An Investigation of the Effectiveness of Study Aid Formats

Mary Anne Saint
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AN INVESTIGATION OF THE EFFECTIVENESS
OF STUDY AID FORMATS

by

Mary Anne Saint

A Thesis
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Faculty of The Graduate College
in partial fulfillment of the
requirements for the
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AN INVESTIGATION OF THE EFFECTIVENESS
OF STUDY AID FORMATS

Mary Anne Saint, M.A.

Western Michigan University, 1985

The effectiveness of matrix organizational format versus outline organizational format versus self-structured study notes was tested with high school subjects. Contrary to predictions, results of a multiple choice and essay question posttest revealed a nonsignificant study aid effect, $F(2, 53) = 1.17, p > .05$. An interaction between passage order and subject sex was significant, $F(2, 53) = 4.68, p < .05$. An analysis of recall, application and analysis levels of learning again revealed a nonsignificant study aid effect, $F(2, 68) = 1.53, p > .05$. A difference among recall, application and analysis posttest scores was significant, $F(2, 4) = 93.25, p < .05$. It was noted that the mean of the Matrix Group was somewhat greater than other groups across all five measures. The probability of one of three groups outscoring other groups across five analyses would result in a chance level of occurrence of .0039. It is speculated that additional experimentation will demonstrate a significant difference in the effectiveness of study aid formats.
ACKNOWLEDGEMENTS

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Mary Anne Saint
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Efficient acquisition and rapid application of knowledge is of prime importance in education and industry. "We could solve our major problems in education if students learned more during each day in school. That does not mean a longer day or year or more homework. It simply means using time more efficiently" (Skinner, 1984, p. 950). Three ways to increase the acquisition of knowledge are to improve the quality of teaching, improve the quality of instructional material and improve the learning skills of the learner. The first two ways are not under the control of the learner; however, if learning skills could be improved it would benefit the learner immediately. For the improvement of learning skills to be of practical benefit, the learning skills would have to be applicable to complex material.

Acquisition of learning strategies for complex material would require interventions and modifications in thinking. Whether covert or overt, thinking is complex human behavior and is appropriate experimental subject matter. "There is no reason why methods of thinking and of the teaching of thinking cannot be analyzed and made more effective" (Skinner, 1957, p. 449).

Learning, in its most basic form, involves acquiring a new behavior and/or changing stimulus control of acquired behavior. Learning is essentially making effective discriminations. Effective learners "clarify stimuli, change them, convert them into different
modalities, isolate them, rearrange them to facilitate comparison, group or regroup them, or add other stimuli" (Skinner, 1968, p. 132).

Skinner implied organization that facilitates comparison is helpful in learning. Others make a similar point about teaching. "Organization, it has been argued is the hallmark of good teaching...any procedure which makes this arrangement or organization more obvious and striking is likely to facilitate the learning of meaningful material" (Hartley and Davies, 1976, p. 239). Organization is worth investigating if we are to understand complex learning processes.

Organization in learning has been studied at various levels of complexity, ranging from organization of words in free recall to organization of passages and student note-taking. Free recall investigations of word lists (Mandler, 1968; D'Agostino, 1969; Moore, Hauck and Furman, 1975) have found that recall was sensitive to organizational strategies. "The model suggested...was one where Ss recall categories and approximately 5 +/- 2 words per category" (Mandler, 1968, p. 235).

Mandler (1968) had subjects individually group sets of 100 words into two to seven categories using any characteristics other than alphabetical or physical word characteristics. He found free recall of words varied systematically with the number of categories in the sorting.

D'Agostino (1969) studied the effects of randomly ordered words
versus blocked ordered words, with and without instruction, on free recall. In the blocked condition, six words from the same category were listed in a randomly determined order within each block of the word lists. In the random order, six words from six different categories were listed in random order within each block for the word list. Some groups were given lists of six categories that were used in word selection. The subjects were told that test words were members of the six categories and were encouraged to learn and remember the categories. Blocked ordered groups, with and without instruction, significantly outscored randomly ordered groups in correct responses and items per categories.

Moore et al (1975) studied self-imposed and super-imposed organization on free recall of word lists. Four treatment groups (self-imposed organization, with and without training, and super-imposed organization, with and without training) sorted words into two to seven categories. A serial memorization group controlled for training. All subjects were matched on number of exposures. The self-imposed organization with training group significantly outperformed other groups. Serial memorization was found more effective than self-imposed or super-imposed organization in which no training was given.

Functional relationships described in these studies of recall of word lists were recall was sensitive to organizational factors, performance was a linear function of number of categories used, same category stimuli presented in blocked order were recalled more than

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random order stimuli, training in self-imposed organization produced higher recall, and serial memorization was more effective than organizational strategies with no training.

Analysis of organizational factors in learning has extended beyond word lists. Effectiveness of organizational strategies has been investigated in narrative and written prose recall. Schwartz and Kulhavy (1981) studied effects of a spatially related map structure on text recall. Subjects listened to a narrative describing events on an imaginary island while studying either a map with spatially located features, a map outline with features listed in a column, or a map outline without features. The spatially located features map group significantly outperformed the other groups in free and cued recall of feature-related information. Cued recall was higher for all groups than free recall.

Annis and Davis (1975) investigated note-taking functions of encoding and external memory device by manipulating note-taking and review conditions. Subjects either took notes during a lecture, or received a copy of the lecturer's notes. Later, subjects either reviewed their own notes, the lecturer's notes, both sets of notes, or were told to mentally review the material. Subjects who reviewed their own notes and/or lecturer's notes scored significantly higher on posttests. Subjects who were told to mentally review without the aid of any notes produced the least recall.

The effectiveness of a hierarchy organization has been evaluated (Holley, Dansereau, McDonald, Garland and Collins, 1979).
Investigators trained subjects in a mapping strategy to reorganize passage information emphasizing six relationships. "...the networking process emphasized the identification and representation of hierarchies (type/part), chains (lines of reasoning/temporal orderings/causal sequences), and clusters (characteristics/definitions/analogies)" (Holley et al, p. 228). Subjects trained in hierarchial mapping techniques significantly outperformed control subjects on fill-in-the-blank and essay tests designed to assess main ideas. Differences in multiple choice and short answer tests to assess details were non-significant. Results indicated that low GPA students benefited more from the strategy than high GPA students.

Functional relationships described in these studies were consistent with word-list studies. Recall was sensitive to organizational factors, recall performance was a function of organization, and cued recall was greater than free recall. In addition, review of notes produced higher recall than mentally reviewing without notes and organizational strategies were of greater benefit to lower rather than higher GPA subjects.

Investigators have studied the effect of passage organization on recall (Schultz and DiVesta, 1972; Freidman and Greitzer, 1976; Shimmerlik and Nolan, 1976). Schultz and DiVesta (1972) studied clustering strategies and passage organization. Experimental passages were developed from information in a six by six matrix. Passage organizations were by concept name (matrix column information), concept attribute (matrix row information), or random
arrangement of sentences. They found subjects recalled significantly more from organized rather than randomly ordered passages. Concept attribute scores increased over three trials, while concept name scores were consistently high. Further analysis showed subjects used a dominant clustering strategy which was gradually abandoned when proved unsuccesful with a particular passage.

Freidman and Greitzer (1976) studied passage organization and amount of study time. Experimental passages were developed from a six by three matrix. Passage organizations were by fish name (matrix column information), or by fish attribute (matrix row information). Some subjects read the same passage twice and others read alternate organizations. Subjects were tested after a two minute and a three minute study period. Free recall followed the organization of the last read passage. As study time increased, free recall increased. Subjects who read the same passage twice recalled significantly more than other subjects for both study conditions.

Shimmerlik and Nolan (1976) investigated the effects of reorganization of passages during note-taking on free recall. Passages were developed from information in a four by four matrix. Passage organizations were by society (matrix column information), and by topic (matrix row information). Subjects, using specified categories, either took notes in the same order as passage organization, or reorganized information. Recall was significantly higher for
subjects who reorganized the information. Average verbal aptitude subjects benefited more from reorganization than high or superior verbal aptitude subjects.

Functional relationships described in these studies were organized material was better recalled, subjects reorganized material rather than abandon a self-imposed organization, reading the same organization twice increased recall, free recall followed the last organization read, reorganizing information in note taking produced higher recall than same organization note taking, and average rather than high verbal aptitude subjects benefited more from reorganizing information.

All of the functional relationships stated so far can be logically concluded from Skinner's statement. Learners were clarifying, changing, grouping and rearranging stimuli into orderly relationships. Subjects who would benefit the most from organizational strategies were those who have not discovered an orderly relationship in complex material. This is consistent with the results that lower, rather than higher GPA or verbal aptitude subjects benefit more from organization interventions.

When learners are successfully manipulating stimuli, they are making effective discriminations. A critical component of all effective learning strategies is effective discrimination, as investigated in the concept formation literature.

Concepts have been spoken of as generalization within a class of stimuli and discrimination between classes of stimuli (Keller and Schoenfeld, 1950). Thus, our concept of red must involve generalization among all stimuli we call red, and
discrimination between these stimuli and others we do not call red (Catania, 1984, p. 144).

Stimulus control literature would define the concept of redness as $S^+$ and non-redness as $S^-$. In wavelength intra-dimensional discrimination training, responding to stimuli that are red and only red, is enhanced by also displaying stimuli that are not red. "Discriminative conditioning between neighboring stimuli would thus sharpen the gradient of generalization between them" (Mackintosh, 1977, p. 493).

In the applied area of concept formation, the stimuli that are red would be called examples, while non-red stimuli would be called nonexamples of the concept domain of redness. A neighboring non-red stimulus we call orange is simultaneously an example of the concept domain of orangeness. Since both redness and orangeness are concept domains defined by wavelength, they are called coordinate concepts.

Markle (1975) specified the requirements for teaching concepts as a classification rule or definition which clearly encompasses or maps onto the concept domain, along with examples and nonexample of the domain. Further, "complex concepts require a complex set of examples, generated according to known rules....nonexamples will usually be examples of coordinate concepts and the relationships between superordinate concepts and their subsets, the coordinates, will be made explicit" (Markle, 1975, p. 3).

Skinner implied organization that facilitated comparison of stimuli was helpful in learning. Markle implied that effective
organization must fulfill certain requirements of generalization within concept domain and discrimination across concept domains to be useful in determining relationships.

A matrix organization fulfills these overall requirements, wherein concept domains are identified by column and defining variables are identified by row. The review of passage organization literature offered several examples of matrices. Schultz et al. (1972) constructed their experimental passages from information displayed in a six by six matrix. Concept domains, imaginary countries, were identified by column. Concept attributes, characteristics of the country, were identified by row. The intersection of a column and row, a cell, displayed information of how that attribute helped define the concept domain. An example from this matrix is the intersection of the concept domain, the imaginary country of Nurovia and the attribute of socioeconomic conditions. The cell contained information that Nurovia has full employment.

Matrix organization, sometimes referred to as tabular presentation, is primarily used in literature for information or data display. "A well-constructed table can be economical in that the author, by isolating the data from the text, enables the reader to quickly see patterns and relationships of the data not readily discernible in text" (American Psychological Association, 1983, p. 83).

Matrix format has also been used in investigating the effect of systemicity in rule structure (Foss, 1968a; 1968b; Danks and Gans, 1975; Meehan and Rosenbloom, 1980). In these studies subjects
learned a matrix-defined rule. "The basic concept behind a rule-induction paradigm is that stimuli and responses are paired in a predictable manner by a rule. The rule then permits generalization to new instances" (Danks and Gans, 1975, p. 210).

Foss (Experiment 1, 1968a) created a miniature linguistic system in a six by six matrix. Geometric shape stimuli were represented by matrix column and color stimuli were represented by matrix row. Each stimulus was paired with a word syllable, resulting in 36 stimulus-response pairs. Some subjects were given information from eight cells, many of which formed the main diagonal in the first four columns and rows. Subjects who mastered paired association rules were able to infer row and column matrix headings to generate responses to novel stimuli. Experiment 2 (1968a), showed that when a systematic relationship among stimuli was found, subjects adhere to the rule, even when the relationship was no longer valid in future stimulus-response conditions.

In a later experiment (1968b), Foss investigated the effects of number of items and their sequence on learning. Subjects were presented with 8, 12 or 16 cells of a four column-four row portion of his six by six miniature linguistic system matrix. Overlapping items were adjacent stimuli which shared either the geometric shape or color property. Nonoverlapping items did not share an adjacent stimulus property. Results indicated the number of items to master, 8, 12 or 16 cells, did not affect learning. Learning was significantly faster in sequenced or overlapped items than in nonoverlapped
Danks and Gans (1975) used a similar miniature linguistic system in the investigation of matrix presentation effects. Subjects were shown the matrix used in construction of the miniature linguistic system either before, during or after learning trials. A 30 second presentation and explanation of a matrix format before or during learning aided rule generalization to novel stimuli.

Meehan and Rosenbloom (1980) created a three by three matrix in which columns indicated color position and rows indicated configuration of lights. Subjects were instructed to press one of three buttons to release the light pattern and present a new pattern. Subjects were presented with varying amounts of stimulus sequencing, ordered from simple to complex. An example of sequencing is presentation of three cells of the matrix to be learned, then three more cells, and finally all cells. Results indicated increased sequencing facilitated learning.

Functional relationships described in these studies were subjects who learned the matrix rule generalized to new instances, a discovered relationship was adhered to even when the relationship was no longer valid, sequencing and not the number of items to master affected learning, presentation of matrix format increased rule generalization to novel stimuli, and increased sequencing increased rule generalization.

