AN EXAMINATION OF STRUCTURAL COMMUNICATION IN LIGHT OF CURRENT INSTRUCTIONAL TECHNIQUES AND IDEAS OF LEARNING

BY

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ABSTRACT

The purpose of this study is to make Structural Communication (SC), a new instructional technology, more accessible to people who might well be interested in its practical benefits and to make its claims of instructional success available to empirical evaluation. Due to the idiosyncratic nature of SC's development, and due to its origin in a rather esoteric context, the small amount of available literature is in a "language" which is unfamiliar to North American researchers in communications, psychology, and education. Thus there is a need for a "translation" of SC's language into frames of reference common to North America.

To accomplish this task the inventors' ideas of learning have been examined, by a comparative analysis, in relation to selected, contemporary North American theories of or perspectives on learning. The perspectives on learning with which SC is compared have been selected because they are generally accepted by a fairly large proportion of researchers in these fields, and if not accepted at least understood and frequently found useful as a means of conceptualizing some parts of their inquiries.

First, the form and rationale of the SC instructional technique (i.e. the Study Unit) is described. Then SC is compared with Linear Programming, B.F. Skinner's instructional technique. Next, SC is examined in relation to the work of D.O. Hebb and D.E. Berlyne to see if there might be a reasonable physiological or neurological basis for SC's claim that a Study Unit is so constructed as to provide "motivation" for learners to learn. Then SC is compared with Discovery Learning and other instructional techniques based on Cognitive Field Psychology. Finally, SC is examined in relation to Henry Ellis' work on the transfer of learning.

Linear Programming and SC define learning differently and as a result are designed to achieve different goals. Although both make some identical claims and/or use some identical terms, it appears that the SC use of the terms is consistent with their true meaning and is generally broader in scope than their Linear Program equivalents. The validity of immediate reinforcement and scheduling or reinforcement in all learning situations is questioned, and a reasonable case made for not doing so in SC. There seem to be a number of points on which linear programming and SC make genuinely competing claims that may be settled by empirical research.

The conclusion of the analysis of Hebb's and Berlyne's theories is that they do provide reasonable bases with which to justify the SC claim that a Study Unit engages and maintains the learner at the optimal level of arousal for learning.

It is a contingent matter whether these ideas will be utilized in the future by authors of SC materials. However, the rather exotic "mentalist" language of SC's inventors does seem to translate readily into terms that are more firmly established in North American research on learning.

The analysis of Discovery Learning led to the conclusion that the claim that SC is a programmed technique which successfully embodies many principles of Cognitive Field Theory is justified. The relatively easy translation of key SC terms and forms into cognitive field theory terms, and forms suggests a manner of better considering SC - i.e. as technologizing in a much more controlled way many of the proposals of cognitive field theorists than even discovery learning can.

The conclusion to be drawn from the analysis of transfer theory is that

a Study Unit embodies all of the "empirical" principles described by Ellis. Furthermore, it is reasonable to assume, that because these principles are embodied in the SC techniques that consistent, long-term practice with Study Units may result in positive transfer of learning. If this is true then it seems likely that transfer of particular skills could be facilitated by the use of SC materials.

The final conclusions of the study are; 1) SC's general claims concerning Study Units seem at least plausible, 2) Study Units have limited use in our educational system but the several other forms of SC may have broad applications, 3) in their present form Study Units are virtually inappropriate for grades K - 12, and 4) that the SC small group form has the most potential for use in the public school system.

TABLE OF CONTENTS

LIST OF FIGURES

INTRODUCTION

Structural Communication (SC) is an instructional technology invented recently in England by J. G. Bennett and A. M. Hodgeson. The aim of SC is to communicate material in a relatively sophisticated way that is more likely to promote understanding than other techniques of instruction. SC claims to accomplish this by breaking material down into carefully organized elements, randomly arrayed into a matrix, and then challenge the learners to examine this array from a series of different perspectives, and finally to compose a coherent response to the challenge. The SC instructional technology, called a Study Unit, will be described in detail in Chapter 1.

My introduction to Structural Communication (SC) occured two years ago when I attended a workshop designed to familiarize teachers with this new instructional technology. I was intrigued with the SC form of programmed instruction, and felt that if the claims made on its behalf were justified then here was an instructional technology with a tremendous potential. Several months later I was fortunate enough to be invited to spend several weeks with Anthony Hodgeson, one of the inventors of SC, in England and form a first hand impression of the validity of the SC claims. I observed the use of SC materials in several classrooms and interviewed teachers and students who had used or were using SC materials. From my own observations and from the comments of the teachers and students whom I interviewed I was led to conclude that SC did in fact work. Of course this experience did not constitute empirical evidence; the sample was too small, there was no formal research design,

the time span was too short etc . . . However, the "success" of the SC materials in this experience stimulated my interest in learning about SC in greater detail. This paper is the culmination of that effort to study SC in greater detail.

Because SC has grown in a rather idiosyncratic manner, a brief account of SC's developmental history may prove useful. The SC technique is based on research conducted by J. G. Bennett in England over the past 25 years. In 1946 Bennett founded the Institute for the Comparative Study of History, Philosophy and the Sciences in order to study the process(es) by which knowledge is organized. The aim of the Institute was to develop from this research practical techniques to improve thinking and understanding.

By 1960 Bennett was confident enough in the results of this research to justify the establishment of an organization whose task it would be to apply the techniques based on that research to a practical educational problem. Thus the Integral Science Education Group (ISERG) was formed under the leadership of A. M. Hodgeson with the task of designing an interdisciplinary curriculum for use by teachers of science courses. In addition to transmitting scientific knowledge it was desired that the curriculum would encourage a greater degree of creativity in science students than existing programs produced.

By 1965 ISERG had developed a detailed matrix system which in modified form is the heart of the SC technology today. The matrix system, in the programmed SC form, allows the author and the learner to engage one another in a "dialogue." In co-operation with R. S. Arbon, a series of electro-mechanical

teaching machines was developed in an effort to automate SC. While these teaching machines failed to become a commercial success at the time, a much more sophisticated generation of these machines is currently in use in the management consulting application of SC.

At this point the technique was judged sufficiently developed to use in schools. Bennett arranged with the University of London Press for the publication of a series of books in a variety of discipline areas that used SC. To date six of these books have been published. Britain's Open University became interested in this series of books and they eventually adopted a modified format for their own programmed course material.

In 1968 The Centre for Structural Communication was founded under the directorship of A. M. Hodgeson. The Centre's task was to develop and market commercial applications of SC, while the Institute continued basic research. The Centre has bred two commercial off-shoots 1) Structural Communication Systems Ltd., and 2) Management SCS Ltd. Structural Communication Systems Ltd. mainly prepares management training courses. Management SCS Ltd. is a management consulting firm which specializes in organizational and human resource development. Between them the two firms have worked with IBM, British American Tobacco Company, Ford of Europe, Unilever, British Petroleum, Westinghouse, Burroughs, and the U. S. Navy as well as many British corporations.

While this energetic group of people have produced an instructional technology as well as commercial applications they

have not produced a body of literature to accompany it. Perhaps because SC was not developed in a university setting there was little or no emphasis on organizing the research which had been done into a series of papers, articles, and other publications. The literature that does exist is virtually limited to Systematics the Journal of the Institute for the Comparative Study of History, Philosophy and the Sciences. Articles in the journal tend to be "state of the art" research notes intended more for internal communication rather than the more formal and thorough treatment familiar to academic researchers.

In part the lack of literature accounts for the minor impact that SC has had to date in North America. However, the main reason SC is still virtually unknown in North America is that in its present form it is relatively inaccessible. By this I mean that due to the idiosyncratic nature of its development, and due to its origin in a rather esoteric context, what little literature is available is in a "language" which is unfamiliar to a typical academic environment.

Thus there is a need for a "translation" which would make SC accessible to people who might well be interested in its practical benefits and also might make available its claims of instructional success to empirical evaluation. This "translation" is important, for clarity concerning the underlying philosophy and operational instructions is essential for proper use of the technique and/or testing it. SC's utility as an instructional technology can best be determined by empirical testing of the basic question "Does it do what it claims to do?" In order to design appropriate empirical tests the researcher

must clearly understand what it is he is testing.

It is therefore the goal of this study to describe and discuss SC as an instructional technology and to translate the language and philosophy of the inventors into frames of reference common to North America. I think this can best be accomplished by describing SC in terms of two distinct levels 1) the technology itself, and 2) the rationale upon which it is based. When I use the term "technology" in relation to SC I define it as the operations, procedures, and materials of which a Study Unit (i.e., the name of the basic SC instructional package) is composed. I define the rationale mentioned in point 2 as the collection of conceptualizations and ideas which characterize the way in which the inventors of SC view human learning. My purpose is to describe and examine the rationale implicit in the SC technology. Occasionally I shall use the phrase "principles of SC." This phrase is not to be taken to imply that a complete theory of SC exists.

To accomplish this task the inventors' ideas of learning have been examined, by a comparative analysis, in relation to selected, contemporary North American theories or perspectives of learning. The other ideas of learning with which SC is compared in this study were selected for their "visibility" in the field of learning. By "visibility" I mean that these positions are familiar to a great number of people and that they are influential views of learning in North America. By establishing points of common reference between these other views of learning and SC I hope to achieve a "translation" of SC into the largest group of common language as possible. If this

attempt is successful then the information in this study should make SC accessible to the maximum number of interested persons in unambiguous terms.

