SIMILARITY AND PROMPTING EFFECTS
IN RETROACTIVE FACILITATION OF
MEANINGFUL LEARNING

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ABSTRACT

SIMILARITY AND PROMPTING EFFECTS
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By

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Experiments investigating retroactive inhibition traditionally take the form of: (1) learn original learning; (2) learn interpolated learning; (3) test retention of original learning. The effects of similarity between original learning and interpolated learning on the retention of rotely-learned original material have been fairly consistent. Experimental evidence indicates that similarity that deviates more than slightly from identity tends to result in retroactive inhibition. There is conflicting evidence with regard to the effect of similarity between original learning and interpolated learning in the retention of meaningfully-learned prose materials. Some recent studies have shown facilitation rather than the expected inhibition. This study investigated the effects of similarity on retention of meaningfully-learned prose materials and attempted to: (1) specify the similarity dimension by designing materials that: were highly similar in organizational structure;

used identical stimulus components in the body of the materials with similar but conflicting response components; and (2) explore the effects of variations in the retention interval on either facilitation or inhibition.

A 3 x 5 analysis of covariance design was employed with four treatments and one control group [(E-1) Compare and Contrast group; (E-2) Prompting group; (E-3) Similarity group; (E-4) Overlearning group; (C-5) Control-Irrelevant group] and three retention intervals between original learning and test of original learning [(R-1) nine days; (R-2) four days; (R-3) three days]. Additional control groups were used to test for possible facilitative effects of interpolated learning.

Results failed to show statistically significant evidence for facilitation or inhibition except when interpolated learning was identical to original learning. Highly consistent trends existed, however, in the direction of retroactive inhibition. Additionally, the separate control groups not receiving original learning showed large differences in interpolated learning group effects. These findings are discussed in relation to the eventual possibility of identifying retroactive inhibition as a significant contributor to the forgetting of meaningfully-learned prose materials and the possibility of an interaction between degree of original learning and strength of retroactive inhibition in retention of meaningfully-learned prose materials.

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To Joyce and our budding life.

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CHAPTER I

REVIEW OF THE LITERATURE, THEORY, AND PURPOSE

Interference Theories

Interference theories of one kind or another have long been among the most popular of theoretical approaches attempting to explain the process of forgetting. While the two most important interference theory constructs have changed places in their relative degree of importance to the forgetting process---"proactive inhibition" supplanting "retroactive inhibition" as the main source of interference---since Underwood's (1957) reanalysis of a large quantity of the relevant data, the theory itself has not been seriously challenged as an explanation of the process of forgetting of rote memorization of verbal learning.

Excellent reviews exist documenting the growth and decline of various interference theories (Swenson, 1941; Slamecka and Ceraso, 1960; Postman, 1961; Underwood and Eckstrand, 1966). Information contained therein will not be repeated here except as required to make specific points.

In general, the basic tenets of the interference theory of forgetting presume that specific responses become unavailable because competing responses learned previous to them (proactive inhibition) or afterwards (retroactive inhibition) compete with them, or block them, or crowd them

out (ceraso, 1967). In a sense, the response with the greatest relative strength wins out. Degree of forgetting caused by retroactive inhibition has been shown in many studies to be directly related to amount and similarity of activities interpolated during the interval between original learning and recall---the greater the similarity and/or the greater the amount of interpolated learning, the greater the retroactive inhibition (RI).

The details of interference theory are supported by large amounts of empirically-gathered data. There is little question that the mechanisms of the theory can adequately handle most forgetting of rotely learned verbal materials. Some kinds of learning, however, which appear to require solely rote memorization processes, stickily refuse to be subsumed under the interference theory umbrella (Underwood and Eckstrand, 1966).

Forgetting of Meaningful Learning

All of the experiments providing unequivocably supportive data for the interference theory of forgetting have one thing in common, they represent findings of highly-controlled, laboratory studies of the forgetting process. As a matter of course, most of these investigations have used variations on rote-verbatim memory tasks. Only one study could be found in the literature dealing with the learning of meaningful materials in a meaningful way (Newman, 1939).

The preceding comments require some qualification.

For the purposes of this paper, the definition of "meaningful learning" will come from Ausubel's (1963) theory of meaningful verbal learning. Meaningful verbal learning is defined as a process in which potentially meaningful material is substantively related to (or subsumed under) an individual's existing knowledge in a non-arbitrary and non-verbatim fashion, so that new meanings are acquired and made more available (Ausubel, 1968, p. 218). Note that this definition presupposes that (1) the material to be learned be potentially meaningful, i.e., substantively relatable in a non-arbitrary fashion; and (2) the learner employs a meaningful learning set to "relate substantive (as opposed to verbatim) aspects of new concepts, information or situations to relevant components of [his] existing cognitive structure in various ways that make possible the incorporation of derivative, elaborative, correlative, supportive, qualifying or representational relationships" (Ausubel, 1963, p. 22).

While the mass of data supportive of the interference theory of forgetting can hardly be challenged within the area of rote verbal learning, it is in this more directly applicable area of meaningful learning that the otherwise incontrovertible evidence breaks down. Most of the studies using "meaningful materials" and "meaningful learning" in attempts to extend the interference paradigm to more meaningful learning do not qualify as meaningful learning given the above definition. Nevertheless, with a rare

exception, they fail to demonstrate retroactive inhibition.

McGeoch and McKinney (1934a, 1934b) attempted to demonstrate retroactive inhibition with materials more meaningful than the usual nonsense syllables. They found that only when they used rote memorization of a short section of poetry were they able to demonstrate retroactive inhibition. On the other hand, they found no decrement in performance with prose materials even though they were using memorization as the learning procedure. Newman (1939) in the only study found using truly meaningful learning and retention, demonstrated retroactive inhibition only for portions of the prose passages learned that were factual, quite specific, and non-essential (i.e., non-meaningful) to the content and task at hand. Retroactive inhibition again failed to be in evidence in the meaningful areas of the learning.

Hall (1955) had his subjects memorize sentences and then tested them on retention at two intervals. He used different types of interpolated learning (IL) materials ranging from some that were highly similar to the original learning (OL) to others that were essentially irrelevant. Despite the fact that this was not totally meaningful learning, he was unable to demonstrate retroactive inhibition.

Heise (1956) used passages at varying levels of Miller and Selfridge's (1950) orders of approximation to English. He had Ss memorize material at one level (first order) and varied the level of interpolated learning. In

a sense, this was a way of varying the levels of similarity of interpolated learning to original learning that had so indisputably caused differences in retroactive inhibition when investigators used the more traditional nonsense syllables. He was able to demonstrate retroactive inhibition only when interpolated learning was at zero and first order (virtually nonsensical word lists) of approximation to English. King and Cofer (1960) followed this up varying order of approximation in both original learning and interpolated learning. They were not able to show any consistent results with regard to the function of differences in similarity of interpolated learning to original learning. In any case, memorizing short passages of nonsensical orders of approximation to English could hardly be considered meaningful learning.

Entwisle and Huggins (1964) were able to demonstrate retroactive inhibition using circuit theory equations with first year engineering students. Mehler and Miller (1964) had Ss memorize sentences. Interpolated learning consisted of variations in similarities of meaning (as judged by judges) and in similarities in syntax (as defined by the language organizational rules of transformational grammar). No retroactive inhibition was demonstrated for semantic content. In fact, evidence appeared that could be interpreted as supportive of a retroactive facilitation phenomenon when interpolated learning materials varied only in syntax. However, since variations in syntax could be viewed as a

rewording of the original material, facilitation may not be a surprising finding.

Slamecka and Ceraso (1960) in a survey of findings on retroactive inhibition point out that "ordinary prose or connected discourse had been until recently, unusually resistent to demonstrable interference effects " (p. 549). They go on to attribute this resistence to methodological problems such as group testing, whole presentation, unlimited recall times, recognition tests and the like. They point out that when "connected discourse was presented in the same manner as the traditional serial list, using the serial anticipation method, [e.g., memory drum presentation] with individually tested Ss, significant retroactive inhibition was obtained and it was shown clearly to be a function of degree of original learning as well as of similarity of subject matter" (p. 459).

Viewed from the perspective of the above definition of meaningful learning, what they seem to be saying is that when potentially meaningful verbal material is dissected into its component parts, presented in an unnatural way, and the learner is forced to learn it by rote, word-by-word memorization, it is then possible to demonstrate retroactive inhibition.

Retroactive Facilitation

In summation, it appears that to date, retroactive inhibition has never been demonstrated with meaningful materials learned in a meaningful way. On the other hand,

there does seem to be a small and contradictory body of evidence to indicate that with meaningful materials and tasks, the traditional retroactive inhibition transfer paradigm does not usually produce retroactive inhibition but may in fact result in "retroactive facilitation"---that is the facilitation of original learning---in certain manipulations of degree and kind of similarity of interpolated learning materials to original learning materials (Ausubel, Robbins, and Blake, 1957; Ausubel, Stager, and Gaite, 1968). In one case, (Ausubel, Robbins, and Blake, 1957) mean scores of Ss suggest that receiving interpolated learning similar in content to original learning were higher than mean scores of Ss who restudied the original passage. In this study, Ss who had read original learning material consisting of the basic tenets of Buddhism, and subsequently read a passage comparing Christianity with Buddhism did significantly better on a seven-day retention test when compared with control Ss who did not undergo any interpolated learning. A comparison of means between the experimental group and a control group which restudied the original passage did not achieve statistical significance. A major problem blocking clear-cut interpretation of the results of this study was that no attempt was made to control for possible facilitative effects of the interpolated learning when the original learning was not involved.

The second study (Ausubel, Stager, and Gaite, 1968) showed statistically significant facilitation of original

learning when topically similar interpolated learning was learned in two separate conditions. Again, however, no attempt was made to control for the possible facilitative influences of interpolated learning.

Katona (1940) in a large number of experiments, demonstrates quite effectively the advantages of meaningful learning in retention, application, and flexibility of transfer, and points out that "fortunately material which cannot be learned by understanding but only by memorizing is rather limited except in the psychological laboratory" (p. 234).

Most of Katona's results have been adequately replicated and supported by other investigators (Hilgard, Irvine, and Whipple, 1953; Hilgard, Edgren, and Irvine, 1954). Ausubel (1968, p. 111) reviewed many other studies, in various areas, that document the superiority of meaningful learning over rote learning when measured by speed of learning and length and amount of retention.

An unfortunate paradox surfaces when these results are viewed in relation to educational research and practice today. The advantages of the meaningful learning process seem hardly debatable. Yet observation of classroom learning seems to indicate that much of what could be learned meaningfully is still learned in a less effective fashion---i.e., through rote memorization processes. The applied discipline of educational psychology has as its primary concern the facilitation of teaching, learning,

retention, and applicability of information. It seems only reasonable that a primary focus for educational psychologists should be the delineation of those tasks that can be learned meaningfully, and the exploration and the delineation of the optimum conditions---the optimal manipulation of content, structure, sequencing, methods of studying, etc.---that will lead to the maximum of meaningful learning. Nevertheless, most research conducted on the forgetting process has centered around rote learning tasks. Results from these experiments have been extrapolated for application to the classroom learning situation, where it appears they were never wholly applicable. It may be that there are those learning experiences that can be best and most efficiently mastered, retained and later applied when learned in a rote, association-connecting fashion, but they are certainly in the minority. As Katona (1940) pointed out, much of what is today learned by "senseless connections" is capable of being learned in a meaningful way.

Bartlett (1932) pointed out many of the pitfalls inherent in performing studies on supposedly "pure" (because they appear to be nonsense semantically) nonsense syllables and subsequently attempting to extrapolate from this unusual brand of learning to more normal meaningful verbal learning. Katona (1940) wagged his finger at this type of exercise, theorizing that the archetype of learning is not to be found in the rote memorization process but in

the meaningful learning process. Perhaps it is worthy that educational psychologists should look more closely at the classroom and the kind of learning that takes place outside of the psychological laboratory, in attempting to gain information that will further the educational process.

Theory of Meaningful Verbal Learning

One theory of verbal learning that will readily handle both retroactive interference of rotely learned materials and retroactive facilitation of meaningfully learned verbal materials is Ausubel's (1963) theory of meaningful verbal learning. At the center of the theory is a model of cognitive organization---a cognitive structure---that is "hierarchically organized in terms of highly inclusive conceptual traces, under which are subsumed traces of less inclusive sub-concepts as well as traces of specific information data" (ibid. 1963, p. 24). Progressive differentiation from regions of greater to lesser inclusiveness is the major organizational principle.

According to Ausubel, meaningful learning occurs only when potentially meaningful material enters the cognitive field and interacts with and is appropriately subsumed under a relevant and more inclusive conceptual system. To be meaningful, the material must be subsumable in a non-arbitrary, non-verbatim fashion---i.e., relatable to stable elements in cognitive structure.

The cognitive learning process, subsumption, secondarily provides the basic mechanism for forgetting. "Obliterative subsumption" is the process of "memorial reduction to the least common denominator capable of representing cumulative prior experience" (1963, p. 26) "...the gradual loss of dissociability strength through a process of obliterative assimilation" (1968, p. 106). In other words, the retention process is one guided by economical considerations in that the more inclusive, more stable and more established anchoring concepts are remembered more readily. "...new ideas become spontaneously and progressively less dissociable from their anchoring ideas as entities in their own right until they are no longer available and are said to be forgotten" (1968, p. 93).

Rote learning tasks are only relatable to cognitive structure in an arbitrary, verbatim fashion. Thus they should be far more susceptible to the effects of interference, be it proactive (from existing previously acquired cognitive structure) or retroactive (from meanings acquired subsequently).

In meaningful learning, the important mechanisms involved are: (1) "the achievement of appropriate relational anchorage within a relevant ideational system and (2) retention of the identifiability (dissociability) of the newly learned material" (1968, p. 109).

The maintenance of availability (dissociability) of a

particular idea in memory then, depends to a great degree on its discriminability in cognitive structure. Enhancement of availability can be brought about in many ways---some more or less traumatic than others. Theoretically, one post hoc way of facilitating discriminability and hence retention of previous learning (henceforth to be referred to as "original learning") would be to provide other relevant ideational materials with which the learner can actively interact in making relational comparisons. If these ideational materials are already established in cognitive structure, cognitive manipulations in which original learning and this "interpolated learning" interact should serve to make elements of both more discriminable and stable thus increasing learning and subsequent retention. If these interpolated learning materials are not already in cognitive structure, then providing them to the learner after the new learning would provide ideational material that the learner could use retroactively in cognitive manipulations such as setting up relational structures, drawing comparisons and contrasts and the like, which should serve to retroactively work on the clarity and stability of original learning and thus facilitate its retention.

As has already been mentioned, meaningful learning presupposes that (1) the material to be learned be potentially meaningful and (2) the learner employ a meaningful learning set to substantively relate learning materials

to each other and to relevant components of his existing cognitive structure during the incorporation of new learning. According to Ausubel, it cannot be presupposed by teachers that students automatically approach the learning situation in this manner. In fact to facilitate learning he suggests that all possible methods be employed by the instructor to get the student to learn meaningfully (Ausubel, 1968). He suggested that meaningful learning can be facilitated by sequencing material so that substantively relatable material be learned in juxtaposition; that students be instructed to approach material in meaningful ways; and that material might even be structured according to the principles of "integrative reconciliation" that is, with relevant relationships, comparisons and contrasts drawn for the student.

Statement of Purpose

The present experiment was designed to investigate the possibility of facilitation of meaningful learning based on some of these precepts. Following the traditional retroactive inhibition paradigm, it was proposed to: (1) have all Ss learn a set of original learning verbal materials; (2) have Ss learn a second, different set of interpolated learning verbal materials; (3) test Ss on the original learning material to determine the effects of interpolated learning on retention of original learning.

The potential significance of the study lay in the possibility of either replicating the findings of Ausubel,

et. al. (1968) indicating retroactive facilitation or in providing evidence for the workings of an interference mechanism in the forgetting of prose materials. In regard to the former, Ausubel, et. al. (1957, 1968) are the only investigators who have ever reported data indicative of retroactive facilitation. On the other hand, no investigations using truly meaningful learning have reported statistically significant interference effects.

Specification of Similarity Dimension. Since degree of similarity between original and interpolated learning has been shown to correlate highly with amount of subsequent inhibition of rotely learned verbal materials, it was felt that tighter specification of this dimension, beyond what Ausubel et. al. (1957) refer to as "confusably similar" would be advisable. This was accomplished by writing two essays to be used as original and interpolated learning materials (Appendix C) that: (1) covered a confusably similar area of subject matter; (2) were conflicting in content in that they discussed two different theoretical explanations of the same phenomena; (3) followed virtually identical organizational structure; (4) had identifiable stimulus elements in the form of paragraph headings that were identical in both. These stimulus elements were followed by response elements (i.e. paragraphs) that were conflicting in that they were each written to the point of view of the particular psychological theory being discussed. It was felt that this

tight specification of the similarity and the conflicting nature of the two learning passages employed would maximize possibilities for retroactive interference were it to occur.

Treatment Conditions. Experimental treatments introduced into the interpolated learning phase were chosen to represent four possible classroom learning conditions: (E-1, Compare and Contrast group) Ss were provided with the similar interpolated learning essay and were guided to make appropriate comparisons and contrasts by occasional paragraphs inserted into the essay that made reference to both points of view and their differences and similarities. This follows Ausubel's principle of integrative reconciliation and is similar to the comparison and contrast treatment given in Ausubel et. al. (1957, 1968); (E-2, Prompting group) Ss were provided with the similar interpolated learning essay and were prompted to relate its content with the previously learned original learning. This was accomplished by inserting into the essay occasional set-off comments suggesting and reminding Ss to compare and contrast some of the information with that learned in the original learning. No content information directly relevant to original learning was given in this condition; (E-3, Similar group) Ss were merely given the similar interpolated learning passage to study. No reference was made to the original learning essay previously studied; (E-4, Overlearning group) Ss were allowed to reread the original learning passage. In the control

group (C-5, Irrelevant group) Ss read an essay discussing the pros and cons of team teaching. This passage was of similar length but dissimilar in content to the original and the interpolated learning materials.

These five treatments were felt to represent five different potential learning sequences that conceivably could be employed in classroom learning. Thus it was anticipated that results might point toward possible applications in curriculum design.

E-1, E-2, and E-3 represent three different degrees of guidance given with respect to the cognitive manipulation of the information being learned. It is this hypothesized cognitive manipulating and structuring that provides Ausubel with the central mechanism in his theory of meaningful verbal learning. As mentioned earlier, his theory of meaningful verbal learning posits cognitive structures organized hierarchically on the principle of progressive differentiation from most inclusive concepts to least inclusive. Ausubel uses the hypothesized cognitive manipulations required in the organizing of these structures to predict and explain improvement in retention of learned information due to similar interpolated learning. According to Ausubel the most efficient way of promoting the performance of these cognitive manipulations is not to leave it up to the learner to perform them spontaneously, but to guide him in making them and/or to make them for him. Thus, if the learner can be guided, prompted, or even

trained to perform these manipulations in his studying, facilitation of retention should result.

Retention of General Versus Specific Information. Since retained information is theoretically structured and stored on the basis of progressive differentiation, Ausubel predicts that less inclusive concepts will be subsumed under more inclusive concepts and obliterated (i.e., forgotten) over time. In the present study, an attempt was made to investigate this difference in retainability by constructing the retention test in two subsections: (1) a specific-factual subsection (items 1-12) that dealt with closely specified factual material; (2) a more general subsection (items 13-36) made up of questions that dealt more with higher order types of learning such as analysis and application. If the test instrument effectively discriminated between these two types of questions, Ausubel's theory would predict greater forgetting over time of the more specific-factual types of questions. Three retention intervals were set up to look more closely at this possibility: R-1 (9 days); R-2 (4 days); R-3 (3 days).

Control Groups. As facilitation found in earlier studies could be explained by reference to possible facilitative effects of interpolated learning materials, an attempt was made to measure the effects of the interpolated learning materials themselves by introducing a separate interpolated-learning only control group ("Control-Interpolated Learning" [C-IL]). A test-only ("Control-Test")

control group was also set up to check on the base level performance of subjects on the test instrument.

Learning Ability. It was anticipated that College Qualification Test scores could be used both as a covariate measure to gain greater precision, and in detecting possible differential effects of treatments due to learning ability. Ausubel and Fitzgerald (1962) report that Ss of lower learning ability responded to interpolated materials guiding them to draw appropriate relationships, with greater facilitation than did Ss of higher learning ability. They proposed that higher ability Ss performed some of the appropriate manipulations without being directed to do so.

Hypotheses

On the basis of the foregoing, the following hypotheses were established:

1. All E groups will perform better on a retention test than the control group provided only with irrelevant interpolated learning material (C-5).

2. Interpolated learning that provides, points out, or prompts similarities and differences between interpolated learning and original learning (E-1, E-2, E-3) will be more effective in facilitating retention than a rereading of the original learning passage (E-4).

3. Interpolated learning that guides or prompts Ss to make comparisons between original and interpolated learning (E-1, E-2) will be more effective than interpolated learning that merely provides the potentially comparable

information (E-3).

4. Specific-factual material (items 1-12) will be retained better over the longer retention interval (R-1) by groups receiving similar interpolated learning (E-1, E-2, E-3) than by groups receiving identical or irrelevant interpolated learning material.

5. Conceptual material (items 13-36) will show a higher degree of resistance to forgetting than will specific-factual material (items 1-12) across the three retention periods.

6. Ss from lower learning ability groups will perform better under conditions where comparisons and contrasts are explicitly drawn and pointed out (E-1) than they will in groups requiring more self-structuring of material (E-2, E-3).

Addendum to Literature Review*

In an attempt to replicate their findings indicating retroactive facilitation (Ausubel, Stager, and Gaite, 1968), Ausubel, Stager, and Gaite (1969) performed another experiment attempting to get at possible effects of proactive facilitation. In a 3 x 2 design, experimental group Ss first studied or overlearned a passage on Buddhism, later studied a "confusably similar" passage on Zen Buddhism.

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* Since the original design and execution of this experiment, three studies have been reported that are similar to and have a direct bearing on it. The results of these are summarized in this section and also will be further discussed in relation to current findings in chapter four.

All Ss were later tested on Zen Buddhism at two retention intervals. Results indicated neither proactive facilitation nor inhibition of either the one-study group or the overlearning group when they were compared with a control group which had first studied only an irrelevant passage on drug addiction before studying the tested passage on Zen Buddhism.

In another direct attempt to replicate and extend the apparent retroactive facilitation effects found earlier (Ausubel, Stager, and Gaite, 1968), Gaite, Ausubel, and Stager (1969) performed two additional experiments. The first varied the time between original learning and interpolated learning, holding retention interval constant. The second used the same materials in a matched group design. Neither study indicated either inhibition or facilitation.

The third study prompted by the apparent results of Ausubel et. al. (1968) indicating retroactive facilitation, was Shuell and Hapkiewicz (1969). They attempted to tighten up on control for possible facilitative effects of interpolated learning. The lack of control of this factor in the Ausubel et. al. (1968) study had led Shuell and Hapkiewicz to hypothesize that it was confounding possible retroactive inhibition effects. Secondarily, they also investigated the effects of instructing Ss to compare and contrast the interpolated learning to the original learning. No significant effects were obtained in any condition.

