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The Effectiveness of the Sq3r Study Strategy for Recall and Recognition Tests

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THE EFFECTIVENESS OF THE SQ3R STUDY STRATEGY FOR RECALL AND RECOGNITION TESTS

by

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VITA

The author, Jocelyn Mand Shaughnessy, is the daughter of Charles Louis Mand and Louise Graham Mand. She was born on April 5, 1958, in Columbus, Ohio.

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CHAPTER I

REVIEW OF THE RELATED LITERATURE

There is overwhelming evidence to suggest that at universities and colleges students do not study as effectively or as efficiently as they could (Robinson, 1970). Consequently, most institutions of higher learning offer study skills courses or programs. Although it is often assumed that study skills programs are directed toward poor students, successful students also participate in such programs. This is not surprising when one considers that study skill strategies are rarely taught to students before college. Adams, Carnine and Gersten (1982) suggest that the logical time to teach study skills to students is in the intermediate grades when they first encounter content area textbooks. However, most students are not exposed to specific study skills approaches, and so they develop their own study strategies. Some of these strategies lead to success as a student and other strategies do not. Even students who earn good grades, and so are considered to be successful, may have inefficient study habits. The purpose of study skills programs is to help students improve the efficiency and effectiveness of their study

strategies, regardless of whether they are good or poor students.

This need to improve the study skills of students has led to research which focuses on how academic achievement can be improved through study skills techniques. Different study skill strategies have been tested under a variety of conditions. In some instances, the study skills approaches have been combined with counseling or behavioral-control approaches. Sometimes the participants have been taught the study strategy in an hour and at other times they have been taught the strategy over a period of weeks. Participants have ranged from good students to poor students and from elementary school to college. The different dependent measures have included GPA, scores on specific tests, changes in attitudes toward studying and the degree of adherence to the study strategy.

The results concerning the effectiveness of particular study strategies have varied. With regard to the research about study skill strategies, Kirschenbaum and Perri (1982, p. 76) support the idea that,

> . . . researchers have not claimed to discover panaceas, and the proliferation of methods to reach a common goal suggests that surprisingly little is known or accepted about which approaches produce the best results for which students under which conditions.

In their examination of recent research, Kirschembaum and Perri conclude that although there are methodological

problems with many studies, there are well-controlled experiments that do suggest that certain study skill interventions improve study and self-regulatory skills.

One of the most popular of the study skill approaches is the SQ3R study technique, which was developed by Francis P. Robinson (1970). In addition to being widely used itself, the components of SQ3R have often been included in other study skill approaches (Dansereau, 1978). The SQ3R method requires several effortful processing stages during study. First, students are to survey the chapter they are studying. This is accomplished by skimming the section headings to learn the general ideas that will be presented in the chapter. The second step is the question stage, in which the student is to turn the first heading in the chapter into a question. The third step is to read to answer the question that was formed from the heading. The fourth step is to recite the answer to the question to test what has been learned. During the recite stage the students are strongly encouraged to write the key points in outline form. Students then repeat the question, read, and recite steps with each successive heading in the chapter. The final and fifth step is to review the chapter by using the questions developed in the question stage to recite the major points under each heading.

Despite the widespread use of the SQ3R study technique in college study skills programs, its usefulness has not been clearly demonstrated in an empirical manner (e.g. Johns & McNamara, 1980; Forrest-Pressley & Gillies, 1983; Cook & Mayer, 1983). The present study attempts to test the effectiveness of SQ3R in a more controlled experimental situation than that which has existed in previously undertaken studies.

The research which surrounds the SQ3R study technique can be divided into two categories. The first category includes studies which have attempted to examine the effectiveness of the SQ3R technique. The second category includes studies which have included SQ3R as a study skills component, but the primary focus of the studies has been something other than testing SQ3R. These more recent studies in the second category have often been directed toward determining what behavioral modification techniques can be used to enhance students' study behaviors. Frequently, the study skills component of these studies has been hopelessly confounded with other treatment variables. However, in certain studies the study skills component does exist as a relatively pure treatment, and the authors have reported tests of the study skills condition. In these instances, the studies have been included in this review of the literature. The review of these

studies will focus on the performance of participants in the study skills condition.

Studies Designed to Examine the Effectiveness of SQ3R

Willmore (1966) compared the effectiveness of reading, underlining, outlining and SQ3R as study methods. The four study methods were taught to students in four university how-to-study classes by one person. Each method was presented in a 50-min lecture, then students applied the techniques during a 2-hour session. Students were asked to study the text material using the study method they were working on until they felt prepared to take the exam. All students used all methods but in varying order.

The dependent measures were scores on a multiple-choice test that immediately followed study, a score on the same test taken two weeks later after reviewing for 5 min, and the amount of time students used to prepare for the test. The results indicated statistically significant differences in preparation time with the reading method taking less time than underlining, outlining, and SQ3R. Underlining took less time than did outlining and SQ3R. With an adjustment for study time there was a significant difference in test scores for the four methods. Underlining scores were higher than reading, outlining, and SQ3R.

Students who used SQ3R had the next highest performance. Reading and underlining were rated as having the most favorable characteristics as a study method by participants.

Donald (1967) examined whether SQ3R would improve the performance of seventh-grade students as compared to a control group that was taught in the traditional manner. One class of seventh-graders was taught the SQ3R technique and encouraged to use it to study reading, history, and geography. The teacher also read positive articles about SQ3R to convince the students of the technique's value. The students in the control classroom studied the material through group work, oral and written reports, silent and oral reading of the texts, and answering questions about the material. The students in each group used the same materials, curriculum and reference books for the same amount of time each day. An analysis of scores on standardized pre and post tests showed no significant difference between groups. On a teacher-constructed test there was a statistically significant difference with the SQ3R group performing better than the control group. The author concluded that the students benefited from SQ3R and that it developed better powers of organization, association, and critical thinking.

Wooster (1958) had university students in a study skills course complete assignments using the SQ3R method.

The SQ3R method was taught by introducing it in the classroom situation through reading and class discussion. Practice sessions in which students were to do a reading assignment by using SQ3R were arranged throughout the quarter. The dependent measures were the reading rates, comprehension test scores, and evaluations of note taking during the practice sessions. An analysis of these measures indicated that there was no improvement from the beginning to the end of the quarter in comprehension or reading rate. The quality of notes improved. However, most students were taking notes as they read rather than from memory as SQ3R encourages. Few students were forming questions as an aid to direct reading or reviewing by recitation. The author attributed the apparent lack of adherence to the SQ3R technique to the manner in which SQ3R had been taught to students. He suggested that the method should be discussed briefly and then attention should be concentrated on each component. This would allow each component to be mastered before the method was attempted as a whole.

Gurrola (1975) examined whether a combination of certain components of SQ3R can produce the same benefits as the entire method. College freshmen who were enrolled in study skills courses used one of the following study methods: question, read; survey, question, read; survey,

question, read, recite; or survey, question, read, recite, review. The analysis indicated no significant gain for one study method as compared to another. However, the survey, question, read, recite method was determined to be more efficient than the other methods. The author suggested that the review step of SQ3R may not contribute to the effectiveness of the method.

The studies that have attempted to directly test SQ3R do not provide overwhelming support for the notion that SQ3R is an effective study strategy. In Willmore's (1966) study, students who used SQ3R had the second highest performance following students who used underlining on a multiple-choice test. In the study conducted by Donald (1967), students who used SQ3R performed significantly better on a teacher-constructed test but not on a standardized test. Wooster (1958) and Gurrola (1975) found no statistically significant improvement on test scores for students who used SQ3R to study.

However, it is difficult to draw conclusions regarding the effectiveness of SQ3R from the above studies when one considers the methodological problems of the experiments. In the study conducted by Willmore (1966), students were required to use four study approaches at different times. It is questionable whether there were transfer effects from one study approach to the next.

This introduces a criticism which can also be directed toward the studies of Donald (1967) and Gurrola (1975). Were the SQ3R participants actually using SQ3R? There is little evidence reported in these studies to verify that sudents were actually using SQ3R.

There are other methodological problems with the studies. In the experiment conducted by Donald (1967) students in the SQ3R classroom had more motivational attention than did the students in the control classroom. There was no control group in the study conducted by Wooster (1958) and in the study conducted by Gurrola (1975). Finally, in each of the four studies, the efficiency as well as the effectiveness of the SQ3R technique was addressed even though the experiments were not designed to specifically test each of these issues. Efficiency was operationalized as reading rate and the amount of study time. Effectiveness was measured by students' performance on tests. When both of these dependent measures are examined in the same experiment, the treatments can be confounded by the amount of exposure students have to the study material. That is, if the efficiency variables are not controlled, they vary across treatment conditions. Any test which is designed to compare treatments is actually comparing the amount of study time and as well as the type of treatments. Differences across treatments could

be due to the amount of exposure to the material or to the study technique or to a combination of both.

Studies that Include SQ3R as a Study Skills Component

Richards (1975) examined whether study skills advice alone or with the addition of self-monitoring or stimulus control techniques would improve students' study habits and exam performance. Ninety students in an undergraduate psychology class who were concerned about improving their study habits volunteered to participate in the experiment. There were two control groups and four treatment groups in the study. A no-contact control group was composed of students in the class who had similar midterm grades to those students in the no-treatment control group. The 90 volunteers were randomly assigned to one of the other five groups. On the basis of their midterm exam scores participants in each of the six groups were categorized as either high-exam scorers or low-exam scorers.

A no-treatment control group came to all treatment sessions and completed seven questionnaires about study behavior, but was not exposed to any other part of the treatment. The study skills advice group completed the study behavior questionnaires and received handouts about the SQ3R study technique, taking notes and exams, writing

term papers and general reading hints. Thus, whenever it was possible the training was conducted by using typed handouts. This was done to minimize the interaction between the experimenter and the participants. The remaining three treatment groups had stimulus control and/or self-monitoring added to this study skills advice base. The training for the four treatment groups occurred in four 1-hr treatment sessions over 5 weeks.

The dependent measures included the final exam grade, the final course grade, and the therapist-developed multiple-choice test over class material. On these three dependent measures the means suggested that the study skills advice treatment may have improved performance as compared to the two control groups. However, the data analysis revealed no statistically significant effect. There was a statistically significant positive effect of study skills advice plus self monitoring as compared to the control group on the final exam and the therapist-developed multiple-choice test. There were no statistically significant differential effects of treatments between high and low exam scorers.

Richards, McReynolds, Holt and Sexton (1976) also included SQ3R as part of the study skills component in an experiment which examined self-monitoring of study behavior. In this study there were no-contact and no-treatment control

groups, a study skills advice group, and six different types of self-monitoring plus study skills advice groups. Participants were 87 undergraduate students in a large psychology course who volunteered to participate in the study. The volunteers felt that they had serious problems with their study habits and academic performance. These volunteer participants were randomly assigned to either the no-treatment control, the study skills advice group or one of the six self-monitoring plus study skills advice groups. The no-contact control was composed of nonvolunteer students who were chosen on the basis of how well their pretreatment exam scores matched those of the participants in the no-treatment control group.

