Mean of Two Control Groups	.74	1,90	.17	<.39
Sex x Treatment	1.12	2,90	.26	<.33

relevant advance organizer was predicted to facilitate learning in this study, these figures reveal higher scores for subjects administered the irrelevant organizer.

A number of factors may account for the failure to achieve results of the expected magnitude and direction. First, the description of a job hierarchy may have lacked psychological validity for 6th grade subjects despite the use of concrete examples at each structural juncture. As previously noted, familiarity with at least one member of an analogy appears necessary for facilitation of learning to occur. Since these youngsters constituted a rural sample, the assumption of varied experience with different occupational groups may not have been justified. It is thus possible that both the relevant organizer and the experimental paragraph were functionally novel for the learner. In that case one might suspect that rather than enhancing acquisition of material contained in the environmental paragraph, the job description would interfere with learning. Post hoc inspection of the raw data suggests this contingency to be at least partially responsible for the results. Several papers from the Job Group showed intrusions of words or phrases from the job description in the productive recall task. In that task, it will be remembered, subjects were instructed to produce verbatim as much of the ecological paragraph as they could remember within a specified time.

A second possibility is that implicit analogies are not sufficiently clear or sufficiently concrete to encourage hypostatization and facilitate learning. The advance organizer employed in the Moby Dick study made explicit the relationships operating in that analogy. Whether the relevant

variable is overt specification of links between two seemingly disparate ideas or whether it is hypostatization per se remains unclear. A study including both implicit and explicit analogies as organizers should provide insight into the problem. For example, it is possible that were some subjects provided with a detailed diagrammatic explanation of the similarities between ecological and occupational hierarchies, facilitation might have occurred. The failure to include both explicit and implicit treatment conditions therefore constitutes a major weakness of the present study.

A third possible explanation for the findings suggests the structural properties of the relevant organizer may have rendered that paragraph more abstract than was originally supposed since concrete examples had been supplied. In that case hypostatization and subsequent facilitation would be less likely to occur. Moreover, Bruner (e.g., Bruner, Olver, and Greenfield, et al, 1966) posits an increasing ability to perform symbolic operations as a function of age. If, as Lenneberg (1967) further suggests, the linguistic system is not fully mature before puberty, it may be that the relevant advance organizer was simply too difficult for these subjects. It has already been noted that both organizers contained approximately the same number of syllables and were judged of comparable reading difficulty. However, those judgments may be invalid or may apply only to the words and sentence structures contained in the paragraphs per se. The comprehension difficulty of ideas presented in the two organizers may be quite different since the job hierarchy constitutes a complex relational concept whereas the story does not.

A fourth alternative explanation may be that the material comprising the irrelevant advance organizer was more interesting to 6th graders, either intrinsically or by association. Children of this age presumably have greater experience in reading stories than in reading academic material and probably receive enjoyment from them. In that case, selective attention may have been differentially operant in the present investigation and could partially account for the findings.

Summary and Conclusion

The present investigation studied the effectiveness of implicit analogies as advance organizers in children's learning. It was hypothesized that analogies which were structurally isomorphic to the target concept would facilitate learning of the latter even though linkages between components of the two concepts were not overtly specified.

Results of the study showed no significant effects of the advance organizer. Interpretation remains unclear, however, since a number of confounding factors may have been involved and several alternative explanations are plausible.

Further study should provide insights into the dynamics of analogical learning. Weaknesses of the present research point to several potentially fruitful areas of investigation. Paragraph structure, interest arousal and developmental aspects of linguistic functioning as well as concreteness-abstractness, imagery and metaphorical aptness all constitute areas for which further inquiry is indicated.

A future program of investigation which may elucidate structural factors in analogical learning could compare the effects of explicit analogies,

implicit analogies and non-analogical explanatory material as advance organizers. Such a series of investigations should provide information about the types and number of links necessary for facilitation of learning to occur. The nature of implicit analogies, for example, remains to be definitively established. Likewise, whether explicit analogies should be developed point-by-point or whether specification of major similarities is sufficient remains an empirical question. Organizers of varying degrees of concreteness ranging from pictorial or diagrammatic material to verbal illustrations should likewise be systematically investigated in such a research program.

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APPENDIX A

INTRODUCTION AND INSTRUCTIONS

Productive Recall Task

INTRODUCTION

My name is Mrs. Hawkins and I work at the University of Wisconsin. My job is to try and find out how boys and girls learn so that we can help develop better programs for all of the students in Wisconsin. Right now, I'm interested in learning what things make learning easier for sixth graders like yourselves. But I can't do this very important job by myself; so when I asked Mr. Seiler if he knew of a group of sixth graders who would be able to help me he suggested I ask this class. Would you help me in an important experiment? Good!