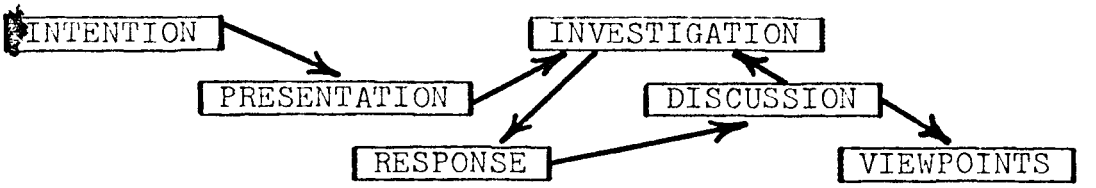
CHAPTER I.

DESCRIPTION OF STRUCTURAL COMMUNICATION

Although SC is relatively new, it has a variety of forms and applications.[1] As was stressed in the Introduction, this study will concentrate on Sc in relation to several other theories or perspectives of learning. It is the purpose of this section to describe SC's basic form - The Study Unit - and to outline its main underlying principles, and to indicate and clarify the vocabulary of SC. The Study Unit and it's component parts and the psychological role of each will be described first to familiarize the reader with the material to which the entire study is addressed. Next, the basic technology of SC will be described, and terms as used in SC will be defined as they are encountered.

The Study Unit is the fundamental element of Structural Communication. Each unit represents to the author, the optimal amount of subject matter which can be transmitted by SC in a single work period. Each unit consists of six interdependent parts, each of which has a distinct function. Figure 1 identifies each of the parts and indicates the most commonly followed pathway which learners take through the unit. Essentially the Study Unit simulates a dialogue in which the learner is repeatedly challenged to form his own opinions before receiving feedback from the author. The study unit consists of the following parts: Intention, Presentation, Investigation, Response Matrix, Comments, and Viewpoints.

Figure 1. The Most Common Pathway Through A Study Unit



INTENTION

This section introduces the subject matter which is the theme of the unit and may specify its behavioral objectives. The Intention is not an overview or outline rather it performs the function of what Ausubel has termed "advanced organizers" (Ausubel; 1969.) In general it serves to orient the learner to the content and context of the message the author hopes to communicate in the unit.

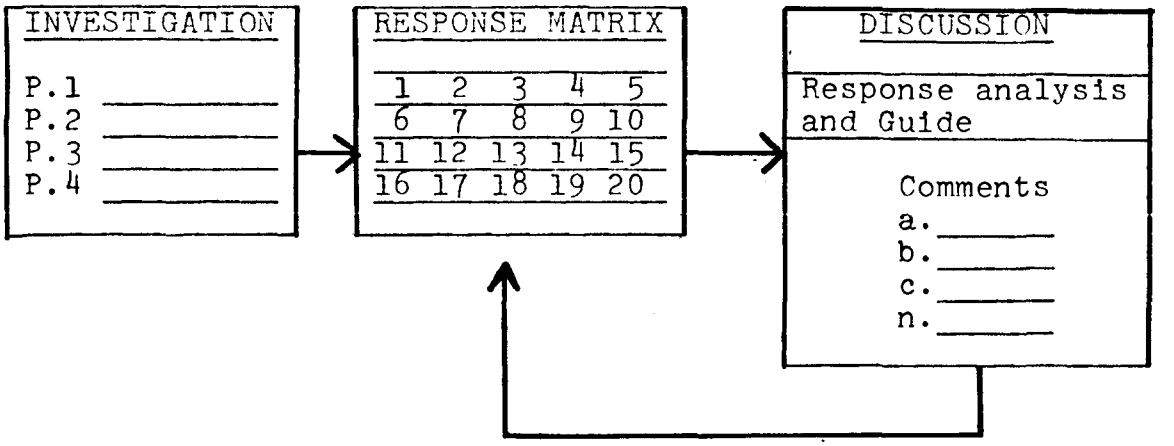
PRESENTATION

This is the learner's first contact with the material of the unit. The Presentation is the body of facts, data, statements etc., that comprises the theme and subthemes within the context of which the message is to be developed. Typically this has been a specially prepared text of some main theme which is being presented in the SC format.

The Presentation may concern virtually any subject and can take many forms, including a specially prepared text. It could be a film, play, novel, or series of readings concerning the main theme. A field trip, or a role-play, or a group experience could be used as the Presentation of a study unit designed to explore in greater depth the significance of aspects of such experiences.

The following three sections of the unit are the most closely inter-connected. The following diagram may help to clarify the description of them.

Figure 2. Components of the SC "Dialogue"



INVESTIGATION

This section contains 3 - 5 carefully "structured" problems about the subject matter contained in the Presentation. The inter-action between these problems (the SC term is "challenges") and the learner's organization of the semantic elements of the matrix in the following section (i.e., Response Matrix) allows the author's message to emerge. Each problem (i.e., "challenge") presents a different perspective on the subject matter of the unit and requires different combinations of the semantic elements of the Response Matrix.

RESPONSE MATRIX

The response Matrix is an array of carefully worded items (a 4 x 5 matrix is most commonly used) that restate the main theme in a condensed form. The matrix is a symbolic map of the theme consisting of phrases that express significant facts,

ideas, and symbols. This "semantic" field is random without any indication of how the statements may be organized to make sense.

The learner uses the elements of the matrix to compose the set of items he feels best answer the challenge. For a 20 item matrix about 8 items may be required to compose an adequate response to each challenge. The necessary "overlapping" provides the above mentioned feature of multiple perspectives. Each overlapping item is a fact or concept etc., which plays a different role depending upon the perspective through which the main theme is being viewed.

The matrix may be viewed as a common vocabulary through which the author and learner of a Study Unit can communicate in a manner that approximates as closely as possible a dialogue. The vocabulary is sufficiently rich semantically to allow this dialogue to be fairly sophisticated with a large degree of freedom of responses and strategies for the learner and one which also provides the author with the means to control the message.

DISCUSSION

The Discussion section is where the "dialogue" between author and learner actually occurs. It is here that the learner's response is analyzed and his understanding of the theme tested. The learner has responded to the challenges by composing sets of items as his answers to the problems, and he now turns to the Discussion Guide. The guide is the tool for analyzing the responses and directs the learner to the author's comment or comments which are appropriate. The analysis takes the form of

routing tests for inclusion or omission. For example such tests might read: "If you included in your response items 2 or 7, read comment A"; or "If you omitted from your response items 7, 12, and 18, read comment B", etc.

This technique allows the author to prepare in advance for a wide variety of responses and to prepare his comments. The author tests for understanding of the material according to his criteria of success. That is the author analyzes his own understanding and expectations and then uses it as his guideline for testing the learner's understanding of the message. Thus the learner is able to, in effect, work backwards and "recreate" the cognitive process by which the author formulated his message.

The first tests are designed to catch omissions of essential items and inclusions of irrelevant items. In both cases the learner is directed to comments in which the author argues his case for including items the learner has omitted or for omitting included items which he (the author) feels are irrelevant to the problem. Depending upon the gravity of the error the learner can be directed to follow a variety of courses, from reviewing the material in the Presentation to merely reading the comment on his particular response and then proceeding to new material.

The next tests are for coherence of the response. For instance if two items are mutually exclusive, but either may be legitimately used, a test for inclusion of both items on one problem response may be used. If both items have been included the learner is directed to a comment that explains their

incompatibility.

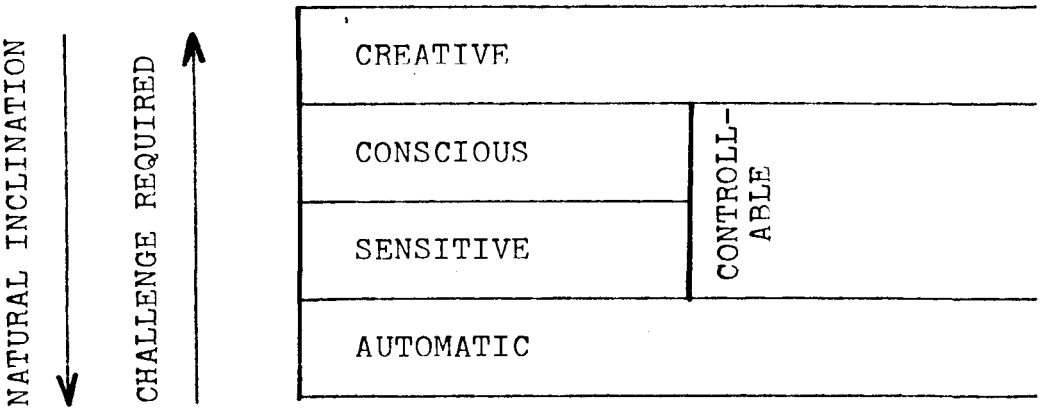
There are close to a million responses possible in a 4 x 5 matrix.[2] However, these are obviously limited by the realities of scope, space and time. The author, in his design of the discussion guide, can analyze the learner's response for a variety of factors; the degree of complexity understood by the learner, the particular problem solving approach used by the learner, etc. In fact the primary limiting factor in testing the learner's response is the author's own ingenuity in designing the discussion guide.[3]

VIEWPOINTS

The presentation of any significant theme will always be influenced by the author's own biases. In this section the author may explicitly discuss his biases, critical points, and his overall view of the material. It is the aim of this section to provide the learner with a forum for points of view other than the author's. Here the author directs the learner to contrasting points of view, or raises questions for the learner's consideration that lead to study of the material in greater depth or breadth. Finally, the Viewpoints play a final integrative role for the summation of the main theme of the Study Unit.