The no-contact control group was never seen by the experimenter. The no-treatment control group came to the first treatment session. They were told that the program was full, but that they could have access to the materials after the semester was over. The study skills advice group received study behavior questionnaires, advice on study skills based on SQ3R and stimulus control suggestions. The six self-monitoring plus study skills advice groups were formed by the factorial combination of two levels of information feedback and three levels of self-administered consequences. As in the study conducted by Richards (1975) all of the treatments were delivered through

the use of handouts. There were four 1-hr treatments over a 5-week period.

The results indicated that on the final exam grades the performance of the self-monitoring plus study skills advice groups was statistically significantly better than that of the control group but not better than the study skills advice group. There were no statistically significant differences among the no-contact control group, the no-treatment control group and the study skills advice group.

Greiner and Karoly (1976) also examined the usefulness of self-monitoring strategies within the context of a study skills program based upon SQ3R. The participants were 96 introductory psychology students who scored below the 50th percentile on a survey of study habits and attitudes and who had a GPA of 3.00 or lower. The students had expressed that they had difficulty with study habits.

Participants were randomly assigned to one of six groups. One group served as a no-treatment control. Participants in this group were contacted and told that the study could not accommodate more students, but that they could participate in a shorter program at the end of the quarter. The other groups met for a 1-hr training lecture in which SQ3R was taught. Participants were asked to keep one page outlines of each of the remaining chapters

that were covered in their psychology class. These outlines were emphasized as being an integral part of the SQ3R technique during the training sessions. They were also asked to use the workbook that accompanied the text to study for tests.

A second training session was conducted in small groups of one to three participants. In this session participants were given training that varied according to their assignment to the treatment conditions. Before the specialized training began, participants received a pamphlet that summarized the earlier lecture on SQ3R. They were encouraged to refer to this material as they used SQ3R to study. In the second session the information control group was given study skills training in how to take examinations. The information-expectancy control group was given the same training in how to take exams as was the information control group. They were also given a strong expectancy that the study skill techniques would result in better grades and study habits. The remaining three groups were given training to various extents in self-monitoring, self-reward, and planning. For all groups the training in the second session was delivered by the use of a slide presentation and tape recording followed by a review handout. The average length of the second training session was 45 min. The time was equalized among groups

by the administration of several diagnostic tests. Two weeks later in a third training session participants first took a quiz and then watched a short tape-recorded review of the techniques that had been taught in the previous sessions.

An analysis of the results indicated that on the change in psychology quiz performance the information-expectancy control performed worse on the second quiz than on the first quiz. The performance of the other control groups did not change significantly. On the survey of study habits and attitudes the no-treatment control and the information-expectancy control alone failed to show significant improvement from the pretreatment to the posttreatment administration. When the posttreatment mean scores were compared, the three control groups did not differ significantly on this measure. There was no significant change in GPA from pretreatment to posttreatment for any group.

Obviously, the studies that have included SQ3R as a study skills component have not been directed toward testing the performance of the students who use this study strategy. However, if SQ3R does not improve performance as compared to a control condition in which students use their own study strategies, it would seem reasonable for students to apply the behavior modification technique to

the study strategies they already use. Overall, there was little indication in the studies conducted by Richards (1975), Richards et al. (1976), and Greiner et al. (1976) that the SQ3R groups were performing better than the control groups. Once again, these studies may not be fair tests. None of the studies included manipulation checks to determine if students actually were using SQ3R. In addition, in each of the studies the procedures for teaching SQ3R included other study-help directions. So, if students were actually to do everything that they were taught to do in the study skills training, they were using more than what SQ3R prescribes. This may have detracted from the effectiveness of the method.

Another possible reason that there is an absence of clear support for the effectiveness of SQ3R is the lack of consistency in the type of dependent measures that have been used to evaluate the effectiveness of study skills treatments. Course final grades, course exam grades, standarized tests, measures of study activities and behaviors, semester G.P.A., and cumulative G.P.A. are some of the measures that have been used. Of interest in the present study is that there has been little attention paid to the type of test that has been used to assess performance. The learning and memory literature suggest that students may prepare differently for a multiple-choice

(recognition) test than for a short-answer (recall) test. (Kinney & Eurich, 1932; Meyer, 1934, both cited in Zechmeister & Nyberg, 1982).

It is possible that study strategies such as SQ3R may differentially enhance performance depending upon the type of test. Much of the test expectancy research has been conducted with lists of words rather than prose materials. As a study strategy such as SQ3R is directed toward learning from text, it is worthwhile to examine whether a test expectancy effect generalizes to prose materials.

Studies of Test Expectancy Effects with Prose Materials

Hakstian (1971) examined the effect of students anticipating an objective, essay, or a combined objective and essay exam on student's study methods and test performance. In Experiment 1 students in a college class were told that their midterm exam would either contain objective, essay, or a combination of objective and essay questions. On the day of the midterm students completed a questionnaire that was designed to assess how students studied for the midterm exam. Their midterm exam consisted of an objective test and an essay test. Two weeks after the midterm participants were given an unexpected retention

exam. The results indicated that there was no effect of test expectancy on study preparation or on exam performance for any of the exams.

In a second experiment participants were asked to study an introductory chapter from a college textbook. They were told what type of test to expect--either an objective, an essay or a combined examination. After a limited study period participants completed a questionnaire that was designed to assess how they studied the chapter, objective test, and an essay test. The results of this experiment confirmed those of the first study. That is, test-expectation affected neither the manner in which participants prepared for the test nor their actual performance.

Schmidt (1983) also examined whether students who were expecting recall or recognition memory tests would employ different encoding processes when studying prose materials. In Experiment 1, participants were asked to learn a series of unrelated sentences that contained fictional or non-fictional information. The results indicated that participants who expected a recall test recalled a greater number of sentences than did participants who expected a recognition memory test. There was no test-expectancy effect for different types of information that were contained in the sentences.

In Experiment 2 participants studied a short essay that contained sentences with different levels of comprehensibility. The results supported the test-expectancy finding of Experiment 1. That is, sentence recall was better for participants who had a recall expectancy. In addition, participants who expected a recall test remembered greater detail than did participants who expected a recognition test. The author concluded that the results suggest that students may learn more when preparing for a short-answer or essay test than when preparing for a multiple-choice test.

d'Ydewalle, Swerts, and DeCorte (1983) examined study time and test performance as a function of test expectation. In Experiment 1 participants studied two excerpts from a history text. A limited amount of study time was permitted on the first text. Then participants took the type of test they were told they would be given-either a multiple-choice test or a fill-in-the-blank test. Participants were then asked to study for a second similar test and to estimate how long they would study. Before taking the test participants estimated how long they had studied. The actual study time was recorded. Half of the participants took an expected test and half took an unexpected test. The results indicated that participants who expected a fill-in-the-blank test planned to use more

study time, actually did use more study time, and reported that they used more study time than did the participants who expected a multiple-choice test. In addition, participants who expected open questions performed better on both tests than did those who expected a multiple-choice test.

In a second experiment a similar procedure was followed except that participants did not estimate their study time. Also, participants were assigned to study the first text excerpt for 4 min, 10 min, or for as long as they wanted to study. There was no significant difference of study time of Text 2 as a function of the different study times of Text 1. The same effect of test expectancy that was found in Experiment 1 was found in Experiment 2.

Rationale for the Present Experiment

The results of the studies described above suggest that the test-expectancy effect that has been found with the learning of lists of words also exists when information is to be learned from prose (Schmidt, 1983; d'Ydewalle et al., 1983). Although the different study strategies have not been identified, it is reasonable to suggest that students with a recall test expectancy are approaching the study process differently than are students with a

recognition test expectancy. For instance, students with a recall test expectancy have been found to plan to study longer (d'Ydewalle et al., 1983) and to remember greater detail (Schmidt, 1983).

The test expectancy effect in prose material introduces an implication for study strategies in general. Perhaps independently of the type of test expected, certain study strategies enhance performance on particular types of tests. This information would be particularly important to know when a specific study strategy, such as SQ3R, is being taught to students to improve their academic achievement. For instance, suppose that SQ3R improves performance on a recall memory test but not on a recognition memory test. In many introductory-level classes retention is tested exclusively by multiple-choice exams which are recognition memory tests. Students who study by using SQ3R for the purpose of improving their exam grades may not demostrate better retention on the multiple-choice test.

The purpose of the present study is to determine the relative effectiveness of the SQ3R study technique for recall and recognition tests. The SQ3R study technique requires effortful processing of information. Students must actively think about what they are reading as they read to answer questions they formulated. They must

practice recalling the information through the recite and review steps. This effortful processing is similar to the type of processing that is necessary to recall information on a fill-in-the-blank test. Therefore, an interaction is predicted such that the SQ3R technique will enhance performance on a recall test but not on a recognition test. It is also expected that there will be no performance difference between a control group and an SQ3R group on a recognition test. Overall, performance on a recognition test is expected to be better than performance on a recall test.

CHAPTER II

METHOD

Design and Participants

There were four conditions in the experiment defined by the factorial combination of the two independent variables: the form of study and the type of memory test. The form of study variable had two levels: students were either taught the SQ3R study technique (SQ3R) or were asked to use the study methods they typically use to prepare for a test (free-study). Half of the participants using each study technique were given a recall test and half were given a recognition test.

Participants were 52 undergraduate introductory psychology students who volunteered to participate in the experiment for course credit. The participants were members of the same psychology class in a small liberal arts college. Approximately 10 students from the class did not participate. There was a range of good and poor students included in the study. Thirteen students were randomly assigned to each of the four conditions. Testing

occurred in groups containing no more than four participants.

Procedure for SQ3R Participants

Participants in the SQ3R group experienced the following sequence of events: a training session, a short break, and then a study and testing period. During the training portion of the experiment the SQ3R technique was described-- first in general terms and then with more of an emphasis on how to use the technique. The experimenter then led the participants through a step-by-step application of SQ3R on the first section of a chapter from a college-level social psychology textbook. The participants were first directed to survey the section headings. Then they were asked to develop a question out of the first heading. After they had an opportunity to do this on their own, the experimenter provided several examples of questions they could have developed and answered any questions about the question step of SQ3R. This procedure was followed with the remaining read, recite, and review steps. That is, the participants tried each step and then the experimenter provided examples of how to do the step and answered questions. This portion of the training took approximately 15 min. Then for an additional 15 min

participants continued to study the chapter on their own by using the read and recite steps. After 15 min had elapsed they were asked to practice the review step for 5 min. A transcript of the training instructions is presented in Appendix A, and the practice chapter is presented in Appendix B. The 35 min training session was followed by a 5 to 10 min break.