CHAPTER II

METHOD

This chapter contains explications of the following: the characteristics of the sample of subjects used; the experimental design; the procedures followed in the carrying out of the study; the actual treatments administered, the makeup of the learning materials and test instrument; and the dependent variables used in the analyses. Each is treated in turn.

Sample

A potential universe of approximately 1,150 subjects was made available for the experiment by the School of Teacher Education, Michigan State University. This represented the full winter term enrollment of the basic sophomore course in Educational Psychology required of all undergraduate Education major (Education 200). The 1,150 students were distributed alphabetically into 33 recitation sections taught by 17 instructors.

The policy of the course was to require participation by students in a research project to a maximum of three hours outside of class. Participation in this study was easily justifiable as a learning experience as the learning materials were highly relevant to the course content. Because participation in the experiment represented a learning experience that was highly relevant to the course

and its examinations, it was felt to be necessary to offer the opportunity to take part to all 1,150 students.

Control of student participation was left up to each individual recitation instructor. The final percentage of participation in the experiment varied from section to section from about 75% to 95% of the students enrolled. The variation was caused by many factors not the least of which were the enthusiasm of the particular instructor, reward and punishment contingencies set up by the instructor for participation, students' class conflicts with scheduled study sessions etc.

Of the approximately 1,150 potential subjects, 988 ultimately signed up and took part to some degree. Data from 98 was discarded for failure to attend all sessions. Data from 16 was discarded because scores on the covariate (College Qualification Test) were not available. Usable data were obtained from 874 subjects: 748 of these took part in the five experimental conditions; 74 took part in an extra-control condition attempting to control for possible facilitory effects of the interpolated learning; 52 took part in a no-treatment condition attempting to establish baseline performance on the retention test. As Education 200 is a sophomore level course, it could not be assumed that Ss were naive to the subject matter to be learned in the experiment. In fact, it was anticipated that since most Education 200 students had previously taken an introductory psychology course, some minimum level of knowledge was expected.

Experimental Design

Main Design. A 3 x 5 analysis of covariance design was used with each subject's College Qualification Test score (a Michigan State University entrance requirement) used as the covariate (Table 1). The usual retroactive inhibition paradigm (c.f. Deese and Hulse, 1958, p. 400) was used in which all subjects receive the same original learning, in this case a 2,100 word essay on the basic ideas of stimulus-response learning theory (Appendix C). The five interpolated learning treatments consisted of three variations of an essay of similar length giving the basic ideas of cognitively-oriented learning theory (E-1, E-2, E-3), a second opportunity to study the original learning (E-4), and a 2,900 word passage dealing with the advantages and disadvantages of team teaching (C-5).

Three retention intervals between original learning and test of original learning were crossed with the five treatments: R-1 = 9 days; R-2 = 4 days; R-3 = 3 days. Table 2 provides the entire design sequence including signup.

Control Groups. A set of five control groups outside of the basic design were used to attempt to assess possible facilitory effects of each of the five interpolated treatments. Sessions for this Control-Interpolated Learning group met on the same days as did the R-2 group. During the original learning session these Ss took the Terman Concept Mastery Test. At their interpolated learning

TABLE 1

EXPERIMENTAL DESIGN

College Qualification Test Covariate

	E-1 Interpolated "Compare and Contrast"	E-2 Interpolated "Prompting"	E-3 Interpolated "Similar"	E-4 Interpolated "Overlearn"	C-5 Interpolated "Irrelevant"
R-1 (9-day retention interval)					
R-2 (4-day retention interval)					
R-3 (3-day retention interval)					

	C-6 "Compare and Contrast" only	C-7 "Prompting" only	C-8 "Similar" only	C-9 "Overlearn" only	C-10 "Irrelevant" only
Interpolated Learning Control (4-day retention interval)					

TABLE 2

DESIGN SEQUENCE

Day Number		1	2	3	4	5	6	7	8	9	10	11
January (1969)	7-14 Sign-up in Recitation Sections	15	16	17	18	19	20	21	22	23	24	25
Day	T Th	W	Th	F	S	S	M	T	W	Th	F	S
Retention Group 1		OL**		IL***							Test (9-day interval)	
Retention Group 2							OL		IL		Test (4-day interval)	
Retention Group 3								OL		IL	Test (3-day interval)	
Control - Interpolated Learning							TCMT*		IL		Test (Interpolated Learning only)	
Control - Test					TCMT							Test (no treatment)

* TCMT = Terman Concept Mastery Test
** OL = Original Learning
*** IL = Interpolated Learning

session, they each randomly received for study one of the five treatments.

An additional control group was used to establish a no-treatment baseline of performance for Education 200 subjects generally. These Control-Test Ss met twice, on Saturday mornings, one week apart. At their first meeting, they took the Terman Concept Mastery Test. At their second session, they took the retention test.

Procedures

Signup. All students of Education 200 were notified that participation in an experiment was a class requirement. They were offered an opportunity to satisfy the requirement by taking part in this experiment. The alternatives to taking part were worked out on an individual basis between each instructor and the students involved.

Each of the 33 recitation sections of the total class was randomly assigned to one of the three retention intervals planned for the study. Three of the sections were randomly assigned to take part in the Control-Interpolated Learning group.

Subjects signed up on individual signup sheets in their recitation classes. They were given three alternative times for which they could sign up and attend on each of the two study session days and the test session day. Students who found that they had unalterable class conflicts and who still wished to take part rather than do an alternative assignment, were allowed to sign up for two

Saturday morning sessions. It was planned that this Saturday group would be used as the no-treatment, Control-Test group to establish baseline performance on the retention test as it could not be assumed that these sophomore students were naive to the content of the learning materials.

Original Learning Sessions. At the original learning study sessions, Ss were handed booklets for study, one per S. Instructions and procedures for the sessions were printed on the covers of the booklets. Additional comments were given verbally (Appendix A) introducing Ss to the learning task set for them. All Ss were required to remain in the study room for the full 45 minutes of the session.

All study booklets were numbered and each was recovered at the end of the session. Ss were informed however that the booklets would be returned to them to keep, at the close of the experiment. They were instructed that they could make any marks, notes, underlining or highlighting they wished to on the booklets, but were requested to not use any outside materials for note-taking.

The Control-Interpolated Learning group Ss took the Terman Concept Mastery Test instead of studying the original learning materials. Control-Test Ss had no original learning session.

Interpolated Learning Sessions. The five treatment study booklets were randomly ordered in cycles of five, each cycle containing one each of the treatments. The cycles were piled on top of each other and each booklet

was numbered in sequence. The cover of each booklet was color-coded according to the color assigned to the treatment therein. (Canary = E-1 Compare and Contrast; Orange = E-2 Prompting; Green = E-3 Similar; Blue = E-4 Overlearning; Pink = C-5 Irrelevant.)

The study room was divided into five sections, each section color-coded according to the particular treatment group assigned to sit there. Study booklets were passed out in sequence to the subjects who were asked to sit in the section of the room color-coded to the color of their booklets. This entire control procedure was an attempt to minimize comparisons among Ss in differing treatment groups.

Instructions and procedures were again written on the front cover of each study booklet. Verbal instructions similar to those given in the original learning session were given (Appendix A). All Ss were again requested to remain in the study session the full 45 minutes. All booklets were recovered at the end of the study session.

The Control-Test group took the Terman Concept Mastery Test as a warmup exercise.

Test Sessions. Ss were handed a test booklet containing the 36-item test as they arrived at the test session. Instructions and procedures were printed on the covers of the tests. Some additional instructions were given verbally and projected on a screen at the front of the room (Appendix A). At this session, Ss were required only to remain at the session until they had completed

the test. When finished they were allowed to leave, turning in their test booklet and answer sheet. Ss were instructed that the booklets, along with the correct answers would be returned to them at their next recitation class session.

Treatments

All Ss studied the same passage at session one; an exposition of the theory and basic ideas of Stimulus-Response Connectionist learning theory (Appendix C-1). At study session two, the interpolated learning session, each S received one of five randomly distributed treatment materials (Appendix C-2). The basic "kernel" of the interpolated learning materials for the E-1, E-2 and E-3 groups consisted of a 2,100 word essay discussing the basic ideas of cognitively-oriented learning theories. This kernel was very similar in organizational structure to the original learning materials and used the same stimulus elements (as indicated under "Learning Materials") as paragraph headings as did the original learning material.

The five treatments were constructed as follows:

E-1. (Compare and Contrast group) The basic kernel discussing cognitively-oriented learning theories was used. At appropriate points in the prose, indented, single-spaced paragraphs were inserted drawing comparisons and contrasts between ideas expressed in the interpolated learning and ideas expressed in the original learning;

E-2. (Prompting group) The basic kernel discussing cognitively-oriented learning theories was used. At

appropriate points in the prose, indented, single-spaced comments were inserted prompting the Ss to relate the ideas in this new learning material with the positions taken in the original learning. No information discussed in the original learning was transmitted. Ss were merely prompted to make the appropriate relations;

E-3. (Similar group) The basic kernel discussing cognitively-oriented learning theories was used. No further instructions were given.

E-4. (Overlearning group) Ss received material identical to the original learning material. The content was identical to that studied in the original learning; the cover sheets and instructions were relevant to the interpolated learning session.

C-5. (Irrelevant group) Ss received material discussing the pros and cons of the team-teaching concept.

Learning Materials

The learning materials used in this study (Appendix C) were designed with an eye toward the more close specification of what might be considered in a molar way, stimulus and response components within the prose passages involved. They were constructed so that the main points to be considered in the passage were first set out in the form of an outline, and were subsequently used in their identical form as set-off paragraph headings. The majority of these paragraph headings were stated in the form of questions, the responses to which followed immediately in the text.

It is with all due respect to Underwood's (1963) caveat about the distinction between the nominal and functional stimulus that these set-off paragraph headings are dubbed "stimuli" and the text that follows them "responses".* These stimuli were identical in both original learning and interpolated learning. As they formed the organizational outline around which both original learning and interpolated learning were built, it is felt reasonable to say that original learning and interpolated learning were highly similar in structure. As both essays used these same stimuli, to which different responses were to be learned, it is felt reasonable to assume that they were potentially highly confusably similar in content.

Instrumentation

The test instrument used as a measure of retention (see Appendix D) was a 36 item multiple-choice test, each question offering five alternative responses designed to be maximally inhibitory of the correct response. For each of the questions, the responses were constructed so that one foil was correct from the point of view of the

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* There are those who probably applaud from the grave Underwood's capitulation to an admonition that had been made 30 years previously, aimed at users of nonsense syllables (c.f. Bartlett, 1932). If this is a worthy warning to the manipulator of nonsense syllables, surely it must apply as well as a problem in learning experiments using prose materials. Thusly, no suppositions are made about the ultimate functional stimuli or responses thereto. The case is rested with the assertion that to the test-wise college student, a set-off paragraph heading is a tip-off for "something to remember."

Stimulus-Response Connectionist learning theories discussed in original learning sessions, and one foil was correct from the point of view of the Cognitively-Oriented learning theories discussed in interpolated learning sessions. The remainder of the alternatives were wrong from either point of view.

Subjects were instructed to answer all questions from the point of view of the Stimulus-Response Connectionist learning theorists. While it is possible that a few of the Ss failed to heed this instruction it is doubtful that any did not receive it; instruction to that effect was projected on a screen at the front of the room and it appeared twice on the test materials.

It was anticipated that an analysis of responses to those foils correct from the S-R point of view could be used as a measure of retention of original learning. Additionally, it was hoped that an analysis of responses to foils that were correct from the cognitive point of view might give at least a partial measure of retroactive inhibition directly attributable to interpolated learning in those groups that received materials explicating the cognitive point of view.

The first twelve questions of the test were constructed as a special subsection of the test. Ten of the twelve stems used for these questions were identical to the stimuli used as paragraph headings in the original

and interpolated learning materials. It was anticipated that the tight specification of stimulus components and the highly specific nature of their respective response components would hold the most promise for the detection of retroactive inhibition if it were to occur. This subsection of the test was to receive both separate and combined analysis.

The remaining 24 questions (items 13-36) were designed to be less specific and more general in nature. While no specific designation was attempted for each question, as a whole they might more readily be classified as requiring cognitive skills such as analysis and application usually placed higher on scales of abilities (c.f. Bloom, 1956).

Dependent Variables

The main dependent variables used for analysis were number correct for the total test, number correct for subsection 1-12, and number correct for subsection 13-36.

Secondarily, responses to the foils representing the cognitively-oriented point of view and responses to foils representing totally incorrect answers from either the stimulus-response connectionist or the cognitively-oriented point of view, were also used for analysis.

CHAPTER III

DATA AND ANALYSES

In this chapter, the results of all analyses are reported. The major analyses were three-by-five analyses of covariance performed on retention test data using College Qualification Test scores as the covariate. Separate analyses were made of: (1) responses to correct S-R foils for the total-test; (2) responses to correct S-R foils for the specific subsection (items 1-12) of the test; (3) responses to correct S-R foils for the general subsection (items 13-36) of the test; (4) responses to correct cognitively-oriented foils (i.e., responses to foils that were correct from the point of view of the cognitively-oriented interpolated learning for E-1, E-2, and E-3) for the total-test; and (5) responses for the total-test to foils that were incorrect from both the cognitive and the stimulus-response points of view.

Following a discussion of procedures used to bring n's to a more usable proportional form, data relevant to the six original hypotheses will be discussed. Additional analyses not specifically relevant to the hypotheses and data from control groups outside of the main design follow. General conclusions and implications stemming from the results will be discussed in chapter four.

Proportional Adjustments

Despite careful control of group assignment designed to keep cell n's as equal as possible, final retention group n's varied from a low of 220 for R-1 (9 days) to a high of 267 for R-3 (3 days). Individual cell n's varied from 41 to 57 (Table 17a, Appendix B). The groups for the longer retention interval were smaller because late signups were assigned to the other two groups which began treatments later and because the attrition rate was slightly greater over the longer retention interval.

In order to meet requirements for Sheffé post hoc analyses, it was decided to use a random procedure to throw out subjects and achieve proportionality across retention groups and equalization of cell n's within each group.* Cell n's for retention group one (the longest interval) were equalized at n = 41. Cell n's for the other two groups were equalized at n = 48 (Table 17b, Appendix B).

Results Relevant to Hypotheses

Generally, results of ancovas failed to permit rejection of the null hypotheses for all predicted outcomes. The results for the total-test scores are reported in Tables 3-6, and are illustrative of those obtained with the subsection

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* In order to check on the effect of the throw-out procedure on the data, the original data was submitted to the same analyses as was the proportionalized data. Reducing n's to proportionality had negligible effect on cell means. The primary noticeable effect was to reduce the size of the F statistic although it remained highly significant beyond $p < .0005$. It seemed apparent that the reduction in size of the F statistic was caused by the reduced N. Results of these analyses are presented in Appendix B.

TABLE 3

UNADJUSTED CELL AND MARGINAL MEANS
AND STANDARD DEVIATIONS FOR TOTAL-TEST SCORES

	E-1	E-2	E-3	E-4	C-5	
R-1 (9 days)						
$\bar{X}$ =	23.83	22.66	22.44	24.71	22.85	23.30
S =	4.67	5.50	5.16	5.34	4.89	5.14
R-2 (4 days)						
$\bar{X}$ =	21.83	22.42	21.50	25.29	22.67	22.74
S =	5.13	4.79	5.15	4.72	4.61	5.02
R-3 (3 days)						
$\bar{X}$ =	23.83	21.77	20.52	25.48	22.94	22.91
S =	5.73	5.47	5.74	4.37	5.21	5.35
$\bar{X}$ =	23.13	22.26	21.44	25.18	22.82	
S =	5.27	5.23	5.38	4.77	4.88	

TABLE 4

ADJUSTED CELL AND MARGINAL MEANS FOR TOTAL-TEST SCORES

	E-1	E-2	E-3	E-4	C-5	$\bar{X}$
R-1	23.70	22.59	22.43	24.71	22.71	23.23
R-2	22.07	22.26	21.54	25.51	22.59	22.80
R-3	23.85	21.77	20.67	25.67	22.58	22.91
$\bar{X}$	23.19	22.19	21.54	25.28	22.61	

TABLE 5

ANALYSIS OF COVARIANCE TABLE FOR TOTAL-TEST SCORES

Source	SS	df	MS	F	P
Retention Groups	21.86	2	10.93	.513	.599
Treatments	1110.78	4	277.69	13.03	<.0005
Retention S Treatments	176.18	8	22.02	1.03	.409
Covariate	3269.13	1	3269.13	153.44	<.0005*
Error	14253.08	669	21.305		

* r = .414

TABLE 6

PAIRWISE SHEFFÉ CONTRASTS ON ADJUSTED GROUP MEANS FOR TOTAL-TEST

	E-2 $\bar{x}$ = 22.19	C-5 $\bar{x}$ = 22.61	E-1 $\bar{x}$ = 23.19	E-4 $\bar{x}$ = 25.28
E-3 $\bar{x}$ = 21.54	.65	1.07	1.65	3.74*
E-2 $\bar{x}$ = 22.19		.42	1.00	3.09*
C-5 $\bar{x}$ = 22.61			.58	2.67*
E-1 $\bar{x}$ = 23.19				2.09*

* Significant $p < .05$

of specific items and the subsection of general items. Differences among the treatment means were statistically significant by ancova but the Sheffé post hoc analyses indicated that the generally superior performance of the Overlearning group (E-4) accounted for most of the variance. The same results were obtained for the subsections of general and specific items (Tables 18 to 22 of Appendix B). Results relevant to each hypothesis is discussed in turn below.

Hypothesis 1. All E groups will perform better on a retention test than the control group provided only with irrelevant interpolated learning material (C-5).

The only E group that performed significantly better on the retention test than the control was the Overlearning group (E-4). The Similar group receiving conflicting material without guides or prompts (E-3) did consistently, though not statistically-significantly, worse on the retention test than did the Irrelevant group (C-5) which received irrelevant interpolated learning (Table 4). This was the case in all retention intervals. All means of other E groups were consistently better than E-3 groups. While trends were apparently consistent, Sheffé post hoc analyses revealed no statistically significant differences other than those due generally to Overlearning group (E-4) superiority (Table 6).

Hypothesis 2. Interpolated learning that points out, prompts, or provides similarities and differences between

interpolated learning and original learning (E-1, E-2, E-3) will be more effective in facilitating retention than a re-reading of the original learning passage (E-4).

Sheffé post hoc comparisons indicated that the Over-learning group (E-4) which reread the original passage performed significantly better than all groups (E-1, E-2, E-3) which read similar and conflicting interpolated learning (Table 6). This is opposite to the predicted direction.

Hypothesis 3. Interpolated learning, prompting Ss in making comparisons between original and interpolated learning (E-2), will be more effective than interpolated learning that merely provides the potentially comparable information (E-3), or interpolated learning that draws the comparisons and contrasts for the Ss (E-1).

In no case was there a statistically significant difference between any of the E groups with the exception of that provided by E-4. However, there were apparent small but consistent effects due to treatments (Table 4, Figures 1 and 2). These indicated a trend that interpolated learning effects for E-1 were more facilitating than those for E-2 which in turn may have helped to overcome a slight inhibiting effect of E-3.

Hypothesis 4. Specific-factual material (items 1-12) will be retained better over the longer retention interval (R-1) by groups receiving similar interpolated learning (E-1, E-2, E-3) than by groups receiving identical or irrelevant interpolated learning material (E-4, C-5).

There was no evidence that this was the case. Results were similar to those reported to the total-test. The cell means (Table 18, Appendix B) indicated that, if anything, the trend was in the opposite direction. There were no consistent or statistically significant effects due to retention interval (Table 5).

Hypothesis 5. Conceptual material (items 13-36) will show a higher degree of resistence to forgetting than will specific-factual material (items 1-12) across the three retention periods.

No evidence accrued to indicate that this occurred. Only in the Overlearning group (E-4) did there seem to be any difference in the performance between the two subsections of the test (Figure 2). When expressed as average percentage of subsection correct this difference within E-4 performance varied only from 61.0% for the specific subsection as compared with 53.8% correct for the general subsection. Apparently the second reading boosted scores on the specific subsection more than it did on the more general questions. Even this slight trend was not apparent in other treatment groups; they performed equally well on both types of questions.

Hypothesis 6. Ss from lower learning ability groups will perform better under conditions where comparisons and contrasts are explicitly drawn and pointed out (E-1) than they will in groups requiring more self-structuring of material (E-2, E-3).