Can anyone tell me what an experiment is? (You do something and see if it makes any difference in something else. For instance, you might plant two seeds in different containers and give one plant food and the other one plain water. If the seed to which you have given food grows faster than the other one, you might decide that the food made a difference.)

In the experiment that we are going to do today, we want to find out whether reading something first will help you to remember something that you read later. If reading something first does help, we would also like to know whether reading anything at all helps you learn the new material or whether it has to be something special. So each of you has a very special part to play in this experiment. Some of you will read one kind of paragraph, some of you will read another kind of paragraph and some of you won't read anything at all. Whether you read something or not you are a very important part of the experiment. Can anyone think of a reason for my not giving some people a paragraph to read? (Reading something first might not make a difference in how well you remember the new material.) Before we begin I want you to know that

no one will see your papers but me and you will not be graded on this work. So please do your very best. Remember that you are representing all sixth graders in this experiment and that is an important job!

INSTRUCTIONS

Now I'm going to pass out these booklets. They are all mixed up so it will be a surprise to see which kind of booklet you get. Please leave the booklet closed and face up on your desk until I tell you what to do with them.

[pass out booklets
fill in front cover]

Now we will begin the first part of the experiment. You will have a short time to read the paragraph which is on the first page inside your booklet. If you have no paragraph, you may draw a picture on the blank page. In a few minutes I will project a new paragraph onto the screen which we will all read together. Then we will see how much of this new paragraph you can remember.

[Reading time: 2.5 min.

Stop

Turn the page. You should now have a blank piece of lined paper in front of you.]

[Show slide of experimental paragraph.
Read aloud while students read silently.]

Now I'd like you to try and write down as much of the paragraph which we just saw on the screen as you can. First try to remember the entire paragraph from the beginning. If this is too hard, try to remember sentences or even words that you saw.

[Writing time: 3.5 min.]

Stop! That looked a little difficult. Shall we try it again? Okay. Then turn the pages of your booklet until you come to another copy of the first paragraph or a blank page. We'll do exactly the same thing this time: first read the paragraph or draw a picture if you have a blank page, then read the paragraph on the screen. After that you can write again.

APPENDIX B

INSTRUCTIONS AND STIMULUS MATERIALS

Free Association Task

Directions

This is a test to see how many words you can think of and write down in a short time. You will be given a word, and you are to write down all the other words which the key word makes you think of.

For example, think of the word KING. Some of the words which KING might bring to mind are

queen

ruler

King Kong

castle

No one is expected to fill in all the spaces on a page, but write as many words as you can. Be sure to think back to the key word after each word you write. A good way to do this is to repeat each key word over and over to yourself as you write.

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APPENDIX C

INSTRUCTIONS AND STIMULUS MATERIALS

Similarity Ratings

In this part of the experiment you are to rate pairs of words according to how much alike in meaning you think they are. In the example below, look at the words in each pair, decide how much alike in meaning they are and circle the number that you think best. If they are not alike, circle a low number such as 1 or 2. If they are very much alike, circle a high number such as 6 or 7. You should circle one of the middle numbers if they are somewhat alike.

	Unlike						Like
Chalk Pencil	1	2	3	4	5	6	7
Night Tree	1	2	3	4	5	6	7

Now turn the page and rate the new list of words in the same way. You will have only a short time for this task so please work as quickly as possible.

	Unlike						Like
BIOSPHERE BIOME	1	2	3	4	5	6	7
ACTIVITY SURGEON	1	2	3	4	5	6	7
ECOSYSTEM PROFESSION	1	2	3	4	5	6	7
WORK JOB	1	2	3	4	5	6	7
BIOSPHERE SPECIALIST	1	2	3	4	5	6	7
ACTIVITY WORK	1	2	3	4	5	6	7
SPECIALIST SURGEON	1	2	3	4	5	6	7
NICHE JOB	1	2	3	4	5	6	7
BIOSPHERE ACTIVITY	1	2	3	4	5	6	7
BIOME NICHE	1	2	3	4	5	6	7
JOB SURGEON	1	2	3	4	5	6	7
BIOME WORK	1	2	3	4	5	6	7
NICHE SPECIALIST	1	2	3	4	5	6	7

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