In order to gain an understanding of the rationale behind the form of the Study Unit it is necessary to describe the underlying principles of SC. The basic hypothesis upon which SC is based is that there are several levels of mental operation and that each is qualitatively different. The inventors of SC dintinquish four levels of operation: Automatic, Sensitive, Conscious, and Creative.

Figure 3. SC Four Level Model of Thinking



From: Egan, Kieran, "Beyond Linear and Branching Programmed Instruction," British Journal of Educational Technology, May, 1974, p. 9.

SC is concerned primarily with the Conscious and Sensitive levels for it is at these two levels that thinking can most effectively be influenced (Bennett, 1967, pp. 228-31.) The following describes the characteristics of the four levels.

CREATIVITY

The inventors of SC define truly creative experiences as "characterized by spontaneity, unexpectedness and the absence of any ratiocinative process." (Bennett, 1967, p. 228). Thus, at the Creative level the subject is unable to identify any conscious cognitive process which resulted in the creative event. It is therefore true discovery. To the inventors of SC the term "creative event" is akin to but distinct from insight because insightful events, such as the sudden solution to a problem, are also characterized by spontaneity and surprise. However, it is possible that insightful solutions can be accounted for by prior knowledge and an intensive effort to

solve the problem. If this is true it seems reasonable to suppose that it may be possible to increase the probability of the incidence of insightful events by providing a favorable psychological environment (see section on Transfer of Learning.)

However, "there is no evidence that true creativity can be trained" (Bennett, 1967, p. 229.) For example, training can increase the viruosity of a musician but it does not appear that training can reliably develop the ability to compose music comparable in quality to that of Mozart or Beethoven. Such persons have an innate, artistic ability to "create." When SC uses the term creative event it is in this latter sense. While it may not be possible to evoke true creativity, training could be valuable, "in recognizing when a creative step has been made and in bringing into use the Conscious and Sensitive levels," to comprehend and integrate the experience (Bennett, 1967, P. 229.) Training in maintaining a favorable psychological climate might increase the strength and frequency of creative events but this is not apparently an explicit goal of an SC study unit.

CONSCIOUS

Conscious, as used in SC, means "a synthetic awareness capable of seeing situations in their organized complexity," (Bennett, 1967, p. 229.) Characteristic features of mental operations on the Conscious level are understanding, hypothesis-formation, original - as distinct from creative - thinking, and impartiality of judgement. Thinking at the Conscious level is synthetic as distinct from associative.

SC is designed to engage the learner primarily at the

Conscious level of thinking for it is at this level that understanding, in the opinion of the inventors of SC, is most effectively influenced.

SENSITIVE

This level is one of limited awareness and the mental activity is primarily associative. In this state mental activity seldom encompasses more than two distinct ideas in a single moment of awareness. Logical thinking, experimentation, self-expression (verbal and symbolic), adaptive and purposive activity are all possible on the Sensitive level without utilizing the Conscious level. "It can be said that we know all we need to know for the purpose of human existence by means of mental operations on the sensitive level," (Bennett, 1967, p. 230.)

AUTOMATIC

This level is below the threshold of mental awareness. Its operations include physical and mental habits formed in early life such as walking, talking, reading and mental calculations and association. "In many cases, the automatic functions cannot easily be acquired unconsciously and must first be learned on the sensitive level. Then . . . the operation passes out of awareness and continues on the automatic level," (Bennett, 1967, p. 230.) The difference between the level of awareness of a skilled driver and someone who is just learning to drive is a familiar example of this phenomenon.

The Automatic level plays little part in SC but it is necessary to be clear about the four levels and the manner in which mental operations pass from one level to another. The SC Four Level Model of Thinking is merely a heuristic device to

facilitate description of a dynamic process. The four levels do not have distinct boundaries, indeed at any given moment of awareness, the physical and mental operations may represent virtual simultaneous utilization of any or all of the four levels. For example, assume that a person plans to visit a friend in a section of town with which he is unfamiliar. Assume further that he is following a rather ambiguous map provided by his friend. He drives to the general area but for some reason gets confused. He drives up a street (Automatic level) while looking at street signs and the map (associative thinking Sensitive level.) As he proceeds he notices that the house numbers are getting smaller and thinks that they should be getting larger if the directions are correct (inferential thinking - Conscious level.) Suddenly he is sure he is going in the wrong direction, turns around and drives directly to his friend's house with no further delay. The latter may be more accurately described as an insightful solution but the characteristics are those of the Creative level. All of these events could have occurred in a matter of seconds and it would be difficult to identify the instant of transition from one level to another.

The problem is one of measuring the instant of transition from a low level of mental operation to a higher one. "Observations of the thinking process lead to the noticing of discontinuities in the trains of association, (Bennett, 1967, p. 231.) The transition from one level to another is characterized by a spontaneous, discontinuous jump. Experiments were conducted by the inventors of SC to gain a better understanding of this

phenomenon, (Bennett, 1967, pp. 231-32.) In one of the experiments subjects read a difficult text and observed their level of mental operation in relation to the text. The levels used in the experiment were defined as 1) complete inattention or fantasy, 2) simple attention, 3) attention to meanings, and 4) critical thinking. The results showed that one fourth of the subject's time was spent below the level of meanings while less than one tenth of their time was spent at the highest level. Time spent in the middle range was characterized by preconceived ideas or the inability to gain a new perspective on the material. Subjectively, the subjects reported that they were always aware of transitions to higher levels of mental operation, an experience they described as moments of "waking up".

Results suggested that the transition to a higher level was inevitably followed by a decline in the intensity of awareness. Subjects reported that it was necessary to renew their attention by a conscious effort such as asking themselves questions about the meaning of the material in the text. The main implication of the experimental results was that in reading, most of the time is characterized by inattention and the lack of effective connection with the material being read. (Bennett, 1967, pp. 231-2.)

Such observations led the inventors of SC to conclude that the intensity of mental operations is similar to the general rule of thermodynamics that intense values subject to random change move toward less intense values. In cruder terms, the human mind is naturally lazy. However, as indicated by the

subjects' self questioning, it is possible to raise the level of mental operation by a "shock" that arouses attention. In the absence of stimulation the mind drops from higher levels until it finally reaches the automatic level. This mind wandering is familiar to us all. However, it's significance for communication has not been sufficiently appreciated. Since this tendency for mental activities to seek the automatic level invariably occurs in the absence of artifical stimulation the inventors of SC generalized the observation into their so called "Law" of Mental Declension. This "Law" has important implications for affecting mental processes. It can be stated as follows:

"To communicate with the lower levels of the mind the impact should be minimal and repetitive."
"To communicate with the higher levels of the mind the impact should be maximal and unique." (Bennett, 1967, p. 233.)

In the first case the effect is to produce and establish an automatic response to a stimulus or a group of stimuli. In the second case, the effect is to awaken the understanding and enable the intention or meaning of the communication to be grasped. The two effects provide the fundamental distinction between programmed learning in all it's current forms and Structural Communication. The distinction between SC and Linear Programming will be dealt with in detail later, for now it is sufficient to emphasize that SC is not a development of Linear Programming; they are different and serve different purposes. Rather than seeing them as competitive it is a matter of choosing the tool appropriate to the task. Whenever a reliable and reproducible response to a set stimulus is required the

method of discrete items and reinforcement is effective. "When the aim is to arouse the critical faculty and to make the (learner) think for himself, the law of mental declension must be allowed for and the necessary counter stimulus provided. This is the key to the success of SC." (Bennett, 1967, p.234.) (Italics Mine).

DECONDITIONING

There is ample evidence to suggest the predominance of lower levels of mental operations and of the difficulty of reaching higher levels. In many learning situations where the learner's attention or interest is minimal, learners have a tendency to "read" their own mental associations without verifying them in relation to the material being studied, (Bennett, 1967, p.236.) It is well known that strong associations form as a result of repetition of impressions in conjunction with one another. In fact this is the manner in which skills are acquired and facts memorized, but neither necessarily requires active participation. There is increasing evidence that behavior acquired through the use of low level operations requires a severe deconditioning shock to "break open" the patterns of association."

The "Hawthorne Effect" suggests that any break in a routine arouses interest. The inventors of SC believe it is: " . . . only at the moment of the arousal of attention is there any change in level (of mental operations) . . . what is needed to sustain attention . . . is the combination of at least two quite distinct sets of impressions. The Automatic working of the mind cannot cope with two different kinds of input at the same time," (Bennett, 1967, p. 237.) (Italics Mine.) However,

if "breaks" in the level of attention are not the result of deliberate intent and design, they may serve only as a series of distractions.

"Shock" - as used by the inventors of SC - has a specific meaning. There are some features that characterize the use of the term "shock" in an SC context. The inventors of SC define a "shock" as unexpected. That is it comes from a direction to which one is blind. This reduces the possibility of reacting to new information on the basis of preconceptions due to expectation or anticipation to a minimum. In addition a "shock" is unique, in the sense that it is not possible to easily "make sense" of the impact. If a "shock" were not unique the impact would become associated with established frames of reference and be assimilated. It is not possible to "make sense" of a unique impact, in an SC context, without actively engaging in synthetic thinking, a type of thinking which only occurs at the higher levels of mental operations.