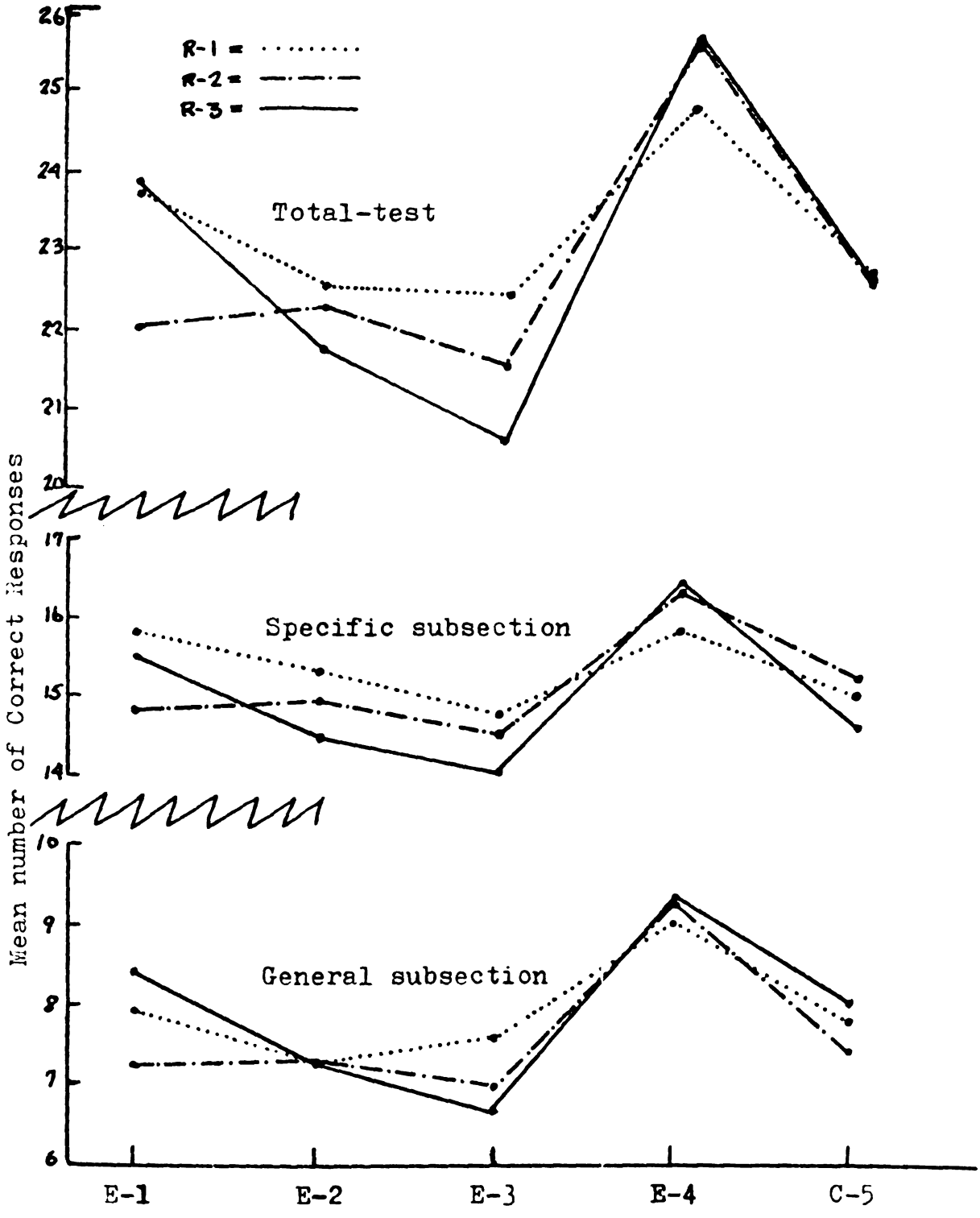

FIGURE 1

ANCOVA CELL MEANS BY TREATMENT GROUPS

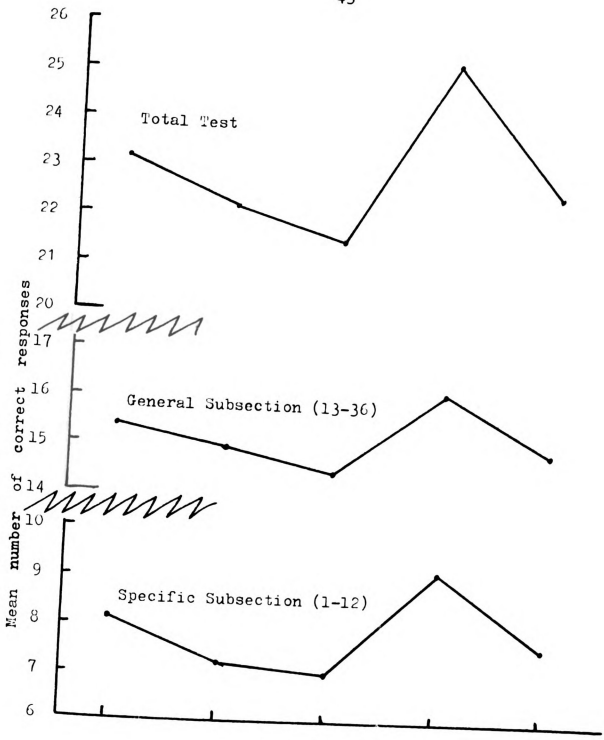

FIGURE 2

ANCOVA TREATMENT MEANS

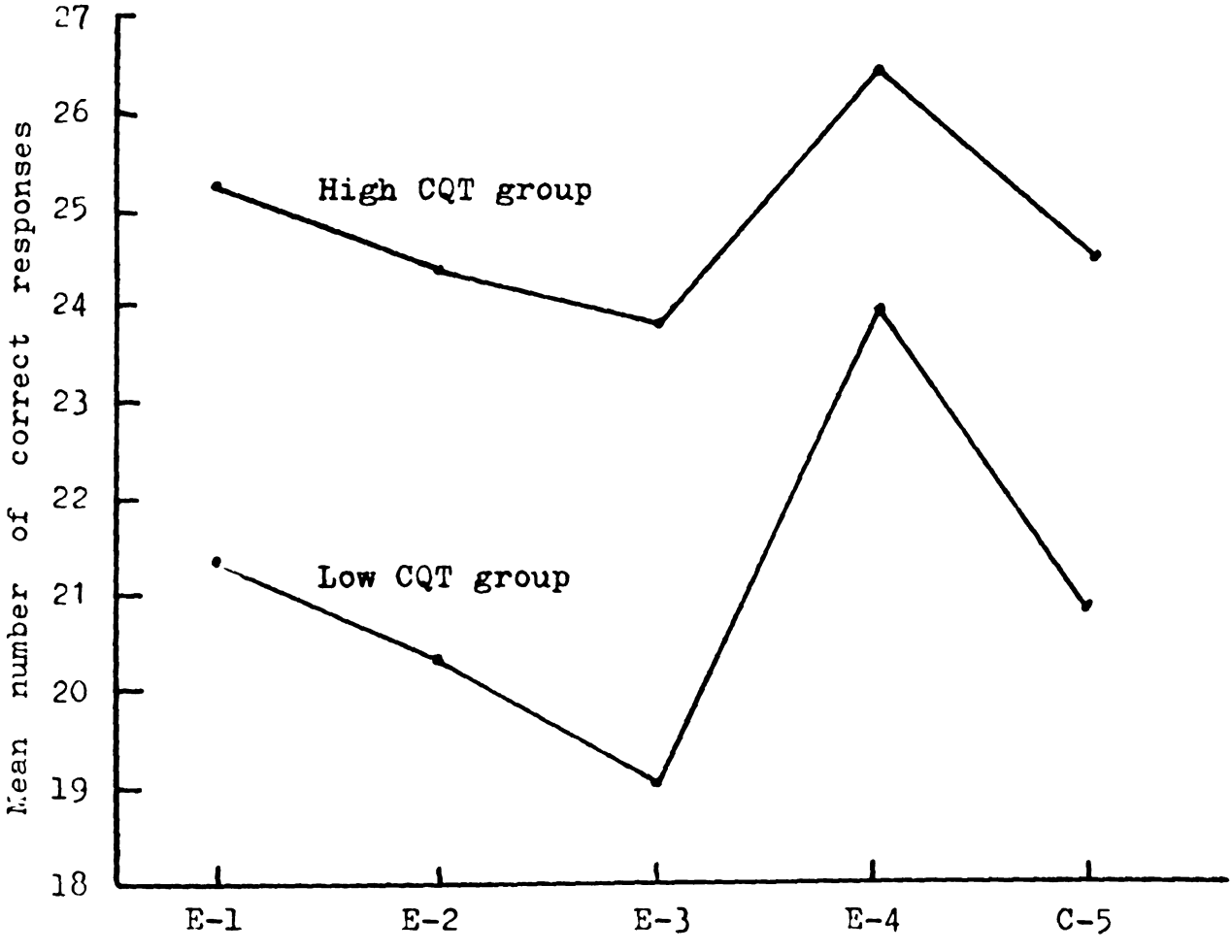

FIGURE 3

TREATMENT MEANS BY HIGH-LOW CQT GROUPINGS (MEDIAN SPLIT)

Although this effect had apparently been demonstrated by Ausubel and Fitzgerald (1962) there was no evidence for any interaction between learning ability and performance on the retention test in the current study. In fact when the population was divided at the median into two groups on learning ability level (as represented by College Qualification Test scores) the only apparent effect was a decrement in scores for the lower level across all groups (Figure 3, Table 27, Appendix B). The correlation between College Qualification Test scores and retention test scores was a respectable $r = .414$ for the total-test.

Results Not Specifically Relevant to Hypotheses

Retention Intervals. The original purpose for the inclusion of varying retention intervals was to investigate the effects of time on the forgetting of specific versus general types of information. As has been reported (Hypothesis 5) no differences were found. Additionally, there was no evidence of any retention interval effect in the total-test analysis previously examined (Table 5) or in the subanalyses (Tables 18-21, Appendix B). This is contrary to what might be expected in light of the forgetting curve usually found in experiments dealing with retention of prose materials. However, given the retroactive design employed in the present experiment, plausible explanations are available. Although none of the variations within retention intervals achieved statistical significance, trends apparent in the data indicative of retroactive inhibition

effects are discussed in chapter four.

Error Responses to Foils. The two types of error foils were: (1) foils correct from the cognitively-oriented interpolated learning studied by the Compare and Contrast group (E-1), the Prompting group (E-2), and the Similar group (E-3); and (2) errors totally incorrect from any point of view expressed in original or interpolated learning.

It was felt that responses to correct cognitively-oriented foils could be considered to be measures of "intrusion" attributable to the interpolated study in the case of E-1, E-2 and E-3. An analysis of covariance performed on responses to these foils indicated that treatment effects achieved statistical significance (Tables 7-9). The differences between means due to these effects seemed to be in the opposite direction from those based on the retention test scores for responses to correct S-R foils (Figure 4).

When these effects were compared with the effects exhibited in the analysis of totally-incorrect foils, (Figure 4, Tables 10-12) it appeared that differences were only partially a function of actual foil content differences. For responses to totally-incorrect foils, treatment effects again exhibited statistical significance in the opposite direction from those appearing in analyses based on responses to correct S-R foils, although differences were apparently not as pronounced (Figure 4).

TABLE 7

UNADJUSTED MEANS AND STANDARD DEVIATIONS FOR TOTAL-TEST RESPONSES TO COGNITIVELY-ORIENTED FOILS

	E-1	E-2	E-3	E-4	C-5	
R-1 (9 days)						
$\bar{X}$ =	4.61	4.90	5.46	4.59	5.56	5.02
S =	2.94	3.53	3.69	3.56	3.23	3.39
R-2 (4 days)						
$\bar{X}$ =	5.21	5.08	6.52	3.40	5.98	5.24
S =	2.97	2.74	4.26	2.43	2.83	3.26
R-3 (3 days)						
$\bar{X}$ =	4.08	5.56	6.31	3.75	5.44	5.03
S =	3.50	3.47	3.38	2.30	3.12	3.30
$\bar{X}$ =	4.64	5.20	6.13	3.88	5.66	
S =	3.17	3.24	3.80	2.80	3.04	

TABLE 8

ADJUSTED CELL AND MARGINAL MEANS FOR TOTAL-TEST RESPONSES TO COGNITIVELY-ORIENTED FOILS

	E-1	E-2	E-3	E-4	C-5	$\bar{X}$
R-1	4.67	4.93	5.48	4.58	5.63	5.06
R-2	5.08	5.18	6.49	3.28	6.01	5.21
R-3	4.07	5.56	6.24	3.66	5.62	5.03
$\bar{X}$	4.61	5.23	6.07	3.84	5.76	

TABLE 9

ANALYSIS OF COVARIANCE TABLE FOR TOTAL-TEST RESPONSES TO COGNITIVELY-ORIENTED FOILS

Source	SS	df	MS	F	P
Retention Groups	4.38	2	2.19	0.239	.787
Treatments	436.62	4	109.16	11.90	<.0005
Retention X Treatments	96.45	8	12.06	1.31	.233
Covariate	934.68	1	934.68	91.00	<.0005*
Error	6136.15	669	9.17		

* r = -.328

TABLE 10

UNADJUSTED MEANS AND STANDARD DEVIATIONS
FOR RESPONSES TO TOTALLY-INCORRECT FOILS

	E-1	E-2	E-3	E-4	C-5	
R-1 (9 days)						
$\bar{X}$ =	7.54	8.32	8.02	6.68	7.56	7.62
S =	3.05	3.82	3.27	3.00	2.79	3.22
R-2 (4 days)						
$\bar{X}$ =	8.81	8.48	7.98	7.19	7.35	7.96
S =	3.89	3.40	2.95	3.60	3.34	3.48
R-3 (3 days)						
$\bar{X}$ =	8.04	8.63	9.10	6.52	7.63	7.98
S =	3.26	3.03	3.84	2.89	3.24	3.36
$\bar{X}$ =	8.16	8.48	8.39	6.80	7.57	
S =	3.45	3.39	3.40	3.18	3.13	

TABLE 11

ADJUSTED CELL AND MARGINAL MEANS FOR RESPONSES TO TOTALLY INCORRECT FOILS (TOTAL-TEST)

	E-1	E-2	E-3	E-4	C-5	$\bar{X}$
R-1	7.60	8.35	8.01	6.68	7.64	7.66
R-2	8.70	8.53	7.96	7.09	7.40	7.94
R-3	8.03	8.63	9.03	6.43	7.80	7.98
$\bar{X}$	8.12	8.52	8.35	6.74	7.62	

TABLE 12

ANALYSIS OF COVARIANCE TABLE BASED ON RESPONSES TO FOILS WHICH WERE TOTALLY INCORRECT

Source	SS	df	MS	F	P
Retention Groups	13.35	2	6.68	.680	.507
Treatments	276.5	4	69.13	7.04	<.0005
Retention X Treatments	64.2	8	8.03	.817	.588
Covariate	794.7	1	794.7	80.9	<.0005*
Error	6571.6	669	9.823		

* r = -.321

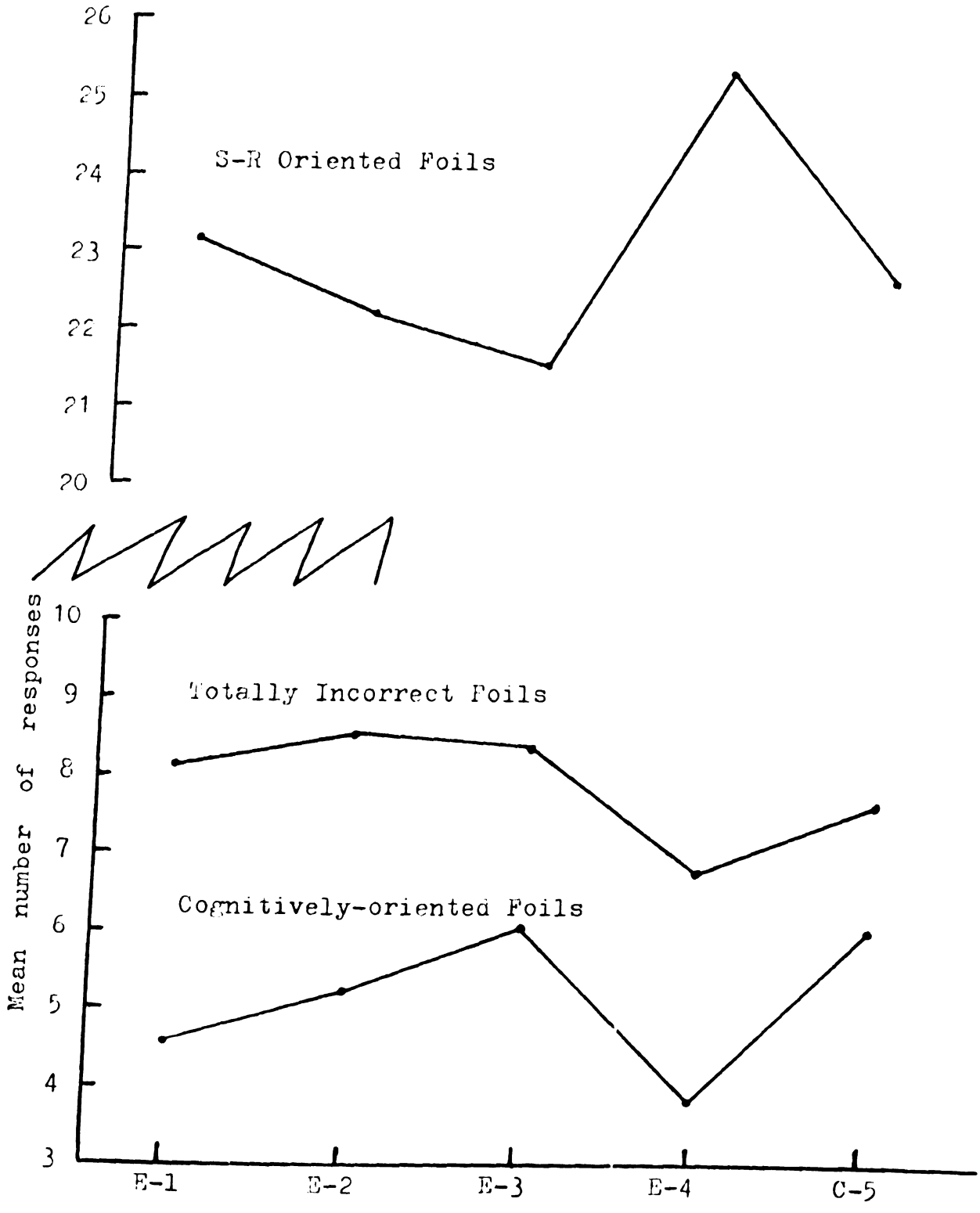

FIGURE 4

MEAN RESPONSES BY FOILS

An additional comparison was made of the differential popularity of the three types of foils across test subsections by computing means and average percentages of response by treatment groups (Table 24, Appendix B). Foil popularity differed generally from that achieved by the Control-Test group, (C-Test) but among E groups it varied only as a result of the superior performance of E-4. Foil differences appeared to be only minimally effective.

Control Groups. One of the major criticisms of previous experiments attempting to show retroactive facilitation was that the possible facilitative effects of interpolated learning could not be ruled out as a factor affecting results. In the present study, five Control-Interpolated Learning (C-IL) groups investigating the effect of each interpolated learning condition were set up and an analysis of covariance was performed on the resulting data (Tables 13-15). Treatment effects achieved significance. Treatment means are presented in Tables 13-14 and reproduced graphically in Figure 5. Pairwise Sheffé contrasts for these data are presented in Table 16. Results of these analyses indicated greater treatment differences than achieved in the main design.

The no-treatment Control-Test group (C-Test) set up to assess base level of performance achieved an overall mean of 14.79. This was substantially different from chance performance of 7.2 ($p < .01$).

Retention Test Characteristics. Statistics from item

TABLE 13

UNADJUSTED MEANS AND STANDARD DEVIATIONS
FOR CONTROL-INTERPOLATED LEARNING GROUPS (C-IL)

C-6	C-7	C-8	C-9	C-10
n = 15	n = 13	n = 18	n = 14	n = 14
$\bar{X}$ = 21.00	$\bar{X}$ = 17.00	$\bar{X}$ = 13.28	$\bar{X}$ = 22.36	$\bar{X}$ = 12.00
S = 5.81	S = 4.83	S = 4.61	S = 5.10	S = 4.80

TABLE 14

ADJUSTED TREATMENT MEANS FOR CONTROL-INTERPOLATED LEARNING (C-IL) GROUPS

C-6	C-7	C-8	C-9	C-10
n = 15	n = 13	n = 18	n = 14	n = 14
$\bar{x}$ = 21.00	$\bar{x}$ = 17.00	$\bar{x}$ = 13.34	$\bar{x}$ = 22.64	$\bar{x}$ = 12.42

TABLE 15

ANALYSIS OF COVARIANCE OF CONTROL-INTERPOLATED LEARNING (C-IL) GROUPS

Source	SS	df	MS	F	P
Between	1195	4	298.75	12.066	$<.01$
Within	1684	68	24.76		
Total	2879	72	39.99		

TABLE 16

PAIRWISE SHEFFÉ CONTRASTS ON ADJUSTED TREATMENT GROUP MEANS FOR CONTROL-INTERPOLATED (C-IL) LEARNING GROUPS

	C-8 $\bar{x}$ = 13.34	C-7 $\bar{x}$ = 17.00	C-6 $\bar{x}$ = 21.00	C-9 $\bar{x}$ = 22.64
C-10 $\bar{x}$ = 12.42	.92	4.58	8.58*	10.22*
C-8 $\bar{x}$ = 13.34		3.70	7.66*	9.30*
C-7 $\bar{x}$ = 17.00			4.00	5.64
C-6 $\bar{x}$ = 21.00				1.64

* Significant $p < .05$

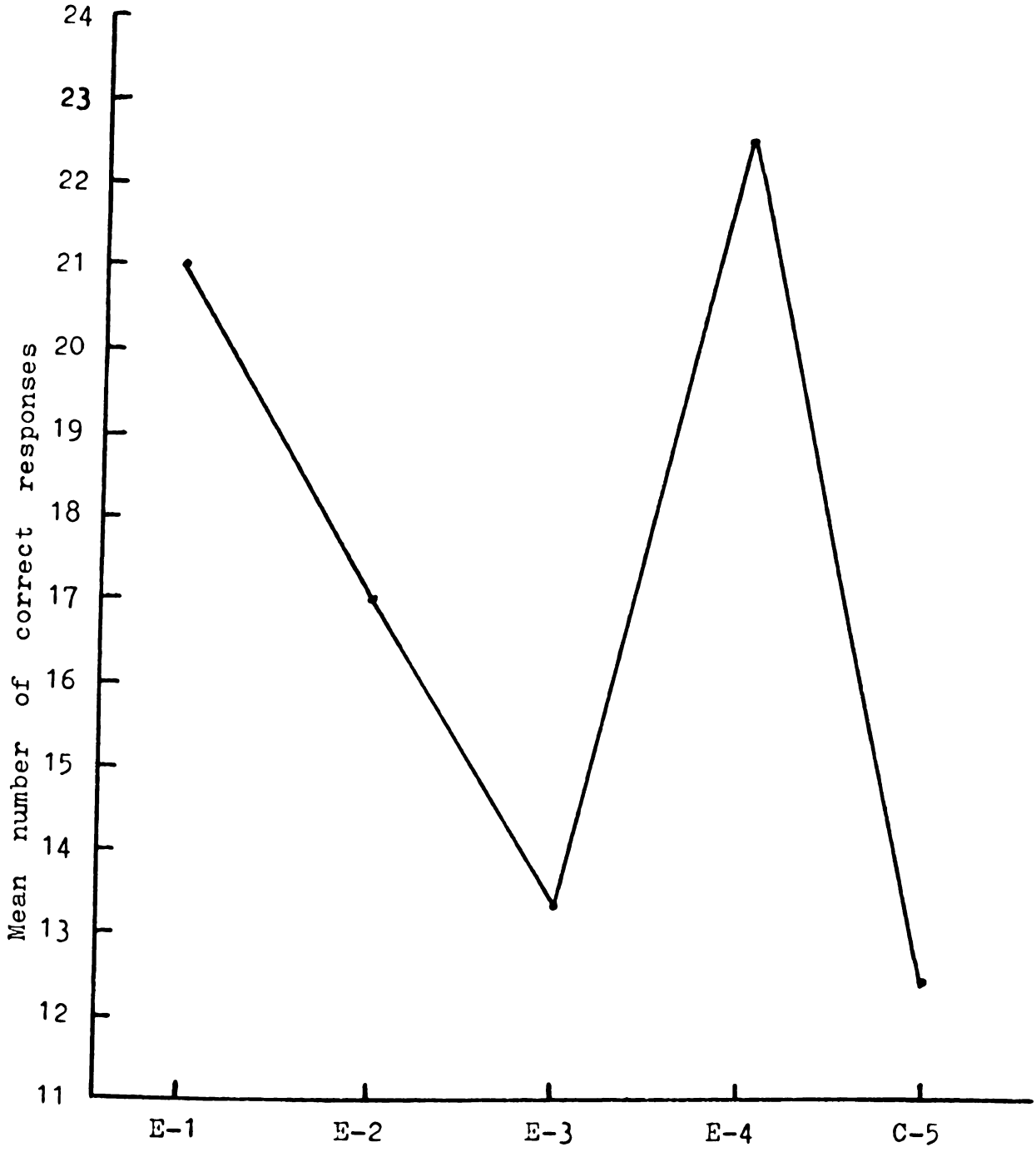

FIGURE 5

ANCOVA TREATMENT MEANS OF INTERPOLATED LEARNING CONTROL GROUPS (C-IL)

analyses performed on the total test and on the specific subsection (items 1-12) are given in Appendix E. Both the total-test and the specific subsection achieved respectable split-half reliability coefficients (KR #20) of .81 and .73 respectively. Item difficulty indices (i.e., percentage of wrong answers) for the total-test ranged from 9-77 with a mean of 38. There were no negatively discriminating items.