After the break, the study and testing period began. Participants were asked to use SQ3R to study an excerpt from an introductory college textbook. The material was chosen from an anthropology textbook because no anthropology course is offered at the college where the experiment was conducted. The passage is presented in Appendix C. Participants were reminded that their test performance as a group would be compared to the performance of a group of students who used their own study techniques. They were also told that the creators of SQ3R maintain that the SQ3R technique will help students to do better on tests than if they used their own study techniques. Participants were strongly encouraged to use the SQ3R technique as they practiced it even though they might have more confidence in their own study techniques. A transcript of the study instructions is presented in Appendix A.

The study period was 45 min. A clock was visible

during the study period. Also, the experimenter told participants when there were 25 min remaining and when there were 10 min remaining. At the 10 min warning the experimenter reminded participants that they should begin their review soon.

After the 45 min period ended, half of the participants took the recognition memory test that is presented in Appendix D, and half took the recall memory test that is presented in Appendix E. As can be seen, the recognition test and the recall test were developed so as to be as similar as possible. The 15 questions are the same; the two tests differ in that response alternatives are provided for the recognition test, and they are not provided for the recall test.

After participants finished the test they completed the questionnaire that is presented in Appendix F. They indicated whether it was Very Easy, Easy, Difficult or Very Difficult to use each component of the SQ3R technique. In addition to the participant's ratings of difficulty, the experimenter observed whether or not each participant surveyed the chapter headings by noting page turning at the beginning of the study session.

At the conclusion of the test period participants were asked to indicate whether they were able to study the entire chapter and if they had enough time to study

the chapter. They indicated how much more time they needed if they had wanted more time. Finally, the experimenter explained the hypothesis concerning performance as a function of type of test and form of study.

Procedure for Free-Study Participants

Participants in the free-study group followed the same procedure as the participants in the SQ3R group with the following exceptions. The first task in the experiment for the free-study group was to solve 15 anagrams. They were told that this task was to help them settle in before the study session began. 10 min were allotted to finish the anagram task.

Following the anagram task the free-study participants began the study session. They were instructed to study in the manner that they usually study for a test. At the 10 min warning they were not told to review for the test. Following both the recall test and the recognition test the participants completed a questionnaire designed to determine how they actually studied for the test. A transcript of the instructions is presented in Appendix A; the anagram task is in Appendix G, and the questionnaire is presented in Appendix H.

CHAPTER III

RESULTS

The results of this study will be presented by examining the performance on the memory test, by analyzing the study strategies that were used by the SQ3R participants and by the free-study participants, and then by examining several other variables that may have systematically influenced performance. Unless otherwise indicated, the results of data analyses were considered to be statistically significant if the probability of error was less than .05.

Analysis of the Memory Tests

The means and standard deviations of the number correct for each condition are presented in Table 1. Answers to questions on the free recall test were considered to be correct if the spelling was phonetically close to the correct answer. The mean number correct for the SQ3R recall group was 7.31, and that for the SQ3R recognition group was 10.62. The mean number correct for the free-study recall and recognition groups was 7.23 and 11.31, respectively. An analysis of variance was performed to determine

Table 1

Means and Standard Deviations for Number Correct on Recall and Recognition Memory Tests for Each Study Group

Study Group		Type of Test: Recall[a]	Type of Test: Recognition[a]
SQ3R	x	7.31	10.62
	SD	1.76	1.88
Free Study	x	7.23	11.31
	SD	2.72	1.71

[a]Maximum Score = 15

whether or not SQ3R differentially enhanced performance on the retention tests. The findings were contrary to the hypothesis that participants who used SQ3R would perform better on the recall memory test than did participants who used their own study methods. That is, there was no statistically significant interaction, $\underline{F}(1, 48) = .415$, $MS_e = 4.644$. There also was no main effect of form of study $\underline{F}(1,48) = .265$,MSe = 4.644.). This suggests that the SQ3R study technique under the conditions of this experiment did not improve participants' performance on either type of test as compared to the performance of participants who used their own study techniques. There was a statistically significant main effect of type of test, $F(1,48) = 38.162$, $MS_e = 4.644$. As can be seen in Table 1, across groups the performance on the recognition memory test was better than the performance on the recall memory test.

Study Strategies of the SQ3R Participants

One possible reason that SQ3R did not enhance performance is that the SQ3R participants had difficulty using the technique. An examination of the manipulation-check questionnaire, of whether participants surveyed and created questions, and of whether they had enough time to

study should provide some information about their study strategies.

Table 2 presents the difficulty ratings of each component of SQ3R for the two test types. As can be seen, the ratings are similar across test types. For instance, 9 participants in the SQ3R recall group rated the recite step as difficult, 3 participants rated it as easy and 1 participant rated it as very difficult. In the SQ3R recognition group 8 participants rated the recite step as difficult, 3 participants rated it as easy and 2 participants rated it as very difficult. A close correspondance between the ratings for each test type existed for the survey, question, and read steps as well.

To simplify the data it was decided to collapse ratings across test types. Due to the small expected frequencies, a chi-square test could not be applied to determine if the distribution of ratings differed significantly between the two test groups (Hayes, 1973). However, given the similarity of the ratings distributions and the random assignment of participants to groups, it seemed reasonable to collapse the ratings across test type.

Table 3 presents the rating data collapsed across test type. The survey step and the question step were rated as the easiest of the components to use. Reading and taking notes were rated as fairly equal in difficulty

Table 2

Ratings of Difficulty of the Components of the SQ3R Study Method for the SQ3R Recall and the SQ3R Recognition Groups

SQ3R Recall[a]

Rating Category	SQ3R Component: Survey		Question		Read		Recite		Notes		Review	
	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%
Very Easy	9	.69	4	.31	0	.0	0	.0	3	.23	1	.08
Easy	4	.31	8	.61	10	.77	3	.23	4	.31	3	.23
Difficult	0	.0	1	.08	3	.23	9	.69	4	.31	5	.38
Very Difficult	0	.0	0	.0	0	.0	1	.08	2	.15	4	.31

SQ3R Recognition[a]

Rating Category	SQ3R Component: Survey		Question		Read		Recite		Notes		Review	
	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%
Very Easy	11	.85	7	.54	0	.0	0	.0	0	.0	0	.0
Easy	2	.15	6	.46	8	.62	3	.23	10	.77	9	.69
Difficult	0	.0	0	.0	5	.38	8	.62	3	.23	4	.31
Very Difficult	0	.0	0	.0	0	.0	2	.15	0	.0	0	.0

[a] $n=13$

Table 3

Ratings of Difficulty of the Components of the SQ3R Study Method Collapsed across Test Type.

Rating	SQ3R Component											
	Survey		Question		Read		Recite		Notes		Review	
	freq	%	freq	%	freq	%	freq	%	freq	%	freq	%
Very Easy	20	.77	11	.42	0	.0	0	.0	3	.12	1	.04
Easy	6	.23	14	.54	18	.69	6	.23	14	.55	12	.46
Difficult	0	.0	1	.04	8	.31	17	.65	7	.27	9	.35
Very Difficult	0	.0	0	.0	0	.0	3	.12	2	.08	4	.15

after the survey and question steps. Reviewing was rated as the next most difficult followed by the most difficult component to use the recite step.

At the beginning of the study period the experimenter had noted whether or not participants briefly examined each page of the chapter before they began to study. As might be expected from the rating of surveying, all 13 participants in both SQ3R groups were observed to survey the text before beginning to study. Almost all participants in both SQ3R groups wrote a question in the text next to each topic heading. There were five topic headings that should have been converted into questions. One participant in the SQ3R recall group did not develop questions for any of these headings even though he had developed questions in his practice text. There were only three cases in which headings were not converted into questions. Two participants in the SQ3R recognition group and one participant in the SQ3R recall group each neglected to form a question for one heading.

When asked whether they had enough time to read through the text, two participants in both the SQ3R recall group and in the SQ3R recognition group indicated that they had not finished the text. Seven participants in the SQ3R recall group and six in the SQ3R recognition group said that they needed more time to study. The amount

of time that they wanted is presented in Table 4. As can be seen, 11 of these participants indicated how much more time they needed. Seven of these participants wanted 15 or fewer minutes to complete their studying. Table 5 presents how participants responded when they were asked what they would do with the extra study time.

These data concerning how participants actually used the SQ3R technique suggest that participants did have some difficulty using the technique. In particular, participants found it difficult to use the recite and review steps, which might be the components of the SQ3R technique that are not frequently incorporated into students' own study strategies. An examination of how the free-study participants actually studied will reveal what study strategies they used.

Study Strategies of the Free-Study Participants

The results of the closed-ended questions on the survey which followed the memory test are presented in Table 6. As for the SQ3R condition, the data were collapsed over test type. A chi-square analysis to determine if the free-study recognition group differed from the free-study recall group was not possible because the test assumption concerning the size of the expected frequencies

Table 4

Amount of Time SQ3R Participants Felt They Needed to Finish Studying

	Test Group	
	SQ3R Recall	SQ3R Recognition
Amount of time	freq.	freq.
5 to 10 minutes	1	2
10 to 15 minutes	4	
15 to 20 minutes	1	1
20 to 30 minutes		1
30 minutes		1
No estimate	1	1
	n = 7	n = 6

Table 5

How SQ3R Participants Responded When Asked How They Would Use Extra Time

	Test Group	
	SQ3R Recall	SQ3R Recognition
Study Strategy	frequency	frequency
Finished reading	3	2
Read more carefully	2	
Completed notes	4	
Reviewed	5	2
Self exam, then review		1
Read and studied certain sections again	1	3
Needed more practice with SQ3R		1
Felt time pressure	1	1

Table 6

Free Study Participants' Responses to Questionnaire about Study Techniques Used During the Experimental Study Session.

	Test Group			
	Free Recall		Free Recognition	
Study Technique	freq[a]	%[b]	freq[a]	%[b]
Survey-number of pages	8	.62	10	.77
Survey-topics	4	.31	6	.46
Formed Question	3	.23	0	.0
Read to answer question	3	.23	1	.08
Underlined important points	10	.77	11	.85
Notes-copying	7	.54	11	.85
Notes own words	10	.77	9	.69
Recited main points	3	.23	2	.15
Review by using notes	10	.77	7	.54
Review by using headings	4	.31	4	.31

[a]The number of the 13 participants who indicated that they used each study technique.

[b]Percentage of the possible 13 participants who used the technique.

could not be met (Hayes, 1973). However, using the same reasoning as was applied to the analysis of the data in the SQ3R condition, it was considered appropriate to combine the data.