Other areas of complex verbal learning can be analyzed using various complexity levels of matrix organization. Simplest of all,
the one by one matrix, is essentially a within cell investigation of one concept domain and one attribute or characteristic. Obvious generalization and discrimination limits are imposed. One characteristic cannot fully fulfill Markle's requirement of a definition which clearly maps onto the concept domain. One concept domain cannot fully fulfill Markle's requirement of examples and nonexamples generated from a known rule.

There may be additional limitations with the one by one matrix. Learners may inadequately state either the concept domain or its attribute. A subset of the concept may be labeled as the complex or superordinate concept under study. An attribute may be obscured by irrelevant characteristics that are present in the particular statement, but do not enhance effective discrimination of the concept. There may be no generalization across irrelevant attributes and no discrimination of critical attributes. As a matrix is expanded, learners are able to correct errors in the labeling of the concept domain or attributes. There is no opportunity for this correction in a one by one matrix.

The next complexity level of matrix organization is one by two, one concept domain and two attributes. Generalization and discrimination are again limited, but there is an opportunity for correction of an inadequate statement of the concept domain. A second attribute increases mapping onto the concept domain. Variations at this level, one column with more rows, commonly called outlines, increase attributes which in turn increase mapping onto the concept.
domain, although not to the extent that the concept can be fully defined. The concept domain may be inadequately or incorrectly defined because there is no opportunity to define limits of the concept domain without testing examples and nonexamples of coordinated concepts.

Research of learning objectives and question asking has focused on the first and second levels of matrix complexity. Although techniques of organizing isolated concept domains are inadequate for concept formation, useful information about defining attributes can be gleaned from the research.

Duchastel and Brown (1974) investigated whether learning objectives function as orienting stimuli which direct attention to complex material to be mastered. Treatment subjects received 12 of the 24 objectives developed for a 2,400 word passage. Subjects using objectives performed better on a posttest of items relevant to the objectives than subjects who did not use objectives. Subjects who did not use objectives performed better on posttest items not covered by objectives.

Kaplan and Simmons (1974) questioned whether objectives should be used as orienting stimuli or as summary/review. Subjects who received objectives before study were told they would be tested on objective relevant material only. Subjects who received objectives after study were originally instructed to learn everything in the passage. Results indicated either presentation of objectives facilitated test performance on items relevant to objectives. Sub-
jects who reviewed objectives after learning scored higher on test items unrelated to objectives.

Kaplan and Rothkopf (1974) studied the effects of passage length and number of objectives learned. Subjects studied texts of varying lengths. There were four sets of specific and/or general objectives. Results indicated subjects who used objectives outperformed subjects who had general instructions, subjects with specifically stated objectives scored higher than subjects with generally stated objectives, incidental learning performance was lower than intentional learning performance, mastery of objective was unrelated to passage length, and amount of study time increased with an increase in number of objectives or passage length.

Rothkopf (1972) also investigated effects of interpersonal interaction and text-embedded questions. All subjects read the first 24 slides of text material without exposure to questions. Written question subjects read questions on slides displayed at either regular or irregular intervals. After a predetermined number of slides, the control switch for the oral question subjects disengaged and a light flashed in the experimenter's booth. A text question was posed to the subject in a neutral voice and no feedback was given. Social contact subjects were asked text-unrelated neutral questions. Posttest scores were significantly higher for text portions which received the questioning treatments. Social contact and no question groups performed similarly. These results indicated text-relevant questions were critical for the facilitative
effect of contact with the teacher-monitor.

Frase and Schwartz (1975) studied whether recall was enhanced by authoring questions. Subjects were instructed to construct and answer any number of questions, a specific number of difficult questions, or to answer tutor questions. Results indicated answering questions, whether self or tutor generated, produced higher recall on items directly related to those questions over just studying. Items unrelated to questioning production were similarly recalled by all groups.

Garner and Alexander (1982) investigated how adults prepare to answer questions over complex material. Subjects were instructed to stop at predetermined text intervals and reflect how they were preparing for the test. Some of verbalized strategies were focusing on details, focusing on the main idea, rereading, relating to personal experience, or formulating what the test question would likely be. Subjects who verbalized a question-formulation strategy performed significantly better on an essay question than subjects who verbalized other learning strategies.

Functional relationships described in these studies were intentional learning was enhanced and incidental learning was hindered by objectives; specific rather than general objectives resulted in greater intentional learning; in teacher-student interaction, questions were critical to increased recall performance; answering questions produced higher recall on items directly related to those questions and subjects who verbalized a question-formulation
strategy outperformed subjects who verbalized other learning strategies.

In these investigations, study of an isolated concept domain and attribute aided learning. Generalization and discrimination were limited because defining boundaries of the concept cannot be established without use of example and nonexamples. Some studies focused on examples, rather than examples and nonexamples.

Watts and Anderson (1971) studied learning at recall and application levels through the use of examples. Subjects who answered application questions by applying the passage concept to new examples scored significantly higher on posttest.

Andre' and Anderson (1978-79) investigated self-generated questioning as a study technique. In training, students were taught to use the passage theme as the basis of questioning and to seek applications and new examples of the concept. Results indicated question-trained subjects scored significantly higher than other subjects. Subjects instructed to formulate questions without training scored higher than subjects instructed to read-reread. The strategy of generating questions was more effective for lower than for higher verbal ability students.

These studies are classified midway between the second and third matrix complexity levels because "...to generate an example or two of his own does not satisfy the requirements of sampling the domain" (Markle, 1975, p. 3). If a learner generated examples according to some rule and if nonexamples were constructed in the
process or were inferred from prior learning, then the learner could form the concept. However, learners generating faulty examples would learn faulty concepts.

The third matrix complexity level, a two by one matrix, fulfills the example/nonexample requirement. The second column, a coordinate concept, will define example/nonexample boundaries. Yet, this complexity level does not fulfill all the requirements of generalization and discrimination. More than one variable is required to define the whole concept domain.

In regards to the earlier example of the concept of redness, all stimuli we call red are defined by more than one variable. Stimuli we call red do not necessarily have to be of the same light intensity. Therefore, intra-dimensional discrimination training along a second variable, light intensity, would be required.

The fourth matrix complexity level, a two by two matrix, fulfills generalization and discrimination requirements. Variations of a two by two matrix, more columns and more rows, will increase the degree of generalization and discrimination mastery achieved.

Tennyson, Wooley and Merrill (1972) studied concept acquisition and the range of examples/nonexamples. Four instructional designs included eight different examples and nonexamples which were either matched or unmatched on relevant and irrelevant attributes. When relevant attributes were different and irrelevant attributes were similar, it was likely that the concept would be correctly classified. It was possible to predict correct classification,
overgeneralization, undergeneralization and misconception.

Gagne' et al (1979) studied concept classification and type of post-question. Subjects either generated examples, summarized text, listed concept attributes or identified examples and nonexamples. All subjects received feedback. Study time was similar across groups. Subjects who identified examples and nonexamples significantly outperformed other subjects.

Functional relationships described in these studies were undergeneralization, overgeneralization, correct classification and misconception of a concept was predicted based on example/nonexample range of attributes; and subjects who identified examples and nonexamples outperformed subjects with other study strategies.

Some of the functional relationships described in studies of organization in learning, concept formation, learning objectives and question-asking have been incorporated into learning strategy programs: recall was sensitive to organizational factors, training in self-imposed organization produced high recall, reorganizing information in note-taking produced higher recall than same organization note-taking, sequencing and not the number of items to master affected learning, increased sequencing increased rule generalization, specific objectives resulted in greater intentional learning, answering questions produced higher recall on items directly related to those questions, and example/nonexample identification outperformed other study strategies.

Organizational strategies from different levels of matrix com-
plexity have been taught. Dansereau, (1979) developed and evaluated a learning strategy training program. Subjects were taught to set the mood for study, to read for understanding, to recall material without use of the text, and to ask questions and review mistakes on tests. Some of the techniques designed to improve comprehension and retention were paraphrase/imagery, networking and analysis of key ideas.

Networking required reorganizing information into node-link maps. Node-links are similar in identification of attributes to a one by many row matrix, and different in display of information. An illustration of a network is similar to an illustration of tree roots and associated branching. A node-link, or branch of a tree root, can be missing without an obvious gap in the structure.

An alternative to networking was identifying key concepts and relationships using a worksheet developed by Diekhoff. The same categories were used for networking and key concepts. Subjects were given precourse, midcourse and postcourse multiple choice and short answer tests. Precourse scores were similar for all groups. Midcourse and postcourse scores were significantly higher for subjects trained in learning strategies. Further analyses indicated the organizational strategy of node-link networking was responsible for the mean difference.

Diekhoff and Dansereau collaborated with Brown (1982) in designing another learning strategy training program, the Node Acquisition and Integration Technique (NAIT). Definition work-
sheets, a one by seven matrix, were used to identify key concept's characteristics, antecedents, consequences or influences, evidence, subsets, superset and elaboration. Comparison worksheets, a two by seven matrix, were used in relationship-guided comparison. Subjects were taught to find similarities and differences in some pairs of concepts, which were represented in a matrix of all possible pairs of concepts.

Students typically find this stage of NAIT somewhat tedious. For that reason, once students understand the principle of using a relationship-guided approach to comparison of concepts and understand what a relationship between concepts is, they are encouraged to forego completion of comparison worksheets and simply write a brief summary of how various concept pairs are related" (Diekhoff, et al, 1982, p. 182).

Pre-experiment test scores were similar in both groups. NAIT trained subjects significantly outperformed other subjects on a postcourse test consisting of ten concept definitions and comparison of four pairs of concepts. Definition subtest scores were consistently higher than comparison subtest scores for all groups. "A significant main effect of subtests was also obtained, but it is unimportant since it only reflects the fact that the Definitions subtest was somewhat simpler that the Comparisons subtest for both groups" (Diekhoff et al, 1982, p. 183).

It was interesting to note that concept attributes of definition and comparison worksheets were identical. Subjects were able to complete definition worksheets, but found transferring this information onto a comparison worksheet and studying it was somewhat tedious. Writing the original analysis of different concepts on one
worksheet which facilitated comparison across all concepts, not just chosen pairs, might facilitate learning. Rather than creating ten one by seven matrices and several two by seven matrices, they could create one ten by seven matrix in which all relationships are displayed.

A behaviorally based system, Learning to Learn (LTL), (Heiman and Slomianko, 1984) has incorporated matrix information maps. Work conducted at the University of Michigan in the late 1960's, under the direction of Dale M. Brethower, identified four skills:

identify the component skills of complex principles/ideas, ...ask questions of new materials, engaging in a covert dialogue with the author or lecturer, forming hypotheses, reading or listening for confirmation,...devise informal feedback mechanisms to assess their own progress,...identify and direct their study behaviors to meet course objectives (Heiman and Slomianko, 1984, p. 2).

Unsuccessful learners were deficient in one or more of these skills and training was designed to correct deficiencies. This analysis is consistent with results of many studies already discussed. Subjects with lower GPAs or lower verbal ability gained more from learning strategy interventions than higher GPA or higher verbal ability subjects. Learning strategies may have enhanced performance in one or more of the undeveloped skills.

Heiman developed and refined LTL over a fourteen year period. Overall data indicated higher retention rates for LTL subjects and significantly higher post GPAs. Results were sufficient to earn the program a recommendation for national dissemination by the Joint Dissemination Review Panel of the U. S. Department of Education.
Question-answer generating, and example/nonexample generating are stressed in LTL. Concept domains and attributes are analyzed in a matrix information map. The LTL system shows that it is possible to create matrix information maps for virtually any course content.

The versatility of LTL's information map is consistent with the use of matrices in literature. Miniature linguistic systems created for the study of a rule-induction paradigm are designed in a matrix format. Experimental passages created for the study of passage organization are constructed from information in a matrix. Tabular presentations are used in data display.

Although the use of matrices is widespread in literature, there has been no analysis of its effectiveness as an organizational format for learners. Data on the value of matrix information maps as compared to other formats were not generated by the LTL system.

There is a practical need for this information. If the matrix organization facilitates concept formation, including generalization and discrimination, then it could have major implications for instructional design, teaching and learning skills. A beginning step would be to determine whether subjects can quickly learn to use the format to produce significant improvements in learning.

The purpose of this study is to investigate the effects of study aid formats on learning. Would subjects who used a matrix format perform better on a posttest than subjects who either used an outline format or wrote self-structured notes? Will subjects using the matrix format outperform other groups at higher levels of
The best technology invented will be of little value to the world if it is not applied to the preintended tasks. Will the subjects who come in contact with a particular study aid format find it helpful and plan to use its design in future courses?

There are three null hypotheses: There is no difference between the effectiveness of matrix, outline and self-structured study aid formats. There is no difference in higher levels of learning between the matrix, outline and self-structured study aid formats. There is no difference in verbalized helpfulness and intended future use of the study aid between matrix, outline and self-structured study aid formats.

A matrix organization may aid learners in clarifying information and facilitating comparison. If so, the matrix format should aid generalization within the concept and discrimination across concepts. On the other hand, a brief exposure to the novel matrix structure may hinder performance on a posttest. Therefore, identical questions in an outline, a structural format previously encountered by the learners, may facilitate performance over the matrix. Further, the self-imposed structure of study notes in the control group may produce higher posttest performance than either the matrix or outline structures, since the learners have only one task, to learn the subject material to be tested. The matrix and outline groups have two tasks: learn the subject material to be tested and use a superimposed structure without much advance
training.