CHAPTER IV

DISCUSSION AND IMPLICATIONS

As was reported in chapter three, results did not permit rejection of the null hypotheses for all hypothesized outcomes. No evidence was found for retroactive facilitation even when Ss were guided to make comparisons and contrasts between original and interpolated learning. This was true for the test as a whole and for both subsections of the test over all retention intervals. Nevertheless, the consistency of some of the trends appearing in the data did allow for speculation, especially when viewed in relation to results of other recent studies.

The discussion which follows is directed toward: (1) the theoretical question of inhibition versus facilitation in meaningful learning; (2) reasons for the failure to find retention interval effects; (3) the lack of effects that could be attributed to foil differences; and (4) the relatively large differences found in Control-Interpolated Learning groups. Finally, some possible implications for further research are discussed.

Retroactive Inhibition Versus Facilitation

The failure to demonstrate retroactive facilitation indicated above is at deviance with results reported by

Ausubel, Robbins, and Blake (1957) and Ausubel, Stager, and Gaite (1968), but is completely in line with later evidence reported since the inception of this current study (see Addendum p. 19). An examination of the mean scores of all three studies reported in January 1969 (Ausubel, Stager, and Gaite, 1969; Gaite, Ausubel, and Stager, 1969; Shuell and Hapkiewicz, 1969) indicated that in each case where a retroactive design was used, uninstructed groups with interpolated learning that was similar and conflicting in content showed a decrement in retention test scores when compared with groups reading a non-similar passage that was consistent, but not statistically significant. The same slight but not statistically significant results occurred in the present study; each of six groups, in three retention intervals, which read interpolated learning that was similar to original learning and received no further information about original learning (i.e., E-3 and E-2) showed a decrement in retention test scores when compared with a control group reading irrelevant material.

It should further be pointed out that as would be predicted by interference theory (c.f. Underwood, 1948) retroactive inhibition seemed to decline over time causing scores to improve from a low in the short retention interval to a high in the long retention interval. Underwood reported data from paired-associate retention studies which indicated a similar improvement in performance after a 48-hour retention interval as compared with performance after a 5-hour

retention interval.* In the present study, in both the Similar (E-3) condition and the Prompting (E-2) condition, mean scores consistently improved as retention interval increased from 3 days to 4 days, to 9 days (Table 4, Figure 1). Both of these treatment conditions parallel the usual retroactive inhibition design. However, in the Compare and Contrast (E-1) condition where additional information was given as an aid in remembering original learning no consistent improvement occurred; in the Irrelevant and the Overlearning groups (C-5 and E-4), where no retroactive inhibition was anticipated, no consistent improvement occurred.

One further inconclusive bit of evidence for retroactive inhibition occurred in the analysis of responses to cognitive foils. Responses to these foils represented choices of foils that were correct from the point of view expressed in interpolated learning, thus errors of this type were analogous to "intrusion errors" reported in rote-learning paired-associate studies (c.f. Underwood, 1948). Sheffé contrasts of the treatment group means to these foils revealed that the Similar group in which maximum retroactive inhibition was to be expected had significantly more intrusion errors when compared with both the Compare and Contrast (E-1) and the Overlearning (E-4) groups (Table 23a). However,

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* Underwood (1948) defined his retention interval as that period between interpolated learning and test. Given that definition, the corresponding intervals in the present study would be R-1, 7 days; R-2, 48 hours; R-3, 24 hours.

it must be pointed out that to some degree, differences appeared to be a function of the makeup of the foils themselves, as a similar but not quite as differentiated pattern emerged in the analysis of totally incorrect foils (Table 23b, Figure 4).

In summary, the evidence for a retroactive inhibition phenomenon that would be predicted by interference theory seemed consistent though not statistically significant in this study and in other recent studies. In contrast, the evidence for retroactive facilitation, as would be predicted by Ausubel's theory of meaningful verbal learning, seemed to be shaky at best and could probably be attributed to chance effects or to the inadequate control over possible facilitative effects of the interpolated passage in the two experiments in which it occurred. This latter explanation is especially useful in interpreting the apparent facilitation found in Ausubel, Robbins, and Blake, (1957) as it was limited to groups that read an interpolated passage that actually drew comparisons and contrasts for the subjects. In the same experiment, the mean score for the group that read material "confusably similar" in content was lower than a control. In the present study, providing the learner with comparisons and contrasts between original learning and interpolated learning also tended to facilitate retention. Again, the differences suggesting this trend were not statistically significant.

Retention Interval Effects

One curious result of the present experiment was the failure to find any differences in amount of retention due to variations in retention interval (Tables 4 and 5, Figure 1). As was mentioned in chapter three, this would have been an unexpected result were it not for the retroactive design employed. However, given the retroactive design there are numerous possible explanations. One might be that the time between original learning and interpolated learning was already too great at the three-day interval to detect any differences due to longer intervals. While meaningful prose learning has been shown to be far more resistent to forgetting than non-meaningful memorization learning, (Ausubel, 1968) this remains a possible explanation.

Overlearning of the original learning and interpolated learning materials remains as another possible explanation. Means in the Irrelevant (C-5) condition, where there were no interfering or confounding variables due to similarity, prompting, or guiding, were almost identical. This seems to point to overlearning as a possible cause of the failure to find differences due to retention interval. Learning sessions were of sufficient duration (45 minutes) to permit overlearning of the 2,100 word original learning passage. While no specific data was kept, it seemed apparent in the observation of the learning sessions and in inspection of the learning materials that many Ss read and reread the materials, sometimes making outlines of the entire passage.

Other Ss read the materials once or twice and used the remainder of the period for study of other class materials. (No attempt was made to control this behavior). In any case it seemed that the time allowed was sufficient for almost all Ss to read the material at least twice if they desired to.

Another interpretation of the failure to find retention interval effects might be made by a group of interference theorists who have postulated a two-factor (i.e., both unlearning and interference mechanisms) theory of forgetting (Melton and Irwin, 1940; Melton and VonLackum, 1941; Hovland, 1951). Given the operation of both of these mechanisms, it might be postulated that as original learning lost strength over the retention period due to unlearning the continuing loss of retroactive inhibition strength would cancel out the decrement in performance that might otherwise have been expected. However, as has already been pointed out, in the comparison of the Similar group to the Irrelevant group which represents the usual retroactive inhibition comparison, retroactive inhibition effects indicated a consistent trend toward decline in strength from a high in the R-3 (3 days) condition to a low in the R-1 (9 days) condition.

Effects of Foil Differences

As has been indicated earlier, one foil per question was correct from the point of view expressed in interpolated learning for groups reading similar materials (E-1, E-2,

and E-3). It might have been predicted from a retroactive inhibition point of view that Ss receiving interpolated learning on which cognitively-oriented foils were based would show a greater propensity toward that type of foil than would Ss not reading cognitively-oriented interpolated learning. No statistical analyses were performed on these data other than the Sheffé comparisons already discussed, however, judging solely on percentages of response to incorrect foil types it would appear that cognitively-oriented foils were just as popular with groups receiving irrelevant interpolated learning (C-5) as they were among groups receiving cognitively-oriented interpolated learning. Among Ss receiving no treatment at all, cognitively-oriented foils were almost as popular as totally-incorrect foils, although there were three times as many of the latter. Apparently even among these relatively naive Ss the cognitively-oriented foils were highly attractive in spite of a lack of study in this area. Ss receiving cognitively-oriented interpolated learning, which pointed out comparisons and contrasts between S-R and cognitively-oriented theories, seemed to reject cognitively-oriented foils slightly more frequently. (Analyses for these data are in Appendix F).

Control-Interpolated Learning Groups

Perhaps the most striking effects reported herein occurred in the means of the separate Control-Interpolated Learning groups (C-IL) set up to assess the facilitative effect of the interpolated learning. Table 14 presents

treatment group means which are graphically portrayed in Figure 5. Pairwise Sheffé contrasts among treatments are presented in Table 16.

Subjects in these control groups who were exposed to verbal materials irrelevant to the content of the test (C-10) achieved a mean score of 12.4. This was significantly different from the chance level of 7.2 ($p < .01$) but did not vary significantly from the mean of 14.79 achieved by the no-treatment Control-Test group. This similar and consistent non-chance performance by Ss who did not study relevant materials could indicate in part a bias in the test instrument itself and/or it may reflect the Ss previous exposure to S-R learning theory. In any case the non-naive quality of Ss performance varied only slightly whether receiving no treatment or totally irrelevant verbal materials.

The control group which studied the original learning (C-9) scored at the same level (22.6) as did Ss who read the original learning materials in the main experimental groups ($\bar{X} = 22.98$). Apparently the original learning passage had a consistent effect on the performance of Ss which was significantly different from no treatment or irrelevant treatment.

The comparison of these groups which read the original learning with the three Control-Interpolated Learning groups which read the kernel discussing cognitively-oriented learning theories was striking. The mean for Ss who read

only the kernel passage presenting cognitively-oriented views (C-8) was similar (13.3) to that of Ss who received no treatment or irrelevant treatment. Reading the cognitively-oriented passage did not affect their already non-naive scores although it would seem that information from it could at least have been used to eliminate incorrect test foils.

On the other hand, Ss who read that same interpolated learning kernel passage, but with very brief comparison and contrast insertions (C-6), scored almost as well (21.0) as did Ss who actually read the passage on which the test was based (C-9). This result could perhaps be explained as totally the result of the encapsulated insertions if one is willing to believe that these were enough to stimulate Ss memory of facts in a course taken a year or more ago. However, seen in relation to the performance of the group given the kernel passage and merely prompted to compare it with what they had learned earlier about S-R learning theory (C-7) a different interpretation seems more relevant. The performance of this C-7 group fell mid-way between the performance of C-6 and C-8. While it was not statistically-significantly different from either of these extreme groups, it occupied the same position relative to C-6 and C-8 as did its counterpart in the main design (E-2) to the groups in the main design which read the same materials (E-1 and E-3).

Precisely the same trends which occurred in the results of the main analysis (Figure 2) occurred in an exaggerated fashion in these control results (Figure 5). While they were not statistically significant in the main analysis where all Ss studied the original learning, many are significant in this control group which did not study the original learning materials on which the test was based.

In attempting to explain these results it is important to remember that these subjects were not naive to the ideas expressed in the original learning. Almost all had taken part in an introductory psychology course in which the basic tenets of S-R connectionist learning theory were explored, one or more years previous to their taking part in the present experiment.

Seen in this light it is not unreasonable to suppose that prompting and guiding Ss to make cognitive manipulations relating interpolated learning to original learning has some facilitative effect on memory of original learning. Shuell and Hapkiewicz (1969) gave Ss interpolated learning study instructions to compare it with the previously learned original learning and obtained facilitative effects which were not statistically significant. In that study interpolated learning followed original learning immediately. In the present study the retention interval was two days in the main design and, effectively, a year or more in the Control-Interpolated Learning group.

It appears that the failure to gain statistical

significance in the main experiment was not due to the lack of facilitative effects of prompting and/or guiding but because knowledge of S-R learning theory was already refreshed by the studying of the original learning material and thereby brought to a reasonably high level of strength. In the control group it is clear that much of the memory of S-R learning theory had fallen below recognition level (C-10). Provision of conflicting material (C-8) had little or no effect on this previous learning, but the prompting, or at least the guiding, of Ss in making relevant comparisons while reading the conflicting material was a reasonably effective means of restoring that previous learning to above recognition threshold while learning additional new material.

Implications for Further Research

Retroactive Inhibition. As has already been indicated, recent studies of learning reported in the literature using conflicting interpolated learning material in retroactive designs all showed small decrements in performance. Similar groups provided with guidance and/or instructions in how to relate the materials have usually shown small increments in performance. There is, however, little statistically significant evidence reported in either direction. It appears that it is difficult to parcel out the effects of similarity in isolation from the effects of structure (i.e., the innumerable inter-associations) built up in the learning of prose materials. Nevertheless, the consistent decrements in performance due to similarity of materials

seem to point toward the possibility of identifying retroactive inhibition as one of the causes of forgetting in prose learning.

Shuell et. al. (1969) in discussing their statistically non-significant findings, commented that "topical similarity" may be too general a factor to influence retention in the same way as when similarity is varied more specifically (as with studies of verbatim recall and paired-associate learning). In the present study an attempt was made to create structurally similar original learning and interpolated learning passages and to isolate stimulus and response elements in both sets of prose materials in an attempt to increase the possibility for retroactive inhibition were it to occur. The results were not statistically significant. However, it may be possible to increase retroactive inhibition effects, if they exist, by even more tightly specifying stimulus and response components in the materials while still retaining the basic properties of prose.

Total Learning. In light of the results of the Control-Interpolated Learning group relative to the results achieved in the main design, it appears that "total-learning" is a dependent variable that should be investigated. By total-learning is meant the total effect on the learning achieved in both sessions, interpolated as well as original. It would seem that, theoretical considerations aside, the effect of similarity and/or prompting and guiding on this

total-learning would be of more practical significance for curriculum sequencing practices than a measure solely of retroactive effects on original learning.

It appears, especially in the case of the Control-Interpolated Learning groups, that original learning was enhanced with only minimally more effort in the form of reading and/or cognitive manipulation of the materials learned. What effect this enhancement had in this case on the total-learning can only be surmised. Perhaps requiring Ss to cognitively interact the two positions resulted in a general increment in both sets of learning when compared with groups learning both positions in relative isolation. If an overall increase in learning can be shown, one of the main postulates of Ausubel's theory will be borne out; the principle of integrative reconciliation. This principle suggests that it is vital to the maximization of learning that new learning be consistently related to that which has already been learned. Ausubel suggests that the carrying out of this structuring of learning material is in a large part the responsibility of those in charge of guiding the learning, i.e., teachers, curriculum designers, textbook authors, etc. This point of view is to some degree at variance with current practices of instruction in which teaching of one topic is often carried out in isolation from other topics and it is left to the learner to integrate them.

Ausubel's (1963) theory would predict that guiding Ss

to build relational structures tying original learning and interpolated learning together logically, would enhance learning and retention of both original learning and interpolated learning. Interference theorists would probably not predict facilitation over and above the learning of the two positions independently without reference to each other---or would perhaps predict slight inhibition of both original learning and interpolated learning due to interference.

Recall Versus Recognition. The results of the present experiment may be in part a function of the multiple-choice method used in testing Ss on information retained. Recognition tests generally have been shown to be less sensitive to differences in retention than recall types of tests (Postman, 1952). It would be possible to generate recall-type test items that, although directed toward one position, could be logically answerable from information in both the original and the interpolated learning. Perhaps a test of this more sensitive type would uncover retroactive inhibition effects. A study by Hall (1955) attempted a relatively similar approach and failed to achieve significant retroactive inhibition though group means again were in the predicted direction.

Control Differences. Some follow-up should be made attempting to parcel out the variables which produced the variations in performance among the Control-Interpolated Learning groups. It might be possible to scale degree of

learning of original learning on a continuum from totally naive, through below recall and recognition threshold, to overlearning. It would then be possible to investigate the influences of prompting and guiding as they operate at these various levels of learning. Measures of total-learning as well as independent measures of retention of original learning and interpolated learning could be taken.

Forgetting of learned prose material occurs. It is apparent that it is of a slightly different sort, or at least more complex than is the forgetting of rotely-learned materials. In discussing this complexity, it is possible to use Ausubel's concept of subsumption in its various structural forms, as well as to talk about interference theory mechanisms such as retroactive and proactive inhibition. The interactions of these and possibly other variables in meaningful learning await uncovering by further research.

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APPENDIX A

VERBAL AND SLIDE PROJECTED INSTRUCTIONS

VERBAL INSTRUCTIONS TO ORIGINAL LEARNING SESSIONS

((To be read to Ss when present))

Welcome to the learning laboratory. This is the first of three sessions you are signed up for. In each of the first two sessions you will be studying an article about some facet of educational psychology.

You will not all read exactly the same material. The differences in the articles are planned. We are trying to find the best way of presenting written material to make it easy to learn and remember. The material is not easy, but you can master it if you concentrate.

Please do not use your books or any other paper while you are studying here. Use only the booklet you have been given. You can write, highlight or outline on this booklet as you wish. It will be collected today at the end of the session, but it will be given back to you in your recitation class.

Be sure to carefully read the instructions on the cover page. You have 45 minutes to study. Begin now.

((Study period, 45 minutes))

Our time is up for today. Make sure your name and your instructor's name is on your booklet. Be sure to drop it in the box by the door when you leave. It is our record of your having attended.

See you for session two in a few days.

VERBAL INSTRUCTIONS TO INTERPOLATED LEARNING SESSIONS

((To be read to Ss when present))

Welcome to the second session of the learning laboratory. You are seated in sections because each color represents a different set of materials. As you can see there are five different versions, each slightly different from the other. We are trying to see which version is easiest for students to learn and remember.

This is another study session. You will have 45 minutes to learn the material you have today. Please do not use your books or any other paper while you are studying here. Use only the booklet you have been given. You can write, highlight or outline on this booklet as you wish. It will be collected today and returned to you in your recitation class.

Be sure to carefully read the instructions on the cover page. You have 45 minutes. Begin now.

((Study period, 45 minutes))

Our time is up for today. Make sure your name and your instructor's name is on your booklet. As you leave be sure to drop your booklet in the box coded with the same color as your cover. It is our record of your having attended.

We'll see you at your next session.

VERBAL INSTRUCTIONS TO CONTROL (C-IL) SESSION

((Terman materials are set up ready to be passed out))

Welcome to part one of the learning laboratory. We are trying to look more closely at the learning and remembering process so that we can find better ways of structuring materials to make them easier to study and learn.

For your first session, you will be taking a standardized test on concept formation. In your next session you will be asked to read and study a passage that you will later be tested on.

All right, let's begin.

((Go through standardized Terman Concept Mastery Test instructions))

VERBAL INSTRUCTIONS TO RETENTION TEST SESSION

((Ss receive a copy of the test and an IBM answer sheet as they file in the test room))

Today you will be taking a test based on the information you studied in your first sessions.

Before we begin, be sure to fill in your name, student number, sex, and Education 200 instructor's name on your answer sheets.

On questions 1-36 of the test, select the foil that best corresponds to the point of view of the Stimulus-Response Connectionist Learning theorists. The remaining questions are only for those people who read the passage on "Team Teaching".

Be sure to read the instructions projected at the front of the room and those on the cover of your test booklet. Good luck and thanks for your cooperation.

RETENTION TEST INSTRUCTIONS PRESENTED IN TEST ROOM BY OVERHEAD PROJECTOR AT BEGINNING OF SESSION

EDUCATION 200

LEARNING LABORATORY

TODAY'S SESSION IS DEVOTED TO A TEST.

PLEASE TAKE ALTERNATE SEATS.

NO TALKING PLEASE.

FILL IN NAME, STUDENT NUMBER, (CODED AND WRITTEN) SEX, AND YOUR INSTRUCTOR'S NAME.

ANSWER QUESTIONS 1-36 ACCORDING TO THE POINT OF VIEW OF THE STIMULUS-RESPONSE CONNECTIONIST LEARNING THEORISTS.

RETENTION TEST INSTRUCTIONS PRESENTED IN TEST ROOM ON OVERHEAD PROJECTOR DURING TEST-TAKING

BEFORE LEAVING....

1. BE SURE YOUR NAME AND STUDENT NUMBER ARE ON <u>BOTH</u> YOUR ANSWER SHEET AND YOUR TEST BOOKLET.

2. TURN IN <u>BOTH</u> YOUR TEST BOOKLET AND YOUR ANSWER SHEETS SEPARATELY IN THE BOXES PROVIDED BY THE DOOR. THEY ARE OUR ATTENDANCE RECORD.

3. IF YOU WOULD LIKE TO KNOW NEXT WEEK HOW YOU DID ON THIS TEST, YOU MUST MARK YOUR ANSWERS ON YOUR TEST BOOKLET. YOUR RECITATION INSTRUCTOR WILL GET BACK YOUR TEST BOOKLET AND THE CORRECT ANSWERS.

THANKS FOR YOUR COOPERATION. MOST OF YOU HAVE REALLY BEEN WONDERFUL.

APPENDIX B

SUPPLEMENTARY TABLES AND ANALYSES

TABLE 17

PROPORTIONAL ADJUSTMENT

17a. Cell and marginal n's before proportional adjustment

	E-1	E-2	E-3	E-4	C-5	Σ
R-1	47	41	41	46	45	220
R-2	53	48	51	57	52	261
R-3	49	56	54	51	57	267
Σ	149	145	146	154	154	748

17b. Cell and marginal n's after proportional adjustment

	E-1	E-2	E-3	E-4	C-5	Σ
R-1	41	41	41	41	41	205
R-2	48	48	48	48	48	240
R-3	48	48	48	48	48	240
Σ	137	137	137	137	137	685

TABLE 18

ADJUSTED CELL AND MARGINAL MEANS FOR SPECIFIC SUBSECTION[a] (1-12)

	E-1	E-2	E-3	E-4[b]	C-5	$\bar{X}$
R-1	7.88	7.25	7.64	8.93	7.73	7.89
R-2	7.24	7.29	6.96	9.23	7.37	7.62
R-3	8.34	7.25	6.64	9.30	7.97	7.90
$\bar{X}$	8.14	7.26	7.07	9.15	7.68	

[a] Mean differences are significant by ancova with $p<.0005$.

[b] Generally superior to other groups by Sheffé test with $p < .05$.

TABLE 19

ANALYSIS OF COVARIANCE TABLE FOR SPECIFIC SUBSECTION (1-12)

Source	SS	df	MS	F	P
Retention Groups	12.04	2	6.02	1.31	.270
Treatments	360.59	4	90.15	19.65	<.0005
Retention X Treatments	51.95	8	6.49	1.42	.186
Covariate	472.73	1	472.73	103.06	<.0005 *
Error	3068.67	669	4.587		

* $r = .341$

TABLE 20

ADJUSTED CELL AND MARGINAL MEANS FOR GENERAL SUBSECTION[a] (13-36)

	E-1	E-2	E-3	E-4[b]	C-5	$\bar{X}$
R-1	15.82	15.34	14.79	15.78	14.98	15.34
R-2	14.84	14.97	14.59	16.28	15.22	15.18
R-3	15.51	14.52	14.03	16.37	14.61	15.01
$\bar{X}$	15.38	14.94	14.46	16.13	14.93	

[a] Mean differences are significant by ancova with $p<.0005$.

[b] Generally superior to other groups by Sheffé test with $p < .05$.