Table 7 presents the combined data. As can be seen, more than half of the free-study participants reported that they underlined important points, took notes in their own words, took notes directly from the text, surveyed to determine the number of pages, and reviewed by reading their notes. When attention is directed toward the use of SQ3R, it is apparent that in general, the SQ3R study approach was not used by the free-study participants. Although 19 participants reported taking notes in their own words, only 10 participants surveyed to determine the topics in the text, eight participants reviewed by reciting the main points under a section heading, five participants recited the main points of a section after reading it, four participants read to answer a question, and three participants formed a question out of section headings. These data suggest that there were some participants who used the note-taking and surveying components of SQ3R. However, overall, the majority of the free-study participants did not use SQ3R as a study strategy.

Table 8 presents participants' responses to the open-ended question about the other study strategies they

Table 7

Free Study Participants' Responses to Study Technique Questionnaire Collapsed Over Test Type.

Study Technique	Condition Free Study freq[a]	% [b]
Survey-number of pages	18	.69
Survey-topics	10	.38
Formed question	3	.12
Read to answer question	4	.15
Underlined important points	21	.81
Notes-copying	18	.69
Notes-own words	19	.73
Recited main points	5	.19
Review by reading notes	17	.65
Review by using headings	8	.31

[a]The number of the 26 participants who indicated that they used the study technique.

[b]Percentage of the possible 26 participants who used the technique.

Table 8

Study Stategies of Free-Study Participants That Were Not Response Alternatives on the Questionnaire Following the Test.

Frequency	Study Strategy
1	Studied pictures and captions
1	Highlighted for a second time with a different emphasis
2	Tried to reread things that were still unclear
3	Reviewed, reread, or memorized highlighted points
1	Took notes from highlighting then studied notes
1	Took notes from highlighting then studied both highlighting and notes
2	Recited definitions or major points
2	Tried to find the relationship between terms and procedure
2	Read once, then took notes
1	Took notes on unfamiliar terms

used. The most frequently cited strategy that was not provided as a survey alternative was the strategy of reviewing, rereading, or memorizing highlighted points. This strategy does not encourage the active retrieval of information which SQ3R advocates in the recite and review steps.

All participants said that they had enough time to read the text once. Four participants in the free-study recall group and nine participants in the free-study recognition group said that they would have liked more time to study. Table 9 presents how they said they would have used the extra time. Reviewing was the most frequently cited strategy.

These data concerning how the free-study participants studied suggest that most of the students used similar study strategies. In this study most of the free-study participants surveyed to determine the number of pages, underlined the important points in the text, took notes from the text or in their own words, and reviewed by reading their notes. Most importantly for the questions of the present study, these findings indicate that the lack of a treatment effect of SQ3R was not because the free-study participants were using the SQ3R study strategy. In addition, the study strategy of the free-study participants was as effective as SQ3R in the way that the SQ3R participants were using it.

Table 9

How SQ3R Participants Responded When Asked How They Would Use Extra Time

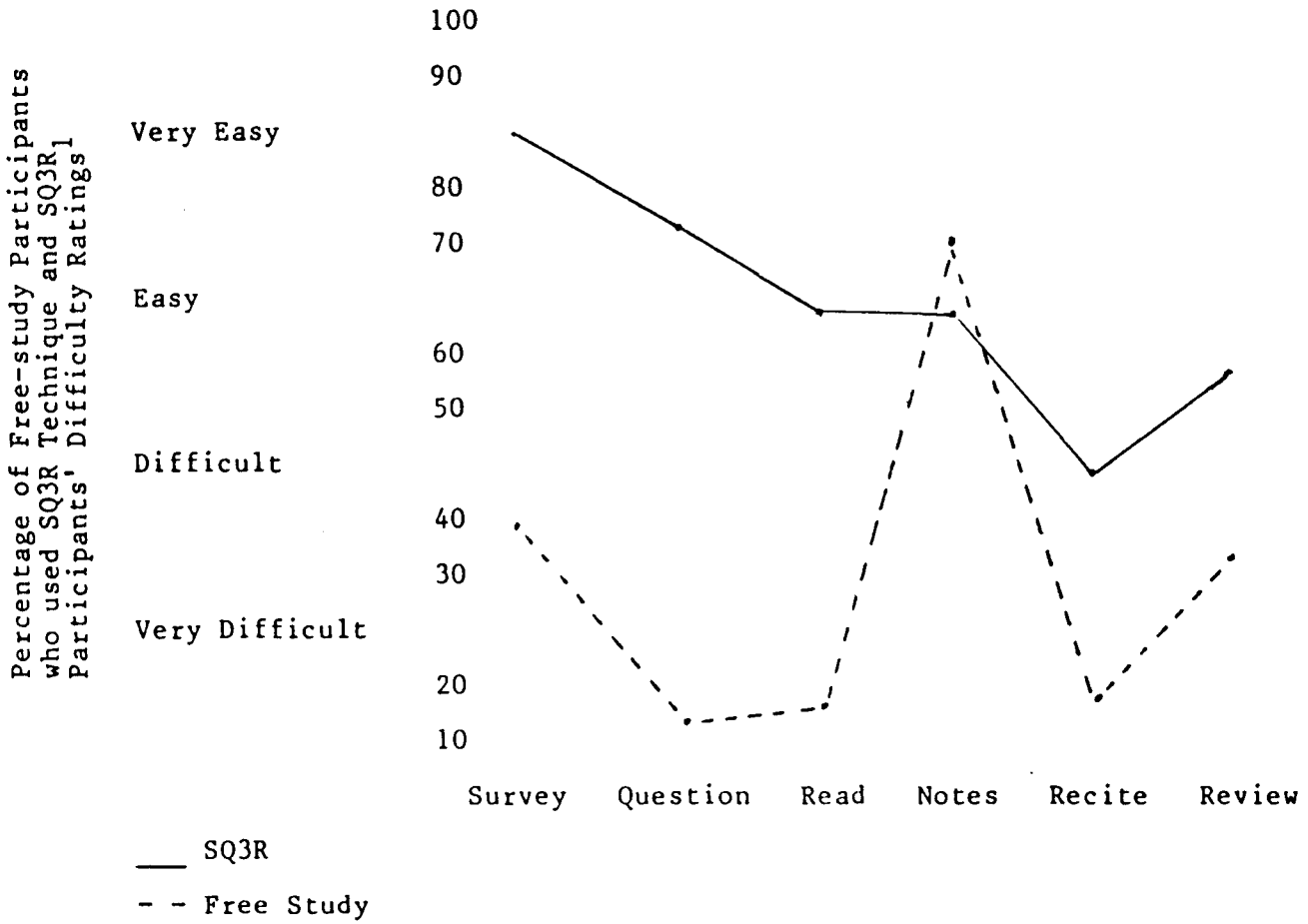
	Test Group	
Study Strategy	Free-Recall frequency	Free-Recognition frequency
Completed notes	1	2
Outlined chapter	1	
Reviewed	3	4
Self-exam, then review		2
Read and studied certain sections again	2	3
Underlined a second time with different emphasis		1
Felt time pressure	1	

Figure 1 presents the free-study participants' reported use of the SQ3R components in comparison to the SQ3R participants' difficulty ratings of the components. As can be seen, the survey, question, and read steps were rated as easy to very easy and 40% or fewer of the free-study participants used them. The note-taking step was rated as easy and over 70% of the free-study participants used it. The recite and review steps were rated as most difficult; under 35% of the free-study participants used these components.

These data suggest that the SQ3R participants may not have incorporated SQ3R into their study approach for the experimental task. The survey, question, read, and note-taking steps could be accomplished without disrupting a student's typical study approach. These steps may have been rated as easy because they did not differ from the participants' normal study strategies (the note-taking component) or because they could be incorporated into the normal study pattern with little effort (the survey, question, and read steps). As is indicated by the free-study participants' reports, students do not typically recite and review in the manner that SQ3R advocates. These steps were rated as difficult to use. It seems unlikely that the SQ3R participants were able to effectively master the recite and review steps. In addition, it is possible

Figure 1

Comparison of SQ3R Participants' Ratings of Difficulty and Free-Study Participants Reported Use of the SQ3R Components



[1]For the question and review components of SQ3R, the SQ3R participants were almost evenly split between two rating categories. This is represented by placing the rating between the two categories. For the other components the most frequently cited rating is indicated.

that they adapted the survey, question, read, and note-taking steps to fit their typical study approach.

Other Variables that Might Influence Test Performance

Several post-hoc correlational analyses were performed to address whether there was a systematic relationship between test performance and reported study strategies. The first analysis examined the relationship between the participants' ratings of how difficult it was to use the critical recite step and their test performance on the recall and recognition test. There was no statistically significant correlation ($r=.132$).

Two other tests were done using the scores in the free-study groups. It seemed possible that there might be a relationship between the number of SQ3R-related study items the free-study participants checked and performance. However, the correlation coefficient was not statistically significant ($r=.014$). Similarly, there was no significant correlation between the total number of study strategies used by free-study participants and performance ($r=.101$).

CHAPTER IV

DISCUSSION

There were three major findings of this study. The first was that under the conditions of this experiment, the SQ3R study technique did not differentially enhance performance on recall and recognition tests. Secondly, participants who used the SQ3R study technique did not perform better on either test than did participants who were using their own study techniques. Finally, some of the participants in the free-study condition reported using components of SQ3R as part of their repetoire of study skills.

The first issue to be addressed is the absence of an effect of SQ3R. It was stated earlier that the effectiveness of SQ3R has been questioned. This is largely due to the lack of valid empirical evidence to support the effectiveness of SQ3R as a study strategy. The present study did attempt to test the SQ3R technique. It can be concluded that under the conditions of this experiment the SQ3R technique does not promote better test performance than does the use of students' own study techniques. However, this can hardly be considered conclusive evidence that SQ3R does not improve test performance in other study situations.

It seems possible that participants were not able to learn SQ3R as an effective study skill. In this study participants had approximately one hour-not only to learn what the components of SQ3R are, but also to learn how to use them. Although participants became familiar with the components of the method, more practice using the technique may be necessary to enhance performance. The data suggest that participants were not able to master the SQ3R technique. The recite and review steps were rated as difficult to use. This suggests that participants were not able to use them in the manner in which SQ3R prescribes.

Participants did rate the survey, question, read, and note-taking components of SQ3R as easy to use. However, these components were also mentioned as study strategies that were used by the free-study participants. One possibility is that the SQ3R participants found the survey, question, read, and note-taking components of SQ3R as easy to use because they may have used some variation of them as part of their typical study strategy.