Based upon the analysis of literature using various complexity levels of the matrix organization, and without regard to the possible novelty of the matrix structure, it is predicted that posttest performance of the subjects who use the matrix study aid will be superior to the outline or study note structure groups. A predicted trend in mean scores from high to low will be matrix, outline and self-structured notes groups. The brief exposure to the study aid will produce somewhat to very helpful self reports but future use may be determined by training in how to construct the study aid.
METHOD

Subjects

Ninety-two students from a rural Southwestern Michigan public high school participated in the experiment. The students were currently enrolled in either American Studies, English III, or one of two Psychology classes. There were 52 females and 40 males.

Subjects were classified as either college preparation track or general studies track, and by high school year level. Of the 52 college preparation track students, 8 were seniors, 32 were juniors and 12 were sophomores. Of the 40 general studies track students, 17 were seniors, 21 were juniors and 2 were sophomores. Within each of these classifications, subjects were randomly assigned to the three experimental groups. There were 31 subjects in Groups 1 and 3, and 30 subjects in Group 2. The classification of subjects by variable is displayed in Appendix Table B-2.

Materials

Copies of all materials used during the experiment are contained in Appendix A. Also, the posttest grading models, multiple choice answer key and five essay question scoring models are contained in Appendix A.

Passages

Five passages developed for use in the study, "Effect of Type
of Objective, Level of Test Questions, and the Judged Importance of Tested Materials Upon Posttest Performance" (Duell, 1974) were deposited with the National Auxiliary Publications Service, Document 02174. Four were selected for content and organization.

Content areas were concepts of overlearning, shaping, negative reinforcement and prompting. Uniform organization of the passages was suitable to construction of an outline study aid and a matrix study aid. Passage construction was described:

Each passage contained approximately 410 words and all passages were similar in organization. The first paragraph contained a descriptive example of the process. The second paragraph introduced the term, its definition, and the names of two psychologists associated with the process. The names were chosen so that each name was used only once. The third paragraph consisted of a second descriptive examples of the process. The fourth and final paragraph contained two related technical terms, their definitions, a descriptive example of each of them; and a summary sentence (Duell, 1974, p. 226).

Three passage orders were counterbalanced across groups. Passage Orders 1, 2 and 3 were randomly selected. Passages were stapled in a packet following one of three passage orders. The first passage order was negative reinforcement, overlearning, shaping, and prompting. The second passage order was shaping, prompting, negative reinforcement and overlearning. The third passage order was prompting, overlearning, shaping and negative reinforcement.

Posttest

The first part of the posttest was 33 multiple choice questions, which were on deposit with the National Auxiliary
Publications Service, Document 02174. Posttest construction was described:

The test consisted of four-alternative multiple-choice items which were randomly ordered. The letter of the correct choice was also randomly ordered. The test consisted of both recognition and application questions. One set of three recognition items was prepared for each passage. These consisted of two questions requiring psychologist's names and a third item requiring one of the two dates as answers. The tested dates were chosen so that for three of the passages the date presented first in the reading was tested, while the second date was tested in the remaining two passages. A second set of three recognition items for each passage required the definitions of the three terms introduced by the passage.

The remaining questions were three application questions from each reading passage...all dealt with the major process introduced by the passage, and all included descriptions of situations different from those described in the reading passage (Duell, 1974, p. 229).

The second part of the posttest was short answer essay questions. The first set was two application questions. One required the subject to give an example of using overlearning with prompting. The other required the subject to write a correct ordering of the concepts of shaping, overlearning and prompting used in one teaching session and to support the answer.

The second set was three analysis questions. One required comparison and contrast of shaping and prompting. Another required comparison and contrast of negative reinforcement and shaping. The third required evaluation of why shaping works better on a continuous rather than an intermittent reinforcement schedule.

Study Aid Examples

Each experimental condition had a different example of a study
aid. Typed instructions, a test to learn how the study aid worked, and a nonexample of a study aid were the same in all experimental conditions. Group 1 received a five column matrix study aid. Group 2 received a four section outline study aid. Group 3 received a handwritten copy of notes.

The six question test required subjects to find information within the study aid example. There were five recognition questions and one analysis question. To answer the analysis question, a subject had to compare and contrast two sets of data listed in the example.

The handwritten nonexample of notes was written in sentences and nonsentences. Instructions cautioned subjects to notice the nonexample was not complete enough to answer the preceding test.

**Study Aids**

As a result of pretesting these study aids with three volunteers, study aid questions and directions were revised. The revised directions stated that the study aid may not be used during the posttest. The volunteers indicated that there was sufficient space for writing notes on the outline and matrix study aids.

Groups 1 and 2 received study aids of differing formats with the same questions. Seven questions were to be answered for each passage. There were three recognition questions: What is the definition? Names and dates? Other important words explained? There were three application questions: How is it done? List one example from passage. Make up an example. There was one analysis
question: When would this be used?

Group 1 received a five column matrix study aid. Column one listed seven questions to be answered for each passage. Columns two through five contained blank cells and were respectively titled, "Negative Reinforcement", "Prompting", "Shaping", and "Overlearning". Group 2 received an outline study aid with four sections which were respectively titled, "Negative Reinforcement", "Prompting", "Shaping", and "Overlearning". Seven questions were repeated for each passage. Group 3 received a blank study aid. Study aid instructions were uniform across groups. Subjects were instructed to write their names on the study aids.

Survey

A survey was administered to identify subject use and reactions to the study aid format. There were three questions. The first question asked if the study aid was used. The second question asked the extent of usefulness of the study aid. The subject was to check one of five choices: not at all, a little help, somewhat helpful, helpful or very helpful. The third question inquired under what conditions the subject would use a similar study aid. A blank space for other comments was provided. Subjects were instructed to write their names on surveys.

Posttest Grading Models

Multiple choice questions were graded from an answer key. Cor-
rect answers received one point and incorrect answers received zero points. The total number of points earned was recorded on the front of the multiple choice test.

Models were constructed for essay answer evaluation. Each of the five models listed the essay question, definitions of the concept(s) quoted from the pertinent passage(s), and criteria for the four grade values of zero through three. Blank and completely incorrect answers were graded zero, partial credit for answers were graded one or two, and full credit for an answer was three.

The final point value for each essay answer was determined by calculating the modal point value of the three evaluators’ scores. If all three point values differed, the median point value was recorded.

Experimental Procedure

The experiment was restricted to the length of a class session, which was 55 minutes. Pretesting of time limit was conducted with a graduate student and a high school sophomore. Both volunteers completed passages, study aid and posttest within the time limit.

The experimenter and two associates were introduced to the subjects in each of the four classes on the day before the experiment. As the experimenter read a rehearsed speech to the subjects, the speech was tape-recorded. Also, the two associates monitored each speech to make sure all information was complete and uniform. If the experimenter failed to explain all the rehearsed information, an
associate would alert the experimenter. After the speech, but before the subjects left the room, the experimenter would then offer the missing information. The two associates determined that each speech offered the same information, so supplementary speeches were not offered.

The subjects were told that a group experiment about methods of study would be conducted the following day. Subjects were shown an example of a 410 word passage and were told that they would be studying four passages similar in length to the displayed model. Each passage would contain four paragraphs.

A test would be administered for the purpose of collecting data. Test grades would not be part of course grades and individual scores would be part of a group score. Subjects were assured that no one other than the investigators would see their grades or tests.

Three statements were written on the chalkboard: Your score will become part of a group score. Your score helps us determine the best learning method. Do not discuss the experiment with others until the following day.

Subjects were then assigned to experimental groups and moved to the location in the classroom where they would sit the following day. The group assignment process was explained and any questions were answered.

On the following day, in each of the four sessions, subjects were told to move to assigned locations. Subjects received a pre-addressed manilla envelope containing items marked 1, 2, 3 and 4.
When the experiment started, subjects were told to remove items marked 1 and 2 and to study these for three minutes. Item 1 was general instructions and Item 2 was the study aid example. At the end of three minutes, subjects were told to put Items 1 and 2 back in the envelope, to pull out Items 3 and 4, and to begin a 20 minute study period. Item 3 was the study aid and Item 4 was a stapled packet of the four passages.

The amount of time remaining in the study period was posted in two locations on the chalkboard and was updated every minute. At the end of the study period, subjects were told to put items 3 and 4 back in the envelopes and to drop the envelopes to the floor. The experimenters then picked up the envelopes.

The test was passed out and subjects were told to begin the 30 minute test period. The one minute transition period was not part of the test period. Investigators picked up the manilla envelopes after passing out tests. The amount of time remaining in the test period was posted in two locations on the chalkboard and was updated every minute.

At the end of the test period, subjects were instructed to fill out the survey which was stapled to the back of the test. One minute was allotted for survey completion. The investigators reminded subjects to make sure their names were on the tests and the tests were collected. Subjects were thanked, reminded that this grade isn't part of their course grade and not to tell others about the experiment until the next day.
Posttest Grading Procedure

Surveys were detached from tests before grading of the tests. All tests were scored without prior knowledge of group affiliation. A code number, 1 through 94 (number 65 and 67 were unintentionally omitted), was assigned to each test. Code numbers were recorded in six places on the test: the back of the last page of the multiple choice questions and on the back of each of the five essay questions. Each test was then physically separated into six categories to be graded: a multiple choice category and categories for each essay question numbered 34 through 38.

Posttest Essay Answer Evaluator Training

Three evaluators, paid $15.00 each, were trained to independently grade essay questions. Evaluators were instructed to study a randomly assigned essay answer model and construct a full credit three point answer, partial credit two and one point answers and a no credit zero point answer based solely on definitions and criteria supplied in the model. Upon completion of this task, an evaluator's adherence to a model's criteria was reviewed by the trainer. Reviews of the constructed examples were conducted individually and in a separate room. When all examples matched the criteria in a model, the evaluator was instructed to grade the essay answers of that model.

All essay answers were to be individually placed on the model and analyzed for point value, and sorted into four groups with
values of zero to three points earned. After the initial sort, the
evaluator was to reread groupings checking for consistency in the
sort. When the evaluator was satisfied with the sort, groupings
were then turned over to reveal a code number on each essay answer.
The grade assigned to the code number was transferred to a blank
recording sheet which listed all code numbers. The four groups were
mixed, put in an envelope and brought to the trainer, along with
the grading sheet.

The trainer randomly pulled out 20 answers to be regraded
using the above procedure. Regrades were recorded on the back of
the recording sheet. Regrades were checked for accuracy and the
evaluator was offered feedback on score-rescore accuracy. If more
than three regraded answers differed from the original grades, the
entire groupings was to be regraded.
Results

Study Aid Use Data

Subjects were classified by study aid use based on survey responses in order to determine independent variable usage. An inspection of notes written on study aids determined that eight subjects incorrectly stated that study aids were not used. Therefore, subjects were additionally classified by wrote on study aid as listed in Appendix Table B-1. Eighteen subjects reported using study aids but did not write on the study aids.

Seventy-one users, as listed in Appendix Table B-3, were identified: 21 in Group 1, 23 in Group 2 and 27 in Group 3. There were 27 males and 44 females of which 45 were college preparation track students and 26 were general track students.

Twenty-one nonusers, as listed in Appendix Table B-4, subjects who neither wrote on the study aids nor said they used the study aids, were identified and their data were removed from the major analyses. A post-hoc decision was made to investigate whether nonusers were subjects with low grade point averages.

The analysis of grade point averages of nonusers, by group, is listed in Appendix Table B-5. The mean GPA per group was 2.48 for Group 1, 2.49 for Group 2 and 2.36 for Group 3. The majority of nonusers in each group had GPAs above 2.1: seven in Group 1, four in Group 2 and three in Group 3. There were three nonusers in Groups 1 and 2, and 1 in Group 3 with GPAs below 2.1.
Posttest Data

Means and standard deviations by group for multiple choice, essay and total posttest scores are listed in Table 1. For Groups 1, 2 and 3, total posttest means were 23.00, 20.65 and 19.63, with standard deviations of 7.67, 7.69 and 7.93, respectively.

Table 1

<table>
<thead>
<tr>
<th>Group</th>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Multiple Choice Scores</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>M</td>
<td>17.48</td>
<td>16.61</td>
<td>15.85</td>
</tr>
<tr>
<td>SD</td>
<td>4.90</td>
<td>4.89</td>
<td>5.17</td>
</tr>
<tr>
<td><strong>Essay Scores</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>M</td>
<td>5.52</td>
<td>4.04</td>
<td>3.78</td>
</tr>
<tr>
<td>SD</td>
<td>4.01</td>
<td>3.57</td>
<td>3.64</td>
</tr>
<tr>
<td><strong>Total Scores</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>M</td>
<td>23.00</td>
<td>20.65</td>
<td>19.63</td>
</tr>
<tr>
<td>SD</td>
<td>7.67</td>
<td>7.69</td>
<td>7.93</td>
</tr>
</tbody>
</table>

A Pearson product-moment correlation revealed a relationship between total multiple choice scores and total essay scores across
groups, $F(71) = .586$, $p < .001$. Therefore, multiple choice and essay scores were added together for additional analysis.

When the thirteen males and eight females were disqualified as subjects, a post hoc decision was made to include sex as a variable in posttest data analysis. Distribution of subjects by sex is listed in Appendix Table B-6. Further, based upon the analysis listed in Appendix Table B-7, passage order was post hoc added as a variable in the posttest data analysis.

A three-way analysis of variance including variables group, sex and passage order was completed on total posttest scores. Contrary to predictions, the analysis revealed a nonsignificant study aid effect, $F(2, 53) = 1.17$, $p > .05$.