TABLE 21

ANALYSIS OF COVARIANCE TABLE FOR GENERAL SUBSECTION (13-36)

Source	SS	df	MS	F	P
Retention Groups	12.38	2	6.19	6.55	.520
Treatments	215.12	4	53.78	5.69	<.0005
Retention X Treatments	57.59	8	7.20	.762	.637
Covariate	1255.57	1	1255.57	132.91	<.0005*
Error	6319.94	669	9.4468		

* r = .398

TABLE 22

PAIRWISE SHEFFÉ CONTRASTS ON ADJUSTED TREATMENT GROUP MEANS FOR SPECIFIC AND GENERAL SUBSECTIONS

22a. Responses to correct S-R foils for specific subsection (1-12)

	E-2	C-5	E-1	E-4
E-3	0.19	0.63	0.76	2.10*
E-2		0.44	0.57	1.92*
C-5			0.13	1.48*
E-1				1.35*

* Significant $p < .05$

22b. Responses to correct S-R foils for general subsection (13-36)

	E-2	C-5	E-1	E-4
E-3	0.44	0.48	0.91	1.70*
E-2		-0.04	0.47	1.26*
C-5			0.43	1.22*
E-1				0.79

* Significant $p < .05$

TABLE 23

PAIRWISE SHEFFÉ CONTRASTS ON ADJUSTED TREATMENT GROUP MEANS FOR RESPONSES TO ERROR FOILS

23a. Responses to correct cognitive foils (total-test)

	E-2	C-5	E-1	E-4
E-3	0.84	0.33	1.48*	2.29*
E-2		0.51	0.65	1.45*
C-5			1.15*	1.96*
E-1				0.80

* Significant $p < .05$

23b. Responses to totally incorrect foils (total-test)

	E-2	C-5	E-1	E-4
E-3	0.19	0.74	0.21	1.62*
E-2		0.93	0.40	1.81*
C-5			0.53	0.88
E-1				1.40*

* Significant $p < .05$

TABLE 24

ANALYSIS OF INCORRECT RESPONSE TYPES EXPRESSED AS MEANS AND AVERAGE PERCENTAGES OF INCORRECT RESPONSES WITHIN TREATMENT GROUP

		E-1	E-2	E-3	E-4	C-5	C-Test
Incorrect foils giving correct cognitive view	$\bar{X}$=	4.61	5.23	6.07	3.84	5.76	10.12
		(36.3%)	(38.2%)	(42.2%)	(36.2%)	(43.0%)	(47.8%)
Totally incorrect foils	$\bar{X}$=	8.12	8.52	8.35	6.74	7.62	11.06
		(63.9%)	(62.2%)	(58.0%)	(63.6%)	(56.9%)	(52.2%)

TABLE 25

ANALYSIS OF RESPONSES TO TYPES OF FOILS EXPRESSED AS MEANS AND AVERAGE PERCENTAGES OF TOTAL RESPONSE WITHIN TREATMENT GROUP

		E-1	E-2	E-3	E-4	C-5	C-Test
Correct S-R foils	$\bar{X}$=	23.19	22.19	21.54	25.28	22.61	14.79
		(64.4%)	(61.6%)	(59.8%)	(70.2%)	(62.8%)	(41.1%)
Incorrect foils giving correct cognitive view	$\bar{X}$=	4.61	5.23	6.07	3.84	5.76	10.12
		(12.8%)	(14.5%)	(16.9%)	(10.7%)	(16.0%)	(28.1%)
Totally incorrect foils	$\bar{X}$=	8.12	8.52	8.35	6.74	7.62	11.06
		(22.6%)	(23.7%)	(23.2%)	(18.7%)	(21.2%)	(30.7%)

TABLE 26

MEAN RESPONSES AND AVERAGE PERCENTAGES OF RESPONSE TO FOIL TYPES BY TEST SUBSECTION FOR NO-TREATMENT CONTROL GROUP (C-TEST)

		Specific Subsection (1-12)	General Subsection (13-36)	Total Test
Correct S-R foils	$\bar{X}$ =	3.63	11.15	14.79
		(30.3%)	(46.5%)	(41.1%)
Incorrect foils giving correct cognitive view	$\bar{X}$ =	3.90	6.31	10.12
		(32.5%)	(26.3%)	(28.1%)
Totally incorrect foils	$\bar{X}$ =	4.52	6.54	11.06
		(37.6%)	(27.3%)	(30.7%)

TABLE 27

CELL N'S AND MEANS BY HIGH-LOW CQT GROUPS (MEDIAN SPLIT)

27a. Low CQT group

	E-1	E-2	E-3	E-4	C-5
R-1	(n=19)	(n=19)	(n=22)	(n=19)	(n=20)
	21.37	19.84	19.18	23.63	20.40
R-2	(n=28)	(n=23)	(n=22)	(n=24)	(n=23)
	20.82	21.22	20.27	24.00	22.04
R-3	(n=27)	(n=28)	(n=25)	(n=23)	(n=20)
	21.78	19.86	17.64	24.09	20.10

27b. High CQT group

	E-1	E-2	E-3	E-4	C-5
R-1	(n=22)	(n=22)	(n=19)	(n=22)	(n=21)
	25.95	25.09	25.16	25.64	25.19
R-2	(n=20)	(n=25)	(n=26)	(n=24)	(n=25)
	23.25	23.52	22.54	26.58	23.24
R-3	(n=21)	(n=20)	(n=23)	(n=24)	(n=28)
	26.48	24.45	23.65	26.88	24.96

TABLE 28

CELL AND MARGINAL MEANS FOR TOTAL-TEST SCORES (UNPROPORTIONALIZED DATA)

	E-1	E-2	E-3	E-4	C-5	$\bar{X}$
R-1	23.89	22.88	22.43	24.45	22.87	23.32
R-2	22.30	22.27	21.19	25.70	22.36	22.78
R-3	23.95	22.01	20.75	25.74	22.94	23.09
$\bar{X}$	23.36	22.37	21.43	25.27	22.70	

TABLE 29

ANALYSIS OF COVARIANCE TABLE FOR TOTAL-TEST SCORES (UNPROPORTIONALIZED DATA)

Source	SS	df	MS	F	P
Retention Groups	35.21	2	17.6	.83	.44
Treatments	1225.10	4	306.27	14.38	<.0005
Retention X Treatments	205.48	8	25.68	1.21	.29
Covariate	3468.25	1	3468.25	162.83	<.0005*
Error	15591.23	732	21.30		

* r = .41

TABLE 30

ADJUSTED CELL AND MARGINAL MEANS FOR SPECIFIC SUBSECTION (1-12) (UNPROPORTIONALIZED DATA)

	E-1	E-2	E-3	E-4	C-5	$\bar{X}$
R-1	7.99	7.36	7.64	8.75	7.77	7.91
R-2	7.29	7.29	6.80	9.29	7.40	7.62
R-3	8.39	7.37	6.67	9.29	8.13	7.98
$\bar{X}$	7.88	7.33	7.03	9.10	7.76	

TABLE 31

ANALYSIS OF COVARIANCE TABLE FOR SPECIFIC SUBSECTION (1-12) (UNPROPORTIONALIZED DATA)

Source	SS	df	MS	F	P
Retention Groups	18.64	2	9.32	2.03	.132
Treatments	374.58	4	93.65	20.39	<.0005
Retention X Treatments	63.06	8	7.88	1.72	.091
Covariate	499.92	1	499.92	108.84	<.0005*
Error	3362.05	732	4.59		

* r = .34

TABLE 32

ADJUSTED CELL AND MARGINAL MEANS FOR GENERAL SUBSECTION (13-36) (UNPROPORTIONALIZED DATA)

	E-1	E-2	E-3	E-4	C-5	$\bar{X}$
R-1	15.90	15.52	14.79	15.70	15.10	15.40
R-2	15.02	14.98	14.39	16.41	14.96	15.16
R-3	15.56	14.65	14.08	16.45	14.81	15.11
$\bar{X}$	15.47	15.03	14.40	16.17	14.94	

TABLE 33

ANALYSIS OF COVARIANCE TABLE FOR GENERAL SUBSECTION (13-36) (UNPROPORTIONALIZED DATA)

Source	SS	df	MS	F	P
Retention Groups	11.83	2	5.91	.6306	.533
Treatments	259.17	4	64.79	6.9083	<.0005
Retention X Treatments	54.46	8	7.18	.766	.633
Covariate	1334.66	1	1334.66	142.3017	<.0005*
Error	6865.48	732	9.38		

* r = .39

TABLE 34

ADJUSTED CELL AND MARGINAL MEANS FOR TOTAL-TEST RESPONSES TO COGNITIVELY-ORIENTED FOILS (UNPROPORTIONALIZED DATA)

	E-1	E-2	E-3	E-4	C-5	$\bar{X}$
R-1	4.72	4.93	5.47	4.72	5.43	5.05
R-2	5.11	5.17	6.72	3.27	6.03	5.26
R-3	3.99	5.32	6.20	3.68	5.39	4.91
$\bar{X}$	4.61	5.14	6.14	3.90	5.62	

TABLE 35

ANALYSIS OF COVARIANCE TABLE FOR TOTAL-TEST RESPONSES TO COGNITIVELY-ORIENTED FOILS (UNPROPORTIONALIZED DATA)

Source	SS	df	MS	F	P
Retention Groups	15.97	2	7.99	0.88	.415
Treatments	451.64	4	112.9	12.44	<.0005
Retention X Treatments	126.81	8	15.85	1.75	.084
Covariate	910.4	1	910.4	100.33	<.0005*
Error	6642.	732	9.07		

* r = -.33

TABLE 36

CELL AND MARGINAL MEANS FOR RESPONSES TO TOTALLY INCORRECT FOILS (TOTAL-TEST) (UNPROPORTIONALIZED DATA)

	E-1	E-2	E-3	E-4	C-5	$\bar{X}$
R-1	7.35	8.35	8.01	6.79	6.66	7.62
R-2	8.42	8.53	8.07	6.91	7.60	7.89
R-3	8.01	8.57	8.92	6.33	7.67	7.89
$\bar{X}$	7.94	8.49	8.34	6.69	7.66	

TABLE 37

ANALYSIS OF COVARIANCE TABLE BASED ON RESPONSES TO FOILS WHICH WERE TOTALLY INCORRECT (UNPROPORTIONALIZED DATA)

Source	SS	df	MS	F	P
Retention Groups	11.424	2	5.712	.5987	.550
Treatments	305.12	4	76.288	7.996	<.0005
Retention X Treatments	55.07	8	6.88	.7215	.673
Covariate	926.33	1	926.33	97.09	<.0005*
Error	6983.88	732	9.54		

* r = -.33

APPENDIX C

LEARNING MATERIALS

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(Please do not open booklet until requested to do so) (OL)

Name _____

Student Number _____

Date _____

Education 200

Instructor's name _____

Learning Laboratory

Part One:

STIMULUS-RESPONSE CONNECTIONIST LEARNING THEORIES

Instructions: Enclosed is Part One of three parts of the Learning Laboratory. It deals with some of the major learning theories namely, "Stimulus-Response Connectionist Theories," and how adherents to the theories look at man, and their viewpoint of how learning takes place. These theories will also be discussed in a number of lecture sessions later in the course.

When the instructor tells you to begin, you will have 45 minutes to read and study the attached passage. Take your time. Learn the information well. At a later date you will be tested on the information.

Make any marks, notes, underlining, or highlighting that will help you to learn the material. When this class is over, the booklets will be collected. However, they will be returned to you when the laboratory exercise is over.

Learning, put very simply, is a relatively permanent change that takes place in an organism and its potential behavior, that cannot be attributed to maturation, instinct, or temporary states of the organism due to fatigue, drugs, etc.

This process, called learning, is a phenomenon that has been discussed by philosophers for centuries. The scientific study of learning began in the 1880's when psychologists began to use systematic and empirical methods attempting to discover how and why it occurs.

Just as there were many philosophical viewpoints, differing in the way they chose to explain learning, so there are today many psychological viewpoints that often follow directly from them. While each psychological theory of learning may have its differences from each of the others, it is possible to group most of the theories into two large groups: the Stimulus-Response Connectionist (or Associationist) group; and the Cognitively-Oriented group.

Philosophical Differences

These two groups clearly differ in their philosophical view of man and his relationship to his environment.* If we consider the learner and his environment to be separate, a basic question on which these two groups hold contrasting viewpoints is, "which has precedence over the other"—"which is dominant over the other?" This basic difference underlies virtually all of the differences between the theoretical ideas of the two groups.

Stimulus-Response Connectionist Viewpoint

Stimulus-Response (S-R) Connectionist theorists see man as being dominated by his environment. Man is a passive reactor to his environment—he responds to stimuli from the environment. Each response becomes connected to the stimuli that

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*The term environment is used here to include all of the influences on the individual. These may be internal, or external, tangible, or intangible. For example, hunger pangs at lunch time, and anxiety over a forthcoming test, are as much a part of the environment as is Erickson Hall, your parents, or the rain on the roof.

evoked it. Each of these individual stimulus-response connections (which will also be referred to as associations or habits) is a unit of learning—it represents a piece of learning. The total complex of all of these stimulus-response connections represents the stored and usable learning of the individual. These individual stimulus-response connections are built up, piece-by-piece, habit-by-habit as man comes to learn and know.

The foregoing conception of man is that of a somewhat mechanical responding machine; connections are made between stimulus events and units of behavior. It is the long history of associations (connections) built up in the individual's contact with and reaction to his constantly changing environment, that determine with each new stimulus event, how the individual will respond.

In summary, the broad view held by this group is of man, dominated by his environment, responding to his environment, building up associative connections in greater and more complex interconnected sequences, in a receptive, mechanical way.

Cognitively-Oriented Viewpoint

In contrast to the S-R Associationist view, those theories that may be loosely classified under the heading "Cognitively-Oriented" generally give man more dominance in his interaction with his environment. According to this line of thought, man not only reacts to his environmental stimuli, but also acts upon—or at least acts in interaction with—his environment.

The term "cognitive" refers to mental processes. It is to these processes—the manner in which man manipulates, transforms, stores and recovers input sensory information—that Cognitively-Oriented theorists direct their attention.

Seen from this perspective, the learner takes in information, and has the potential to act upon it in some way. For example: he can accept it as true, or reject it as false; he can store it in his mind in the same form as he perceived it, or change it a little to suit his value and informational system; he can recall an

older memory and compare this new bit of information to the old memory; he can use it to make a decision and act upon the environment in accordance with his decision.

This theoretical perspective provides us with a view of man as an active (rather than reactive) organism, in the center of his environment, responding to it, taking in information from it, constructing plans and strategies based on the information, and acting on his environment in accordance with his information.

Basic Questions about Learning

Because of the basic difference in viewpoint between the two groups, there is a great deal of controversy between them over fact, interpretation, and the explanation of the "how" in learning. Each group answers basic questions about learning according to its own view.

Some of the basic questions that a theory of learning should be able to explain adequately are listed below. Following that, each of them is considered individually, and the Stimulus-Response Connectionist viewpoint is discussed.

1. What is learned?
2. How is sequential behavior, such as ongoing movement or thought, explained?
3. Does learning one thing help you in learning something else?
4. What happens when we remember? When we forget?
5. How important is reward to learning?
6. What is the role of practice in learning?
7. What is the place of understanding and insight in learning?
8. What are the limits (the capacities) of learning?

(1) What is learned?

Stimulus-Response Connectionist theorists assert that man learns connections (associations, habits). Each time a response occurs, (be it a thought or an overt

action)* in connection with or because of a stimulus (or combination of stimuli), a connection has been learned. It is through the maze of interconnections that are built up by an individual continually reacting to his environment, that his behavior is explained.

(2) How is sequential behavior, such as ongoing movement or thought explained?

S-R Connectionist theorists rely on sequences, or "chains" of associations to explain ongoing behavior. One association, having been acted upon, calls up another association, one of a large complex of possible associations. In this way, sequential behavior is carried out. It is theorized that one response acts as the stimulus for the next response. For example, a typist, seeing the word "the" calls up that S-R chain and types out "t-h-e". If we look more closely at the experienced typist, the response of typing the "t" may act as the stimulus for the typing of the "h", and the typing of the "h" may act as the stimulus for the typing of the "e", and so on.

Or, for another example, a man learning a golf swing learns a long sequence of muscle movements that are chained together. These S-R-S-R-S-R chains, precisely learned, to the exclusion of distractions, allow the expert golfer to reproduce his swing almost precisely the same each time he does it. In contrast, the less expert golfer, whose swing is made up of less refined, less precise, and more distractable S-R chains, has a more erratic and less predictable swing.

To explain thinking, which is far more complex a skill than simple muscle movements, it is necessary to consider the complex array of associations built up in the mind. These are inter-associated in multitudinous ways and are grouped together to make up more inclusive entities, such as concepts, principles, and strategies. These larger entities with their connected associations, make up thought.

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*A response is any form of behavior. The term behavior includes both overt, tangible behavior and covert mental thought.

As always, the basic unit of learning is the association—the connection of a particular stimulus to a particular response. The more complex the skill (for example, creative thinking) the more complex the inter-associations and chains of associations that go into making up the behavior.

(3) Does learning one thing help you to learn something else?

If all learning is made up of more or less complex combinations of associations, then it seems reasonable to assume that learning one thing should help you in learning something else if the two things are similar enough. If two skills are similar, they must use some of the same associations. For example, it seems reasonable that a baseball player who learns a good, even, swing, may subsequently find it easier to learn to swing a tennis racquet. If he becomes a switch-hitter in baseball, this might help him with his backhand in tennis.

If this principle applies at this rather simple level, why shouldn't it apply at a more complex level? S-R theorists say that it does—to the extent that the basic units (i.e. S-R associations) needed for subsequent learning were previously learned as part of the original learning.

The following seemingly foolish and simplistic example may help to explain. Let us say that a particular bit of learning requires 200 associations, and a second bit of learning that is to be learned later also requires 200 associations. If fifty of those to be learned for the second bit of learning are the same as fifty of those learned in the original 200, then the individual who had mastered the original skill would have fewer associations to learn in mastering the second skill. Thus, to the degree that the two skills require the same sub-components (i.e. S-R Connections), learning the first skill will help in learning the second.

(4) What happens when we remember? When we forget?

Remembering, to the S-R Associationist, is the result of the maintenance of

sufficient strength of the stimulus-response connections. Since it was a response connected to a stimulus that represented the learning, if it is to be remembered, the connection must remain, strongly enough to be recallable out of the maze of associations in memory.

Forgetting then is merely the result of losing the strength of the S-R connections that made the learning recallable. Many theories attempt to explain why the connections become weakened over time. The most popular theory currently espoused by Associationists, uses the interference caused by previous learning and by subsequent learning to explain forgetting.

To explain further, since all learning is represented by connections between stimuli and responses, these inter-connections become very complex. More than one stimuli can come to evoke the same response, and more than one response can be evoked by the same stimulus. For example, the response "hunger" can be evoked by: (1) an empty stomach; (2) the time at which you usually eat; (3) a sign stating "Pizza" which stimulates fond memories associated with pizza; (4) etc. On the other hand, one stimulus, for example the "Pizza" sign, can stimulate any number of responses which may have become associated with it, including a warm mental image of the waitress, or unhappy memories of an upset stomach. So you see, even at this very simple level, the interconnections among associations become very complex.

It seems reasonable then, that one reason why we forget is that a competing response has been learned (connected to) the same stimulus and that this connection interferes with the connection we want to remember. All of the individual associations gain and lose strength relative to each other as we go through life experiencing and learning. If the association we want to remember is strong enough relative to the other associations around it, we will remember it. If it is too weak, we will not be able to remember it and say that we "forgot" it.

(5) How important is reward to learning?

To most S-R Connectionists, learning takes place best when some form of reward occurs. (Remember that reward can take the form of the achievement of something desirable or the avoidance of something undesirable.) While reward may not be altogether necessary, most S-R theorists feel that reward strengthens associative connections and makes them more resistant to interference. Naturally, reward can take many forms; it can be tangible, or merely an internal feeling of satisfaction or of relief. In any case, when the reward is appropriate to the task, and seen as a reward by the learner, it should always act to increase the likelihood of learning taking place.

(6) What is the role of practice in learning?

Most S-R Associationists feel that practice is not a sufficient condition for learning to occur. Repetition of a response adds little to the strength of the S-R connection unless the response is followed by some form of reward. Practice is important though, especially for more complex learning, as it allows for more chance of continued reward of success, thus increasing learning.

(7) What is the place of understanding and insight in learning?

S-R Connectionists minimize the role of understanding on the part of the learner. In fact, one can learn some associations (e.g. reflexes and phobias) without any understanding. How well, or how much one understands, is dependent on the number and strength of associative connections. The best way to gain understanding is to build a body of associative connections appropriate to that understanding.

"Insight" is not even recognized as a phenomenon of learning except as it may happen to grow out of the application of earlier learned habits (connections) to the new task.

(8) What are the limits (capacity) of learning?

To the S-R Associationist, the obvious answer is that learning capacity depends upon the number of connections and their availability. People differ in their capacity for associations. This difference is predominantly quantitative in that it reflects that capacity of the individual system to form and maintain S-R connections.

Conclusion

S-R theorists build their theories around a picture of man as a mechanistic responder, who learns by associating (connecting) stimuli to responses. Every explanation of the system is built from the one basic unit of behavior, the stimulus-response associative connection. All learning is represented by combinations of these associations. It is the complexity and strength of these associations that determine much of the "how" and "why" of learning.

(Please do not open booklet until requested to do so) (C & C)

Name _____

Student Number _____

Date _____

Instructor's name _____

Education 200

Learning Laboratory

Part Two:

COGNITIVELY-ORIENTED LEARNING THEORIES

Instructions: Enclosed is Part Two of the Learning Laboratory Exercise. In our first session, we learned about the Stimulus-Response Connectionist theory of how learning takes place. Another major group of learning theorists is one that we call the Cognitively-Oriented group. Today you will be studying how this group looks at man, and the process of human learning. Very brief comparisons with the Stimulus-Response Connectionist viewpoint which you studied earlier will also be made where appropriate. The material should serve to introduce some lecture sessions scheduled for later in the course.

When the instructor tells you to begin, you will have 45 minutes to read and study the attached passage. Take your time. Learn the information well. At a later date you will be tested on this as well as on the Stimulus-Response Connectionist theory.

Make any marks, notes, underlining, or highlighting that will help you to learn the material. When this class is over, the booklets will be collected. However, they will be returned to you when the laboratory exercise is over.

Cognitively-Oriented theorists view man as a purposive, willful organism, who directs his behavior toward the achievement of goals. While he is not always seen as dominating his environment, he is at least in interaction with it, and has the potential to dominate it—to manipulate it—in achieving his goals.

The learner, viewed from the perspective of the Cognitivist, takes in information and stores it in mental "cognitive structures." He has the potential to cognitively manipulate it and devise plans and strategies based on it. For example: he can accept it as true or reject it as false; he can store it in his mind in the same form as he perceived it, or change it a little to suit his value and informational system; he can recall an older memory, and compare this new bit of information to the old memory; he can use it to make a decision and act upon the environment in accordance with his decision.

Learning is defined by psychologists as a relatively permanent change that takes place in an organism (and thus potentially in his behavior). Changes in behavior to the Cognitivist, occur as the result of changes in mental cognitive structures—i.e. changes in the way the organism cognitively structures the information he has at his disposal—and changes in his goals. It is the learner's perception of his environment (the way his cognitive system has interpreted the sensory information that he has received), seen in relation to his goals and the activity of his muscles and glands that determines his behavior.

In summary, this theoretical perspective provides us with a view of man as an active organism, in the center of his environment, responding to it, taking in information from it, constructing plans and strategies based on his information about it, and acting purposefully on his environment in accordance with his information. The term "cognitive" refers to mental processes. It is to these processes—the manner in which man manipulates, transforms, stores and recovers input sensory information—that Cognitively-Oriented theorists direct their attention.

(This basic difference from the Stimulus-Response Connectionist viewpoint in the way of looking at man's relationship with his environment, underlies virtually all of the differences in the theoretical explanations of the two groups. S-R theorists view man as more of a reacting organism who is prodded along by external and internal stimuli, building up behavior patterns based on S-R connections, which determine his potential behavior.)