Another possibility is that the SQ3R participants used the survey, question, read, and note-taking components in the way that the SQ3R technique suggests. However, these components without the recite and review steps do not result in improved performance. It will be recalled that Gurrola (1974) did attempt to examine whether a combi-

nation of certain components of SQ3R would improve performance. Gurrola (1974) did not include a group that used only the recite and review steps or only the recite step. Participants may use a variation of the survey, question, read, and note-taking steps or use the steps exactly as SQ3R prescribes. However, it seems possible that the recite and/or review steps are the crucial components to improve performance.

Another factor to consider is that the participants in this study could be considered to be competent learners. That is, there may be little room for improvement by changing study strategies. A majority of the students in a psychology class were included in the experiment, yielding a range of abilities. However, all of the students were successful enough to have been admitted to a college with high academic standards. In addition, most of the students had completed at least one semester of college-level work. Thus, even if the SQ3R students had mastered the technique, there may not have been a performance difference because the free-study participants were such adept learners.

The absence of a performance effect due to SQ3R implies that the hypothesis concerning a differential effect of SQ3R depending upon type of test could not be examined. This remains an important applied question. Study skills programs certainly do not want to endorse

study strategies that may enhance performance on a particular type of test without being able to convey that information to students. To examine this question it is necessary to first ensure that students are using the study strategy in an effective manner.

The performance of the free-study participants introduces an additional implication for applied settings. The data suggest, not surprisingly, that students may learn more efficiently with their own "less effective" study strategies than with a new "more effective" approach. When students are asked to use new study strategies in a pressured situation, they may revert to their typical study strategies. If this is true, study skills programs will be of most benefit to students if study skills instruction spans a period of time such that students can gradually incorporate them into their study approach. Students also need to believe that the new strategies will be effective if they are to use them.

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APPENDIX A

TRANSCRIPT OF INSTRUCTIONS

SQ3R-Training Instructions

In this experiment we are going to ask you to use a particular technique to study material that we will be presenting to you. After a training and practice session we will take a short break. Then we will ask you to study part of a textbook chapter using the technique and then take a short test covering what you have studied. As a group, your performance on the test will be compared to the performance of students who are using their own study techniques.

The purpose of this session is to train you to use this technique. The name of this technique is SQ3R and you can see on the poster what each letter stands for. The technique involves five stages: survey, question, read, recite, and review. I'm going to take a few moments now to describe each of these stages briefly. Then I will make a few additional comments about each stage, and we will try to make use of the technique with a sample set of materials.

In the survey portion of the technique, you are to glance over the headings in the chapter to see the few big points which will be developed. This survey should not take more than a minute and will show three to six core ideas around which the discussion will cluster. This orientation will help you organize the ideas as you read them later.

In the question section you turn the first heading into a question. Each question will arouse your curiosity and help you to understand that section. Turning a heading into a question can be done on the instant of reading the heading, but it demands a conscious effort on your part to make this a question for which you must read to find the answer.

The read section. Read to answer that question, but be sure to read until the end of the first headed section. This is not a passive plodding along each line, but an active search for the answer.

The recite section. Having read the first section, look away from what you have been reading and try briefly to recite the answer to your question. You should jot down critical points in outline form on a sheet of paper. Make these notes very brief. If you can't write notes from memory you should glance over the section again. You would repeat the question, read and recite steps on each headed section. That is, you would turn the next heading into a question, read to answer that question, and recite the answer by jotting down critical points in your outline. You would read in this way until the entire chapter is completed. The final stage is review. When the lesson has been completely read, look over your notes to get a birds-eye view of the points and of their relationship and check your memory as to the content by reciting the major subpoints under each heading. This checking of memory should be done by covering up the notes and trying to recall the main points. Then expose each major point and try to recall the subpoints under it.

Now I'll make a few additional comments about each section. This technique will at first seem unfamiliar to you because it probably differs from your typical study technique. Try to be sure to follow each of these points as closely as possible as you apply this technique.

The survey. A survey of headings in a lesson should take only a minute. Some of you may be in the habit of reading once you get started studying, so it will take a conscious effort on your part just to look at the headings and then to estimate what the lesson is about.

Reading to answer questions. Changing the heading into a question should be a conscious effort to orient yourself actively toward the material you are reading. You should definitely have in mind what you want to learn as you read each section and not just passively read it line by line. Reading textbooks is work; as a reader you must know what you are looking for, look for it, and then organize your thinking on the topic you are reading about.

Reciting. The tendency in reading is to keep going, but you should stop at the end of each headed section to see if you can answer the question you asked at the start of the section. You should write down the critical points in the section in outline form. As I indicated earlier, this procedure tends to act as a check on whether you have comprehended the material and the recitation fixes

the ideas in memory. Remember that if you can't answer your question or write down the critical points, you need to look at the section again and then try the recite stage again.

It is very important that note-taking require little time and energy. The notes should be very brief. Many students have difficulty with the note-taking part of the SQ3R method. Some think that they are to use old habits of lengthy note-taking where all details are copied from the book, usually as complete sentences. This technique so disrupts the progress of reading that the train of thought is lost. Other students stop when they see something important and copy it into their notes. Many of these students copy a sentence into their notes without ever having read it for meaning, because as soon as they see something in italics they start copying.

SQ3R note-taking has the following characteristics. When you begin to read, no notes are to be written until the whole headed section is completed. The notes should be jotted down from memory and not from the text. The notes should be in your own words and should be brief, little more than a word or a phrase. Such brief wording also keeps the notes in compact form so that they can easily be used later in review.

Review. Review immediately after reading should be brief, probably not more than 3-5 minutes. The total outline should be looked over to get an overview, but the review should not be limited to this. As indicated earlier, self-recitation should be used to make sure that the material is better fixed in memory. A good way to do this is to cover the notes, recite the main points, and then see if you are correct. Then cover up the notes again, recite the sub-points under the first main point, and again check them for accuracy. This system should be repeated on each major point. This method helps you to see the organization which exists between the various ideas and also helps to indicate what is not yet mastered, so that you can go back and go over these points again.

Now that you have had an overview of the entire method and some specific comments on each stage, let's try to apply this technique to some concrete study material. (GIVE SAMPLE TEXT AND PAPER) The copy I have just given you consists of a section of a chapter of a social psychology textbook. Let's take a look at this chapter

first to carry out the survey step of SQ3R. Take a few seconds now, and glance over just the heading of each of the various sections. (PAUSE BRIEFLY)

Okay, now let's begin to work. The second set of steps in SQ3R is to take each section, develop a question, read that section, and recite the answer to that question. Let's do that together for the first section. First, let's convert that heading into a question and write it next to the heading. It is often helpful to use the Who, When, What, Where, Why, How interrogative words in formulating these questions. (LET SUBJECTS WRITE DOWN QUESTION) When we look at this first heading, "The presence of others can boost performance," we could consider a question such as, "When does the presence of others boost performance?" or "How can the presence of others boost performance?" Now read the section to answer your question. (PAUSE)

After having read the section you begin the recite step. It is now essential that you make note of the important information to answer the question that you have raised. Look away from the section and repeat to yourself the answer to your question and the major points. Write down these major points in your own words in outline form. (PAUSE) The most important concept in that first section was social facilitation and it answers the question "How can the presence of others boost performance?".

Before you continue with the other sections I'd like to mention one additional helpful hint about the recite stage. Some sections are quite long so it's difficult to remember all the points. When you come across a long section break it up into smaller sections. Don't spend a lot of time trying to decide how to divide it but when you get to a point in your reading where you feel that you are forgetting points, do the recite step. After you finish the recite step for that portion of the section, continue reading the section and do the recite step again.

Now please continue to study the text on your own using the question, read, recite, review process. Feel free to ask any questions that you have about how you should use the steps as you progress through the text. Are there any questions before you begin?

SQ3R--Study and Test Instructions

As was mentioned earlier, the purpose of this experiment is to compare two types of study methods. You will be using SQ3R to study a selection from a textbook. Another group of students will be asked to study the same text selection. However, they will study in just the same way as they usually study for a test. The people who developed SQ3R say that it will help students do better on tests than if they used their own study methods. We recognize that it is probably more comfortable to use your own study techniques at this point and that you probably have more confidence in them than you do in the SQ3R technique. However, it is critical to this project that you use SQ3R as we just practiced it to study this text selection.

Now we will begin the study session. You will have 45 min to study the material. There is a clock in the back of the room so that you can check how much time you have left. Also, I will tell you when you have 25 min left and when you have about 10 min left and should begin your review. From what other students have said we know that you will need all of the time to master the material in the text. The test is a comprehensive test that contains several different types of questions. Remember to write down the question that you formulate for each heading by that heading in the booklet. Please turn the booklet and your notes over on your desk when you feel that you are completely ready to take the test. As I mentioned though, it is unlikely that you will finish early.

Are there any questions before we begin?

Free-Study--Anagram and Study Instructions

The purpose of this experiment is to compare two types of study methods. One group in the experiment will be learning a specific study technique and will be asked to use it to study a selection from a textbook. You will be asked to study the same text selection. However, we want you to study in just the same way as you usually study for a test. The people who developed the study technique say that it will help students do better on tests than if they used their own study methods. But, this may not be true. You might think of it as a

competition--that you want to prove that the way you study is just as good if not better than any other study method.

Before I give you the text selection we would like you to take a few minutes to work on another task so that you have a chance to settle in before we start the study session. I am going to give you several anagrams to solve. As you may know, an anagram is a series of letters that can be rearranged to form a word. Your job is to solve as many of the anagrams as you can. If you get "stuck" on one move on to another and then come back later. If you finish before I ask you to stop, please turn your paper over. You will have about 10 min. Are there any questions before I pass out the anagrams?

Free-Study--Study and Test Instructions

Now we will begin the study session. Remember, we want you to study this material in the same way as you usually study for a test. For instance, if you usually underline in the book, feel free to do that in these booklets. You will have 45 min to study the material. There is a clock in the back of the room so that you can check how much time you have left. Also, I will tell you when there are 25 min left and then again when there are 10 min left. From what other students have said we know that you will need all of the time to master the material in the text. The test is a comprehensive test that contains several different types of questions. I will give each of you several pieces of blank paper in case you usually take notes as you study. Please turn the booklet and any notes over on your desk when you feel that you are completely ready to take the test. As I mentioned though, it is unlikely that you will finish early. Remember to pace yourself so that you cover all of the text material. The material at the end of the text is just as important as the material in the beginning.

Are there any questions before we begin?

APPENDIX B

PRACTICE CHAPTER

SOCIAL FACILITATION

The most elementary question in social psychology could be: How are individuals affected by the mere presence of other people? "Mere presence" means people are not competing, do not reward or punish, and in fact do nothing except be present as a passive audience or as co-actors. Would the mere presence of other people affect your jogging, eating, typing, or exam performance? The search for the answer is a delighful scientific mystery story.