The Sex x Passage Order interaction was significant, $F(2, 53) = 4.68$, $p < .05$. The mean score for females who received Passage Order 2 was 24.22. The mean score for females who received Passage Order 3 was 20.98. These means scores were higher than for males who received the same passage orders. The mean score for males who received Passage Order 2 was 16.47. The means score for males who received Passage Order 3 was 17.90.

As illustrated in Figure 1, this trend reversed for Passage Order 1. The mean score for males was 25.49, while the mean score for females was 21.13. The number of subjects contributing to each mean score by sex and passage order use differed. Passage Order 1 was received by 8 were males and 13 were females. Passage Order 2 was received by 9 were males and 14 were females. Passage Order 3 was received by 10 were males and 17 were females.
Posttest Levels of Learning Analysis

A two factor mixed design with repeated measures on one factor was completed on percent totals of points awarded to recall level, application level and analysis level questions. Totals of points awarded as a percentage of total possible points in each classification were used since there was an unequal number of questions per category and different point values for multiple choice and essay.
questions. There were 24 multiple choice recall, 11 multiple choice and 2 essay application and 3 essay analysis questions. Means and standard deviations expressed as percentages of possible points that could be awarded by group for recall, application and analysis posttest scores are listed in Table 2.

Table 2

Means and Standard Deviations of Posttest Level of Learning Scores Expressed as Percentages

<table>
<thead>
<tr>
<th></th>
<th>Group 1</th>
<th>Group 2</th>
<th>Group 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Recall Level Scores</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>M</td>
<td>50</td>
<td>48</td>
<td>44</td>
</tr>
<tr>
<td>SD</td>
<td>19</td>
<td>18</td>
<td>14</td>
</tr>
<tr>
<td>Application Level Scores</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>M</td>
<td>57</td>
<td>49</td>
<td>46</td>
</tr>
<tr>
<td>SD</td>
<td>22</td>
<td>19</td>
<td>20</td>
</tr>
<tr>
<td>Analysis Level Scores</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>M</td>
<td>30</td>
<td>18</td>
<td>20</td>
</tr>
<tr>
<td>SD</td>
<td>28</td>
<td>25</td>
<td>25</td>
</tr>
</tbody>
</table>

Contrary to predictions, the analysis revealed a nonsignificant study aid effect, $F (2, 68) = 1.53, p > .05$. A difference, being
contributed by analysis scores, among recall, application and analysis posttest scores was significant, \( F(2, 4) = 93.25, F < .05. \) The largest mean percentages for recall, application and analysis level scores were found in Group 1, 50, 57 and 30, respectively. These were followed by Group 2 mean percentages in recall and application level scores, 48 and 49, respectively. Group 3 mean percentage of analysis level scores, 20, was larger than Group 2 mean percentage of 18. Group 3 mean percentages were 44 and 46 for recall and application posttest scores.

**Study Aid Analysis**

Analysis of the amount and type of study aid notes written was based upon opportunities subjects had to answer in response to study aid questions plus any extra notes they may have written. For example, a date or a five word example of the concept of shaping would each be scored as one study aid note written; the former was scored recall level and the latter was scored an application level note.

Although there were equal recall and application study aid questions, one recall question had four responses and a second recall question had two responses. Therefore, for Groups 1 and 2 there were seven responses to recall questions, three responses to application questions and one response to an analysis question, per passage. Group 3 subjects' notes were classified according to the study aid questions for Groups 1 and 2, plus any extra notes.

Means and standard deviations of amount and type of notes are listed in Table 3. Groups 1, 2 and 3 respectively contained 14, 12
and 27 subjects who wrote study aid notes.

Table 3
Study Aid Analysis

<table>
<thead>
<tr>
<th></th>
<th>Group 1</th>
<th>Group 2</th>
<th>Group 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Notes written at Recall Level</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>M</td>
<td>18.79</td>
<td>15.25</td>
<td>12.82</td>
</tr>
<tr>
<td>SD</td>
<td>4.67</td>
<td>8.39</td>
<td>8.54</td>
</tr>
<tr>
<td>Notes written at Application Level</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>M</td>
<td>5.21</td>
<td>3.92</td>
<td>2.44</td>
</tr>
<tr>
<td>SD</td>
<td>2.75</td>
<td>4.32</td>
<td>3.07</td>
</tr>
<tr>
<td>Notes written at Analysis Level</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>M</td>
<td>2.36</td>
<td>1.17</td>
<td>.19</td>
</tr>
<tr>
<td>SD</td>
<td>1.39</td>
<td>1.34</td>
<td>.48</td>
</tr>
</tbody>
</table>

Within the three classifications Group 1 means were the largest: 18.79 for recall, 5.21 for application and 2.36 for analysis level notes. These were followed by Group 2 means, 15.25 for recall, 3.92 for application and 1.17 for analysis level notes. Group 3 means were 12.82 for recall, 2.44 for application and .19 for analysis level notes. Within each group, the recall mean was highest, followed by the application and then the analysis mean.
Survey Data

Responses were tallied converted to percentages, and listed in Table 4. There were 21, 23 and 27 responses for Groups 1, 2 and 3.

Table 4
Survey Responses Expressed in Percentages

<table>
<thead>
<tr>
<th></th>
<th>Group 1</th>
<th>Group 2</th>
<th>Group 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>How helpful was the study aid?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Not at all</td>
<td>14</td>
<td>4</td>
<td>19</td>
</tr>
<tr>
<td>A little help</td>
<td>10</td>
<td>35</td>
<td>33</td>
</tr>
<tr>
<td>Somewhat helpful</td>
<td>43</td>
<td>48</td>
<td>33</td>
</tr>
<tr>
<td>Helpful</td>
<td>19</td>
<td>13</td>
<td>11</td>
</tr>
<tr>
<td>Very helpful</td>
<td>14</td>
<td>0</td>
<td>4</td>
</tr>
<tr>
<td>Planned to use this style study aid in at least one course</td>
<td>5</td>
<td>17</td>
<td>19</td>
</tr>
<tr>
<td>Would only use this style study aid if someone else constructed the questions</td>
<td>43</td>
<td>48</td>
<td>26</td>
</tr>
<tr>
<td>Would not use this style study aid even if the teacher passed it out</td>
<td>48</td>
<td>30</td>
<td>48</td>
</tr>
<tr>
<td>Did not reply</td>
<td>4</td>
<td>5</td>
<td>7</td>
</tr>
<tr>
<td>Negative Comments</td>
<td>5</td>
<td>9</td>
<td>22</td>
</tr>
<tr>
<td>Positive Comments</td>
<td>19</td>
<td>4</td>
<td>7</td>
</tr>
<tr>
<td>Neutral Comments</td>
<td>79</td>
<td>87</td>
<td>70</td>
</tr>
</tbody>
</table>
The percentage of subjects who found the study aid somewhat to very helpful was 76%, 61% and 48% in Groups 1, 2 and 3, respectively, while subjects who planned to use this style study aid in at least one course was 5%, 17% and 19%, respectively. There were more positive than negative comments stated by Group 1, whereas there were more negative than positive comments stated by Group 2 and Group 3.

Examples of positive comments were "The study aid reminded me to look for details...to focus on the main point. Examples of negative comments were, "This is boring...too hard." Neutral comments were "I have no comments to make."

Inter-Evaluator Agreement

Each evaluator scored 460 essay answers: 5 answers for each of the original 92 subjects. All three evaluators disagreed on the point value to be awarded 5% of the time. Two evaluators agreed and the third evaluator disagreed on point values 45% of the time. Total agreement on point values was 50%. Chance level of total agreement was calculated as 1.56% using the probability formula, \( (P_1)^{.25} \times (P_2)^{.25} \times (P_3)^{.25} \times 100\% \).

Intra-Evaluator Accuracy

Score-rescore accuracy on five essay questions ranged from 85% to 100% for two evaluators and 90% to 100% for the third evaluator. No evaluator had to rescore an entire essay question for failure to attain minimum standards. Percent intra-evaluator accuracy is
listed in Table 5.

Table 5
Percent Intra-Evaluator Accuracy

<table>
<thead>
<tr>
<th>Question</th>
<th>Evaluator</th>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Question 34</td>
<td></td>
<td>90</td>
<td>90</td>
<td>90</td>
</tr>
<tr>
<td>Question 35</td>
<td></td>
<td>100</td>
<td>100</td>
<td>85</td>
</tr>
<tr>
<td>Question 36</td>
<td></td>
<td>85</td>
<td>90</td>
<td>100</td>
</tr>
<tr>
<td>Question 37</td>
<td></td>
<td>100</td>
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DISCUSSION

This thesis began with a quote: "We could solve our major problems in education if students learned more during each day in school. That does not mean a longer day or year or more homework. It simply means using time more efficiently" (Skinner, 1984, p. 950). This investigation contended that an organization of study notes which facilitated comparison through generalization within a concept domain and discrimination across concept domains would help students use study time more efficiently. Further, it was suggested that a matrix organization fulfilled these requirements, whereas an outline organization or unstructured study notes were limited in utility.

The effectiveness of matrix organization as a study format for learners has not been investigated in the literature. If matrix format enhanced generalization across relevant attributes and discrimination among irrelevant attributes, this information would have practical value to education. Efficient acquisition and rapid application of knowledge would be enhanced by improved learning skills where study incorporated matrix study aids, improved quality of teaching where concepts would be presented in matrix format, and improved instructional design, where chapter summaries are presented in a matrix.

The first step in investigating whether matrix organization would produce significant improvement in learning was to test matrix
study aid versus an outline study aid versus self-structured study notes with brief prior exposure to a study aid example. Three questions were asked. The results of an experiment to answer these questions will be discussed, along with secondary areas of consideration. A general discussion will offer possible explanations of why the results occurred, implications for education and future experiments in this series.

Posttest Data

The question of interest was: Would subjects who used a matrix format perform better on a posttest than subjects who either used an outline format or wrote self-structured notes? A predicted trend was found across multiple choice and essay question posttest scores. Group 1 outscored Group 2, who in turn, outscored Group 3. Posttest total score means were 23.00, 20.65 and 19.63, respectively. Standard deviations were large: 7.67, 7.69 and 7.93 for Groups 1, 2 and 3, respectively.

Since the results proved nonsignificant, p > .05, there was no justication of confidence in this trend. And yet, the trend of matrix, outline and study notes performance was evident across several different analyses. As stated, multiple choice and essay question posttest means followed this trend, along with recall level means and application level means. The one exception was analysis level means where performance was matrix, study notes and outline. Four of five posttest analyses following the same trend and matrix group means being somewhat larger in five out of five analyses is more
consistent than expected by chance. Calculating chance level of occurrence as the probability of one of three groups outscoring other groups across five analyses would result in a chance level of .0039.

A secondary analysis of notes written also followed the trend of matrix, outline and study notes. With so many measures producing the same trend, it is speculated that additional experimentation in this area will demonstrate a significant difference in the effectiveness of study aid formats.

Posttest Levels of Learning

The question of interest was: Will subjects using the matrix format outperform other groups at higher levels of learning? Contrary to prediction, the analysis revealed a nonsignificant study aid effect, $p > .05$, while the trend of matrix, outline and study notes was found in recall and application levels. Analysis level means were 30, 18 and 20 for Groups 1, 2 and 3, respectively. This was the only analysis in which the study note group mean was greater than the outline group mean. Standard deviations were large and overlapping.

A difference among recall, application and analysis levels of posttest scores was significant, $p < .05$. Across all groups, application level means were greater than recall means. Subjects correctly applied the concepts to new examples more than they recalled specific facts listed in the four passages. Analysis level means were less than recall means.

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Survey Results

The question of interest was: Will the subjects who come in contact with a particular study aid format find it helpful and plan to use its design in future courses? More subjects found the study aids to be somewhat to very helpful than less helpful: 76%, 61% and 48% in Groups 1, 2 and 3, respectively.

In the Matrix Group, 14% found the study aid to be very helpful compared to 0% in Group 2 and 4% in Group 3. Matrix and Outline Groups had identical study aid questions. If the quality of helpfulness were only determined by the presence of study aid questions, one would expect some subjects in Group 2 to rate the outline as very helpful.

Subjects who planned to use the tested style study aid in at least one course were 5%, 17% and 19% respectively, in Groups 1, 2 and 3. Self-structured notes received the highest percent ratings. This is reasonable, since it is the most familiar format to subjects. An outline is a format already taught in writing skills, and so a percentage close to self-structured notes is not unreasonable. Only 5% of Group 1, one subject, indicated plans to use the matrix study aid in at least one course. The percentage is much lower than the outline or study note percentages. Possible explanations are advantages of the matrix format may not be evident, or unavailability of matrix construction training limited its usefulness.

Subjects who said they would only use the tested style study aid if someone else constructed the questions were 43%, 48% and 26%
in Groups 1, 2 and 3, respectively. Since Group 3 was not provided with study aid questions, response to this statement may mean if provided with questions, 26% of these subjects would use them. The high percentages of response to this statement in both Group 1 and 2 may indicate a need to train subjects in question generation.

Subjects who would not use the tested style study aid even if the teacher passed it out were 48%, 30% and 48%, in Groups 1, 2 and 3, respectively. Since Group 1 and 2 had identical study aid questions, the large difference in percents may be primarily attributed to the structure of the study aid. Since there was an opportunity to indicate that if questions were constructed by someone else they would be used, it appears that 48% of Group 3 would rather not write study notes.