Basic Questions about Learning

Cited below are eight basic questions that a theory of learning should be able to explain adequately. Following the list, each question is considered individually, and the viewpoint of the Cognitively-Oriented group of theorists is discussed. Brief references will also be made to the viewpoint of the Stimulus-Response Connectionist theorists.

1. What is learned?
2. How is sequential behavior, such as ongoing movement or thought explained?
3. Does learning one thing help you in learning something else?
4. What happens when we remember? When we forget?
5. How important is reward to learning?
6. What is the role of practice in learning?
7. What is the place of understanding and insight in learning?
8. What are the limits (the capacities) of learning?

(1) What is learned?

The Cognitively-Oriented theorist feels that learning is the incorporation into "cognitive structures" of some new bit of sensory-perceptual information. With each new bit received and stored, the cognitive structure of the individual changes slightly: the information is added on to the structure or introduced into the learner's organizational pattern in a relevant position; relationships between the new information and previously stored information may be set up; successful strategies (plans of action) are also learned and incorporated into the cognitive structures. Stored in these cognitive structures is what the

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learner was born with plus the composite of all the learning that he has built up during his lifetime of experiences.

No one theory exists of the organization of these cognitive structures, but it is certain that in order to explain varying aspects of human thinking, different kinds of relationships must be present in them. One system of cognitive organization would have to be spatial. Otherwise it would be difficult to explain our uncanny ability to mentally understand and picture space relationships without experiencing them firsthand. For example, even though you may never have been to or seen Erickson Hall, if a friend told you that it was across the street from Shaw Dormitory bus stop and beside the river on Farm Lane, you could probably pinpoint its location in your mind, and find it with no difficulty.

Another organizational system would have to be temporal. Otherwise we would have trouble understanding relationships in time without actually experiencing them. For example, even though you have probably never recited or memorized the sequence of our more recent presidents, most of you would have little trouble in putting "Roosevelt, Nixon, Kennedy, Johnson, Eisenhower, Truman" in the correct order with a little thought.

In summary, to the Cognitivist, what are learned are skills ideas, meanings, concepts, principles, and the like. The information is kept stored in organized cognitive structures. These structures are continually added to as learning progresses. Much of the information is incorporated in meaningful relationships with other material already in cognitive structures.

> (This differs from the S-R view that man learns associations, connections. These associations, inter-connected in multitudinous ways are the S-R group's basis for all behavior. It is their viewpoint that man cannot willfully build new behavior unless an associative connection has already been learned that is at least similar to the new behavior.)

(2) How is sequential behavior,* such as ongoing movement or thought explained?

Cognitively-Oriented theorists see man as a purposive, goal-directed organism. In light of the learner's motivation to achieve a goal, ongoing sequential behavior is easily explained by inferring central brain processes such as expectations and memories, which integrate and guide his goal-seeking behavior. In other words, the organism learns to expect certain positive or negative results from various actions that he might take, and these guide his planning and his behavior in getting toward his goal and in getting away from whatever he may wish to avoid.

An individual's potential behavior is based on, but not rigidly determined by the information and skills he has learned. He can use the information in new plans and new behavior, but he is not limited to exact replicas of the behavior patterns that are contained in his cognitive structures. Behavior always has the potential of being creative and constructive—of willfully using and going beyond what is in cognitive structures.

> (In contrast, the S-R theorist holds that man's behavior is dependent on the S-R connections that he has built up in his past. Sequential behavior is explained by sequences of these S-R connections, chained together.)

(3) Does learning one thing help in learning something else?

Learning, if it is to be maximally retained and usable, is not just stored randomly. It should be related to (eg. compared and contrasted to) other learning, and stored appropriately in relation to other material in cognitive structures. Thus it is very helpful if new learning has the benefit of previous

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*Remember, the term "behavior" can refer to overt, tangible acts, or to covert mental processes.

learning to help "anchor" it—to make it more retainable. If this is true, then learning one thing will aid subsequent learning as long as the cognitive skills learned previously can be applied, and as long as the content of both is similar enough to allow the learner to relate one to the other, thereby increasing understanding.

Crucial to aiding learning is that the learner comes to understand the essential relationships in the learning task. Since Cognitivists hold that part of learning is the acquisition of learning strategies (plans of attack), if the pattern of relationships is similar from one learning situation to the next, effective transfer of learning can be expected if the individual applies his earlier learning. This may occur consciously or spontaneously. If the relationships are well understood by the learner, the applicability of the learning to new but similar situations is increased.

> (In comparison, the S-R Connectionist viewpoint, has much more stringent requirements. The effect of older learning upon new learning is limited to the number of S-R connections previously established that are usable in the new learning.)

(4) What happens when we remember? When we forget?

Cognitive structures represent the sum total of an individual's learning at any given time. Information is stored in these structures. It can be drawn upon and recalled when needed as long as the individual elements of the material maintain sufficient strength so that they can be discriminated from other elements in cognitive structure and brought out for use.

Cognitive theorists do not totally agree on why we forget. Generally it is assumed to be caused by: (1) the processes of decay (or fading) over time; (2) the assimilation of the more discrete and specific elements into the larger, more inclusive concepts; and (3) the competition of alternative memories. All

of these processes are affected by how well the information was learned in the first place. For example, if in learning informational material, logical and meaningul relationships within the material itself and between the material and other material are learned, the information will be more resistant to forgetting than it would be if it were rotely learned in a verbatim manner. Other factors can also influence forgetting. For example, we learn and remember what we wish to believe more readily than what we wish to disregard.

> (In comparison, remembering to the S-R Connectionist depends on the maintainance of sufficient strength of the stimulus-response connections. Forgetting is usually thought to be caused primarily by interference caused by other connections.)

(5) How important is reward to learning?

Reward is seen by Cognitive theorists as important as a regulator of behavior. (Remember, reward can take the form of the achievement of something desirable or the avoidance of something undersiable.) The expectation of reward or of punishment guides behavior. Very little would be accomplished were it not for the anticipation of some kind of reward. This reward can take many forms—for example, food from the killing of an animal, or more indirectly, a well-developed intellect and a good-paying job as a reward for a few years of study in a college.

Cognitivists emphasize internal sources of reward as being more satisfactory than tangible rewards. For example, the satisfaction brought by success, has more ongoing and far-reaching effects than would an increase in pay. Successful completion of a task and the satisfaction thereby experienced, leads to a further striving for more success experiences. It tends to raise the learner's self-confidence, to encourage him to try again in later tasks, and to increase the attractiveness of later learning tasks as possible success experiences. While tangible rewards certainly perform some of the above functions, their effects are seen as less central to the learning situation, and shorter-lived.

(S-R Connectionist theorists see reward as much more central and much more direct in its effects on learning. Some would even infer that little or no learning will take place without reward. This group holds that reward acts directly on the S-R connection to strengthen the bond. This effect of reward takes place with or without the learner's understanding.)

(6) What is the role of practice in learning?

Learning refers to relatively permanent changes in the cognitive structure, as the learner experiences initial and successive attempts at a learning task. Although much learning may take place in the first attempt on a task, practice is necessary in order to maximize learning, retention, and later application of learning. Practice increases the clarity and stability of new learning in the cognitive structure, thus making it more resistant to forgetting. This is particularly true if the learner attempts to relate the material to what he already has learned and stored in cognitive structures.

(Most S-R theorists would agree that practice is a necessary part of learning. However, practice without reward is usually considered to be of little help to learning.)

(7) What is the place of understanding and insight in learning?

Understanding is at the center of cognitive explanations of the learning process. Sensible learning requires that the learner understand the structure of the task—that he attempt to perceive the relationships between the whole task, and its various sub-parts. Moreover, since learning is goal-directed, it is best accomplished when the learner perceives the means-ends relationships in the problem—that is, where he is going, and how best to get there. He can then reason out sensible approaches to the problem.

Through the sensible structuring of the problem itself, and of his approach to the problem, the learner increases the possibility of insightful experiences. Insight is the "see the light", "Eureka" experience that occurs when one manipulates the facets of the problem correctly making clearer the relationships between the goal and the steps necessary in getting there.

(In direct contrast, while understanding is central to cognitive explanations of learning, S-R theorists minimize its role. Associations can be learned without understanding. Insight, if it exists at all, is only due to previously learned associations.)

(8) What are the limits (the capacities) of learning?

Capacities for learning are the result of the limitations set by genetics on one individual as compared with another. It must be assumed that heredity sets some absolute limits on the growth of individual cognitive structures and it is also probable that the environment may have some irreversible effects on these limitations during the development of the individual. However, most cognitivists would hold that the idea of a fixed capacity or limit on learning is relatively unimportant as it is assumed that most individuals operate at a level far below capacity.

(The S-R Connectionist view is more mechanistic. Capacity refers to the quantity of associations that can be learned and maintained by an individual.)

Conclusion

Cognitively-Oriented theorists view man as a goal-seeking, dynamic organism. Learning, is the building up of cognitive structures storing learned information and skills. It is the size, the degree of differentiation, and the clarity of the learning represented in these cognitive structures, along with the learner's goals and the current state of the learner's environment that will determine his behavior.

(To the S-R Connectionist, the goals of the individual play little part in determining his behavior. It is the number and kind of connections that he has built up that will determine his behavior.)

(If you have time, review this material trying to understand the whole position and how the separate parts fit together.)

(Please do not open booklet until requested to do so) (P)

Name _____

Student Number _____

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Instructor's name_____

Education 200

Learning Laboratory

Part Two:

COGNITIVELY-ORIENTED LEARNING THEORIES

Instructions: Enclosed is Part Two of the Learning Laboratory Exercise. In our first session, we learned about the Stimulus-Response Connectionist theory of how learning takes place. Another major group of learning theorists is one that we call the Cognitively-Oriented group. Today you will be studying how this group looks at man, and the process of human learning. The material should serve to introduce some lecture sessions scheduled for later in the course.

When the instructor tells you to begin, you will have 45 minutes to read and study the attached passage. Take your time. Learn the information well. At a later date you will be tested on this as well as on the Stimulus-Response Connectionist theory.

While you are reading, it would be a good idea if you spent some of your time thinking and comparing this viewpoint with the ideas of the Stimulus-Response Connectionist theories that you studied a few days ago.

Make any marks, notes, underlining, or highlighting that will help you to learn the material. When this class is over, the booklets will be collected. However, they will be returned to you when the laboratory exercise is over.

Cognitively-Oriented theorists view man as a purposive, willful, organism, who directs his behavior toward the achievement of goals. While he is not always seen as dominating his environment, he is at least in interaction with it, and has the potential to dominate it—to manipulate it—in achieving his goals.

(Compare this with the S-R Connectionist view of man in relation to his environment.)

The learner, viewed from the perspective of the Cognitivist, takes in information and stores it in mental "cognitive structures." He has the potential to cognitively manipulate it and devise plans and strategies based on it. For example: he can accept it as true, or reject it as false; he can store it in his mind in the same form as he perceived it, or change it a little to suit his value and informational system; he can recall an older menory, and compare this new bit of information to the old memory; he can use it to make a decision and act upon the environment in accordance with his decision.

(S-R theorists differ radically on this point.)

Learning is defined by psychologists as a relatively permanent change that takes place in an organism (and thus potentially in his behavior). Changes in behavior to the Cognitivist, occur as the result of changes in mental cognitive structures—i.e. changes in the way the organism cognitively structures the information he has at his disposal—and changes in his goals. It is the learner's perception of his environment (the way his cognitive system has interpreted the sensory information that he has received), seen in relation to his goals and the activity of his muscles and glands that determines his behavior.

(How do S-R theorists view "goals"?)

In summary, this theoretical perspective provides us with a view of man as an active organism, in the center of his environment, responding to it, taking in

information from it, constructing plans and strategies based on his information about it, and acting purposefully on his environment in accordance with his information. The term "cognitive" refers to mental processes. It is to these processes—the manner in which man manipulates, transforms, stores, and recovers input sensory information—that Cognitively-Oriented theorists direct their attention.

> (This basic difference from the Stimulus-Response Connectionist viewpoint in the way of looking at man's relationship with his environment, underlies virtually all of the differences in the theoretical explanations of the two groups. Try to understand it, and use it to compare the positions of the two groups.)

Basic Questions About Learning

Cited below are eight basic questions that a theory of learning should be able to explain adequately. Following the list, each question is considered individually, and the viewpoint of the Cognitively-Oriented group of theorists is discussed.

> (Compare the explanations expressed below with the explanations of the S-R theorists you have studied earlier.)

1. What is learned?
2. How is sequential behavior, such as ongoing movement or thought explained?
3. Does learning one thing help you in learning something else?
4. What happens when we remember? When we forget?
5. How important is reward to learning?
6. What is the role of practice in learning?
7. What is the place of understanding and insight in learning?
8. What are the limits (the capacities) lf learning?

(1) What is learned?

The Cognitively-Oriented theorist feels that learning is the incorporation into "cognitive structures" of some new bit of sensory-perceptual information.

With each new bit received and stored, the cognitive structure of the individual changes slightly: the information is added on to the structure or introduced into the learner's organizational pattern in a relevant position; relationships between the new information and previously stored information may be set up; successful strategies (plans of action) are also learned and incorporated into the cognitive structures. Stored in these cognitive structures is what the learner was born with plus the composite of all the learning that he has built up during his lifetime of experiences.

(What and how do S-R theorists say man learns?)

No one theory exists of the organization of these cognitive structures, but it is certain that in order to explain varying aspects of human thinking, different kinds of relationships must be present in them. One system of cognitive organization would have to be spatial. Otherwise it would be difficult to explain our uncanny ability to mentally understand and picture space relationships without experiencing them firsthand. For example, even though you may never have been to or seen Erickson Hall, if a friend told you that it was across the street from Shaw Dormitory bus stop and beside the river on Farm Lane, you could probably pinpoint its location in your mind, and find it with no difficulty.

Another organizational system would have to be temporal. Otherwise we would have trouble understanding relationships in time without actually experienceing them. For example, even though you have probably never recited or memorized the sequence of our more recent presidents, most of you would have little trouble in putting "Roosevelt, Nixon, Kennedy, Johnson, Eisenhower, Truman" in the correct order with a little thought.

In summary, to the Cognitivist, what are learned are skills, ideas, meanings, concepts, principles, and the like. The information is kept stored in organized

cognitive structures. These structures are continually added to as learning progresses. Much of the information is incorporated in meaningful relationships with other material already in cognitive structures.

(Compare this view with the way S-R theorists explain learning.)

(2) How is sequential behavior,* such as ongoing movement or thought explained?

Cognitively-Oriented theorists see man as a purposive, goal-directed organism. In light of the learner's motivation to achieve a goal, ongoing sequential behavior is easily explained by inferring central brain processes such as expectations, and memories, which integrate and guide his goal-seeking behavior. In other words, the organism learns to expect certain positive or negative results from various actions that he might take, and these guide his planning and his behavior in getting toward his goal and in getting away from whatever he may wish to avoid.

An individual's potential behavior is based on, but not rigidly determined by the information and skills he has learned. He can use the information in new plans and new behavior, but he is not limited to exact replicas of the behavior patterns that are contained in his cognitive structures. Behavior always has the potential of being creative and constructive—of willfully using and going beyond what is in cognitive structures.

(This differs radically with what you learned about S-R theories of learning.)

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*Remember, the term "behavior" can refer to overt, tangible acts, or to covert mental processes.

(3) Does learning one thing help in learning something else?

Learning, if it is to be maximally retained and usable, is not just stored randomly. It should be related to (eg. compared and contrasted to) other learning, and stored appropriately in relation to other material in cognitive structures. Thus it is very helpful if new learning has the benefit of previous learning to help "anchor" it—to make it more retainable. If this is true, then learning one thing will aid subsequent learning as long as the cognitive skills learned previously can be applied, and as long as the content of both is similar enough to allow the learner to relate one to the other, thereby increasing understanding.

Crucial to aiding learning is that the learner comes to understand the essential relationships in the learning task. Since Cognitivists hold that part of learning is the acquisition of learning strategies (plans of attack), if the pattern of relationships is similar from one learning situation to the next, effective transfer of learning can be expected if the individual applies his earlier learning. This may occur consciously or spontaneously. If the relationships are well understood by the learner, the applicability of the learning to new but similar situations is increased.

> (S-R Connectionist theorists also feel that learning one thing can help in learning a second. Compare their explanation with this one.)

(4) What happens when we remember? When we forget?

Cognitive structures represent the sum total of an individual's learning at any given time. Information is stored in these structures. It can be drawn upon and recalled when needed as long as the individual elements of the material maintain sufficient strength so that they can be discriminated from other elements in cognitive structure and brought out for use.

Cognitive theorists do not totally agree on why we forget. Generally it is assumed to be caused by: (1) the processes of decay (or fading) over time; (2) the assimilation of the more discrete and specific elements into the larger, more inclusive concepts; and (3) the competition of alternative memories. All of these processes are affected by how well the information was learned in the first place. For example, if in learning informational material, logical and meaningful relationships within the material itself and between the material and other material are learned, the information will be more resistant to forgetting than it would be if it were rotely learned in a verbatim manner. Other factors can also influence forgetting. For example, we learn and remember what we wish to believe more readily than what we wish to disregard.

(S-R theories are more precise in dealing with remembering and forgetting. Can you compare them?)

(5) How important is reward to learning?

Reward is seen by Cognitive theorists as important as a regulator of behavior. (Remember, reward can take the form of the achievement of something desirable or the avoidance of something undesirable.) The expectation of reward or of punishment guides behavior. Very little would be accomplished were it not for the anticipation of some kind of reward. This reward can take many forms—for example, food from the killing of an animal, or more indirectly, a well-developed intellect and a good-paying job as a reward for a few years of study in a college.

Cognitivists emphasize internal sources of reward as being more satisfactory than tangible rewards. For example, the satisfaction brought by success, has more ongoing and far-reaching effects than would an increase in pay. Successful completion of a task and the satisfaction thereby experienced, leads to a further striving for more success experiences. It tends to raise the learner's self-confidence, to encourage him to try again in later tasks, and to increase the

attractiveness of later learning tasks as possible success experiences. While tangible rewards certainly perform some of the above functions, their effects are seen as less central to the learning situation, and shorter-lived.

(Do S-R theorists agree or disagree there? Which position seems most tenable?)

(6) What is the role of practice in learning?

Learning refers to relatively permanent changes in the cognitive structure, as the learner experiences initial and successive attempts at a learning task. Although much learning may take place in the first attempt on a task, practice is necessary in order to maximize learning, retention, and later application of learning. Practice increases the clarity and stability of new learning in the cognitive structure, thus making it more resistant to forgetting. This is particularly true if the learner attempts to relate the material to what he already has learned and stored in cognitive structures.

(Try to relate the preceding ideas concerning practice and reward to S-R explanations.)

(7) What is the place of understanding and insight in learning?

Understanding is at the center of cognitive explanations of the learning process. Sensible learning requires that the learner understand the structure of the task—that he attempt to perceive the relationships between the whole task, and its various sub-parts. Moreover, since learning is goal-directed, it is best accomplished when the learner perceives the means-ends relationships in the problem—that is, where he is going, and how best to get there. He can then reason out sensible approaches to the problem.

Through the sensible structuring of the problem itself, and of his approach to the problem, the learner increases the possibility of insightful experiences.

Insight is the "see the light", "Eureka" experience that occurs when one manipulates the facets of the problem correctly making clearer the relationships between the goal and the steps necessary ingetting there.

> (The basic difference in philosophical viewpoint between Cognitivists and S-R theorists is emphasized by their differences in explanations on this point. Why do they contrast?)

(8) What are the limits (the capacities) of learning?

Capacities for learning are the result of the limitations set by genetics on one individual as compared with another. It must be assumed that heredity sets some absolute limits on the growth of individual cognitive structures, and it is also probable that the environment may have some irreversible effects on these limitations during the development of the individual. However, most Cognitivists would hold that the idea of a fixed capacity or limit on learning is relatively unimportant as it is assumed that most individuals operate at a level far below capacity.

> (There is a difference from the S-R view here. Do the two positions conflict?)

Conclusion

Cognitively-Oriented theorists view man as a goal-seeking, dynamic organism. Learning, is the building up of cognitive structures storing learned information and skills. It is the size, the degree of differentiation, and the clarity of the learning represented in these cognitive structures, along with the learner's goals and the current state of the learner's environment that will determine his behavior.

(If you have time, review this material, trying to understand the whole position and how the separate parts fit together. Try to see in what ways it is similar to/or different from the S-R view.)

(Please do not open booklet until requested to do so) (S)

Name _____

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Education 200

Learning Laboratory

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In summary, this theoretical perspective provides us with a view of man as an active organism, in the center of his environment, responding to it, taking in information from it, constructing plans and strategies based on his information about it, and acting purposefully on his environment in accordance with his information. The term "cognitive" refers to mental processes. It is to these processes—the manner in which man manipulates, transforms, stores, and recovers

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up during his lifetime of experiences.

No one theory exists of the organization of these cognitive structures, but it is certain that in order to explain varying aspects of human thinking, different kinds of relationships must be present in them. One system of cognitive organization would have to be spatial. Otherwise it would be difficult to explain our uncanny ability to mentally understand and picture space relationships without experiencing them firsthand. For example, even though you may never have been to or seen Erickson Hall, if a friend told you that it was across the street from Shaw Dormitory bus stop and beside the river on Farm Lane, you could probably pinpoint its location in your mind, and find it with no difficulty.

Another organizational system would have to be temporal. Otherwise we would have trouble understanding relationships in time without actually experiencing them. For example, even though you have probably never recited or memorized the sequence of our more recent presidents, most of you would have little trouble in putting "Roosevelt, Nixon, Kennedy, Johnson, Eisenhower, Truman" in the correct order with a little thought.

In summary, to the Cognitivist, what are learned are skills, ideas, meanings, concepts, principles, and the like. The information is kept stored in organized cognitive structures. These structures are continually added to as learning progresses. Much of the information is incorporated in meaningful relationships with other material already in cognitive structures.

(2) How is sequential behavior,* such as ongoing movement or thought explained?

Cognitively-Oriented theorists see man as a purposive, goal-directed organism. In light of the learner's motivation to achieve a goal, ongoing

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*Remember, the term "behavior" can refer to overt, tangible acts, or to covert mental processes.

sequential behavior is easily explained by inferring central brain processes such as expectations, and memories, which integrate and guide his goal-seeking behavior. In other words, the organism learns to expect certain positive or negative results from various actions that he might take, and these guide his planning and his behavior in getting toward his goal and in getting away from whatever he may wish to avoid.

An individual's potential behavior is based on, but not rigidly determined by the information and skills he has learned. He can use the information in new plans and new behavior, but he is not limited to exact replicas of the behavior patterns that are contained in his cognitive structures. Behavior always has the potential of being creative and constructive—of willfully using and going beyond what is in cognitive structures.

(3) Does learning one thing help in learning something else?

Learning, if it is to be maximally retained and usable, is not just stored randomly. It should be related to (eg. compared and contrasted to) other learning, and stored appropriately in relation to other material in cognitive structures. Thus it is very helpful if new learning has the benefit of previous learning to help "anchor" it—to make it more retainable. If this is true, then learning one thing will aid subsequent learning as long as the cognitive skills learned previously can be applied, and as long as the content of both is similar enough to allow the learner to relate one to the other, thereby increasing understanding.