Human beings seem to find inconsistencies or ambiguities uncomfortable, and attempt to resolve and integrate them quickly. This human trait represents a danger of deconditioning by shock for the mind is susceptible to suggestions on ways of making sense of the situation and such suggestions are easily assimilated. To emphasize the deliberate and purposive nature of an SC "shock," the term "challenge" is used. A shock is merely an impact that may or may not have any positive intention or result. However, an SC challenge makes an appeal to the intelligence of the learner. Therefore, in an SC Study Unit "shocks" are administered within the context of a program of

constructive work.

The Principle of Challenge

"A challenge is an obstacle placed, intentionally or by accident in the line of activity that can be overcome only by increased determination and generally by a higher intensity of mental operation," (Bennett, 1967, p. 238.) The learner must have complete freedom of choice to accept or reject the challenge. If there is no choice then the term challenge is inappropriate. "The principle of challenge is the counter-part of the "Law" of Mental Declension, for it asserts that it is possible to use the self-assertive instinct in man to overcome his mental laziness," (Bennett, 1967, p. 238.) To be effective the challenge must meet the learner at the right time and in the right form. The best form has been found to be presenting problems which are to be solved indirectly by using the subject matter of the presentation. (Bennett, 1967, P. 239). For example, children are presented with material describing parlimentary procedure and Robert's Rules of Order, and then they are challenged to form a mock organization which operates under these rules (i.e., political party, United Nations, etc. . .). This type of challenge seems to be eagerly accepted and in practice the children seem to make a real effort to understand and use this information correctly.[5]

STRUCTURAL HOMOLOGY

The inventors of SC believe that most situations can be thought of as having both a knowable and an intelligible content. The knowable content is information, and the intelligible content is the theme. The SC technique is based on the hypothe-

sis that the knowable and intelligible components of a situation are homologous though not identical. Homology in this context means that there is a basic correspondence of the essential elements. For example, the body of an automobile is homologous with its functional mechanisms, though there are many body features that are irrelevant for understanding how a car works. Conversely, an understanding of the principles of a self-propelled vehicle cannot be evoked merely by describing the mechanical parts of the vehicle. These principles may be referred to as the intelligible, as distinct from the knowable automobile.

The hypothesis of structural homology provides the conceptual basis for explaining why it is possible "to convey knowledge without understanding, and how it is also possible to use knowledge in such a way that experience will lead to understanding," (Bennett, 1967, p. 242.) In the SC use of the term it is interaction with knowledge in an active, meaningful manner that results in understanding. In short, understanding is defined as an act of intelligence combined with participation in an action.

"Subject matter" is the SC term for the informational content of a message, and "theme" is the SC term for the ideational component. The "subject matter" contains the letter of the message, the "theme" the spirit of the message. The "subject matter" can be learned on the Automatic level, but the "theme" is grasped at the Conscious level of the mind. When both are brought together on the Sensitive level the learner is said to both know and understand the message and it's content, (Bennett,

1967, p. 242.)

The Communication of Understanding

The inventors of SC believe that the "art" of communicating understanding consists in devising a means whereby the learner can simulate the process by which the author of the message reached his own understanding of it's content. In a Study Unit the learner "tests" his understanding by analyzing his response with the discussion guide and the author's comments. Verbally this action takes the form of a "dialogue" in which the author and learner are equally active. Not all verbal communication is successful. Unless the learner makes a response which demonstrates his grasp of the author's message the latter has no way of telling whether his message has been conveyed. Two conditions are necessary for this process to be maximally efficient. A wide range of expression in composing a response, and a response which can be rapidly and exactly verified. A few exchanges of challenge and response, given these two conditions, should clarify both the author's message and the learner's understanding of it, and enable them both to verify the degree of agreement they have reached.

This process of agreement is based on the psychological principle of concordance. Concordance involves "the independent judgement of (the people involved in an act of communication) . . . Many human situations involving communication depend not on people memorizing the information given but on reaching a concordance on the meaning to be given to the information," (Bennett, 1967, p. 240.) (Italics Mine). In SC concordance does not mean that agreement is reached concerning

validity of the message. Instead it means a process that ensures that the author's message has been perceived intact and without distortion by the learner.

Whether or not the communication is verbal the basic SC requirement is that it should take the form of a dialogue conducted within a framework that facilitates unambiguous expression of the author's message and the learner's response. The inventors of SC claim to have achieved this form of communication with the Study Unit.

The requirement of unambiguous evaluation is quite different from that of verbal or factual accuracy. Unambiguous evaluation implies a flexible and adaptable dialogue. It is possible to have "all the facts straight" and remain unclear as to their meaning. However clearly the meanings may be expressed, understanding depends on the interplay of a variety of factors, so that, in SC useage, it is the totality of the message that contains the meaning. The inventors of SC feel that if this message is broken down into units small enough to be verified on a binary basis, the interrelationships of the elements is lost, and it is this aspect of a message that is often most relevant to adequate understanding.

Four Kinds of Communication (Bennett, 1967, pp.289-291)

Telling

The author (A) and the learner (L) have a one-way contact. A tells L his message. This is the situation if A gives a lecture with no discussion or puts his message in the form of a written statement or book. L has no way of ascertaining whether he has grasped either A's message or it's factual

content.

Discussion

A gives his message. L responds with questions which A answers. This is the situation of a lecture with discussion. There is feed-back, but not assurance of understanding by L of A's line of thought.

Dialogue

A does not give his message in one piece but builds it up by an exchange in which L is an active partner. The limitation of this method is that A and L must be in personal contact. A is limited by time to the number of L's to which he can transmit his message, and by his skill in the art of dialogue to bring the learner to the point of demonstrable comprehension.

Dramatic Presentation

The best example of this method is a stage production of an author's work. In the abstract this is a four way interaction in which the playwright, producer, actors and audience are equally involved in every stage of rehersal and production. Great drama can evoke the experience it portrays, but it does not follow that the learner has correctly grasped the author's message.

An SC Study Unit is a combination of the dialogue and the dramatic presentation. The evocation of experience itself does not guarantee understanding. For this the give and take of the Socratic dialogue is necessary.[6] SC's claim for originality lies in the active participation of the learner in the actual act of transmitting a message. In a Study Unit communication is open-ended to the extent that the learner has

a far wider degree of freedom in making his response than he can fully utilize. In a 4 x 5 matrix there are nearly one million different responses that could be made. At the same time, the author retains his hold of the situation in the construction of his message, and his arrangements for the learner's responses. The latter is accomplished in the Discussion section by the Discussion Guide which analyzes the learner's responses and by the Discussion Comments which provide the learner with feed-back from the author which are directly related to his (the learner's) particular response. The action is rehearsed, but not predetermined.[7] That is, the author has worked (rehearsed) his own way through the message in order to construct the Study Unit. The plot is definite, but it is open-ended and depends on the learner's responses. The author has followed his own cognitive strategy to develop the message but he realizes that the learner may employ a variety of cognitive strategies which are different but yield the same result. The organization of the subject matter does not betray the author's message, the learner discovers it for himself. The "dialogue" is so organized that the learner not only verifies his degree of success in comprehending the author's message, but builds up his (the learner's) grasp in the act of testing it.

1. The Study Unit, which is the subject of this study, is the least open-ended programmed form of SC. As the degree of learner input increases the SC form must necessarily change to accomodate it. For example in the management decision making form the process is SC but the content (i.e., subject matter) is totally contributed by the learner. Some of the other applications of SC are; 1) Simulations, 2) Discussion Guides, 3) Problem Solving, and 4) Decision Making.

2. At first glance this claim may seem overly generous but it is in fact accurate. In an SC 20 cell matrix, each cell is a phrase, statement or datum which is distinct from all the others. Thus in an SC Study Unit permutations are irrelevant - i.e., the response 1, 7, 14, is identical to the response 7, 1, 14. Thus only combinations are relevant. In an SC Study Unit each response may (theoretically) contain 0 to 20 cells of the matrix. Using the equation 2^{n-1} it is possible to compute the number of possible combinations of "n" things taken "r" at a time. The final answer is 2^{20} equals 1, 048, 576 possible combinations.

3. It should be clear to the reader that the author of a Study Unit plays a very important part in the success or failure of a Study Unit. However, the inventors of SC seem to take for granted that all authors will successfully fulfill their role, for nowhere in their writings do they spend any time discussing or describing the requisite qualities for

authors of Study Units. I examine this point in the concluding chapter of this study.

4. The increasing evidence to which Bennett refers is the work of A. C. Abercrombie, and Bion. However, Bennett does not provide any specific titles or dates of their works nor does he provide a bibliography whereby the interested reader might examine the evidence he cites.

5. My own observation of the use of SC material in English classrooms tends to support this claim. The children display a great deal of enthusiasm and interest while using the materials. Whether this was due to the novelty of the materials or in fact was due to the effectiveness of their design remains open to testing. It remains for empirical testing however to determine whether or not the optimal form for programmed instructional materials in general is in fact the inductive problem solving form. I explore this question in greater detail in the concluding chapter of this study.

6. This statement requires clarification. If the reader is familiar with the Socratic dialogues found in Plato's written works he would have good cause for misgivings about SC if the inventors of SC use this as their model of a "give and take" dialogue. Plato describes a carrot and stick approach and one in which Socrates blatantly manipulates his "partners" in dialogue. However, the inventors of SC intend their use of the term "dialogue" to connote an equal, open-ended sharing of ideas in a question and response mode.