Covert and Overt Study Aid Use

Using a matrix or outline study aid can be accomplished in one of two ways. Subjects can write on the study aid, or just review the study aid to identify passage organization and/or possible test questions. Some subjects in this experiment wrote on study aids, while others said they used study aids and did not write on them. A post-experiment decision was made to conduct a secondary analysis to answer this question: Will subjects who write perform better on a posttest that those who covertly use the same matrix or outline study aid? Kaplan (1976) found no difference in intentional learning posttest scores between overt and covert responding to objectives.
Means and standard deviations of multiple choice, essay and total posttest scores categorized by group and by overt or probable covert use of study aid are listed in Appendix Table B-8. Respectively, in Groups 1, 2 and 3, total score means of those who wrote on the study aid were 23.50, 20.08 and 19.63. In Groups 1 and 2, respectively, total score means of those who reported study aid use and did not write on it were 22.00 and 21.27. Group 3 was not relevant for this kind of classification. Standard deviations overlap and there was no significant difference found between those who wrote on the study aid and those who said they used the study aid but didn't write on it. Results of this analysis are consistent with Kaplan's findings.

Means and standard deviations of posttest levels of learning categorized by group and by overt or probable covert use of study aid are listed in Appendix Table B-9. In Group 3, there were no subjects who reported study aid used and did not write on it.

The largest mean percentages for recall, application and analysis level scores, 50, 58 and 34 were found in Group 1 for those subjects who wrote on study aids. Application level means were larger than recall level means for subjects who wrote on the study aids and for Group 1 subjects who reported study aid used and did not write on it. For Group 2 subjects who reported the study aid used but not written upon, the recall level mean, 53, was larger than the application level mean, 48. Again, standard deviations overlap and there was no significant difference found between those who wrote on the study aid and those who said they used the study aid.
aid but didn't write on it. Results of this analysis are also consistent with Kaplan's findings.

Study Aid Analysis

Other secondary questions of interest were: Would matrix and/or outline study aid subjects write more notes, many of which would be at higher levels of learning, than the self-structured note writers? Would self-structured note-writers write more notes which were irrelevant to the posttest?

Group 1 and 2 subjects wrote more notes at the recall, application and analysis levels while answering study aid questions than Group 3, which did not receive study aid questions. Group 1 means, 18.79, 5.21 and 2.36 were greater than Group 2 means, 15.25, 3.92 and 1.17 or Group 3 means 12.82, 2.44 and .19 across recall, application and analysis levels, respectively. Again, standard deviations are large and overlap.

Without study aid questions, many Group 3 subjects wrote more notes irrelevant to posttest questions. Extra notes in Group 3 totalled 24 recall, 3 application and 1 analysis. Nineteen of 27 subjects in Group 3, or 70%, wrote extra notes. No extra notes were written in Group 2. Extra notes in Group 1, totalled 8 recall and 3 application. Four of 14 subjects, or 28%, wrote extra notes in Group 1. Possible explanations are study aid questions may reduce the amount of notes irrelevant to posttests, or without study aid questions, the focus of complex material to be learned may not be clear.
General Discussion

Insignificant results raise further questions in experiments. Questions were raised concerning study aid questions, study aid examples, passage order and study aid interaction, uniform study and test periods, and performance consequences.

Why didn't study aid questions produce significant posttest differences between Groups 1 and 2 and Group 3? Frase and Schwartz (1975) found that answering questions, whether self or tutor generated, produced higher recall on items directly related to those questions over just studying. This is consistent with Skinner's statement of learners clarifying and changing stimuli. Study aid questions should have brought the learner more into contact with the passages, clarifying what needed to be learned. Perhaps answering study aid questions enhanced learning, but due to the brief exposure to the study aid, not every subject answered every study aid question. Another possible explanation may be judged importance of passage information and self-derived objectives initiated by Group 3's Study Aid Example.

Duell (1974) found that the judged importance of an objective affected learning. When objectives matched what learners judged as important, posttest scores of objective users and nonusers were similar. When learners judged material unimportant or irrelevant to the posttest and objectives directed attention to that material, objective users significantly outperformed nonusers on posttests. Although Group 3 wrote many extra notes, the amount of notes
matching study aid questions given to Groups 1 and 2 was very consistent across those who wrote notes. The questions matched what some Group 3 learners judged as important in the passages.

Why were self-structured notes adequate in Group 3? This question may be approached by answering: Did the study aid example of inadequate notes have varying effectiveness across groups?

The design of the Study Aid Example used an example of inadequate handwritten notes across all three groups. This nonexample was most familiar to subjects and offered a quick point of reference. On the other hand, Gagne' et al (1979) discussed nonexamples as close-in or similar to examples, as distractors which may aid discrimination of relevant attributes. As a nonexample of a matrix or an outline, the handwritten study notes did not fulfill the requirements of non-examples.

The study aid example and non-example requirements were fulfilled for Group 3. This opinion is supported by some survey scores and comments. Forty-eight percent of Group 3 found that study aid, a blank sheet of paper, somewhat to very helpful. Along with the opportunity to write summary notes, it is contended the study aid example and nonexample of notes helped. Several subjects who scored the blank study aid as very helpful, also wrote comments that they were reminded by the Study Aid Example to focus on main ideas and look for passage details. Morgan (1981) found that subjects instructed in self-derived objectives in private study outperformed control groups given study advice in controlled study sessions. Group 3's example and nonexample may have served as adequate in-
struction for deriving key passage questions. If this were the case, and if focusing on main points and passage details were judged important to the learners, Group 3's study notes should have matched answers to study aid questions of Groups 1 and 2. Although 70% of Group 3 wrote extra study notes, the majority of notes written matched study aid questions.

Along with self-derived questions and study aid nonexamples possibly contributing to insignificant overall results, a significant Order x Sex interaction, \( p < .05 \), drew attention to passage order as an area to be queried. Males who received the first passage order which started with Negative Reinforcement, outscored females who received the same order. In the second and third passage order, females outscored males.

Although passage order was randomized and counterbalanced across groups, one-third of Groups 1 and 2 received the first passage order which started with the same concept, Negative Reinforcement, as the study aid. Subjects in Groups 1 and 2 who received the first passage order and who wrote notes, filled in notes about the Negative Reinforcement. When the second passage, Overlearning, was different than the next concept, Prompting, on the study aid study aid, some subjects continued writing, while one subject changed matrix column headings to reflect the passage order, and several other subjects discontinued writing notes.

Perhaps some subjects stopped writing notes because the noted redundancy of questions aided in deciding what the focus of the posttest would be. On the other hand, some subjects may have
stopped writing because they didn't want to spend valuable study
time figuring out what portion of the study aid to use next.

Although males whose passage order matched with the first
column of the study aid outscored other subjects, passage order
interaction with the study aid could well have been an advantage to
Group 3 and a disadvantage to Groups 1 and 2. Group 3 subjects,
using a blank sheet of paper, were able to start taking notes imme­
diately. Two-thirds of the subjects in Groups 1 and 2 had a first
passage that was different than the first concept listed on the
study aid. These subjects had to analyze what portion of the study
aid to use first. The more time spent analyzing what portion of the
study aid to use meant less time studying for the posttest.

The amount of time allocated to Directions and Study Aid Exam­
ple exposure, study of passages and testing was constrained by the
setting. The high school's class period was 55 minutes. Direction
and Study Aid Examples were allotted 3 minutes and 20 minutes was
allotted for passage study. Personal observations during these
periods were the majority of subjects spent one minute on Directions
and two minutes on the Study Aid Examples, and most subjects were
finished with passage study several minutes before the period ended.
Two minutes may have been sufficient time for reading the Study Aid
Example, but not for studying it.

As stated earlier, Matrix and Outline Groups actually had two
tasks: learn the subject matter to be tested and use a super­
imposed study note format. Most subjects, across all groups,
stopped studying several minutes before the period end. This may
indicate that in Groups 1 and 2, either the two tasks did not interfere with each other, or that subjects chose to attend to one task over the second task. If there were task interference, it is reasonable to assume that attention was allocated to the passages.

Amount of study time may also be a factor in why some subjects used the study aid and did not write on it, or stopped writing on it. Reviewing the questions and checking for answers in the passages took less time than writing the answer in addition to the review and check.

The posttest was allocated 30 minutes. A personal observation was that all subjects completed the posttest at least three minutes before the period end. Many subjects were finished much earlier than three minutes. Analysis of posttests revealed that several subjects did not answer any of the essay questions, while many others skipped around the page. Since the essay questions were listed after the multiple choice questions there may have not been enough time to sufficiently draft and write a short essay answer.

Another explanation is also plausible. Answering multiple choice questions had a requirement or cost to the subjects, of thinking about the choices listed and selecting the correct answer. Answering essay questions had further requirements or costs. These questions called for constructions of new examples of one or several concepts, comparisons and contrasts of concepts and rationales for answers. Since consequences for performance under testing conditions were not varied, subjects stopped working when answer requirements increased.
Admittance to a scheduled guest lecture on learning the following day was not contingent on performance on posttest. Instructors, and rightly so, were not permitted in the testing room. Subjects were told that the posttest was not part of their course grade, individual scores would become part of the group score, and they would not be identified. In effect, subjects could study the material, and complete the posttest for the sake of science. Or, they could perform at a minimum level with no consequences for lack of performance.

Future experiments in this series should design material which would fit into a course and become part of the course grade. If results proved significant, those students who did not receive the superior treatment should be given exposure to the treatment and have their test grade adjusted for bias.

In addition, college populations with longer class periods should be tested. The additional class length would allow for longer passages or additional passages to be studied. It is possible that less structured study aid organizations become inadequate at higher volumes of information.

Also, rather than holding time constant across groups, future experiments should allow subjects to work at their own pace and have the student record that data. If the matrix organization were demonstrated as a superior study aid format, and study time were less than other study aid formats, this result would increase its potential usage.

Additional class length would allow for a more elaborate
programmed instruction in benefits and applications of matrix and outline study aids. Also, the programmed instruction should contain at least two nonexamples of study aid formats. One nonexample would be the familiar self-structured study notes, while the second nonexample would reflect the particular study aid format strategy. For example, in matrix study aid groups, both an example and nonexample of a matrix will be listed, along with a nonexample of self-structured study notes.

A major improvement in future study aids should be concepts listed in the same order as passages to be read. If three passage orders are used, study aid formats reflecting those order should be used.

The first step in investigating whether matrix organization would produce significant improvement in learning, testing a matrix study aid versus an outline study aid versus self-structured study notes with brief exposure to a study aid example, has been accomplished. Strategical and technical improvements for future experiments in this series were discussed. These improvements were based on analyses and possible interpretations of experimental results.

Although the first experiment of the effectiveness of matrix organization as a format to help students use study time more efficiently, by facilitating comparison through generalization within a concept domain and discrimination across concept domains did not demonstrate significance, matrix groups means were always somewhat larger than other groups. The probability of one of three groups outscoring other groups across five analyses would result in a
chance level of occurrence of .0039. It is speculated that future experiments including the cited improvements will demonstrate a significant difference in the effectiveness of study aid formats.
APPENDIX A

Materials

You will study 4 passages.

A. You may look back to any passage during the study time.

B. You will be given a study aid to use in your studying. (Please write your name on it.)

C. The amount of time you have to study will be announced and the amount of time remaining will be updated on the chalkboard.

You will be tested on the material in the 4 passages.

A. You may not use the 4 written passages or the study aid while you are answering the test questions.

B. The test has 33 multiple-choice questions and 5 essay questions. (Please write your name on the test.)

C. The amount of time you have to answer the test questions will be announced and the amount of time remaining will be updated on the chalkboard.

You will answer a short survey.

A. Please write your name on it.
NEGATIVE REINFORCEMENT

A dog is placed in a box containing an electric grid on the floor. The electricity is turned on. The dog moves frantically about the box until he accidentally presses a lever. As soon as the lever is pressed the electricity is turned off. If this sequence is repeated several times, the dog will act in a predictable way. When the electricity is turned on the dog will immediately press the lever thus turning off the electricity. In other words the dog has learned to press the lever in a situation where he did not before training.

The above sequence of events is an example of negative reinforcement as described by J. Deese (1953) and M.H. Marx (1969) and other psychologists who study learning. Negative reinforcement occurs whenever a response eliminates or removes a noxious or "unpleasant" event. The response that removes the noxious stimulus will be emitted more and more frequently in that situation as learning progresses. If someone wants to teach a particular behavior (the desired behavior) he could attempt to arrange a sequence of events where the desired behavior eliminated a noxious stimulus.

Another example is the following sequence of events. The baby cries. The new mother sticks a bottle in the baby's mouth, the baby continues to cry. The mother speaks to the baby but to no avail. She smiles, the baby still cries. Eventually the mother picks up the baby and it stops crying. Should this sequence of events be repeated many times whenever the baby cries one would expect the mother to pick up the baby.

Negative reinforcement is like and yet different from the following two processes: positive reinforcement, a process wherein the desired response is followed by a positive or "pleasant" event; and punishment, a process in which the response of interest is followed by a noxious stimulus or "unpleasant" event. For example if every time the child stands on his head his parents praise him, he is receiving positive reinforcement (assuming he finds his parents' praise "pleasant") for standing on his head. However, if every time the child stands on his head his parents scold him or tell him to stop it, he is receiving punishment (assuming he finds the scolding or command to stop "unpleasant") for standing on his head. Negative reinforcement is only one of many ways in which organisms learn to behave the way they do.
OVERLEARNING

A student is learning how to spell a list of words. Each word is pronounced, the student's spelling is checked and if wrong the correct spelling is shown to the student. The student misses three of the ten words. The same procedure is repeated with the words ordered differently. The second time the student misses one word, the third time none. Even though the student correctly spelled all the words the tutor repeats the procedures three additional times.