The Presence Of Others Can Boost Performance

Almost ninety years ago, Norman Triplett (1898), a psychologist interested in bicycle racing, noticed that cyclists' times were faster when racing together than when racing alone against the clock. Before he peddled his hunch (that the presence of others boosts performance), Triplett conducted one of social psychology's early laboratory experiments. Children told to wind string on a fishing reel as rapidly as possible wound faster than when they worked with co-actors than with working alone.

Subsequent experiments--in the early decades of this century--found that the presence of others also improves the speed with which people do simple multiplication problems and cross out designated letters, and improves the accuracy with which people perform simple motor tasks such as keeping a metal stick in contact with a dime-size disc on a moving turntable (Allport, 1920; Dashiell, 1930; Travis, 1925). This social-faciliation effect, as it came to be called, also occurs with animals. In the presence of others of their species, ants excavate more sand and chickens eat more grain (Bayer, 1929; Chen, 1937).

The Presence Of Others Can Hurt Performance

On the other hand, some studies conducted about the same time revealed that the presence of others could

also hinder performance on certain tasks. In the presence of others, cockroaches, parakeets, and greenfinches learn mazes more slowly than when alone (Allee & Masure, 1936; Gates & Allee, 1933; Klopfer, 1958). This disruptive effect also occurs with people. The presence of others diminishes people's efficiency at learning nonsense syllables, completing a maze, and performing complex multiplication problems (Dashiell, 1930; Pessin, 1933; Pessin & Husband, 1933).

Saying that the presence of others sometimes facilitates performance and sometimes hinders it is about as satisfying as a weather forecast predicting that it might be sunny, but then again it might rain. Consequently, by 1940, research activity in this area fizzled. For twenty-five years it lay dormant until awakened by the touch of a new idea.

The General Rule

Can these seemingly contradictory findings be reconciled by a general rule? Social psychologist Robert Zajonc (pronounced Zy-ence, rhymes with science), wondered. As often happens at creative moments in science, Zajonc (1965) used one field of research to illuminate another. In this case the illumination came from a well-esablished principle in experimental psychology: Arousal enhances whatever response tendency is dominant. That is, on easy tasks (for which the most likely ("dominant") response is the correct one), increased arousal enhances performance. For example, people solve easy anagrams, such as akee, fastest when they are anxious. On complex tasks (for which the correct answer is not the dominant response), increased arousal accentuates incorrect responding. Thus on harder anagrams people do worse when anxious.

Could this principle solve the mystery of social facilitation? It seemed reasonable to presume that people are more aroused or energized in the presence of others. (Most of us can recall feeling more tense or excited when before an audience.) If social arousal does not facilitate dominant responses, it should boost performance on easy tasks and hurt performance on difficult tasks. Looking back at the confusing results, everything seemed to fit. Winding fishing reels, doing simple multiplication problems, and eating were all easy tasks for which the observed responses were well-learned or naturally dominant.

And sure enough, having others around boosted performance. Oh the other hand, learning new material, doing a maze, or solving complex math problems were more difficult tasks for which the correct responses were initially less probable. And sure enough, the presence of others increased incorrect responding on these tasks. The same general rule-arousal facilitates dominant responses-seemed to work in both cases. Suddenly, what had been assumed to be contradictory results were now recognized as not contradictory at all.

Zajonc's solution, so simple and elegant, left other social psychologists thinking what Thomas H. Huxley thought after first reading Darwin's Origin of Species: "How extremely stupid not to have thought of that!" It seemed obvious--once Zajonc had pointed it out. Perhaps, however, the pieces appeared to merge so neatly only because they were being viewed through the spectacles of hindsight. But a question no hindsight can answer yet remained: Would the solution survive direct experimental tests?

Indeed it has survived. First, several experiments in which Zajonc and his associates manufactured an arbitrary dominant response confirmed that an audience enhanced this response. In one, Zajonc and Stephen Sales (1966) asked people to pronounce various nonsense words between one and sixteen times. The people were then told that the same words would be flashed on a screen, one at a time. Each time, they were to guess which had appeared. When the people were shown only random black lines for 1/100 second, people "saw" mostly the the words they had pronounced most frequently. These words had become the dominant responses. The same test was also given in the presence of two others. From wnat you have learned thus far, what do you think the effect was? As Figure 9-1 indicates, Zajonc and Sales found exactly what they had predicted: to an even greater extent, the people guessed the most frequently practiced words.

Subsequent experiments have confirmed this effect-the facilitation of dominant responses-in various ways. For example, Peter Hunt and Joseph Hillery (1973) found that in the presence of others, University of Akron students took less time to learn a simple maze and more time to learn one that was complex (just as the cockroaches did in the experiment previously cited). And Paul Paulus and his collaborators (1980) report that when tested with others, University of Texas at Arlington students performed more poorly on complex tasks, such as a paper-and-pencil I.Q. test, than when tested alone.

We have seen that people do respond to the presence of others. But are people really aroused by the presence of observers? In times of stress, a comrade can be comforting. However, researchers have occasionally found that with others present, people perspire more, breathe faster, tense their muscles more, and have higher blood pressure and a faster heart rate (Geen, 1980; Moore & Baron, 1983).

Why Are We Aroused in the Presence of Others?

Deodorant producers certainly have capitalized on this effect. Nearly all their advertising depicts the phenomenon. What is it about other people that causes arousal? Is it their mere presence? The answers are still being debated. However, there is evidence to support three possible factors, each of which may play a role.

Nickolas Cottrell surmised that observers make us apprehensive because we know they may be evaluating us. To test whether this evaluation apprehension exists, Cottrell and his associates (1968) replicated Zajonc and Sales' nonsense-syllables study at Kent State University and added a third condition. In this "mere presence" condition the observers, supposedly in preparation for a perception experiment, were blindfolded in order to prevent them from evaluating the subjects' performance. In contrast to the effect of the watching audience, the mere presence of these blindfolded people did not boost well-practiced responses. Other experiments confirmed Cottrell's conclusion: The enhancement of dominant responses is strongest when people think they are being evaluated (Menchy & Glass, 1968; Paulus & Murdoch, 1971; Martens & Landers, 1972; Sasfy and Okun, 1974; Bray & Sugarman, 1980). Perhaps this is one reason why two-thirds of college basketball games are won by the home team (Hirt & Kimble, 1981), why in both laboratory and everyday situations the larger audience, the more apprehensive people feel (Jackson & Latane, 1981) and why people perform best when their co-actor is slightly superior (Seta, 1982). What is more, those most affected by the presence of others tend to be socially anxious; they are people concerned with how others evaluate them (Geen, 1980; Gastorf, Suls, & Sanders, 1980).

Glenn Sanders, Robert S. Baron, and Danny Moore (1978; Baron, Moore, & Sanders, 1978; Sanders & Baron, 1975) carry evaluation apprehension a step further. They theorize that people who are concerned with how co-actors are doing on the task or how an audience is reacting get distracted from the task at hand. Their experiments suggest that this conflict between paying attention to others and paying attention to the task makes people even more aroused. Evidence that people are indeed "driven by distraction" comes from experiments in which social facilitation is produced not just by the presence of another person, but by even a nonhuman distraction, such as bursts of light (Sanders, 1981a; 1981b).

Zajonc, however, believes that the mere presence of others does produce some arousal even when there exists no evaluation apprehension or conflict. For example, people's color preferences are stronger when they make judgements with others present (Goldman, 1967). On such a task, there is no "good" or "right" answer for others to evaluate, hence no reason to be concerned with their reactions.

Similarly, Hazel Markus (1978) had University of Michigan men prepare for an experiment by putting on special socks, shoes and a lab coat. She then "canceled" the experiment, so the students put their own clothes back on. This clothes changing was done either alone, in front of a supposed fellow subject who watched, or in the presence of someone else who, with back to the subject, acted as if he were repairing some equipment. When someone else was in the room the unfamiliar clothes took longer to put on, and the familiar clothes were put on more quickly, even when the other person's back was turned. So it seems that even when people are not being evaluated for "correct" answers, the "bodily presence of another", as Triplett surmised back in 1898, "serves to liberate latent energy not ordinarily available." Perhaps, however, the mere presence of another is arousing because it distracts. Nevertheless, the fact that facilitation effects also occur with animals, which probably are not consciously worrying about how other animals are evaluating them, hints at some type of innate social arousal mechanism running through much of the zoological world. I think that Wanda, our jogger, would agree. Most joggers report that jogging with someone else, even

one who neither competes nor evaluates, somehow energizes.

This is a good time to remind ourselves of the purpose of a theory. As we noted in Chapter 1, a good theory is a scientific shorthand: It simplifies and summarizes a variety of observations. Social faciliation tneory does this well. It is a simple summary of many research findings. A good theory also offers clear predictions that can be used (1) to confirm or modify the theory, (2) to generate new exploration, and (3) to suggest practical application. Social facilitation theory has definitely generated the first two types of prediction: (1) the basics of the theory (that the presence of others is arousing, and that this social arousal enhances dominant responses) have been confirmed, and (2) the theory has brought new life to a long dormant field of research. Does it also suggest (3) some practical applications?

APPENDIX C

STUDY PASSAGE

THE SEARCH FOR HUMAN ORIGINS

EARLY THEORIES OF HUMAN ORIGINS

Where did humans come from? The question of our origins has preoccupied human thought for thousands, conceivably for tens of thousands, of years. It is responsible for a large number of myths, associated with the world's religions, each myth an attempt to explain the creation of the earth and of humankind. Many of these explanations are exceedingly interesting and beautiful, but today much of their detail is no longer regarded as strictly factual. Instead, they are interpreted as reflections of people's past yearning to fathom mysteries they could not possible understand, their fear of the unknown, and their often poetic attempts to construct a kind of theological prehistory to satisfy their curiosity and their need for meaning.

THE MODERN STUDY OF HUMAN ORIGINS

Paleoanthropology is the branch of science dealing with the study of early humans. It involves connecting human and nonhuman on a chain so long lost that the few links we have almost defy assembly. For those engaged in this science, today is a time of extraordinary interest. Recent discoveries and analysis now begin to make it possible to lay out some of those links next to one another and to look at them closely in relation to one another.

In 1859, when Darwin propounded the theory of evolution, scientists knew of only two fossils that were relevant to the search for our origins: one of an extinct ape and another of the early type of Homosapiens called Neandertal man. Just a little more than a hundred years later, expeditions in the Lake Turkana area of East Africa unearthed more than 150 near-human bones in a single five-year period. One of these bones, the so-called Lothagam jaw,

is about 5.5 million years old; it is evidence that creatures not unlike us existed more than 3 million years earlier than any fossil find had previously indicated. The discovery and interpretation of such evidence of our ancestors involves many specialists.

The knowledge and insights of other modern sciences also contribute to attempts to understand our ancestors. Atomic physicists, for example, have determined that certain radioactive elements discharge energy at a constant rate and, in the process, turn into certain other materials. This knowledge has provided paleontologists with new methods to establish the age of fossils and interpret the stages in the evolution of life.