7. The inventors of SC claim that a Study Unit is open-ended and that the learner's response is not predetermined. However, I think this claim merits closer investigation. In Chapter 2 of this study I explore in greater detail the question of whether or not the author does in fact covertly manipulate the learner's response.

CHAPTER II.

LINEAR PROGRAMMING

The first of the other instructional techniques to be examined in this study is B. F. Skinner's, which he calls Linear Programming, and is based on principles of behavioral (S-R) psychology. Skinner developed Linear Programming to apply results of his research to practical, human, learning situations. Because he is such a prolific writer, because so much of his writing is devoted to specific descriptions of methods for modifying human behavior, and due to the fact that his experiments have in many cases been successfully reproduced and verified, Linear Programming has come to be regarded by many members of the educational community as the best application of behaviorism to learning. This chapter refers only to the printed or textbook form of Linear Programming. Other forms such as, CAI, PLATO, etc., . . . have been ommitted because they are technology intensive forms of Programmed Instruction and to compare them with SC texts would be akin to comparing apples to oranges and equally inappropriate.

Linear Programming, Skinner claims, is based on the established principles by which all organisms learn, and in his own words "the application of Operant Conditioning to education is simple and direct," (Skinner, 1968, p. 64.) However, in spite of Skinner's considerable success in applying his ideas to human learning it has not yet been proven that <u>all</u> human learning conforms to the same principles involved in conditioning a pigeon. It is not presently clear whether all "levels" of human intellectual activity are of the same type or that

they can be conditioned according to the principles of Operant Conditioning.

Skinner endorses the behaviorist belief that only overt behavior, that is behavior which can be observed by others, is appropriate for scientific research. Skinner identifies two types of responses, those elictied by a stimulus (i.e., respondents) and those emitted by a subject in the absence of an identifiable stimulus (i.e., operants.) In other words respondent behavior is a reaction to the environment whereas operant behavior acts upon the environment. Skinner maintains that respondent behavior can only explain some human behavior because the majority of stimuli to which people respond are not known. He further maintains that most significant learning involves operant behavior because people appear to learn in situations involving actions upon the environment which result in a change in behavior.

A concise way of describing operant conditioning is that when a response, regardless of the stimulus that may have elicited it, is followed by a reinforcer, the probability of the response being repeated under similar conditions is increased. Further, the association between the response and the reinforcement can be strengthened by repetition and will eventually come to have control over the response.

This behavioral definition of learning leads to the first area of disagreement between SC and Linear Programming. Skinner states; "it is true that the techniques which are emerging from the experimental study of learning are not designed to 'develop the mind' or to further some vague 'under-

standing' of . . . principles. They are designed, on the contrary, to establish the very behaviors which are taken to be the evidence of such mental states or processes," (Skinner, 1968, p. 26.) This position is clearly antithetical to that upon which SC is based, namely that human beings engage in mental operations that can sensibly be characterized on an experimental basis and that these characteristics can be used as a base for designing techniques for learning. However, this difference in position does not imply that either technology is incorrect, it means only that their objectives are different and that their rhetoric suggests fairly fundamental differences in methodology. SC is specifically designed to "encourage understanding of relationships" whereas Skinner has stated that Linear Programming is designed to "establish behaviors."

In The Technology of Teaching, Skinner discusses several generally desireable requirements for any form of programmed instruction: 1) individualizing instruction, 2) controlling the learner's progress through the program, 3) requiring the learner to compose responses, and 4) to provide the learner with reinforcement. Skinner claims that Linear Programming is the instructional technology "in which the most efficient progress to an eventually complex repertoire can be made," (Skinner, 1968, p. 24.) The rest of this section will discuss the manner in which SC fulfills the general requirements of programmed instruction, as described by Skinner, and explore specifically where and how it may be more (or less) efficient than Linear Programming.

The first area of overlap between the two technologies is the shared emphasis on "structuring" the learning experience. However, there is a distinct difference in the assumptions about learners upon which they are built. Behaviorists believe that learning is related to their control over the experience (i.e., the program.) The only responsibility of the learner is to make himself available to react to the program. In short, except in terms of physical activity, learner input is minimal. In contrast, SC is designed (according to the inventors) to encourage learner input in terms of ideas, opinions, and judgements as well as the physical activity of marking down a response. The basic SC assumption is that the learner is largely responsible for his own learning even though he interacts with structured material.

Linear Programming, Skinner claims, allows for "individualized" instruction. "Individualizing," as commonly defined in an educational context, means to recognize and account for individual differences and/or individual styles of learning. Linear Programming is an instructional technology, which by design, asks all learners the same questions (as does SC) but requires identical answers, and that each learner proceed through the program in an identical sequence of events. It would appear that only in the sense of individual pace is there any acknowledgement of individual differences or styles of learning in Linear Programming.

SC also claims to allow for individualizing and bases its claim on the precise attention it gives to every individual's learning style. The key to this claim is the Response Matrix.

In a 4 x 5 matrix there are over a million different possible responses to each problem. Obviously a large number of these responses will be inadequate or meaningless. For example, to indicate the extremes, if a single matrix item is given as the entire answer to a problem, or if all twenty items are listed, the answer will be insufficient in the first case (normally an adequate response requires 6-8 items according to the inventors) and incoherent in the latter case. However, it should be equally clear, that with a million possibilities there will be a large number of complete and coherent responses. It is therefore reasonable to assume that individual differences and learning styles can be accomodated by such a wide range of responses.

Furthermore, tests in English schools revealed that rarely did any two out of the hundreds of students tested follow the same pathway through a Study Unit. In addition computer analysis of other groups have evidence that quite different learning strategies were employed to compose responses. To indicate only the extremes again, there were several distinct strategies, among them scanning and core selection. In the first case the learner scanned the matrix testing items for relevance on a yes/no basis. The items left by the initial scan were then weighted together in various combinations and were either deleted or new ones added. The other distinctive strategy involved selecting a core of items around which the response was subsequently built. Items were then added to the core to enrich it and also to make connections with peripheral but relevant items, (Egan, 1974.)

Skinner describes a learner working his way through a Linear Program as being engaged in composing responses. "The student must compose his response rather than select it from a set of alternatives . . . one reason for this is that we want him to recall rather than recognize - to make a response as well as see that it is right," (Skinner, 1968, p. 33.) By "composing a response" Skinner is referring to the activity of filling in blank spaces with the "correct" (i.e., as determined by the programmer) word or phrase. Skinner's explanation for the presence of the blank spaces is; "The whole process of becoming competent in any field must be divided into a very large number of very small steps, and reinforcement must be contingent upon the accomplishment of each step," (Skinner, 1968, p. 21.) The rationale for breaking a program into small, discrete steps is provided by the results of many thousands of hours and experiments conducted by Skinner and his associates on the shaping of animal behavior. Shaping means that rather than wait for a desired operant to occur spontaneously, or where a desired operant is so complex that it would never occur naturally, every move or step that takes the subject closer to the desired final response is reinforced. This method is also known as the method of successive approximations. The assumption is that a linear sequence is additive and that mastery of all the individual steps will result in the desired terminal behavior which in behavioral terms is synonymous with learning having occurred. Clearly in order for shaping to be successful the environment must be strictly controlled.

In a Study Unit the desired "terminal behavior" is under-

standing of the author's message. Both techniques make the claim that learners compose responses. Is this claim justifiable in the SC technology?

As commonly used, "compose" means to assemble diverse elements into a coherent form. SC requires a combinatorial response, that is it requires the learner to select that set of items from the Response Matrix which in his opinion forms the best (i.e., most coherent) response to the challenge. At first glance it may appear that the matrix is merely a complex variation of a multiple choice technique. What is it about the construction of a Study Unit that makes it significantly different from a multiple choice technique and how does it ensure that the learner "composes" responses in the true sense of the term?

The challenges and matrix items are designed together in such a way that an adequate response cannot be composed on the same basis as a multiple choice technique. The inventors of SC believe the learner must examine items and their interrelationships as part of a set of items, not in isolation. Addition or deletion of a single item affects and alters the relationships and meaning of the items in the set. The learner discovers that an item which serves one purpose in one set of items, will serve a different purpose or have a different meaning as a member of another set of items. Thus the SC process of composing a response requires a sophisticated analytical effort to form a coherent response. This process allows the learner to see that relationships are as significant to meaning as the individual items themselves. In SC terms

this is the marriage of the intelligible and the knowable parts of a message, which is termed understanding. In a Study Unit "composing" an adequate response is not a matter of choosing a set of "right" answers, as is the case in multiple choice techniques, rather it is arranging elements to form a single coherent response. It appears reasonable therefore to conclude that the SC use of the term "compose" is consistent with the true sense of the term and is less appropriate as used in Linear Programming.

An additional implication of breaking terminal behavior down into small discrete steps is that the negative consequences of being wrong are reduced to a minimum and the program is therefore non-aversive. In a trivial sense, one might conclude that SC is also a non-aversive technique for different reasons: Its form of response allows both time and freedom for the learner to organize his answer as best makes sense to him, and the comments are designed to be maximally helpful and in no way punitive. The point is that the learner completes the process of answering a challenge and then analyses his response by refering to the discussion section which enables the learner to engage in a "dialogue" about his response with the author.

An example of an SC comment from a Study Unit on Geomorphology may help to illustrate this procedure.