Practice beyond the stage at which a task can be performed without error is overlearning. The use of this procedure has been investigated by such experimenters as W.C. Krueger (1929) and, more recently, B.J. Underwood (1954). Studies requiring students to learn lists of foreign words, nonsense syllables, numbers, and ordinary words have shown that some overlearning reduces forgetting.

Consider the instructor who is teaching his class the multiplication tables for the number 6. He gives his class a sheet to work containing all the possible combinations. When the students completes the page he holds up his hand, the teacher checks his paper writing the correct answer beside errors, and gives the student another practice sheet when the student decides he has studied the old paper long enough. When a student correctly answers all the problems the teacher praises him but still gives him another practice sheet until he has successfully completed four sheet in a row. This additional practice beyond the point of the first perfect paper is overlearning.

Overlearning begins when original learning, practice up to the stage at which a task can be performed without error, ends. In the first example the spelling practice when the student made three, one, and no errors for the first time is original learning. Although the examples of overlearning that have been given describe additional practice occurring at the same time as the original practice it would also be possible to view additional practice at a later time as overlearning. Practice of material previously practiced is called distributed practice. An example of distributed practice might be additional practice of the multiplication tables for the number 5 after the students learn the 6's. If the students learned the 5's prior to the 6's this would be distributed practice on the 5's and would also be overlearning for students who could already give the correct answers to all the 5 combinations before they practiced the 6's. Studies show that overlearning is one of several practices that may be used to decrease forgetting.
PROMPTING

A child is presented with a card containing the printed words s-h-o-e and p-i-e and is asked to point and read. The student is unable to read the words. The child is then shown a card containing the printed word s-h-o-e paired with a picture of a shoe. The card with the word-picture pair is removed from sight. The child is again shown the card containing the printed words s-h-o-e and p-i-e and told to point and read. This time the child points to s-h-o-e and says "shoe".

The introduction of the word-picture pair which serves as a hint to enable the child to produce the desired behavior (the behavior being taught), is called prompting by R.C. Anderson (1967) who, along with other experimenters, has investigated teaching sequences using such aids. In studies using college students Anderson has demonstrated that prompted teaching materials can be effective for teaching but that the prompts must be used carefully or they can reduce the amount learned, contrary to the earlier claims of J.O. Cook (1963). Prompting occurs anytime the student is given extra information during training that tips off or suggests the desired answer. Of course, these prompts are removed when the student is tested to find out whether he has learned the material.

Consider the following example. A teacher wants his students to learn the name of the largest city in Kansas. He knows by experience that if he simply asks the question on the worksheet the students will not be able to give the answer. So he places the following item on the worksheet: The largest city in Kansas is W______. The "W" at the beginning of the blank serves as a hint or suggestion that leads to the answer, "Wichita".

Prompts have been classified into two types: thematic prompts, prompts that give a clue to the meaning or theme of the correct answer; and formal prompts, prompts that give a clue concerning the form of the correct answer. In the first example the picture of the shoe is a thematic prompt because the picture suggested the meaning of the correct answer, the verbal response "shoe"; while in the second example the "W" at the beginning of the blank is a formal prompt since it tells the student something about the form of the correct answer, that it begins with a "W". Prompts added to teaching materials have increased the amount people learn from the materials and so can be useful to the teacher.
A trainer wants to teach a hungry dog to touch a doorknob with his nose. The trainer could watch the dog for a long time and wait until the dog accidently touches his nose to the knob and then reinforce or reward him by giving him a dog biscuit. Rather than wait until the dog voluntarily touches the knob, the trainer might reinforce the hungry dog for each action that progressively takes him closer to touching the doorknob. First, he might reinforce the dog for facing the door, then for advancing half-way to the door, next for standing at the door, then for raising his head, and finally for touching the knob. From then on the trainer would reinforce the dog only when he touches the knob with his nose.

Reinforcing behaviors that take the learner progressively closer to the desired behavior (the behavior being taught) is called shaping. This procedure was first utilized with animals as described by K. Breland (1966). Since its introduction the procedure has also been successfully used with human subjects by S.W. Bijou (1965) and others. The major advantage of shaping is that it results in the desired behavior more quickly than waiting. It is conceivable that the exact desired behavior might never occur in the absence of shaping.

Shaping might be used by a language teacher who wants his students to learn how to speak a second language. The desired behavior is well pronounced sentences in the second language. Before this behavior is attained usually the students will produce odd sounds, awkward words, then phrases, and finally the desired articulate sentences. If the teacher praises and compliments each new behavior that brings the student closer to the desired behavior, he is using shaping. The effective use of shaping entails requiring the student to progress just a bit closer to the desired response for each reinforcer.

Two general types of reinforcement may be used: continuous reinforcement wherein every desired response the organism produces is reinforced, and intermittent reinforcement when the desired response is reinforced only part of the time. Consider a trainer who wants to teach a dog to lie down. If every time the dog lies down he is given a pat on the head, the trainer is using continuous reinforcement. If the dog is sometimes patted and sometimes ignored when he lies down, the trainer is using intermittent reinforcement. Studies show that shaping is best accomplished though the use of continuous reinforcement.
Here is an example of a study aid that another student wrote and used in studying for the test that is printed below the study aid. To learn how this study aid works, please answer the questions in that test. (You will be using the same kind of study aid for the 4 passages).

**STUDY AID**

<table>
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<th>Grade Point Average?</th>
<th>Alice</th>
<th>Bob</th>
<th>Carol</th>
<th>David</th>
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<th>85</th>
<th>95</th>
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</table>

| Hours studied?      | 2     | 2    | 3     | 4     |

**TEST**

1. Which students received the same history test score?
2. Which student(s) recorded the most hours studied?
3. Which students recorded the same number of hours studied?
4. Which student has the highest GPA?
5. What was the lowest history test score?
6. How are Alice's data similar to David's data? How are the data different?

Notice, these questions can be answered with the format that the student used. Below is an example of yet another student's notes that were not complete enough to answer the test questions.

**STUDY AID**

Four students studied for a history test. Everyone studied 2-4 hours. All passed (80%). GPAs 2.19-3.75.
Here is an example of a study aid that another student wrote and used in studying for the test that is printed below the study aid. To learn how this study aid works, please answer the questions in that test. (You will be using the same kind of study aid for the 4 passages).

STUDY AID

I. Alice
   A. Grade Point Average? 3.64
   B. History test score? 95
   C. Hours studied? 2

II. Bob
   A. Grade Point Average? 2.19
   B. History test score? 80
   C. Hours studied? 2

III. Carol
   A. Grade Point Average? 2.45
   B. History test score? 95
   C. Hours studied? 3

IV. David
   A. Grade Point Average? 3.25
   B. History test score? 95
   C. Hours studied? 4

TEST

1. Which students received the same history test score?
2. Which student(s) recorded the most hours studied?
3. Which students recorded the same number of hours studied?
4. Which student has the highest GPA?
5. What was the lowest history test score?
6. How are Alice's data similar to David's data? How are the data different?

Notice, these questions can be answered with the format that the student used. Below is an example of yet another student's notes that were not complete enough to answer the test questions.

STUDY AID

Four students studied for a history test. Everyone studied 2-4 hours and passed (80+). GPAs: 2.19, 3.75.
Here is an example of a study aid that another student wrote and used in studying for the test that is printed below the study aid. To learn how this study aid works, please answer the questions in that test. (You will be using the same kind of study aid for the 4 passages).

**STUDY AID**

Four students studied for a history test. The test covered chapters 7-14. Alice studied two hours and scored 95. Her grade point average is 3.64. Bob has a grade point of 2.13, scored 80 and studied 2 hours. Carol - 3 hr. - 85 - gpa 2.65. David gpa 3.75 - 4 hr. - 95.

**TEST**

1. Which students received the same history test score?
2. Which student(s) recorded the most hours studied?
3. Which students recorded the same number of hours studied?
4. Which student has the highest GPA?
5. What was the lowest history test score?
6. How are Alice’s data similar to David’s data? How are the data different?

Notice, these questions can be answered with the format that the student used. Below is an example of yet another student's notes that were not complete enough to answer the test questions.

**STUDY AID**

Four students studied for a history test. Everyone studied 2-4 hours and all passed (80+). gpa 2.19-3.75
You may use this study aid while you study. You may not use the 4 written passages or this study aid while you are answering the test questions.

<table>
<thead>
<tr>
<th></th>
<th>NEGATIVE REINFORCEMENT</th>
<th>PROMPTING</th>
<th>SHAPING</th>
<th>OVERLEARNING</th>
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<td><strong>How is it done?</strong></td>
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<td><strong>Names and dates?</strong></td>
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<td><strong>Other important words explained?</strong></td>
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</tr>
<tr>
<td><strong>List one examples from passage.</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Make up an example.</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
You may use this study aid while you study. You may not use the 4 written passages or this study aid while you are answering the test questions.

STUDY AID

I. NEGATIVE REINFORCEMENT

A. What is the definition?
B. How is it done?
C. Names and dates?
D. When would this be used?
E. Other important words explained?
F. List one example from passage.
G. Make up an example.

II. PROMPTING

A. What is the definition?
B. How is it done?
C. Names and dates?
D. When would this be used?
E. Other important words explained?
F. List one example from passage.
G. Make up an example.

III. SHAPING

A. What is the definition?
B. How is it done?
C. Names and dates?
D. When would this be used?
E. Other important words explained?
F. List one example from passage.
G. Make up an example.

IV. OVERLEARNING

A. What is the definition?
B. How is it done?
C. Names and dates?
D. When would this be used?
E. Other important words explained?
F. List one example from passage.
G. Make up an example.
You may take notes on this study aid while you study. You may not use the 4 written passages or this study aid while you are answering the test questions.
Directions: Carefully read each item and decide which choice best answers the question. Circle the letter of that response.

1. The teacher wants the student to learn the names of the capitals for all the states in the U.S. On each trial he gives the student a list of states and the student writes the name of the corresponding capital. Which of the following sequences best illustrates overlearning?

A. 1st trial: Kansas, Nebraska, Colorado - Student misses none
   2nd trial: Kansas, Nebraska, Colorado - Student misses none
   3rd trial: Kansas, Nebraska, Colorado - Student misses none

B. 1st trial: Kansas, Nebraska, Colorado - Student misses none
   2nd trial: Oklahoma, Nevada, California - Student misses two (Calif. correct)
   3rd trial: Oklahoma, Nevada, Missouri - Student misses none

C. 1st trial: Kansas, Nebraska, Colorado - Student misses all
   2nd trial: Kansas, Nebraska, Colorado - Student misses all
   3rd trial: Kansas, Nebraska, Colorado - Student misses none

D. 1st trial: Kansas, Nebraska, Colorado - Student misses all
   2nd trial: Kansas, Nebraska, Colorado - Student misses none
   3rd trial: Texas, Missouri, Illinois - Student misses all

2. From the paragraphs which description do you readily associate with distributed practice?

A. Practice of material that has never been practiced before
B. Practice of material that was correctly worked before
C. Practice of material that has been previously practiced
D. Practice of material before it can be performed without error

3. From the paragraphs which name do you readily associate with the concept of shaping?

A. Krueger  B. Brelang  C. Anderson  D. Marx

4. From the paragraphs which name do you readily associate with the concept of overlearning?

A. Frase  B. Ausubel  C. Bijou  D. Krueger
5. Which of the following situations best illustrates prompting?

A. During training before the child chooses an answer, if the child starts to press the wrong button, the teacher frowns.

B. During training after the child chooses an answer, if the child presses the wrong button, the teacher frowns.

C. During training after the child chooses an answer, a light is turned on behind the correct answer.

D. During training before the child chooses an answer, lights flash on behind all the choices.

6. The teacher wants the student to write a date correctly. Which of the following sequences best illustrates shaping?

A. First attempt: 18 January - Teacher does not praise
   Second attempt: 1970, 18 - Teacher praises
   Third attempt: January 1970 18 - Teacher does not praise

B. First attempt: 18 January - Teacher praises
   Second attempt: January 18 - Teacher praises
   Third attempt: 1970 January 18 - Teacher praises

C. First attempt: 18 January - Teacher does not praise
   Second attempt: January 18 - Teacher does not praise
   Third attempt: January 18, 1970 - Teacher praises

D. First attempt: 18 January - Teacher praises
   Second attempt: January 18 - Teacher praises
   Third attempt: January 18, 1970 - Teacher praises

7. From the paragraphs which description do you readily associate with formal prompts?

A. Giving extra information during training that tips-off or suggests the meaning of the desired response.

B. Giving extra information during training the tips off or suggests the type of test question that will be asked

C. Giving extra information during training that tips-off or suggests the content of the next paragraph

D. Giving extra information during training that tips-off or suggests the form of the desired response

8. From the paragraphs which date do your readily associate with the concept of overlearning?

9. The teacher wants the child to learn to say Mississippi. Which of the following sequences best illustrates shaping?

A. 1st attempt: Teacher: "Mis-sis-sip-pi"
   Child: "Mis-pi-sip"
   Teacher: "Watch me say the word"

   2nd attempt: Teacher: "Mis-sis-sip-pi"
   Child: "Mis-sap-pi"
   Teacher: "Listen to me carefully"

   3rd attempt: Teacher: "Mis-sis-sip-pi"
   Child: "Mis-sis-pi"
   Teacher: "Let's try it again"

B. 1st attempt: Teacher: "Mis-sis-sip-pi"
   Child: "Mis-pi-sip"
   Teacher: "Good"

   2nd attempt: Teacher: "Mis-sis-sip-pi"
   Child: "Mis-sip"
   Teacher: "Fine"

   3rd attempt: Teacher: "Mis-sis-sip-pi"
   Child: "Mis-sip"
   Teacher: "Good"

C. 1st attempt: Teacher: "Mis-sis-sip-pi"
   Child: "Mis-pi-sip"
   Teacher: "Wrong"

   2nd attempt: Teacher: "Mis-sis-sip-pi"
   Child: "Mis-sis-sip"
   Teacher: "Incorrect"

   3rd attempt: Teacher: "Mis-sis-sip-pi"
   Child: "Mis-sis-sip-pi"
   Teacher: "Good"

D. 1st attempt: Teacher: "Mis-sis-sip-pi"
   Child: "Mis-sip-pi"
   Teacher: "Good"

   2nd attempt: Teacher: "Mis-sis-sip-pi"
   Child: "Mis-sip-pi"
   Teacher: "Good"

   3rd attempt: Teacher: "Mis-sis-sip-pi"
   Child: "Mis-sis-sip-pi"
   Teacher: "Excellent"

10. From the paragraphs which description do you readily associate with positive reinforcement?

A. Following the stimulus with a positive or pleasant event

B. Preceding the desired response with a positive or pleasant event

C. Following the desired response with a positive or pleasant event

D. Preceding the stimulus with a positive or pleasant event
11. From the paragraphs which description do you readily associate with negative reinforcement?