Equally valuable have been the contributions of modern biochemistry. In the past decade biochemists have deciphered the code found in the substance DNA (see Chapter 4) by which instructions for building new cells and new organisms are passed along. Knowledge of this code provides insights into how members of a species reproduce themselves, generation after generation, virtually unchanged; how, on the other hand, minute variations do occur in offspring; and how these variations may accumulate over time. Knowledge of how these variations create differences in the structures of proteins can be used to determine the affinity between differnt types of organisms. Some scientists believe that these differences accumulate at a steady rate over time, so that this biochemical knowledge can provide yet another method of dating, and thus be used to determine when existing species of animals first emerged.

Other clues to the past are coming from studies of a very different kind, involving living animals--the science of animal behavior, called ethology. It is a relatively new displine, but a flourishing one. Studies of the behavior of living animals (for example, the chimpanzees shown in Figure 1-2) have been used to help explain the basis for some human behaviors and to suggest how ancestral humans may have acted and why. We will see the usefulness of animal behavior studies when we discuss the social organization of our ancestors (Chapter 9).

PALEOANTHROPOLOGY IN PROGRESS

The Scarcity of Human Fossils

Humans are a maddeningly poor source of fossils. In 1956, the paleontologist G.H.R. von Koenigswald calculated that if all the then-known fragments of human being older than the Neandertal people were gathered together they could be comfortably displayed on a medium-sized table. Although many more fossils of early hominids have been found since then, discoveries are still rare.

Why are human fossils so scarce? Why can one go to good fossil sites almost anywhere in the world and find millions of shell remains or thousands of bones of extinct reptiles and mammals, while peoples earlier than Neandertal are known from only a handful of sites at which investigators, working through tons of deposits, pile up other finds by the bushel basket before recovering a single human tooth?

There are many reasons. First, the commonness of marine fossils is a direct reflection of the abundance of these creatures when they were alive. It also reflects the tremendous span of time during which they abounded. Many of them swarmed through the waters of the earth for hundreds of millions of years. When they died, they sank and were covered by sediments. Their way of life--their life in the water--preserved them, as did their extremely durable shells, the ony parts of them that now remain. Humans, by contrast, have never been as numerous as oysters and clams. They existed in small numbers, reproduced slowly and in small numbers, and lived a relatively long time. They were more intelligent than, for example, dinosaurs, and were perhaps less apt to get mired in bogs, marshes, or quicksands. Most important, their way of life was different. They were not sea creatures or riverside browsers but lively, wide-ranging food-gatherers and hunters. They often lived and died in the open, where their bones could be gnawed by scavengers and bleached and decomposed in the sun and rain. In hot climates, particularly in tropical forests and woodlands, the soil is likely to be markedly acid. Bones dissolve in such soils, and early humans that lived and died in such an environment would have had a very poor chance of leaving remains that would last until today. Finally, human ancestors have been on earth only a few million years.

There simply has not been as much time for them to scatter their bones about as there has been for some of the older species of animals.

Relative Dating Methods: Earth and Fossils

To begin to understand our ancestors' fossil remains, we must know how old these bits and pieces are. Strange shapes and sizes may suggest all sorts of intriguing ideas and hypotheses about who descended from whom. But these hypotheses can be nailed down tightly only by reliable dating.

The problem of determining the age of fossils is handled in several ways. The first is through geology, the study of the earth itself. This branch of science is concerned with the location, size, and nature of the various layers of clay, silt, sand, lava, limestone, and other kinds of rock that constitute the earth's surface, and with their relationship to one another. It examines certain processes, such as erosion, the accumulation of layers of silt at the bottom of the sea, and their compaction into rock again by heat and pressure; it notes that these processes take place now at measurable rates and assumes that the same processes took place at comparable rates in the past. Analysis of these layers, or strata--a scientific discipline known as stratigraphy--permits the working out of a rough picture of past earth history (see Figure 1-3). From this informaiton the fossils found in different rock structures can be arranged in order of age.

The second way to determine relative age is through studying the fossils themselves. Fossil types are usually not the same in different layers. Animals evolved through time and thus their fossils provide clues of their own, particularly if the time sequence can be worked out. The evolution of the horse, for example, is very well known through fossils. Over a period of about 60 million years, the creature developed from an animal the size of a dog with four toes on each foot to the modern large animal with one toe per foot; the numerous intermediate fossils stages located in various geological strata tell this story with great clarity. Fossils of ancestral horses become tools for dating, because any other animal or plant fossil that occurs in the same layer as one of the ancestral horses can be considered the same age.

Once relative ages are established, one fossil can help date another.

One problem paleontologists have had to face is the establishment of contemporaneity when fossils from the same site are said to be associated but their association is questioned. This problem is now less serious than in earlier days for two reasons. First, today we can check claims of contemporaneity and association by chemically analyzing the bone: bones of roughly the same age should have roughly the same chemical analyses. The chemicals usually assayed are nitrogen (which occurs in bone in the form of the protein collagen and is lost slowly during fossilization), and uranium and flourine (both of which frequently enter bone from the surrounding ground water and increase in concentration over a long period). Such analyses can be a very valuable tool in the establishment of contemporaneity at a particular site: they are especially valuable if it is suspected that a skeleton has been buried within a deposit that is substantially older than the skeleton itself (as was the case in the famous Piltdown hoax discussed in Chapter 10).

The second reason that contemporaneity can be more clearly established is that more careful records are now being kept of excavations. Early investgators usually failed to realize the importance of careful analysis of fossil sites and the position of fossils. Too often they dug with reckless abandon, recovering only the largest bones and major pieces of worked stone. They did not appreciate the information they could get from the position of things relative to one another--and from the surrounding earth itself. Many questions will occur to the curious and well-trained observer. Is there evidence of fire? Was it natural or controlled by man? Do certain kinds of animal bones predominate at one level and decrease at another, indicating a change of diet or climate? Do the deposits preserve snails, or perhaps pollen grains, which are more sensitive clues to vegetation, and hence climate, than the mineral deposits themselves? With their careful plotting of finds and sites, paleontologists can come closer to answering these questions.

Five Chronometric Dating Methods: From Physics and Biochemistry

Through the constant cross-checking and fitting together of enormous amounts of both rock and fossil

evidence, science has been able to construct a rather detailed chronology of the past. But this chronology provides only relative dates: chronometric, or absolute dates, are lacking.

Atomic physics provides the finest technique for obtaining chronometric dates. We know that certain radioactive elements discharge energy at a constant rate, known as the decay rate. Radium, for example, turns slowly but steadily into lead. Once this steady decay rate is known, it is only a matter of laboratory technique to dertermine how old a piece of radium is by measuring how much of it is still radium and how much is lead.

One long-lasting radioactive substance used for chronometric dating is potassium 40. This breaks down into the gas argon at a constant and known rate. Because it is found in volcanic ash and lava, potassium-argon dating can be used to date fossils located in volcanic rock or ash or sandwiched between two layers of volcanic matter. The clock starts as the lava or ash cools (argon produced previously escaped when the potassium was heated in the volcano), and it continues steadily. It takes 1,265 million years for half the potassium 40 in a given sample to decay into argon (this period of time is known as potassim 40's half-life). The age of the rock can therefore be calculated with remarkable precision by determining the ratio of argon gas to potassium 40. Clearly, argon is produced extremely slowly, so the method cannot be used with great accuracy for dates of less than 0.5 million years, because very little argon will have been generated. Problems arise when the rock sample containing the potassium also contains air (which itself contains small quantities of argon) or if the rock had been reheated by later volcanic eruptions, which may have driven off the argon already produced by radioactive decay. The other more general difficulty is that the method can only be used to date fossils from areas where volcanic eruptions occurred at about the same time that the fossils were deposited. Fortunately, many of the most important fossil sites in East Africa are in an area where volcanic activity was widespread (see Chapter 7), but in much of Asia, America and Europe, this method cannot be used.

Another useful radioactive element is carbon 14, which reverts to atmospheric nitrogen. (See Figure 1-4) Physicist Willard Libby showed that carbon 14 is present

in the atmosphere as carbon dioxide (CO_2) and is incorporated into all plant material. In the plant, the proportion of carbon 14 to the stable atom carbon 12 is the same as the proportion of the two in the atmosphere. The clock starts when the CO_2 is taken into the plant (which animals may feed on) and is buried as either fiber or wood, or as the collagen in bone, or as charcoal left by a fire (which is found in many archaeological sites). As the organism becomes fossilized, the carbon 12 increases. The laboratory technique consists in measuring the ratio of carbon 14 to carbon 12 in these prehistoric samples. Carbon 14 has a half-life of only 5,730 years and therefore measurements of the age of carbon compounds will cover a relatively short period. The method is most useful between 500 and 40,000 years B.P., although it can be extended a little.

Errors in this method arise from a number of factors. It was originally supposed that the carbon 14 level in the atmosphere was constant, but we now know that this is not so. Volcanoes produce CO_2 without carbon 14, which causes local reductions in the level of carbon 14 in the atmosphere. A more serious variation is in the atmospheric level itself, which varies according to variations in the chemical reactions in the upper atmosphere that create the carbon 14 in the first place. Samples can also become contaminated by modern organic compounds (such as the inks with which the fossils are labeled) or by modern CO_2 from the atmosphere. Although these factors somewhat limit the value of carbon-14 dating, the method has proved of great value to anthropologists when it is carefully used.

Another dating method that depends in a different way on radioactive decay is the fission-track method. The rare radioactive element uranium 238 splits spontaneously to create a minute region of crystal disruption in a mineral. The disruption is called a track. In the laboratory, microscopic examination can determine track densities in mineral crystals containing uranium 238, in proportion to total uranium content. Since the rate of spontaneous fission is known, the age of the crystal can be calculated. However, the clock is started (as with potassium-argon) with the eruption of volcanoes, so this method has the same geographical limitations as the potassium-argon method.

The main value of the fission-track method at present is as a cross-check on the potassium-argon method. The

same volcanic samples can often be used and the comparison aids the detection of errors. The fission-track method itself has other problems. With low uranium content and rather recently formed minerals, the track density will be low. Heating eliminates tracks (as we have seen heating also causes problems with potassium-argon dating). Fission-track dating, however, has proved of great value in dating samples from the beginning of the earth to about 300,000 years B.P. It is now being used quite widely in dating early periods of human evolution in volcanically active regions.