"Discussion Guide: If you have omitted 3 or 10, read Comment D.
Comment D: You have selected the essential factors which lead to the formation of a U-shaped valley. The large masses

of ice which we term glaciers move slowly down the emerging valley and grind away by abrasion the rocks. The glacier also transports the products of abrasion and deposits them in the form of moraines. Spurs which may have been formed by river action at an earlier climatic stage are ground back.

However, you have not yet got clear subsidiary factors which are important. Certain conditions are required to enable glaciers to form and also to enable them to move. Some conditions which appear in your table of factors (i.e., the matrix) may be totally irrelevant and others, though applicable to the general conditions of mountain valleys, may not be significant.

Revise your answer in the light of these comments." (Hodgeson, 1967.)

Such feedback acknowledges that the learner has grasped the essential factors which provides what the behaviorists call positive reinforcement, and also indicates the area where the learner does not yet have a complete grasp of the message (e.g., the test for the omission of items 3 or 10.) The information in the comment gives the learner some constructive hints about how the items he ommitted may be related to the challenge. This is a sharp contrast to Linear Programming which only tells the learner whether his response is "right" or "wrong." Due to the effort involved and the greater complexity of an SC response, it is reasonable to assume that the consequences of being wrong are greater in a Study Unit than in a Linear Program. For example, it seems likely that a student might find the consequence (i.e., appearing stupid to his peers) of an incorrect SC response more threatening than failure to correctly supply the missing word or phrase in a linear

program because the SC response, much more obviously represents the student's own thinking and (in the student's own mind) perhaps his intelligence. However, the learner is not in a stimulus poor environment such as a Skinner box, and it is possible that being wrong will not have the aversive effect on the learner that an incorrect response had for Skinner's rats. In addition to receiving right/wrong verification in an SC Study Unit the learner also receives reinforcement and additional information which makes the feedback to the learner less stark, and therefore hopefully less aversive.

A more important point in regards to the style of the SC feedback is the point that the author's comment instructed the learner to "revise your answer in light of these comments." Even though the author is supplying the learner with reinforcement and information he is nontheless sending the learner in search of a "right" answer (i.e., an answer which meets the author's criteria for a successful response.) This raises the question of whether or not a Study Unit really does encourage learner input. Is the learner in fact free to form his own opinion and "compose a response" or is he being covertly manipulated toward the "right" answer in a rather sophisticated manner?

Clearly, the response matrix inhibits the learner's freedom of response, but I would argue that this is one of SC's important contributions to teaching in general - i.e., a technique for asking questions of learners so that learning is optimized. I think a good question/response technique should reduce the task to manageable proportions yet allow freedom within the

restrictions. SC questions are designed to contain a considerable degree of repetition in order to clarify the purpose of the question and direct the learner to the restricted set of items (i.e., the Response Matrix) from which he can construct his response.

SC seems to me to represent an important instructional position between the two extremes of an overly restrictive response technique that inhibits creative thinking - such as one finds in Linear Programs - and the too open technique that lacks any clear guiding limits to the learner's inquiry, and thus may discourage thinking of any kind.

It should be clear that SC is not appropriate to all types of questions all the time. In fact, for certain purposes, essay responses, or linear program and multiple - choice responses are more appropriate and useful. However, for situations involving questions and a supplied response technique (i.e., many forms of guided discovery), materials such as SC Study Units are appropriate.

The term "dialogue" leads to another area of contrast with Skinner's claims that a learner working his way through a Linear Program is, in some respects, engaging in "dialogue" with a private tutor (Skinner, 1968, pp. 37-38.) The use of the term in the SC context has already been described, but what of the "dialogue" in a Linear Program? Skinner describes composing a response in a Linear Program as akin to a good tutor-learner dialogue. It is a most unusual instructor who always says the same thing to each learner. Equally unusual is the practice of omitting a word or phrase from what is

being said, and then insisting that the learner supply the exact missing word or phrase before the instructor will move on to his next comment. However, is the SC process better described by the term? While SC certainly falls short of "face to face" dialogue between an author and learner the learner's range of possible responses and the richness of the author's feedback is a reasonable approximation of the term.

An additional element of Linear Programming is the presence of reinforcers. Reinforcers are a key feature of Operant Conditioning and as such deserve detailed description. Skinner defines reinforcers as any and all stimuli that increase the probability of a response occurring. He identifies two types of reinforcers, positive and negative. A positive reinforcer is a stimulus which when added to a situation increases the probability of a repetition of a response. A negative reinforcer is a stimulus which when taken away from a situation, increases the probability of a repetition of a response. It is important to note that the effect of either type of reinforcer is to increase the probability of the response being repeated. Also, it is the consequence of the response and not the quality of the stimulus that determines whether or not a stimulus is a reinforcer.

Skinner maintains that small discrete steps are essential because a correct response can be reinforced immediately. He attaches great importance to the immediacy of reinforcement and justifies this emphasis on the results of his experimental research. The inventors of SC agree that reinforcement is important to a learning technique. The specific way in which

the construction of a Study Unit provides reinforcement is described in greater detail in the section of this study entitled "Arousal Theory." The present question is the validity of immediate reinforcement in all learning situations.

A Study Unit definitely fails to meet Skinner's requirement of immediate reinforcement, i.e., within seconds after a correct response. In a Study Unit once the learner has composed a response he must then locate the appropriate test(s) for his response in the Discussion Guide. The guide then directs him to the appropriate item in the Discussion Comments section. The learner must then read the author's comment before he has a complete reinforcement of his response. This process takes several minutes at least and so is not immediate, it is instead delayed reinforcement.

There is reason, however, to question the validity of immediate reinforcement in all learning situations. First, Skinner generalizes from research conducted on animals, as well as Linear Programs and human subjects, and it is possible that human beings do not require immediate reinforcement especially since they exist in stimulus rich environments from which they may be receiving additional reinforcement. There is also evidence, (Sturges and Crawford, 1964), which suggests that immediate reinforcement may not always be optimal. Such studies suggest that delayed reinforcement sometimes leads to a better initial learning and/or retention, depending on the type of material and the ability level of the learner. The point is that a richer kind of learning than is possible with Linear Programming may not be best promoted by immediate feedback. I

think that SC lacks advantages that Skinner has shown to exist when immediate feedback is given. However, SC does provide delayed reinforcement. Whether or not this is effective can only be determined by empirical testing.

Another area of overlap between Linear Programming and SC is the claim of enhancing learning efficiency. Efficiency, in behavioral terms, is defined by the parameters of Acquisition (initial learning), Rate of Responding, and Extinction (length of time learning is retained.) In the course of his research Skinner discovered that the variable most effective in affecting these parameters is the manner in which reinforcement is distributed, which he calls Scheduling of Reinforcement. This is especially true in experimental situations because the type and mode of the reinforcers can be precisely controlled. Skinner maintains that by manipulating schedules of reinforcement the parameters described above can be affected.

EFFECTS ON ACQUISITION:

Acquisition is the measure of learning which is concerned with the rate at which a new response is acquired as a function of reinforcement. Initial learning is most rapid where a continuous schedule of reinforcement is employed, that is every correct response is reinforced. Initial learning under intermittent schedules is more difficult, slower, and less likely to occur.

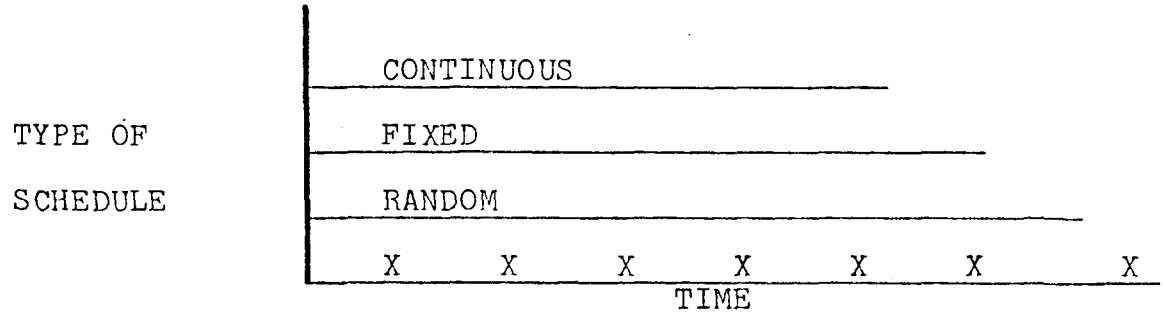
EFFECTS ON EXTINCTION:

Extinction is the measure of learning which is concerned with the rate at which an acquired response disappears after reinforcement is removed. While a continuous schedule of re-

inforcement leads to the most rapid learning, it also leads to the most rapid rate of extinction. The schedule with the longest extinction period is the Random Ratio schedule (see Figure 4).

Figure 4. Extinction of Learning

(Idealized figure of extinction rates)



EFFECTS ON RATE OF RESPONDING:

Another measure of learning is the rate at which a subject responds as a function of reinforcement. This variable is extremely sensitive to schedules of reinforcement. Here again the Random Ratio schedule produces the highest rate. In addition to being the highest rate, it is also relatively unvarying.

The essential difference between SC and Linear Programming is their definition of learning efficiency. The behaviorists define it in terms of increasing the rates of acquisition, responding, and extinction. In contrast SC was designed to control not only a learner's acquisition of facts but also the process by which he is brought to appreciate the flexible nature of knowledge. Thus SC requires learners to use the same facts in a variety of ways to solve several different but related problems. Thus SC defines learning efficiency as the

acquisition of facts plus the meaning of these facts or knowledge of how to use a fact or concept properly.