A. Following the stimulus with a noxious or unpleasant event

B. Preceding the stimulus with a noxious or unpleasant event that is ended by the stimulus

C. Preceding the desired response with a noxious or unpleasant event that is ended by the response

D. Following the response of interest with a noxious or unpleasant event

12. From the paragraphs which description do you readily associate with punishment?

A. Reinforcing behaviors that take the learner progressively closer to the desired behavior

B. Preceding the desired response with a noxious or unpleasant event that is ended by the response

C. Reinforcing the learner only part of the time when he performs the desired behavior

D. Following the response of interest with a noxious or unpleasant event

13. The teacher wants the student to learn the meanings of several words. The teacher gives the student the word and the student must write the meaning. Which of the following sequences best illustrates overlearning?

A. 1st trial: drub, bravura, izzard - Child misses two (izzard correct)
   2nd trial: drub, bravura, piebald - Child misses all
   3rd trial: drub, bravura, piebald - Child misses one (drub incorrect)

B. 1st trial: drub, bravura, izzard - Child misses one (drub incorrect)
   2nd trial: drub, piebald, taconite - Child misses none
   3rd trial: unlimber, mesocarp, cannikin - Child misses all

C. 1st trial: drub, bravura, izzard - Child misses none
   2nd trial: piebald, taconite, unlimber - Child misses two (taconite correct)
   3rd trial: drub, bravura, izzard - Child misses none

D. 1st trial: drub, bravura, izzard - Child misses all
   2nd trial: drub, bravura, izzard - Child misses one (izzard incorrect)
   3rd trial: izzard, piebald, unlimber - Child misses none
14. The teacher wants the student to learn how to identify by name the pictures of various animals. He has several pictures of each kind of animal. Which of the following sequences best illustrates overlearning?

A. 1st picture: cat - Child: "cat"
   2nd picture: dog - Child: "dog"
   3rd picture: horse - Child: "cow"

B. 1st picture: cat - Child: "dog"
   2nd picture: cat - Child: "cat"
   3rd picture: horse - Child: "cow"

C. 1st picture: cat - Child: "cat"
   2nd picture: horse - Child: "cow"
   3rd picture: cow - Child: "cow"

D. 1st picture: cat - Child: "cat"
   2nd picture: cat - Child "cat"
   3rd picture: dog - Child: "dog"

15. From the paragraphs which description do you readily associate with thematic prompts?

A. Giving extra information during training that tips-off or suggests the content of the next paragraph

B. Giving extra information during training that tips-off or suggests the type of test question that will be asked

C. Giving extra information during training that tips-off or suggests the form of the desired response

D. Giving extra information during training that tips-off or suggests the meaning of the desired response

16. From the paragraphs which description do you readily associate with overlearning?

A. Practice of material that has been previously practiced

B. Practice beyond the stage at which a task can be performed without error

C. Practice up to the stage at which a task can be performed without error

D. Practice of material that has been practiced before but not learned
17. From the paragraphs which description do you readily associate with prompting?

A. Reinforcing behaviors that take the learner progressively closer to the desired behavior
B. Giving extra information during training that tips-off or suggests the correct answer
C. Reinforcing the learner every time he performs the desired behavior
D. Giving introductory material which provides the learner with the basic structure of the information he is to acquire

18. From the paragraphs which name do you readily associate with the concept of negative reinforcement?

A. Marx  B. Bijou  C. Brelan  D. Frase

19. From the paragraphs which name do you readily associate with the concepts of overlearning?

A. Underwood  B. Marx  C. Deese  D. Anderson

20. From the paragraphs which name do you readily associate with the concept of shaping?

A. Bijou  B. Cook  C. Underwood  D. Frase

21. From the paragraphs which name do you readily associate with the concept of negative reinforcement?

A. Anderson  B. Deese  C. Ausubel  D. Krueger

22. From the paragraphs which description do you readily associate with original learning?

A. Practice of material that has been previously practiced
B. Practice beyond the stage at which a task can be performed without error
C. Practice of material that has never been practiced before
D. Practice up to the stage at which a task can be performed without error
23. From the paragraphs which date do you readily associate with the concept of prompting?


24. From the paragraphs which description do you readily associate with continuous reinforcement?

A. Reinforcing behaviors that take the learner progressively closer to the desired behavior
B. Reinforcing the learner everytime he performs the desired behavior
C. Reinforcing the learner only part of the time when he performs the desired behavior
D. Reinforcing the learner everytime he attempts the desired behavior

25. From the paragraphs which description do you readily associate with intermittent reinforcement?

A. Reinforcing the learner only part of the time when he performs the desired behavior
B. Reinforcing the learner everytime he attempts to perform the desired behavior
C. Reinforcing behaviors that take the learner progressively closer to the desired behavior
D. Reinforcing the learner everytime he performs the desired behavior

26. Which of the following situations best illustrates prompting?

A. Whenever the child must choose an answer, the correct answer is followed by a piece of candy
B. Whenever the child must choose an answer, an incorrect answer is followed by a buzzer
C. Whenever the child must choose an answer, an incorrect answer is followed by a pause
D. Whenever a child must choose an answer, a toy is placed above the correct alternative
27. From the paragraphs which name do you readily associate with the concept of prompting?
   A. Breland      B. Deese      C. Anderson      D. Frase

28. From the paragraphs which name do you readily associate with the concept of prompting?
   A. Underwood    B. Cook       C. Bijou        D. Ausubel

29. From the paragraphs which description do you readily associate with shaping?
   A. Reinforcing the learner only part of the time when he performs the desired behavior
   B. Reinforcing behaviors that take the learner progressively closer to the desired behavior
   C. Following the response of interest with a noxious or unpleasant event
   D. Reinforcing the learner every time he performs the desired behavior

30. Which of the following situations best illustrates negative reinforcement?
   A. A light is turned on. The thirsty rat presses a bar and receives a dipper of water. The light goes off, the rat presses the bar and nothing happens. The light is turned on, the rat presses the bar and receives a dipper of water.
   B. A cat touches a light with his paw and receives an electric shock to his brain. He rubs against the light, nothing happens. He touches the light with his paw and receives an electric shock to his brain.
   C. A dog receives a shock to his brain. While thrashing about the cage he raised both front paws simultaneously and the electricity is turned off. The electricity is turned on and he immediately raises both front paws.
   D. A bear sniffs a pan. Nothing happens. He touches the pan with his right paw. Nothing happens. He turns the pan over. Nothing happens. He turns the pan over again. Nothing happens. He leaves the pan.

31. From the paragraphs which date do you readily associate with the concept of shaping?

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32. Which of the following situations best illustrates prompting?

A. Each time a new question is presented to the child, a green light appears over the question.
B. Each time a new question is presented to the child, a green light appears over the correct answer.
C. Each time a new question is presented to the child, the teacher smiles at the student.
D. Each time a new question is presented to the child, an empty circle appears below each of the alternatives.

33. From the paragraphs which date do you readily associate with the concept of negative reinforcement?


*******

QUESTIONS 34 TO 38 ARE ESSAY QUESTIONS.
PLEASE WRITE YOUR ANSWERS TO THE ESSAY QUESTIONS IN THE SPACE PROVIDED
*******

34. Give an example of using overlearning with prompting.
35. The concepts of shaping, overlearning, and prompting are to be used in ONE teaching session. What ordering of the concepts would produce the best results? Support your answer.

36. How is the concept of shaping similar to the concept of prompting? How is it different?

37. How is the concept of negative reinforcement similar to the concept of shaping? How is it different?

38. Why does shaping work better on a continuous rather than an intermittent reinforcement schedule?
NAME_____________________

SURVEY

1. I used the study aid. YES___ NO___

2. How helpful was the study aid to you? (check one)
   ___ Not at all
   ___ A little help
   ___ Somewhat helpful
   ___ Helpful
   ___ Very helpful

3. Check the statement that applies best.
   ___ I plan to use this style of study aid in at least one course.
   ___ I would only use this style of study aid if someone else constructed the questions.
   ___ I would not use this style of study aid even if the teacher passed it out.

OTHER COMMENTS

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Multiple Choice Question Answer Key

1. A 18. A
2. C 19. A
3. B 20. A
5. A 22. D
6. D 23. B
7. D 24. B
8. A 25. A
9. D 26. D
10. C 27. C
12. D 29. B
13. C 30. C
15. D 32. B
16. B 33. C
17. B
QUESTION 34

Give an example of using overlearning with prompting.

GRADING KEY

3 = This answer contains a correct example of overlearning with prompting.
2 = This answer contains a correct example of overlearning OR prompting.
1 = This answer contains correct definitions of overlearning and prompting.
0 = This answer is blank or does not match the three categories listed.

This is the concept of prompting, as quoted from the passage entitled, "Prompting."
"Prompting occurs anytime the student is given extra information during training that tips off or suggests the desired answer... Prompts have been classified into two types: thematic prompts, prompts that give a clue to the meaning or theme of the correct answer; and formal prompts, prompts that give a clue concerning the form of the correct answer."

This is the concept of overlearning, as quoted from the passage entitled, "Overlearning."
"Practice beyond the stage at which a task can be performed without error is overlearning... Overlearning begins when original learning, practice up to the stage at which a task can be performed without error, ends."

These quotes are listed to help you judge whether the example in question should be scored as a 3 or a 2. The quotes also serve as the definitions to be used in scoring answers that are not examples and so may only receive 1 point.
QUESTION 35

The concepts of shaping, overlearning and prompting are to be used in ONE teaching session. What ordering of the concepts would produce the best results? Support your answer.

GRADING KEY

This is a two part scoring system. In order to receive credit the student must list one of the two acceptable orders and support the answer.

There are two acceptable orders:
- prompting, shaping, overlearning
- shaping, prompting, overlearning

3 = This answer contains an acceptable order and the three terms are used correctly in the support of the order.

2 = This answer contains an acceptable order and at least one term is used correctly in the support of the order.

1 = One of the acceptable orders is listed.

0 = This answer is blank or does not match the three categories listed.

This is the concept of prompting, as quoted from the passage entitled, "Prompting."
"Prompting occurs anytime the student is given extra information during training that tips off or suggests the desired answer... a hint to enable the child to produce the desired behavior (the behavior being taught), is called prompting."

This is the concept of shaping, as quoted from the passage entitled, "Shaping."
"Reinforcing behaviors that take the learner progressively closer to the desired behavior (the behavior being taught) is called shaping... The effective use of shaping entails requiring the student to progress just a bit closer to the desired response for each reinforcer."

This is the concept of overlearning, as quoted from the passage entitled, "Overlearning."
"Practice beyond the stage at which a task can be performed without error is overlearning... Overlearning begins when original learning, practice up to the stage at which a task can be performed without error, ends."

These quotes serve as definitions of the three concepts. Support of an answer does not require defining the terms, but from the support, you will determine whether or not the student uses the terms correctly.
QUESTION 36

How is the concept of shaping similar to the concept of prompting? How is it different?

GRADING KEY

3 = This answer contains a correct comparison and a correct contrast of prompting and shaping.

2 = The answer contains a correct comparison OR a correct contrast of prompting and shaping.

1 = This answer contains correct definitions of prompting and shaping.

0 = This answer is blank or does not match the three categories listed.

This is the concept of prompting, as quoted from the passage entitled, "Prompting."
"Prompting occurs anytime the student is given extra information during training that tips off or suggests the desired answer... a hint to enable the child to produce the desired behavior (the behavior being taught), is called prompting."

This is the concept of shaping, as quoted from the passage entitled, "Shaping."
"Reinforcing behaviors that take the learner progressively closer to the desired behavior (the behavior being taught) is called shaping...The effective use of shaping entails requiring the student to progress just a bit closer to the desired response for each reinforcer."

These quotes are listed to help you judge whether the comparison and/or contrast in question should be judged as correct. The quotes also serve as the definitions to be used in scoring answers that are not comparisons and/or contrasts and so may only receive 1 point.
QUESTION 37

How is the concept of negative reinforcement similar to the concept of shaping? How is it different?

GRADING KEY

3 = This answer contains a correct comparison and a correct contrast of negative reinforcement and shaping.

2 = This answer contains a correct comparison OR a correct contrast of negative reinforcement and shaping.

1 = This answer contains correct definitions of negative reinforcement and shaping.