Crucial to aiding learning is that the learner comes to understand the essential relationships in the learning task. Since Cognitivists hold that part of learning is the acquisition of learning strategies (plans of attack), if the

pattern of relationships is similar from one learning situation to the next, effective transfer of learning can be expected if the individual applies his earlier learning. This may occur consciously or spontaneously. If the relationships are well understood by the learner, the applicability of the learning to new but similar situations is increased.

(4) What happens when we remember? When we forget?

Cognitive structures represent the sum total of an individual's learning at any given time. Information is stored in these structures. It can be drawn upon and recalled when needed as long as the individual elements of the material maintain sufficient strength so that they can be discriminated from other elements in cognitive structure and brought out for use.

Cognitive theorists do not totally agree on why we forget. Generally it is assumed to be caused by: (1) the processes of decay (or fading) over time; (2) the assimilation of the more discrete and specific elements into the larger, more inclusive concepts; and (3) the competition of alternative memories. All of these processes are affected by how well the information was learned in the first place. For example, if in learning informational material, logical and meaningful relationships within the material itself and between the material and other material are learned, the information will be more resistant to forgetting than it would be if it were rotely learned in a verbatim manner. Other factors can also influence forgetting. For example, we learn and remember what we wish to believe more readily than what we wish to disregard.

(5) How important is reward to learning?

Reward is seen by Cognitive theorists as important as a regulator of behavior.

(Remember, reward can take the form of the achievement of something desirable or the avoidance of something undesirable.) The expectation of reward or of punishment guides behavior. Very little would be accomplished were it not for the anticipation of some kind of reward. This reward can take many forms—for example, food from the killing of an animal, or more indirectly, a well-developed intellect and a good-paying job as a reward for a few years of study in a college.

Cognitivists emphasize internal sources of reward as being more satisfactory than tangible rewards. For example, the satisfaction brought by success, has more ongoing and far-reaching effects than would an increase in pay. Successful completion of a task and the satisfaction thereby experienced, leads to a further striving for more success experiences. It tends to raise the learner's self-confidence, to encourage him to try again in later tasks, and to increase the attractiveness of later learning tasks as possible success experiences. While tangible rewards certainly perform some of the above functions, their effects are seen as less central to the learning situation, and shorter-lived.

(6) What is the role of practice in learning?

Learning refers to relatively permanent changes in the cognitive structure, as the learner experiences initial and successive attempts at a learning task. Although much learning may take place in the first attempt on a task, practice is necessary in order to maximize learning, retention, and later application of learning. Practice increases the clarity and stability of new learning in the cognitive structure, thus making it more resistant to forgetting. This is particularly true if the learner attempts to relate the material to what he already has learned and stored in cognitive structures.

(7) What is the place of understanding and insight in learning?

Understanding is at the center of cognitive explanations of the learning process. Sensible learning requires that the learner understand the structure of the task—that he attempt to perceive the relationships between the whole task, and its various sub-parts. Moreover, since learning is goal-directed, it is best accomplished when the learner perceives the means-ends relationships in the problem—that is, where he is going, and how best to get there. He can then reason out sensible approaches to the problem.

Through the sensible structuring of the problem itself, and of his approach to the problem, the learner increases the possibility of insightful experiences. Insight is the "see the light", "Eureka" experience that occurs when one manipulates the facets of the problem correctly making clearer the relationships between the goal and the steps necessary in getting there.

(8) What are the limits (the capacities) of learning?

Capacities for learning are the result of the limitations set by genetics on one individual as compared with another. It must be assumed that heredity sets some absolute limits on the growth of individual cognitive structures, and it is also probable that the environment may have some irreversible effects on these limitations during the development of the individual. However, most Cognitivists would hold that the idea of a fixed capacity or limit on learning is relatively unimportant as it is assumed that most individuals operate at a level far below capacity.

Conclusion

Cognitively-Oriented theorists view man as a goal-seeking dynamic organism.

Learning, is the building up of cognitive structures storing learned information and skills. It is the size, the degree of differentiation, and the clarity of the learning represented in these cognitive structures, along with the learner's goals and the current state of the learner's environment that will determine his behavior.

(If you have time, review this material, trying to understand the whole position and how the separate parts fit together.)

(Please do not open booklet until requested to do so.) (20L)

Name _____

Student Number _____

Date _____

Instructor's name _____

Education 200

Learning Laboratory

Part Two:

STIMULUS-RESPONSE CONNECTIONIST LEARNING THEORIES

Instructions: For Part Two of the Learning Laboratory, you will have an opportunity to re-study the article about Stimulus-Response-Connectionist learning theories that you studied before. Try to learn it as well as you can. These theories will also be discussed in a number of lecture sessions later in the course.

When the instructor tells you to begin, you will have 45 minutes to read and study. Take your time. Learn the information well. At a later date you will be tested on the information.

Make any marks, notes, underlining, or highlighting that will help you to learn the material. When this class is over, the booklets will be collected. However, they will be returned to you when the laboratory exercise is over.

Learning, put very simply, is a relatively permanent change that takes place in an organism and its potential behavior, that cannot be attributed to maturation, instinct, or temporary states of the organism due to fatigue, drugs, etc.

This process, called learning, is a phenomenon that has been discussed by philosophers for centuries. The scientific study of learning began in the 1880's when psychologists began to use systematic and empirical methods attempting to discover how and why it occurs.

Just as there were many philosophical viewpoints, differing in the way they chose to explain learning, so there are today many psychological viewpoints that often follow directly from them. While each psychological theory of learning may have its differences from each of the others, it is possible to group most of the theories into two large groups: the Stimulus-Response Connectionist (or Associationist) group; and the Cognitively-Oriented group.

Philosophical Differences

These two groups clearly differ in their philosophical view of man and his relationship to his environment.* If we consider the learner and his environment to be separate, a basic question on which these two groups hold contrasting viewpoints is, "which has precedence over the other"—"which is dominant over the other?" This basic difference underlies virtually all of the differences between the theoretical ideas of the two groups.

Stimulus-Response Connectionist Viewpoint

Stimulus-Response (S-R) Connectionist theorists see man as being dominated by his environment. Man is a passive reactor to his environment—he responds to stimuli from the environment. Each response becomes connected to the stimuli that

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*The term environment is used here to include all of the influences on the individual. These may be internal, or external, tangible, or intangible. For example, hunger pangs at lunch time, and anxiety over a forthcoming test, are as much a part of the environment as is Erickson Hall, your parents, or the rain on the roof.

evoked it. Each of these individual stimulus-response connections (which will also be referred to as associations or habits) is a unit of learning—it represents a piece of learning. The total complex of all of these stimulus-response connections represents the stored and usable learning of the individual. These individual stimulus-response connections are built up, piece-by-piece, habit-by-habit as man comes to learn and know.

The foregoing conception of man is that of a somewhat mechanical responding machine; connections are made between stimulus events and units of behavior. It is the long history of associations (connections) built up in the individual's contact with and reaction to his constantly changing environment, that determine with each new stimulus event, how the individual will respond.

In summary, the broad view held by this group is of man, dominated by his environment, responding to his environment, building up associative connections in greater and more complex interconnected sequences, in a receptive, mechanical way.

Cognitively-Oriented Viewpoint

In contrast to the S-R Associationist view, those theories that may be loosely classified under the heading "Cognitively-Oriented" generally give man more dominance in his interaction with his environment. According to this line of thought, man not only reacts to his environmental stimuli, but also acts upon—or at least acts in interaction with—his environment.

The term "cognitive" refers to mental processes. It is to these processes—the manner in which man manipulates, transforms, stores and recovers input sensory information—that Cognitively-Oriented theorists direct their attention.

Seen from this perspective, the learner takes in information, and has the potential to act upon it in some way. For example: he can accept it as true, or reject it as false; he can store it in his mind in the same form as he perceived it, or change it a little to suit his value and informational system; he can recall an

older memory and compare this new bit of information to the old memory; he can use it to make a decision and act upon the environment in accordance with his decision.

This theoretical perspective provides us with a view of man as an active (rather than reactive) organism, in the center of his environment, responding to it, taking in information from it, constructing plans and strategies based on the information, and acting on his environment in accordance with his information.

Basic Questions about Learning

Because of the basic difference in viewpoint between the two groups, there is a great deal of controversy between them over fact, interpretation, and the explanation of the "how" in learning. Each group answers basic questions about learning according to its own view.

Some of the basic questions that a theory of learning should be able to explain adequately are listed below. Following that, each of them is considered individually, and the Stimulus-Response Connectionist viewpoint is discussed.

1. What is learned?
2. How is sequential behavior, such as ongoing movement or thought, explained?
3. Does learning one thing help you in learning something else?
4. What happens when we remember? When we forget?
5. How important is reward to learning?
6. What is the role of practice in learning?
7. What is the place of understanding and insight in learning?
8. What are the limits (the capacities) of learning?

(1) What is learned?

Stimulus-Response Connectionist theorists assert that man learns connections (associations, habits). Each time a response occurs, (be it a thought or an overt

action)* in connection with or because of a stimulus (or combination of stimuli), a connection has been learned. It is through the maze of interconnections that are built up by an individual continually reacting to his environment, that his behavior is explained.

(2) How is sequential behavior, such as ongoing movement or thought explained?

S-R Connectionist theorists rely on sequences, or "chains" of associations to explain ongoing behavior. One association, having been acted upon, calls up another association, one of a large complex of possible associations. In this way, sequential behavior is carried out. It is theorized that one response acts as the stimulus for the next response. For example, a typist, seeing the word "the" calls up that S-R chain and types out "t-h-e". If we look more closely at the experienced typist, the response of typing the "t" may act as the stimulus for the typing of the "h", and the typing of the "h" may act as the stimulus for the typing of the "e", and so on.

Or, for another example, a man learning a golf swing learns a long sequence of muscle movements that are chained together. These S-R-S-R-S-R chains, precisely learned, to the exclusion of distractions, allow the expert golfer to reproduce his swing almost precisely the same each time he does it. In contrast, the less expert golfer, whose swing is made up of less refined, less precise, and more distractable S-R chains, has a more erratic and less predictable swing.

To explain thinking, which is far more complex a skill than simple muscle movements, it is necessary to consider the complex array of associations built up in the mind. These are inter-associated in multitudinous ways and are grouped together to make up more inclusive entities, such as concepts, principles, and strategies. These larger entities with their connected associations, make up thought.

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*A response is any form of behavior. The term behavior includes both overt, tangible behavior and covert mental thought.

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As always, the basic unit of learning is the association—the connection of a particular stimulus to a particular response. The more complex the skill (for example, creative thinking) the more complex the inter-associations and chains of associations that go into making up the behavior.

(3) Does learning one thing help you to learn something else?

If all learning is made up of more or less complex combinations of associations, then it seems reasonable to assume that learning one thing should help you in learning something else if the two things are similar enough. If two skills are similar, they must use some of the same associations. For example, it seems reasonable that a baseball player who learns a good, even, swing, may subsequently find it easier to learn to swing a tennis racquet. If he becomes a switch-hitter in baseball, this might help him with his backhand in tennis.

If this principle applies at this rather simple level, why shouldn't it apply at a more complex level? S-R theorists say that it does—to the extent that the basic units (i.e. S-R associations) needed for subsequent learning were previously learned as part of the original learning.

The following seemingly foolish and simplistic example may help to explain. Let us say that a particular bit of learning requires 200 associations, and a second bit of learning that is to be learned later also requires 200 associations. If fifty of those to be learned for the second bit of learning are the same as fifty of those learned in the original 200, then the individual who had mastered the original skill would have fewer associations to learn in mastering the second skill. Thus, to the degree that the two skills require the same sub-components (i.e. S-R Connections), learning the first skill will help in learning the second.

(4) What happens when we remember? When we forget?

Remembering, to the S-R Associationist, is the result of the maintenance of

sufficient strength of the stimulus-response connections. Since it was a response connected to a stimulus that represented the learning, if it is to be remembered, the connection must remain, strongly enough to be recallable out of the maze of associations in memory.

Forgetting then is merely the result of losing the strength of the S-R connections that made the learning recallable. Many theories attempt to explain why the connections become weakened over time. The most popular theory currently espoused by Associationists, uses the interference caused by previous learning and by subsequent learning to explain forgetting.

To explain further, since all learning is represented by connections between stimuli and responses, these inter-connections become very complex. More than one stimuli can come to evoke the same response, and more than one response can be evoked by the same stimulus. For example, the response "hunger" can be evoked by: (1) an empty stomach; (2) the time at which you usually eat; (3) a sign stating "Pizza" which stimulates fond memories associated with pizza; (4) etc. On the other hand, one stimulus, for example the "Pizza" sign, can stimulate any number of responses which may have become associated with it, including a warm mental image of the waitress, or unhappy memories of an upset stomach. So you see, even at this very simple level, the interconnections among associations become very complex.

It seems reasonable then, that one reason why we forget is that a competing response has been learned (connected to) the same stimulus and that this connection interferes with the connection we want to remember. All of the individual associations gain and lose strength relative to each other as we go through life experiencing and learning. If the association we want to remember is strong enough relative to the other associations around it, we will remember it. If it is too weak, we will not be able to remember it and say that we "forgot" it.

(5) How important is reward to learning?

To most S-R Connectionists, learning takes place best when some form of reward occurs. (Remember that reward can take the form of the achievement of something desirable or the avoidance of something undesirable.) While reward may not be altogether necessary, most S-R theorists feel that reward strengthens associative connections and makes them more resistant to interference. Naturally, reward can take many forms; it can be tangible, or merely an internal feeling of satisfaction or of relief. In any case, when the reward is appropriate to the task, and seen as a reward by the learner, it should always act to increase the likelihood of learning taking place.

(6) What is the role of practice in learning?

Most S-R Associationists feel that practice is not a sufficient condition for learning to occur. Repetition of a response adds little to the strength of the S-R connection unless the response is followed by some form of reward. Practice is important though, especially for more complex learning, as it allows for more chance of continued reward of success, thus increasing learning.

(7) What is the place of understanding and insight in learning?

S-R Connectionists minimize the role of understanding on the part of the learner. In fact, one can learn some associations (e.g. reflexes and phobias) without any understanding. How well, or how much one understands, is dependent on the number and strength of associative connections. The best way to gain understanding is to build a body of associative connections appropriate to that understanding.

"Insight" is not even recognized as a phenomenon of learning except as it may happen to grow out of the application of earlier learned habits (connections) to the new task.

(8) What are the limits (capacity) of learning?

To the S-R Associationist, the obvious answer is that learning capacity depends upon the number of connections and their availability. People differ in their capacity for associations. This difference is predominantly quantitative in that it reflects that capacity of the individual system to form and maintain S-R connections.

Conclusion

S-R theorists build their theories around a picture of man as a mechanistic responder, who learns by associating (connecting) stimuli to responses. Every explanation of the system is built from the one basic unit of behavior, the stimulus-response associative connection. All learning is represented by combinations of these associations. It is the complexity and strength of these associations that determine much of the "how" and "why" of learning.

(Please do not open booklet until requested to do so) (I)

Name_____

Student Number_____

Date_____

Instructor's name_____

Education 200

Learning Laboratory

Part Two:

TEAM TEACHING

Instructions: Enclosed is Part Two of the Learning Laboratory Exercise. In our first session, we learned about the Stimulus-Response Connectionist theory of how learning takes place. Today you will be studying about team teaching. The material should serve to help introduce a lecture session scheduled for later in the course.

When the instructor tells you to begin, you will have 45 minutes to read and study the attached passage. Take your time. Learn the information well. At a later date you will be tested on this as well as on the Stimulus-Response Connectionist theory.

Make any marks, notes, underlining, or highlighting that will help you to learn the material. When this class is over, the booklets will be collected. However, they will be returned to you when the laboratory exercise is over.

Team teaching is another of the important innovations in instruction during recent years. Most innovations spur discussions regarding their value, and in this article nine "advantages" consistently associated with the team teaching concept are cited in terms of an explicit set of assumptions. As with any idea which involves one person working with one or more other people, what may make the difference, so far as success is concerned, is not so much whether the idea is good, but whether the relationship between the people involved is. How about yourself? What do you think would make the difference as to whether or not you could work in a team-teaching situation?

At the moment, it appears likely that in hundreds of secondary schools and in many elementary schools the instructional staffs are doing something which they call team teaching. What types of team teaching are reported by school systems? What are characteristics of present developments? What advantages are claimed for team teaching, and what problems are inherent in the structures already adopted?

Types of Team Teaching

The education profession has suffered for years because it has lacked precise terminology. Team teaching is another example—the term already has almost as many meanings as there are school systems doing something with it. At present, there appear to be at least the following five types of team teaching in various stages of development and/or experimentation. Variations from these types are, of course, myriad.

(1) A hierarchy of teaching assignment

Several school systems (see Anderson, Johnson, Stone) have attempted to

develop instructional teams which are based upon a specified hierarchy of teaching assignments. At the top of the hierarchy is a team leader who is a person with superior educational preparation, several years of teaching experience, and leadership qualities. The team leader often is given a lighter teaching load and a salary commensurate with the leadership responsibilities he is asked to assume. The team, in school systems developing hierarchal assignments, usually also consists of senior teachers (who receive extra pay, but not as much as that received by the team leader), regular teachers (often those without previous experience or those new to the system), part-time teaching assistants, and clerical aides. In order to cover the costs of the increased salaries for leadership and for clerical help, additional pupils are assigned to the team—usually at least one extra class section for three or four certified teachers.

(2) Coordinate- or co-teaching

In school systems using this approach, teachers are assigned to a large group of pupils (usually a multiple of the number the teachers would have under more traditional assignments; e.g., two teachers to 60 youngsters, three teachers to 90) and they plan together as peers how best to provide for the pupils for whom they are responsible. As in the previously described "hierarchy" plan, sometimes instruction is provided to the entire group by one teacher. Sometimes one teacher works with most of the youngsters in the group while the other works with a small group of the gifted or with those needing remedial instruction. Sometimes each of the teachers has a "normal-sized" group of about 30 pupils each. Attempts are made in the planning to utilize to the fullest extent the strengths of each teacher. Such plans usually have been described as existing within established departments at secondary school levels or at grade levels in elementary schools.

(3) Team teaching across departmental lines

In several junior and senior high schools attempts have been made to improve the program, and hopefully to improve learning, by devising schedules for instructional teams which provide a two- or three-period block of related content (e.g., American history, American literature). Students have, normally, one period with the social studies teacher, followed by one period with the English teacher (or the reverse). Often, when desirable, the two groups are combined for the double period—as for a field trip, orientation to a new unit, lecture by an outstanding resource person, visual aids, and the like. The teachers have at least one free period at the same hour so that joint planning is possible.

(4) Part- or full-time helpers

Many descriptions of team teaching indicate a fairly standard teaching role for the regularly certificated teacher, but seek to improve his teaching effectiveness by providing additional help of various kinds, including instructional secretaries, theme or paper correctors, laboratory assistants, learning materials coordinators, and audio-visual experts. To employ the additional personnel without substantial increases in instructional costs, teachers usually are asked to accept responsibility for a larger number of learners than normal (usually 35 to 40). The teacher retains active control of the planning and most instructional phases of teaching, utilizing the helpers on the team for particular tasks of a more routine nature.

(5) Trading groups

In an informal way this method of capitalizing on the particular strengths of teachers has been utilized for years by elementary school teachers. The

teachers have said, in essence, "If you'll take my art--you're good in it and I'm not--I'll take your music," or "If you take my science, I'll take your social studies." Until recently, such "trading" was rare at the secondary school level, but it may be growing now as a result of the staff utilization studies.

Several reports indicate that two or three teachers of a particular subject, such as general science, plan their work so that they trade groups for particular units of content. The trading is done, ostensibly, to make certain that the groups receive instruction from the best-qualified teacher of the team, and also to ensure that the teachers have an opportunity to provide instruction geared to their own interests and competencies.

An Assessment

Any attempt at assessment of educational practices is, of necessity, made from a value base. In most previously published reports, an attempt has been made to assess practices in team teaching by utilizing three types of data: achievement as measured by standardized or by locally-constructed tests, teacher opinions (sometimes buttressed by student and parent opinions), and per-pupil costs. The data collected and reported generally indicate:

(a) Students do as well or perhaps a little better on standardized tests when taught by teaching teams of the various types described. Usually the obtained differences are not significant when fairly sophisticated statistical measures are employed to analyze the data.

(b) Teachers, generally, are willing to continue the team approach, although there are numerous indications that not all teachers make good team members. Increasingly, reports indicate that differences among teachers need

to be recognized equally as much as do variations among learners (see Hanvey and Tenenberg, Weiss). The reports seem to show a feeling of, "We are working on the frontier—trying to find a better way of proceeding," which undoubtedly has positive value for heightened morale. The increased workloads (meetings, meetings, meetings!) seem to have been shouldered with enthusiasm by the participants. In the long pull, better ways of equalizing instructional loads probably will need to be developed or morale may slip.

(c) Students and their parents generally favor what has been tried. Many learners are at first skeptical or negative, but as teachers gain confidence and competence in their changed roles, reports from them indicate positive support for the team approach. (d) Costs rise slightly. The extent of the increased costs usually is not specifically reported. Three ways of bearing the increased costs have been utilized: increased local appropriations, employing fewer qualified teachers and increasing the pupil-teacher ratio, and support from foundations. Many of the additional costs have been the result of improved instructional resources—books, films, overhead projectors, and the like.

While these criteria of achievement, opinion, and cost are measurable, to some extent at least, they do not necessarily provide good bases for assessment unless one subscribes to the following premises: (a) that education is best which results in highest achievement as measured by tests, standardized or otherwise; (b) that education is best which results in expressed teacher satisfaction with administrative practices (and perhaps student and parent approval also); (c) that education is best which increases present per-pupil costs only slightly and may in time tend to lower costs. These premises seem to be questionable as criteria for a profession to use in assessing the worth of an innovation.

The assessment which follows, also made from a value base, is developed to the extent possible on the following assumptions: (a) learning of high quality requires interaction between the teacher and the learner and between the learner and other learners; (b) learning of high quality is more likely to occur when teachers are patient, understanding, intellectually alert, and free to make decisions based upon their best professional judgment; (c) what is learned must be used (more functionally than on an examination) or before long it will not be known.

These assumptions obviously eliminate cost as a function of quality (although most administrators at present must consider the cost-quality factor) because the writer assumes that this nation can afford instruction of high quality for its children and youth. The assumptions also eliminate teacher opinions as expressed on questionnaires or verbally to members of the administrative and supervisory staffs. What is essential for effective learning is not necessarily highly correlated with what teachers prefer. To state the assumption another way, what teachers consider to be good teaching may not result in the most effective learning. The spotlight should be focused on the learning process rather than on teaching.

These assumptions also eliminate achievement as measured by tests. Teachers know what most achievement tests contain or are likely to contain. Using almost any organizational structure, they can, therefore, make sure that the learners make about average gains in achievement. Obviously, any structure which results in marked improvement on standardized tests should be seriously considered. Whether the instructional technique or structure should be adopted widely, even if better test results are obtained, is another matter—a matter for professional judgment. Students who score higher on

standardized tests, in other words, are not necessarily better educated.