The conclusion to be drawn from these comments is that it is not a question of which technique is right, it is a matter of identifying the type of learning to which each technique is appropriate. Linear Programming is designed to engage learners in associative activities. Such activities suggest only that the learner is aware and that he reacts. In contrast SC is aimed at what the inventors of SC call the Conscious level. At this level the learner engages in thinking that expands comprehension, restructures ideas, and involves reflection. Thus it would seem that Linear Programming is appropriate to tasks which require associative activities and that SC is appropriate to those tasks which require thinking at the Conscious level. The problem with trying to compare these is that the language of behaviorism allows no meaning to the claims made on behalf of SC. I am inclined to sympathize with those who find Linear Programming deficient in engaging students in relatively sophisticated learning. Because the language of behaviorists prevents them from considering SC claims as meaningful, it seems to me that this is a deficiency of their language rather than a clear case for refuting SC.

The next area of overlap is the way in which each of the two techniques controls the learner's progress through the program. Linear Programming controls the learning experience in the following manner. The Programmer first defines the terminal behavior (i.e., what will the final behavior look like?) and then arranges the material in small discrete steps. He then

arranges these steps into linear sequences (e.g., stimulus - response - reinforcement) so that progress through all of the sequences in the program will result in the desired terminal behavior. Mastery of each step of the linear sequence must be demonstrated in order to proceed to the subsequent step. The assumption is that a linear sequence is additive and that mastery of all the individual steps will result in the desired terminal behavior which in behavioral terms is synonymous with learning having occurred.

The author of a Study Unit retains control of his message in the way in which he constructs the Investigation and Response Matrix and by what is entailed in the learner's mode of response.

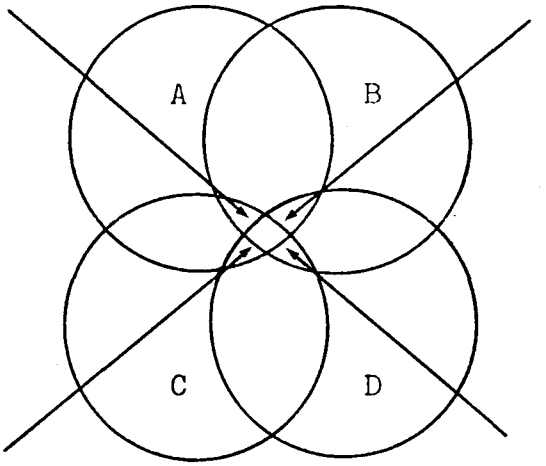
Typically the author begins by defining what it is he wishes the learner to understand upon completion of the Study Unit. To do this he draws a "concept map" which articulates the facts, ideas, concepts etc., . . . which constitute the subject matter (i.e., in SC usage the informational content.); Now he begins to isolate the main themes and organizing principles in accordance with what he thinks is the essential perception for adequate understanding of his message. Each challenge is developed to explore these main themes and their interrelationships. (see Figure 5.)

The circles A, B, C, & D of the Venn diagram each represent a main theme and the fact that they overlap suggests that all of the themes are interrelated. The arrows represent the challenges and illustrate how the message is engaged by the

learner from several different perspectives.

Figure 5. Thematic Overlap

p.1 p.2



p.4 p.3

Each of the circles contains the ideas, concepts etc. . . which the author places at random in the Response Matrix. These items are so arranged that there are no obvious clues to indicate that they are more appropriate to one challenge than another. The challenges are composed so that adequate responses to all the challenges will utilize all of the matrix items and in such a manner that they overlap and inter-connect. Thus one item may be appropriate to one or all of the challenges. However, each item will have a different meaning or function in each challenge so the learner is forced to engage in sophisticated thinking about the various aspects of the author's message. The learner's response then is in effect a reversal of the author's act of construction. This allows the learner to "simulate" the author's cognitive process and is a feature unique to SC.

Therefore, in a Study Unit, the author retains control of

his message and the learner's progress through the unit by the way in which he constructs the unit. The difference between the control in a Study Unit and that in a Linear Program is the amount of flexibility allowed the learner in composing his response and the simulation of the author's cognitive process which is found only in a Study Unit. What is lost with SC is the ability to shape learning to a precisely predetermined end, and what is gained is a less precise, but more general control.

Summary:

This summary is provided to identify concisely the areas in which there is an overlapping of the two techniques. The headings of agreement and disagreement are meant to indicate agreement in principle or vice versa, or to indicate that where identical terms are used there is a sharp contrast in the degree to which each technique meets the true sense of the term.

AREAS OF AGREEMENT:

1. Schools are inefficient learning environments.
2. Instruction should be individualized.
3. Programmed techniques should be non-aversive.
4. Learning experiences should be "structured."
5. Skinner's general requirements for programmed instruction are valid.
6. Programmed instruction should provide a "dialogue."

AREAS OF DISAGREEMENT:

1. Basic objectives.
2. Definition of learning.
3. Definition of learning efficiency.
4. The validity of immediate reinforcement in all learning situations.

5. The validity of scheduling of reinforcement for all types of learning.
6. Use of the term "dialogue."
7. Use of the term "individualizing."
8. Use of the phrase "composing a response."
9. Reducing the learning process to small discrete steps.

Conclusion:

Linear Programming and SC define learning differently and as a result are designed to achieve different goals. Both make some identical claims and/or use some identical terms. Each of these claims and terms are examined and a conclusion as to the validity of it's usage by each technique is drawn. The conclusion in regard to the terms is that the SC use of the terms is consistent with their true meaning and is generally broader in scope than their linear program equivalents. The validity of immediate reinforcement and scheduling of reinforcement in all learning situations is questioned, and a reasonable case made for not doing so in SC. There seem to be a number of points on which linear programming and SC make genuinely competing claims that may be settled by empirical research.

CHAPTER III.

AROUSAL THEORY

In this section SC will be analysed in relation to the views of learning of D. O. Hebb and D. E. Berlyne. The intention of this section is to determine whether or not Hebb's work suggests that SC is based on principles that provide an acceptable rationale for the way in which a Study Unit is constructed. Similarly, SC will be analyzed in relation to Berlyne's work to see if it provides a supporting argument for SC's claim that a Study Unit maintains mental operations at or near the optimal level of learning.

Behaviorist theories provide a reasonable explanation of some types of learning (e.g., associative learning such as conditioning a dog to salivate in response to a bell ringing) but they do not provide an adequate explanation for instances in which there is a significant delay between a stimulus and a response. For example, a teacher gives his students the following assignment:

> "Choose one of the topics from the list I have given you. When you have researched your chosen topic thoroughly write a report describing your conclusions and the reasoning you followed to arrive at them. Turn in your written reports in two weeks."

The question relevant to learning is, what occurs during the delay between the stimulus (i.e., assignment) and the response (i.e., the written reports?) It is probable that the students are engaged in some sort of activity that is related to both the stimulus and the response at least part of the time because

eventually the response required by the stimulus is made, i.e., the students turn in written reports. Such activities, between stimulus and response, we may call mental activities that mediate responses to stimuli. Hebb's theory emphasizes the physiological and neurological bases of the part played by mediating processes in human learning.

The inventors of SC are in agreement with Hebb on this most fundamental issue - they both ackowledge that a process called "thinking" exists and must be dealt with in order to offer a satisfactory account of human learning. Briefly, Hebb is concerned with explaining higher mental activity in terms of mediational processes, and the inventors of SC are concerned with the most effective way to engage people in these higher mental processes. The aspect of Hebb's work that is most relevant to SC's concern with engaging people in higher mental processes, is the part that "arousal" plays in human learning.

The ability of an organism to react to external stimuli and to modify it's behavior due to repeated stimulation are two properties inherent in most learning theories. These two properties are generally called, respectively, reactivity, and plasticity. For Hebb, reactivity and plasticity are not properties of behavior, rather they are properties of the human nervous system that account for behavior. Hebb describes the way stimuli and the nervous system interact to yield responses.

Hebb identifies two properties of stimuli: the cue and arousal functions. The cue function is the property that identifies the nature of the stimulus - i.e., the message.

The message or content of a stimulus interacts with associated areas of the cerebral cortex in what Hebb describes as the Conceptual Nervous System. The arousal function of the stimulus is effected through the Reticular Activating System (RAS.) When the RAS is stimulated by the arousal function of a stimulus it activates the cortex in a generalized manner. That is, many areas of the cortex other than those associated with the cue function are activated. The result is an increase in arousal. Without this activation, the cortex would be unable to respond to the cue function of a stimulus, (Hebb, 1958 and Berlyne, 1960.) In short, arousal is essential for the human nervous system to interact with the external environment. But how does arousal in the human nervous system occur and how does it provide an explanation of learning?

Hebb, in his presidential address to the sixty-eighth Annual Convention of the American Psychological Association, stressed the need for serious analytical study of the thought processes for he felt that "Learning theory (i.e., arousal) still has certain advantages in dealing with real behavior . . . especially where motivation is concerned," (Hebb, 1960.) Hebb's research on sensory deprivation is the most relevant to SC in relation to motivation. These studies suggest that a major motivational factor for much, if not most, significant human behavior is to satisfy or reduce a generalized need for stimulation. Experiments where conducted in which subjects were deprived of all sensory input. They wore opaque eye shields to prevent vision, ear plugs to eliminate hearing, gloves to eliminate touch, and they were placed in darkened, soundproofed rooms. The subjects quickly (less than 24 hours usually) became

erratic, irrational, and reported suffering hallucinations. These studies indicated that stimulation is necessary to human beings and that their behavior is most nearly optimal under conditions of moderate arousal. In addition it was found that people try to maintain

arousal at or near that optimal level. The latter tendency is called homeostasis which simply means that people strive to maintain a state of equilibrium between their need for stimulation and its satisfaction.