0 = This answer is blank or does not match the three categories listed.

This is the concept of negative reinforcement, as quoted from the passage entitled, "Negative Reinforcement."
Negative reinforcement occurs whenever a response eliminates or removes a noxious or "unpleasant" event...If someone wants to teach a particular behavior (the desired behavior) he could attempt to arrange a sequence of events where the desired behavior eliminated a noxious stimulus."

This is the concept of shaping, as quoted from the passage entitled, "Shaping."
"Reinforcing behaviors that take the learner progressively closer to the desired behavior (the behavior being taught) is called shaping...The effective use of shaping entails requiring the student to progress just a bit closer to the desired response for each reinforcer."

These quotes are listed to help you judge whether the comparison and/or contrast in question should be judged as correct. The quotes also serve as the definitions to be used in scoring answers that are not comparisons and/or contrasts and so may only receive 1 point.
QUESTION 38

Why does shaping work better on a continuous rather than an intermittent reinforcement schedule?

GRADING KEY

3 = This answer contains a correct reason inferred from the paragraph listed below the grading key.

2 = This answer contains correct definitions of continuous reinforcement and intermittent reinforcement.

1 = This answer contains a correct definition of continuous reinforcement OR intermittent reinforcement.

0 = This answer is blank or does not match the three categories listed.

This is the concept of shaping, as quoted from the passage entitled, "Shaping."
"Reinforcing behaviors that take the learner progressively closer to the desired behavior (the behavior being taught) is called shaping...The effective use of shaping entails requiring the student to progress just a bit closer to the desired response for each reinforcer."

This is the paragraph explaining continuous reinforcement and intermittent reinforcement, as quoted from the passage entitled, "Shaping."
"Two general types of reinforcement may be used: continuous reinforcement wherein every desired response the organism produces is reinforced, and intermittent reinforcement when the desired response is reinforced only part of the time. Consider a trainer who wants to teach a dog to lie down. If every time the dog lies down he is given a pat on the head, the trainer is using continuous reinforcement. If the dog is sometimes patted and sometimes ignored when he lies down, the trainer is using intermittent reinforcement. Studies show that shaping is best accomplished through the use of continuous reinforcement."

This paragraph is quoted to help you judge whether the answer in question should be judged as correct. It also contains the definitions to be used in scoring answers that may receive 1 or 2 points.
APPENDIX B

Secondary Analyses

Subjects were classified by study aid use based on survey responses in order to determine independent variable usage. Upon physical inspection of notes written on study aids, it was determined that some subjects incorrectly classified themselves as non-users. A post-hoc decision of classifying subjects by wrote on study aid and by self-report was made. Results of these classifications are listed in Table B-1.

Table B-1
Contact with Independent Variable - Study Aid Use

<table>
<thead>
<tr>
<th>Group</th>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reported study aid use and wrote on study aid</td>
<td>13</td>
<td>10</td>
<td>22</td>
</tr>
<tr>
<td>Reported study aid use and did not write on study aid</td>
<td>7</td>
<td>11</td>
<td>0</td>
</tr>
<tr>
<td>Total study aid not used and wrote on study aid</td>
<td>1</td>
<td>2</td>
<td>5</td>
</tr>
<tr>
<td>Total study aid users</td>
<td>21</td>
<td>23</td>
<td>27</td>
</tr>
<tr>
<td>Reported study aid not used and did not write on study aid</td>
<td>10</td>
<td>7</td>
<td>4</td>
</tr>
</tbody>
</table>
Table B-2 lists the original random selection of 92 subjects. Of the college preparation track subjects, there were: 8 seniors, 32 juniors and 12 sophomores. Of the general studies track subjects, there were: 17 seniors, 21 juniors and 2 sophomores.

Table B-2
Classification of Subjects before Experiment

<table>
<thead>
<tr>
<th></th>
<th>Group</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
</tr>
<tr>
<td>College Preparation</td>
<td></td>
</tr>
<tr>
<td>Seniors</td>
<td>3</td>
</tr>
<tr>
<td>Juniors</td>
<td>11</td>
</tr>
<tr>
<td>Sophomores</td>
<td>4</td>
</tr>
<tr>
<td>Total</td>
<td>18</td>
</tr>
<tr>
<td>General Studies</td>
<td></td>
</tr>
<tr>
<td>Seniors</td>
<td>7</td>
</tr>
<tr>
<td>Juniors</td>
<td>6</td>
</tr>
<tr>
<td>Sophomores</td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
<td>13</td>
</tr>
<tr>
<td>Grand Total</td>
<td>31</td>
</tr>
</tbody>
</table>

Table B-3 lists the classification of study aid users. Of college preparation track subjects, there were 8 seniors, 29 juniors
and 8 sophomores. Of the general studies track subjects, there were 11 seniors, 13 juniors and 2 sophomores. Seventy-one of the original ninety-two subjects were study aid users.

Table B-3
Study Aid Users

<table>
<thead>
<tr>
<th></th>
<th>Group</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
</tr>
<tr>
<td>College Preparation</td>
<td></td>
</tr>
<tr>
<td>Seniors</td>
<td>3</td>
</tr>
<tr>
<td>Juniors</td>
<td>10</td>
</tr>
<tr>
<td>Sophomores</td>
<td>2</td>
</tr>
<tr>
<td>Total</td>
<td>15</td>
</tr>
<tr>
<td>General Studies</td>
<td></td>
</tr>
<tr>
<td>Seniors</td>
<td>4</td>
</tr>
<tr>
<td>Juniors</td>
<td>2</td>
</tr>
<tr>
<td>Sophomores</td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
<td>6</td>
</tr>
<tr>
<td>Grand Total</td>
<td>21</td>
</tr>
</tbody>
</table>

Table B-4 lists the classification of study aid nonusers. Of college preparation track subjects, there were 3 juniors and 4 sophomores. Of the general studies track subjects, there were 6 seniors, and 8 juniors.
### Table B-4

**Study Aid Nonusers**

<table>
<thead>
<tr>
<th></th>
<th>Group 1</th>
<th>Group 2</th>
<th>Group 3</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>College Preparation</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Seniors</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Juniors</td>
<td>1</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Sophomores</td>
<td>2</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>3</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td><strong>General Studies</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Seniors</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Juniors</td>
<td>4</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Sophomores</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>7</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td><strong>Grand Total</strong></td>
<td>10</td>
<td>7</td>
<td>4</td>
</tr>
</tbody>
</table>

A post-hoc decision was made to investigate whether nonusers were subjects with low grade point averages. The analysis of GPAs is listed in Table B-5. The average GPA per group of nonusers was 2.48 in Group 1, 2.49 in Group 2 and 2.36 in Group 3. The majority of nonusers in each group had GPAs above 2.1. There were seven nonusers in Group 1, four non-users in Group 2 and three nonusers in Group 3 with GPAs over 2.1.
Table B-5

Grade Point Average of Nonusers

<table>
<thead>
<tr>
<th></th>
<th>Group</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Grade Point Average between:</td>
<td></td>
</tr>
<tr>
<td>3.1 and 4.0</td>
<td>1</td>
</tr>
<tr>
<td>2.1 and 3.0</td>
<td>6</td>
</tr>
<tr>
<td>1.1 and 2.0</td>
<td>2</td>
</tr>
<tr>
<td>&lt;1 and 1.0</td>
<td>1</td>
</tr>
</tbody>
</table>

Subject's sex was a post hoc variable in data analysis. Table B-6 lists the number of males and females study aid users.

Table B-6

Number of Males and Females per Group

<table>
<thead>
<tr>
<th></th>
<th>Group</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Males</td>
<td>8</td>
</tr>
<tr>
<td>Females</td>
<td>13</td>
</tr>
<tr>
<td>Total</td>
<td>21</td>
</tr>
</tbody>
</table>
Passage order may have also played a role in study aid usage for Groups 1 and 2. Although three random orderings of passages were counter-balanced within groups, inspection of passage orders for those who did not use study aids indicated higher drop-out rates for Passage Orders 1 and 2. Of the 21 nonusers, 8 received Passage Order 1, 8 received Passage Order 2 and 5 received Passage Order 3.

Across groups, 21 subjects used Passage Order 1, 23 subjects used Passage Order 2 and 27 used Passage Order 3. A decision to add passage order as a variable in the analysis of variance was made.

Table B-7

Used Study Aid by Passage Order

<table>
<thead>
<tr>
<th></th>
<th>Passage Order</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Group</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>7</td>
</tr>
<tr>
<td>2</td>
<td>6</td>
</tr>
<tr>
<td>3</td>
<td>8</td>
</tr>
<tr>
<td>Total</td>
<td>21</td>
</tr>
</tbody>
</table>

Means and standard deviations for multiple choice, essay and total posttest scores categorized by group and by overt or probable covert use of study aid are listed in Table B-8.
Table B-8
Posttest Scores by Overt and Probable Covert Use of Study Aid

<table>
<thead>
<tr>
<th>Group</th>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wrote on study aid</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Multiple Choice</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>M</td>
<td>17.57</td>
<td>15.67</td>
<td>15.85</td>
</tr>
<tr>
<td>SD</td>
<td>4.75</td>
<td>5.17</td>
<td>5.17</td>
</tr>
<tr>
<td>Essay</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>M</td>
<td>5.93</td>
<td>4.42</td>
<td>3.78</td>
</tr>
<tr>
<td>SD</td>
<td>3.71</td>
<td>4.69</td>
<td>3.64</td>
</tr>
<tr>
<td>Total Score</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>M</td>
<td>23.50</td>
<td>20.08</td>
<td>19.63</td>
</tr>
<tr>
<td>SD</td>
<td>6.60</td>
<td>8.80</td>
<td>7.93</td>
</tr>
<tr>
<td>Reported study aid use and did not write on it</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Multiple Choice</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>M</td>
<td>17.29</td>
<td>17.64</td>
<td>-</td>
</tr>
<tr>
<td>SD</td>
<td>5.76</td>
<td>2.25</td>
<td>-</td>
</tr>
<tr>
<td>Essay</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>M</td>
<td>4.71</td>
<td>3.64</td>
<td>-</td>
</tr>
<tr>
<td>SD</td>
<td>4.75</td>
<td>2.28</td>
<td>-</td>
</tr>
<tr>
<td>Total Score</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>M</td>
<td>22.00</td>
<td>21.27</td>
<td>-</td>
</tr>
<tr>
<td>SD</td>
<td>10.18</td>
<td>6.34</td>
<td>-</td>
</tr>
</tbody>
</table>
In Groups 1, 2 and 3, respectively, total score means of those who wrote on the study aid were 23.50, 20.08 and 19.63. In Groups 1 and 2, respectively, total score means of those who reported study aid use and did not write on it were 22.00 and 21.27. Group 3 was not relevant for this kind of classification. Posttest results were also analyzed by recall, application and analysis levels of learning. Percent totals of points awarded in each classification were used since there was an unequal number of posttest questions per category and different point values for multiple choice and essay questions.

Means and standard deviations expressed as percents for recall, application and analysis posttest scores classified by group by those who wrote on study aids and those who said they used the study aid but did not write on it are listed in Table B-9.

Application level means were larger than recall level means for subjects who wrote on the study aids and for Group 1 subjects who reported study aid used and did not write on it. For Group 2 subjects who reported study aid used but not written upon the recall level mean, 53, was larger than the application level mean, 48.

The largest mean percentages for recall, application and analysis level scores, 50, 58 and 34 were found in Group 1 for those subjects who wrote on study aids. Contrary to predictions, analysis revealed a nonsignificant study aid effect, $F(2, 68) = 1.53, p > .05$. A difference, being contributed by analysis scores, among recall, application and analysis levels of posttest scores was significant, $F(2, 4) = 93.25, p < .05$. 

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Table B-9

Levels of Learning Analysis by Overt and Covert Use of Study Aid

<table>
<thead>
<tr>
<th></th>
<th>Group</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
</tr>
<tr>
<td><strong>Wrote on study aid</strong></td>
<td></td>
</tr>
<tr>
<td>Recall Level Scores</td>
<td></td>
</tr>
<tr>
<td>M</td>
<td>50</td>
</tr>
<tr>
<td>SD</td>
<td>17</td>
</tr>
<tr>
<td>Application Level Scores</td>
<td></td>
</tr>
<tr>
<td>M</td>
<td>58</td>
</tr>
<tr>
<td>SD</td>
<td>22</td>
</tr>
<tr>
<td>Analysis Level Scores</td>
<td></td>
</tr>
<tr>
<td>M</td>
<td>34</td>
</tr>
<tr>
<td>SD</td>
<td>29</td>
</tr>
<tr>
<td><strong>Reported study aid use and did not write on it</strong></td>
<td></td>
</tr>
<tr>
<td>Recall Level Scores</td>
<td></td>
</tr>
<tr>
<td>M</td>
<td>49</td>
</tr>
<tr>
<td>SD</td>
<td>23</td>
</tr>
<tr>
<td>Application Level Scores</td>
<td></td>
</tr>
<tr>
<td>M</td>
<td>55</td>
</tr>
<tr>
<td>SD</td>
<td>23</td>
</tr>
<tr>
<td>Analysis Level Scores</td>
<td></td>
</tr>
<tr>
<td>M</td>
<td>22</td>
</tr>
<tr>
<td>SD</td>
<td>28</td>
</tr>
</tbody>
</table>
BIBLIOGRAPHY


Tennyson, R. D., Wolley, F. R. and Merrill, M. D. (1972). Exemplar and nonexemplar variables which produce correct concept classification behavior and specified classification errors. Journal of Educational Psychology, 63(2), 144-152.


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