What assessment can be made of the various types of team teaching using the value assumption that good learning results from the interaction of learner and learners with patient, understanding, intellectually alert, free teachers who see that what is learned is used? Nine "advantages" consistently reported for team teaching are given below. In each instance, some comments based upon the value orientation of the writer follow in regular type.

(1) Few pupils are limited to the instructional competence of a single teacher at a grade level or in a department at the secondary level. As a result, few teachers in this arrangement get to know individual pupils as well as in traditional arrangements. Interaction between the superior teachers and the learners (especially in the hierarchal plan) is minimal. Personal contacts of learners with teachers tend to be limited to teachers of lesser competence and experience.

(2) Persons most highly qualified provide instruction to large groups, thus saving much time for the total staff which can be used for more effective planning and for instruction in smaller-than-average groups. Questions learners have during the lecture must be deferred until a later time. Moreover, what the teacher wants to teach is not necessarily what the pupil needs or wants to learn. The learner may, in fact, already know what is being presented to a large group. The same problem exists, of course, when teachers lecture to normal-sized groups. May there not be a better way to teach?

(3) In presentations to large groups, better use is made of visual aids because more time can be devoted to the preparation of needed materials by specially-

qualified team members. Substituting a picture of a magnet on an overhead projector as a lecturer explains how it works (as was shown recently in the television report, "The Influential Americans") may result in undesirable verbalization not sufficiently based on real, firsthand experiences by the learners themselves. Skillful presentations do not necessarily result in effective learning experiences.

(4) Most uniformity in instruction is achieved because all students are taught, both in the large groups and the small, by the same teachers. Sections pupils are assigned to thus make less difference than in traditionally organized schools. Uniformity in instruction is not necessarily desirable. The degree of desirability depends largely upon how much flexibility is provided for the very bright students and the slow learners. Individualization of instruction, whether in traditional or team approaches to teaching, is a valid and desirable goal. To the degree that attention to individual differences is provided (this varies in different team teaching plans), the learning is likely to be effective.

(5) Less repetition is required of teachers, especially at the secondary level where several sections of the same class have been traditionally assigned. Repeating a lecture to several sections of the same class probably is wasteful- but getting to know the pupil is essential for interaction. Almost all reports indicate that less discussion occurs as team teaching is undertaken. Perhaps more "ground" can be covered, but that is no guarantee that more learning has taken place.

(6) Teacher competencies are better utilized. Instruction tends to become more formal, less spontaneous. In the hierarchal plan, young, inexperienced

teachers undoubtedly have more opportunity to learn from team leaders, but the conception is supported that superior teachers lecture to large groups while teachers drawing lower salaries and with less teaching experience work with smaller groups. Learners, as a result, get individual help from teachers who probably are least qualified to give it. These weaknesses, it should be noted, are not apparent in the coordinate and interdepartmental plans where teachers operate as peers.

(7) Better provisions are made for helpers—librarians, audio-visual experts, clerks, and the like—to do routine tasks. A definite boon to the profession! The only problem which should be noted: effective coordination of such helpers takes time. In the opinion of this analyst, such help should and could be provided regardless of the structure for teaching developed by the school system.

(8) Group size is clearly related to function. Large groups are formed for activities which are effective with large groups and vice versa. This concept makes sense. In the judgment of this assessor, the "coordinate" and the "across departmental lines" teams have the greatest possibility of built-in flexibility at this point. The "hierarchal plan," because of the specified roles, probably has the least likelihood of achieving flexibility in grouping.

(9) Of necessity, students assume more responsibility for their own learning. As more and more instruction is provided in large groups, a greater share of the school day is given to independent study on the part of learners. If education is effective, the more mature the learner, the more able to guide and direct his own learning endeavors he should be. Generally, then, this claimed advantage of team teaching is desirable. Perhaps even a greater measure of independence could be achieved other ways, however.

Conclusion

The worth of attempts at team teaching are not proven to date. The main value of the attempts which have been made thus far undoubtedly lies in the staff growth which has occurred as a result of the experimentation.

Experimentation should be continued. Much more sophisticated research designs should be used, so that variables in the situations can be more carefully controlled. While team teaching is being tested more carefully, some school systems (perhaps the same ones) should also be testing other approaches to improvement of learning, such as: assigning not more than 20 pupils to a teacher, shortening the teacher-directed part of the school day and lengthening the pupil-directed portions of the day, utilizing more programmed materials as these become available, basing more instruction on the "workshop way of learning," orienting in-service education programs for teachers more toward intellectual growth, providing better learning materials centers and instructional secretaries in every school, and lengthening the school year for a larger number of teachers so that more time for planning and preparation is available.

(If you have time, review this material, trying to understand the whole position and how the separate parts fit together.)

APPENDIX D

RETENTION TEST

(Please do not open booklet until requested to do so.)

Name _____

Student Number _____

Instructor's Name _____

Education 200

Learning Laboratory

EVALUATION

Instructions:

1. This is a test; no talking please.
2. Please sit in alternate seats.
3. Fill in your answer sheets with (a) your name, (b) your student number and code it on the right, (c) your sex, and (d) your instructor's name.
4. Fill in the information asked for on this booklet.
5. When requested to do so, open the booklet and begin answering the questions.

Inside are a number of multiple-choice questions that have relevance to the material you studied in the first two sessions of the Learning Laboratory.

The first 36 questions are about learning theories. Answer them all from the point of view of the Stimulus-Response Connectionist learning theorists, by choosing the best alternative from among those offered.

Questions 37-40 are only for those people who studied the article on "team teaching." Those who did not read this article need not bother answering them.

This booklet and the correct answers to the questions will be returned to you in your recitation sections. If you wish to remember the answers you selected, you should key them somehow in the booklet, possibly by circling your choices.

When leaving, please turn in your pencil, your question booklet, and your answer form.

Make sure your name, your student number, and your instructor's name are on your booklet.

Directions: Answer questions 1-36 from the point of view of the Stimulus-Response Connectionist learning theorists.

(1) Learning is defined as:

1. Changes in the environment that cause maturation.
2. Maturation.
3. Changes in instinct not due to traumatic experiences.
4. Changes that take place in an organism's mental structures and its potential behavior that are relatively permanent and not due to instinct or maturation.
5. Changes that take place in an organism and its potential behavior that are relatively permanent and not due to maturation and instinct.

(2) Philosophical position. What is the basic philosophical position of the Stimulus-Response Connectionist group of theorists.

1. Man is a passive tool of his environment which willfully manipulates him.
2. Man is dominated by his environment; a passive reactor who learns each time he reacts and his reactions become associated with the environmental stimuli that evoked them.
3. Each man is a unique individual whose behavior is determined uniquely by the manner and degree of differentiation of his phenomenological field.
4. Man interacts with his environment, responding to its stimulation, but also creatively initiating behavior that will help him reach his goals.
5. Man is outside of his environment and operates independently of it.

(3) What is learned?

1. Associations.
2. Emotions.
3. Habits.
4. Ideas.
5. Meanings.

(4) How is sequential behavior such as ongoing movement or thought explained?

1. By reference to the relationships in the individual's experiences.
2. By reference to chains of habits built up by the individual.
3. By reference to the goals of the individual and his perception of the state of his environment.
4. By reference to the learner's perception of the state of his environment.
5. By reference to the information the learner has built-up and stored.

(5) Does learning one thing help you to learn something else?

1. If the learner understands the structure of the learning task and the way its sub-parts relate to each other and to his experiences.
2. If the content of the earlier learning experience is not too similar to that of the current learning experience.
3. If the two tasks share a number of the same or similar associations.
4. If previous learning has provided contrasting anchorage for the subsequent learning.
5. If the learner has a suitable and well-differentiated perception of the problem.

(6) What happens when we remember?

1. Remembering is the result of the maintenance of sufficient strength of the learned association, relative to other learned associations, that will enable it to be recallable out of memory.
2. Remembering is the result of maintenance of sufficient "strength" of elements in storage so that they can be discriminated from other elements in mental structures.
3. Remembering is the result of the maintenance of stability and clarity of cognitive strategies.
4. Remembering is the result of the actuation of positively charged neurones which fire, creating a memory.
5. Remembering is the result of the development of a sufficient number of stimulus response connections each lending strength to the others.

(7) What happens when we forget?

1. Individual connections decay or fade over time.
2. Individual memories are subsumed into larger, more inclusive concepts, or they fade over time.
3. Individual associations are repressed by unconscious or sometimes conscious desires to forget.
4. Individual responses connected to the same stimulus, compete with each other causing interference.
5. Individual elements merge with other more stable elements and are obliterated before they can achieve identity of their own.

(8) How important is reward to learning?

1. The anticipation of reward or punishment is a regulator of behavior.
2. Reward is an important device with the training of animals, but has little to do with the education of humans.
3. Reward tends to automatically produce greater stability and clarity to elements in cognitive structure.
4. Tangible rewards are important to children while more internal rewards have more effect with adults.
5. Learning takes place best when some form of reward occurs.

(9) What is the role of practice in learning?

1. Practice beyond the initial attempt at a task is necessary to learning.
2. Practice seldom results in an increase of learning.
3. Practice is often not a sufficient condition for much learning to occur.
4. Practice renders learning less resistant to interference.
5. Practice increases the stability and clarity of learning in storage.

(10) What is the place of understanding in learning?

1. Without understanding there can be no later application of the learning.
2. Reward will not operate to strengthen learning unless the learner understands what he is doing.
3. Understanding is not necessary with routine tasks.
4. Understanding is not a necessary condition for learning to occur.
5. An understanding of the relationships inherent within a task and between it and other learning is often important in facilitating optimal learning.

(11) What is the place of insight in learning?

1. Insight into the structure of a task is necessary to sensible learning and is important if the learning is going to later be maximally applicable to similar tasks.
2. Insight is not recognized as a phenomenon that occurs in the learning process.
3. Insight operates sporadically if at all, and has unpredictable consequences.
4. The concept "insight" serves to help explain certain behaviors exhibited by animals used in experiments, but it is not a useful term when used with regard to humans.
5. Insight occurs when an individual, after struggling unsuccessfully to solve a problem,is given a hint which aids him enormously.

(12) What are the limits (capacities) of learning?

1. Learning capacity is relatively unimportant as it seems apparent that most individuals never operate anywhere near capacity.
2. An individual's capacity for learning is limited by the number of associative bonds that he can form and maintain.
3. Learning capacity is determined by the number of learning experiences the individual undergoes.
4. Capacity is amenable to great change through environmental enrichment as the individual matures.
5. Capacities are the result of the limitations set by genetics on one individual's cognitive growth as compared with another.

(13) Bill, who was a poor student when in school, always walks faster than normal when he is going by his old alma-mater. He has been graduated for five years and is a successful operator of a gasoline station. Bill says that he still feels uneasy when he visits the school grounds.

S-R Connectionists would say that:

1. He learned the habit of walking fast at school.
2. He doesn't want to see any of his old friends.
3. School is associated with unhappy experiences, which have not lost their strength.
4. He has learned to expect unhappy experiences at school.
5. Attending school was rewarding to him.

(14) Behavior is explained by S-R Connectionists by reference to:

1. The organism's goals and what he has stored in cognitive structures.
2. Understanding the means-ends relationships in a given situation.
3. The inherited intelligence and capacity of the individual.
4. The inherited intelligence, modified by the capacity of the individual.
5. The myriad complex of associations that the individual has built up in his backlog of experiences.

(15) "Practice makes perfect." This is a proverb that we have all heard at one time or another. S-R theorists would say that:

1. It is not necessarily true unless practice is rewarded.
2. It is true especially if the learner understands the relationships in the task he is attempting to learn.
3. It is not true because practice tends to decrease the clarity and stability of new learning, by mixing up elements.
4. It is true because practice regulates behavior.
5. It is not necessarily true when the learner is too highly motivated.

(16) A teacher who is well founded in the S-R principles of learning wants his students to learn how to multiply properly. Which of the following is a consideration he might deem to be most important: (19)

1. That the students understand the relationships in the learning.
2. That the students practice with blocks, and other kinds of manipulatable aids before going into the more abstract aspects of multiplication.
3. That the students get insight from the teacher into the more complex ideas of negative numbers and "carrying" in addition.
4. That the students first learn well the skills involved in addition.
5. That the period for the learning of multiplication comes just before recess.

(2(

(17) According to S-R Connectionist theorists, what is it that is learned?

1. Relationships between anticipations and actions.
2. Relationships between objects and meanings.
3. Relationships between stimuli and rewards.
4. Relationships between goals and ends.
5. Relationships between events and reactions.

(18) To the S-R theorists, which of the following would be most helpful in learning how to solve a mathematical problem:

1. Understanding the inter-relationships of the structure of the problem.
2. A great deal of experience in solving many other problems each similar but slightly different from the current problem.
3. Memorizing the fundamentals of mathematics eg. addition, subtraction, multiplication, the laws of associativity, transitivity, etc.
4. A creative approach to the problem which would lead the learner to many divergent paths to the goal.
5. A large number of inter-connections related to mathematics.

(19) People who are familiar with more than one foreign language often comment that sometimes when they desire to speak a word in one language, it comes out in another, and for a few moments it is difficult for them to think of the correct word. S-R theorists believe that this is because:

1. Associations have gotten mixed up.
2. Memories are competing in mental structures.
3. One of the words is interfering with the memory of the other.
4. The individual learned the languages in a rote, senseless way.
5. One or the other of the languages was not stored in a well structured way.

(20) When Genese was four years old, she was riding in a car which was involved in a severe automobile accident. Although she was not hurt, she says that she can remember that moment of fear with a clarity that makes it seem as though it were yesterday, although it was 25 years ago. S-R theorists would maintain that:

1. The associations made at that moment in her life have maintained their strength.
2. We often remember bothersome thoughts even though we don't want to.
3. The trauma connected with the incident gave it a great deal of clarity and stability in her memory.
4. She is likely to experience trepidation when she rides in automobiles for the rest of her life.
5. A psychologist could help her forget by taking her mentally back to that moment to re-live it thus easing the strain on her libido.

(21) One way to stop smoking might be to chemically treat cigarettes in some way so as to make them taste badly. If this method worked, S-R theorists would say that:

1. Bad tastes are unpleasant to smokers.
2. The smoker soon understood that smoking led to a bad taste in the mouth.
3. The smoker connected the chemical to the bad taste.
4. Cigarette smoking no longer had good connections.
5. The sight of a cigarette became associated with an unpleasant taste in the mouth.

(22) Fran loves to watch "I Love Lucy" but her school marks are not very good. If her father believes in the S-R theories of behavior and wishes to help her improve her school grades, he should:

1. Wait until she is watching "I Love Lucy" and then tell her to go study her schoolwork.

2. Have her study early before "I Love Lucy."

3. Tell her to study before "I Love Lucy" and that if she shows him that she has studied well, she will then be able to watch "I Love Lucy."

4. Try to help her to understand the relationships present in her homework and how they may relate to situations on the "I Love Lucy" show.

5. Tell her that she will not be allowed to watch "I Love Lucy" until after her next report card, and if it doesn't improve she'll be grounded.

(23) Ralph worked very hard in the first and second grades. Nevertheless he still received mostly C's, D's and a few F's. An S-R psychologist would predict that unless there is some change in his school situation, he will drop out of school as soon as he gets a chance to, because:

1. Practice without reward does not maximize learning.

2. Failure experiences will cause him to come to anticipate failure at school.

3. Schools have a tendency to weed out those who are less able.

4. Teachers frown on under-achievers.

5. School will become associated with noxious and punishing experiences such as failure and humiliation.

(24) Don had worked far into the night on a number of algebra problems assigned as homework, but the answer to one of them had evaded him for over an hour. As he rested a minute over a snack thinking about the problem, a new twist to the problem came to him and he quickly solved the problem. S-R theorists would say that:

1. The moment of relaxation cut down on interference.

2. The idea came because while snacking and thinking, he thought of new associations which helped him in solving the problem.

3. While snacking, he experienced insight into the problem.

4. New sensory-perceptual cues aided him when he changed his set.

5. He changed his phenomenological field.

(25) The best way to gain understanding into a problem is to:

1. Practice the task over and over.
2. Attempt to perceive your relationship with the task.
3. Attempt to perceive the relationships within the task and the relationships between the task and other similar tasks.
4. Build up a body of associative connections appropriate to the desired understanding.
5. Try to step outside yourself and understand the task objectively.

(26) From the moment of birth until he dies, man is in an almost constant state of activity—mental and physical. An adequate theory of learning must account for this behavior. S-R theorists would say that:

1. Man begins life with habit patterns, but soon learns to determine his goals and plan methods of attaining them.
2. Man takes in information and changes it to suit his desires and his perception of the environment.
3. Man builds up habit patterns by reacting to the prodding of his environment and it is the relative strength of these habits that determine his behavior.
4. Most of the possible responses that a given individual will have at his disposal at adulthood are "wired in" at birth, and mature as the individual develops.
5. Each man's behavior is unique, both to himself and to each unique situation in which he finds himself.

(27) If the S-R conception of forgetting is true, then:

1. It should be possible to learn meaningfully and reduce forgetting to an inconsequential minimum.
2. Man forgets primarily because his capacity is limited.
3. The more stable informational anchorage a person retains, the less he will have a tendency to forget.
4. Serums and other drugs will soon aid psychologists in combatting forgetting.
5. The more a person learns, especially of material that is similar, the more he is liable to forget.

(28) Learning is built up:

1. As individual elements are added to and related to cognitive structures.
2. As an individual's reactions become associated with stimulus events.
3. The learner incorporates information and randomly stores it.
4. The environment structures learning experiences for the individual.
5. Each generation of man adds to the universal conscious.

(29) The broad S-R philosophical perspective of man in relation to his environment is:

1. Man as a creator of behavior.
2. Man as a reacter.
3. Man as a planner.
4. Man deciding his relations with the environment.
5. Man as a willful connector of associations.

(30) Each time an individual responds in some way:

1. New information is incorporated but it does not effect behavior unless it is understood well.
2. The environment responds.
3. He meets with renewed challenges.
4. His expectations are confirmed or altered.
5. A connection is made and learning occurs.

(31) To an S-R theorist, the process of thinking is explained as the result of:

1. The arrangement of each man's complex array of learned associations into larger, interconnected entities such as concepts, principles, problem-solving strategies, and the like.
2. The manipulation of stored information, through the use of learned information processing strategies.
3. An instinctual process that is inherited by the learner.
4. The coordination of all previously learned information into a planned attack on the problem.
5. The firing of nerve endings which actuate neurones.

(32) When they got their new car with an automatic transmission, Fred's wife Zoe found that she kept on pressing the floor with her left foot when it seemed like it was time to shift. S-R psychologists would say that:

1. Her foot operated independently of her brain.
2. The associative chain that she had built up in driving a stick shift car was still strong enough to evoke maladaptive behavior.
3. Her cognitive structures contained the skill needed to help her in driving a stick shift car, and although it was no longer needed, her behavior planner continued to call it up when it seemed appropriate.
4. To most effectively "stamp out" the response, she should sit on her foot.
5. It would be a while before her earlier learned associations were completely cut off.

(33) S-R learning theorists speculate that forgetting might be caused by:

1. The desire to repress unhappy experiences.
2. Fading and distortion in brain structures.
3. A poorly developed brain mass.
4. Interference by environmental stimuli.
5. The competition of responses connected to the same stimuli.

(34) High grades in school are considered to be given as rewards for effort and good work. Fully one-third of the students in the public schools hardly ever receive a grade higher than "C". S-R theorists would say that it is understandable why close to one-third of our students never finish high school because:

1. Many students do not have the capacity necessary to learn enough to complete high school requirements.
2. Schools fail to provide the right stimuli for many students.
3. A's and B's are continually given to the same people.
4. People learn to avoid situations where punishment and little or no reward has been experienced.
5. People can anticipate reward or punishment and they tend to plan their lives so as to maximize reward and minimize unpleasant experiences.

(35) Jenny knocked over and broke her mother's favorite lamp. She knew from past experience that her mother would spank her if she found out. When her mother came home, she told her that the dog had broken the lamp. Her mother believed her, and dismissed the incident. According to the S-R view, when she is in another similar situation, she will lie again. This demonstrates what basic S-R principle:

1. Interference.

2. Learned behavior strategies.

3. Stimulus-controlled response.

4. Reward.

5. Insight.

(36) John, a college sophomore, complains that he is "just not good at any kind of math." An S-R psychologist would speculate that perhaps:

1. John's past experience did not include enough correct, rewarded practice in the area of mathematics.

2. John's capacity for math associations is small.

3. If John's past teachers in math had carefully followed S-R learning principles, he would probably excell in math today.

4. John lacks a secure grounding in and understanding of the basic principles involved in mathematics.

5. John's associational network involves too many interfering connections.

* *

(((If you studied the passage on "Team Teaching" answer questions 37-40. If you did not study the passage on "Team Teaching," check to see you have answered all of the previous questions. If you have, you are free to leave.

Be sure to turn in your question booklet and your answer sheet as you leave. Is your name and other information on both?

Thank you for your cooperation. We hope you have enjoyed the Learning Laboratory and that you were able to learn something.)))

(37) Which of the following is not a type of "team teaching?"

1. A hierarchy of teaching assignments.

2. Part or full-time helpers.

3. Trading groups.

4. Field trip specialists.

5. Coordinate teaching

(38) The author listed all but one of the following as "advantages" of team teaching. Which do you consider to be the weakest:

1. The most experienced and best teachers lecture to large group sessions while the less experienced teachers work with small groups of students, providing more individualized, personal help.

2. Better provisions are made for helpers--librarians, audio-visual experts, clerks, and the like--to do routine tasks.

3. Teacher competencies are better utilized.

4. Of necessity, students assume more responsibility for their own learning.

5. Group size is clearly related to function. Large groups are formed for activities which are effective for large groups; small groups are used where they will be more effective.

(39) Schools that have changed over to some kind of team teaching have reported that it:

1. Lowers costs of educating.

2. Raises costs of educating.

3. Is looked on favorably by most faculty members from the start.

4. Has shown that good traditional type teachers make good team teachers.

5. Has virtually eliminated the need for part-time helpers.

(40) A conclusion that can be drawn from the article "Team Teaching" is:

1. Team teaching has been proved worthy and valuable.

2. Experimentation in team teaching should be continued.

3. Team teaching is not as flexible as more traditional approaches but serves to facilitate learning.

4. Team teaching is more efficient than traditional approaches, and will soon be in general use.

5. Team teaching is good for large schools but not very realistic for small schools.

That's all. Check and make sure that you have answered all questions. Make sure your name and the other information is on both the answer sheet and the question booklet.

Pass in your question booklet, and your answer sheet as you leave.

Thank you for your cooperation.

APPENDIX E

RETENTION TEST STATISTICS

TABLE 31

SUMMARY OF TEST DATA FOR SPECIFIC SUBSECTION

Mean item difficulty = 39.

Mean item discrimination = 57.

Mean point biserial correlation = 50.

Kuder Richardson reliability #20 = .7297

Standard error of measurement = 1.4248

Distribution of Item Difficulty Indices

	Number of items	Percentage
81-100	0	0
61- 80	1	8
41- 60	5	42
21- 40	4	33
00- 20	2	17

Distribution of Discrimination Indices

	Number of items	Percentage
81-100	1	8
61- 80	3	25
41- 60	7	58
21- 40	1	8
00- 20	0	0
Less than 00	0	0