The value of radioactive dating methods has been greatly increased by using them to date changes that we now know to have occured in the earth's magnetic field. It appears that the north-south magnetic field of the earth has reversed in direction many times during the eartn's history. (On such an occasion, a compass needle would point south instead of north.) The direction of the prehistoric magnetic field can be detected by measuring the direction of the magnetic field in the sample in the laboratory and comparing it with the north-south orientation of the sample at the site. Such measurements of so-called fossil magnetism of dated rocks have enabled geophysicists to prepare a chart (see Figure 1-5) that indicates past ages of normal and reversed magnetism. The data help us to tell the age of sites for which potassium-argon or fission-track dates are not available. For example, Bed IV at Olduvai Gorge in East Africa was too late in time to contain volcanic ash deposits, yet we know it is probably much younger than one million years B.P. It is normal throughout its polarity, but Bed III, which lies below it, is reversed. Looking at Figure 1-5, we can see that the bottom of Bed IV is about 690,000 years old and that therefore the deposits of the bed post-date this point in time. In this way, magnetism can help anthropologists, in some instances, date deposits where some general indications of geological age are available but volcanic rocks are not present. Fossil magnetism can also be used to cross-check potassium-argon and fission-track dates at particular sites.

A very different kind of dating method has been developed as a result of the study of the degenerative processes that occur in animal bones after death. In living animals, various amino acids in solution change the direction of polarized light under the microscope; depending on their effect, they are called left-handed

or right-handed compounds. During the process of decay, amino acids slowly lose this "handedness" because of a natural chemical rearrangement of the molecules called racemization. The rate of this loss at any particular temperature is known, and when calibrated by carton 14 tests it can be used to date bone. Thus, in an ideal situation, layers of bone that lie between samples dated with carbon 14, can themselves be dated with some accuracy. The method has the advantage of being direct, but the disadvantage of being dependent on temperature. It is only valuable if it can be calibrated in the actual sites in which it is being applied. If it is calibrated by carbon dates at one site, it cannot reliably be applied to another; a different history of temperature variations may seriously affect the accuracy of the dates obtained. The rate of decay limits the time period over which this method is useful, and it tends to be unreliable outside the period of 1,000 to 100,000 years B.P. But racemization has been used with some success in both Africa and North America. In fact, it has indicated a surprisingly early appearance of modern humans in North America (see Chaper 16). However, more calibration is required before these dates can be finally accepted.

We will see in Chapter 4 that the process of evolution involves slow changes at the biochemical level in every species. Some evicence indicates that various proteins change in time at a roughly constant rate. Thus we can calculate the time when the lineages leading to different living species diverged from their common ancestor by counting the changes in the various proteins. The protein clock requires very careful calibration and its reliability is still somewhat uncertain and may be limited. But it has been used to indicate the dates of some important events in human evolution, though these differ from the dates obtained by primary chronometric methods.

Further evidence of the age of species divergences can sometimes be gained from our knowledge of continental drift, which is calibrated by the potassium-argon method. For example, New World and Old World primates shared a common ancestor (Chapter 5) and did not diverge until the North American and Eurasian land masses separated and the North Atlantic Ocean was formed. This event is now believed to have occured about 55 million years ago, soon after the appearance of the first primates. This date may now be taken as a reasonable estimate of the date of the separation of the two primate groups.

Figure 1-6 summarizes the various dating techniques and Table 1-1 summarizes their effective time spans. These are stirring times for paleoanthropologists. Not only is the body of evidence growing almost faster than it can be analyzed, but there are still surprises in store and problems unsolved. Each fact, each new bit of evidence that is found, speeds up the overall process of coming to an understanding of the story of human evolution.

APPENDIX D

RECOGNITION MEMORY TEST

No._____

Please circle the correct response.

1. The study of fossil remains and other evidence of the ancient forms of hominid life is

   a. Geology
   b. Paleontology
   c. Stratigraphy
   d. Paleoanthropology

2. An early type of Homo sapiens now extinct, whose fossils were known to Darwin when he proposed the theory of evolution was

   a. Lothgam man
   b. Neandertal man
   c. Turkana man
   d. Olduvai man

3. The study of animal behavior is called

   a. Geology
   b. Ethology
   c. Adaptation
   d. Ethnology

4. The study of fossil remains and the nature of organisms that lived in the past is

   a. Paleoanthropology
   b. Paleontology
   c. Stratigraphy
   d. Geology

5. The study of the sequence of geologic strata or layers formed by materials dropped by wind or water is called

   a. Stratigraphy
   b. Geology
   c. Paleontology
   d. Paleoanthropology

6. The amount of time it takes for half of the radioactive atoms in a sample to decay is its

   a. Organic decomposition rate
   b. Fission rate
   c. Disintegration rate
   d. Half-life

7. The chronometric dating technique that is accurate earlier than 500,000 B.P. uses

   a. Potassium 40
   b. Uranium 238
   c. Flourine 17
   d. Carbon 14

8. The chronometric dating technique that is used to date fossils of, or associated with, fiber, wood, bone or charcoal uses

   a. Potassium 40
   b. Uranium 238
   c. Flourine 17
   d. Carbon 14

9. The chronometric dating technique that is accurate between the present and 40,000 B.P. uses

   a. Potassium 40
   b. Uranium 238
   c. Flourine 17
   d. Carbon 14

10. Chronometric dating technique(s) that can be used to date fossils from areas where local volcanic erruptions occured use(s)

    a. Uranium 238 and Potassium 40
    b. Carbon 14
    c. Racemization
    d. Protein clock and Carbon 14

11. The chronometric dating technique that is accurate earlier than 300,000 B.P. uses

    a. Carbon 12
    b. Uranium 238
    c. Flourine 17
    d. Carbon 14

12. Measurements of the _____ of dated rocks have enabled geophysicists prepare a chart that indicates past ages of reversal in the earth's polarity.

    a. Half-life
    b. Fission
    c. Fossil Magnetism
    d. Radioactive decay

13. The natural chemical rearrangement of molecules which occurs during the process of decay is called

    a. Calibration
    b. Racemization
    c. Fission
    d. Fossil magnetism

14. Calibrated technique(s) used to estimate the age of fossils and species divergence is (are)

    a. The carbon 14 technique
    b. The protein clock, continental drift techniques
    c. The fission-track technique
    d. The uranium 238 technique

15. The term given for the divergence of North America and Eurasia land masses that formed the North Atlantic Ocean 55 million years ago is

    a. Continental drift
    b. Stratigraphic deposition
    c. Continental divergence
    d. Chronometric shift

AFTER YOU FINISH THE ABOVE 15 QUESTIONS PLEASE TURN THE PAGE TO ANSWER SEVERAL QUESTIONS ABOUT HOW YOU STUDIED THE TEXT.

APPENDIX E

RECALL MEMORY TEST

No.___

Please complete the sentences.

1. The study of fossil remains and other evidence of the ancient forms of hominid life is_____.

2. An early type of Homo Sapiens now extinct, whose fossils were known to Darwin when he proposed the theory of evolution was_____.

3. The study of animal behavior is_____.

4. The study of fossil remains and the nature of organisms that lived in the past is_____.

5. The study of the sequence of geologic strata or layers formed by materials dropped by wind or water is called_____.

6. The amount of time it takes for half of the radioactive atoms in a sample to decay is its_____.

7. The chronometric dating technique that is accurate earlier than 500,000 B.P. uses_____.

8. The chronometric dating technique that is used to date fossils of, or associated with, fiber, wood, bone, or charcoal uses_____.

9. The chronometric dating technique that is accurate between the present and 40,000 B.P. uses_____.

10. A chronometric dating technique that can be used to date fossils from areas where local volcanic erruptions occurred uses_____.

11. The chronometric dating technique that is accurate earlier than 300,000 B.P. uses_____.

12. Measurements of the _____ of dated rocks have enabled geophysicists to prepare a chart that indicates past ages of reversal in the earth's polarity.

13. The natural chemical rearrangement of molecules which occurs during the process of decay is called_____.

14. One calibrated technique used to estimate the age of fossils and species divergence is _____.

15. The term given for the divergence of North America and Eurasia land masses that formed the North Atlantic Ocean 55 million years ago is _____.

AFTER YOU FINISH THE ABOVE 15 QUESTIONS PLEASE TURN THE PAGE TO ANSWER SEVERAL QUESTIONS ABOUT HOW YOU STUDIED THE TEXT.

APPENDIX F

SQ3R RATING QUESTIONNAIRE

We are interested in how difficult it was to use the SQ3R method as it was described to you during our training session. Please indicate whether it was Very Easy, Easy, Difficult, or Very Difficult to use each of the components of the SQ3R method while you were studying the text.

		Very Easy	Easy	Difficult	Very Difficult
1.	To survey or preview the text.	____	____	____	____
2.	To make each section heading into a question.	____	____	____	____
3.	To read to find the answer(s) to the question.	____	____	____	____
4.	To recite the main points of each section immediately after reading the section.	____	____	____	____
5.	To take notes in your own words.	____	____	____	____
6.	To review the entire text selection by reciting the major subpoints under each heading.	____	____	____	____

APPENDIX G

ANAGRAM TASK

No. _____

Please solve as many anagrams as you can. Write your answers in the space provided.

1. _____ esta
2. _____ altnp
3. _____ ihdlc
4. _____ trtsia
5. _____ iwntre
6. _____ sutd
7. _____ hcari
8. _____ rief
9. _____ ihed
10. _____ itckte
11. _____ ohres
12. _____ amstre
13. _____ nigk
14. _____ uhhcrc
15. _____ ppela

APPENDIX H

STUDY STRATEGY QUESTIONNAIRE

Please put a checkmark in the space provided to indicate any of the following study techniques that you used to learn the text material. It is possible that you did not use any of these techniques, but if you did, please put a checkmark in the corresponding blank.

1. _____ Surveyed or previewed the text to determine how many pages there were to be read.

2. _____ Surveyed or previewed the text to look at the topics that were to be covered.

3. _____ Formed a question out of each section heading before reading the section.

4. _____ Read to answer a particular question you formulated from a section heading.

5. _____ Underlined or highlighted important points in the text.

6. _____ Took notes by copying directly from the book.

7. _____ Took notes from your own words.

8. _____ Recited the main points of each headed section after reading that section.

9. _____ Reviewed the entire text selection by reading your notes.

10. _____ Reviewed the entire text selection by looking at each heading in the text and trying to recite the major points under that heading.

Please describe anything that is not already indicated above that you did to learn the text material.

APPROVAL SHEET

The thesis submitted by Jocelyn Mand Shaughnessy has been read and approved by the following committee:

Dr. Eugene Zechmeister, Director
Professor, Psychology, and
Dean of Social Sciences, Loyola

Dr. Emil Posavac
Professor and Department Chairman
Psychology, Loyola

The final copies have been examined by the director of the thesis and the signature which appears below verifies the fact that any necessary changes have been incorporated and that the thesis is now given final approval by the Committee with reference to content and form.

The thesis is therefore accepted in partial fulfillment of the requirements for the degree of Masters of Arts.

Date 11/26/86

Director's Signature