In Hebb's view the relationship between arousal and homeostasis is based on two assumptions about the levels of arousal.

1. There is an optimal level of arousal that differs for different tasks.

This assumption certainly seems reasonable. An intense activity such as playing tennis requires a higher level of arousal than an activity as familiar as eating. In a Study Unit this assumption is embodied in the Challenge - Response interval. That is, the task - engaging in synthetic thinking - requires that the learner operate at an optimal level of arousal and that it is the challenge that forces the learner to this level. The challenge, of course, must be appropriate to the task. SC's four level model of thinking is consistent with this assumption for it defines each level as being characterized by distinct and qualitatively different levels of concentration and effort. In an SC Study Unit the task (engaging in synthetic thinking) occurs, according to the inventors of SC, at the Conscious level. The Conscious level is in the central range of the scale and it is reasonable to assume that the arousal in this range is correspondingly moderate. Because moderate levels of arousal are generally accepted as optimal, it is reasonable to assume that a learner interacting with a Study Unit at the Conscious level is engaged in activity at the optimal level of arousal and should therefore be most

able to learn.

2. The organism behaves in such a way as to maintain the level of arousal which is most appropriate for the behavior in which it is then engaged.

This assumption means simply that the effectiveness of behavior will increase as arousal increases until the optimal level is reached. Beyond this level, increased arousal reduces the effectiveness of behavior. An obvious example of the latter state is a person who is unable to move or act in an emergency. At the opposite extreme a too low level of arousal results in equally inappropriate behavior such as a student sleeping through a lecture covering material upon which he is to be tested the following morning.

Hebb concluded that the CNS-RAS system is semiautonomous in that it requires some degree of external stimulation for continued cortical functioning. This conclusion is one of the most important areas of overlap between SC and Hebb's theory for it provides SC with a physiological and neurological base with which to justify its claim that "shocks" must be built into a Study Unit in order to maintain a learner's level of arousal at the optimal level of learning. Anything that is a break in routine arouses interest. In a Study Unit Hebb's "external stimulation" is provided by the challenge. The problem is to maintain the increased level of interest while the learner is engaged in mental activity above the Automatic level and focusing it on relevant learning tasks. Studies indicate, (Bennett, 1967), that the mind cannot simultaneously cope with two different kinds of input without engaging higher

mental processes. Any binary demand forces the mind into a level above the Automatic level of mental operations. Is there anything in the construction of a Study Unit, that motivates the learner to participate in the desired activity?

In reference to this last question the experimental work of D. E. Berlyne is worth considering. Berlyne has advanced an explanation based on the arousing properties of conflict. His contention is that much of the exploratory (i.e., curiosity) and epistemic behavior (i.e., knowledge oriented) of human beings is explainable in terms of conflict. One of Berlyne's major contributions is his identification of the nature of stimuli which cause arousal. He maintains that it is not so much the strength or quantity of stimulation that activates the RAS as it is the novelty, change, surprisingness, incongruity, complexity, ambiguity, and indistinctness of stimuli, (Berlyne, 1960, pp. 177-79.) Berlyne's term for these properties of stimuli is collative variables. Berlyne suggests that these properties of stimuli cause arousal because they create conceptual conflict. The assumption (#2 in the relationship of arousal and homeostasis) that people engage in behavior designed to reduce conflict situations is, according to Berlyne, behavior that removes the collative variables of stimuli. Berlyne maintains that the most effective way to remove collative variables is to acquire information, (Berlyne, 1960, pp. 202-09.) After all, a stimulus is no longer ambiguous or surprising once it is familiar.

Berlyne's observations about the collative variables of stimuli are applied by SC, perhaps unknowingly, in the construc-

tion of the Response Matrix. The elements of the matrix contain all of the collative variables of stimuli that Berlyne identifies, and it is by using them in order to compose a response to a challenge that the learner is forced into conceptual conflict. The items are complex because they are elements of larger structures and the inter-relationships of the component elements must be understood in order to comprehend these larger structures. Ambiguity, incongruity, and indistinctness all exist because all of the matrix items are relevant to all of the problems. However, the items are phrased in such a way that their relationship to any given problem is not obvious, and sophisticated thinking must be employed in order to establish a connection between an item and a problem.

For example, in the SC Viewfinder Kits, one of the topics to be studied is called "You and the Law." One of the problems is: "Do you think the police are doing a good job?" Two items which appear in the Response Matrix are; "The courts are doing a good job," and "Crime pays." Obviously, both items are related to the topic of an individual's relationship to the law, but the two items seem to be mutually exclusive. The inclusion of both of these items in the learner's response does not provide an adequate answer to the problem. These two items illustrate the type of conflict that must be resolved by the learner in order to answer the problems. It is just this type of conflict - conceptual conflict - that Berlyne asserts increases arousal.

The other types of collative variables are also found in the Response Matrix. For example, novel (i.e., new to the

learner) statements can be presented in the matrix; "Possession of x grams of marijuana is now a misdemeanor in B. C." This may be completely new information to the learner and may be quite a change from a law with which he was familiar, e.g.; "Possession of x grams of marijuana is a felony in B. C." The fact that this particular law has changed to a milder form may come as a real surprise to the learner. So it is clear that SC has the potential to induce conceptual conflict, and if Berlyne is correct, learners will acquire information in order to reduce the conceptual conflict into which the Study Unit has forced them. If the author is aware of the potential of conceptual conflict, he might enhance the effectiveness of SC materials by designing a response matrix that utilizes collative variables extensively. It is however a contingent matter whether or not this potential is actualized in any particular Study Unit.

In Chapter II one of the ways in which a Study Unit provides the learner with reinforcement was described. It was also stated that the reinforcing nature of a Study Unit would be described in greater detail in this section on Arousal Theory. Essentially the question to be answered is, "What is it about the construction of a Study Unit that is reinforcing to the learner?" In this chapter the basis of much, if not most, significant human behavior has been attributed to a single, generalized need for stimulation. Hebb explains the part that arousal plays in learning and finally Berlyne has identified the arousing potential of collative variables of stimuli and the attendant human tendency to acquire information to resolve

the conceptual conflict raised by these variables.

Briefly, a Study Unit is reinforcing because it forces the learner into an uncomfortable need state (i.e., conceptual conflict) and capitalizes on the appropriate human tendencies to provide the learner with the means to resolve that conflict or to satisfy the need. According to behavioral research on animals, things that reduce or satisfy needs are effective reinforcers. But specifically how does a Study Unit achieve this?

First the learner is aroused, that is he is forced to the optimal level of arousal by being confronted with a challenge. In order to respond to the challenge the learner must compose a response using the elements of the Response Matrix. The elements of the matrix are phrased so as to contain what Berlyne calls the collative variables of stimuli, and as such they force the learner into conceptual conflict (i.e., a need state.) Berlyne's idea that learners faced with conceptual conflict will acquire information to remove the conflict is consistent with the SC notion that people try to "make sense" of conflicting or new input. The act of composing a response, in the SC meaning of the term, to a challenge forces the learner to acquire information - thereby reducing conflict - and to "make sense" of the conflict. Thus it is reasonable to assume that both information and understanding is achieved by the learner.

In summary, the most important features of this section are:

1) SC, Hebb, and Berlyne agree that "thinking" exists and that models of thinking provide a valid heuristic device

for theories of learning.

2) There is an optimal level of arousal for learning which varies with the task.

3) An SC challenge forces the learner to this optimal level and maintains it.

4) The elements of the Response Matrix create conceptual conflict.

5) Composing a response to an SC challenge reduces the conceptual conflict.

6) A Study Unit is constructed so as to motivate the learner to learn.

The conclusion to be drawn from this section is that the theories of Hebb and Berlyne do provide reasonable bases with which to justify the SC claim that a Study Unit engages the learner at the optimal level of arousal and maintains the learner at the optimal level of arousal for learning. It is a contingent matter whether these ideas will be utilized in the future by authors of SC materials. However, the rather exotic "mentalist" language of SC's inventors does seem to translate readily into terms that are more firmly established in North American research on learning.

CHAPTER III - NOTES

8. The original experiments in a long sequence of related investigations in this area were conducted at McGill University under the direction of Hebb. His collaborators, Bexton, Heron, and Scott, reported the results of the initial studies in 1954 and 1956. Since then several other studies have replicated their early findings, (see for example Shultz, 1965, or Zubeck, 1969.)

CHAPTER IV.

DISCOVERY LEARNING

The inventors of SC claim that it is the first teaching technique that successfully embodies principles that most cognitive field theorists in education have been proposing in order to encourage effective learning. In this chapter SC will be analyzed in relation to principles of Gestalt psychology and to the instructional technology of Discovery Learning. A well known spokesman of Discovery Learning is Jerome Bruner and his writings will provide the statements of the ideas and concepts which describe this technology. The intention of this chapter is to determine which specific cognitive field theory principles are embodied in SC and to make clear any areas of significant differences in views of learning and/or in the use of terms.

GESTALT

Around 1910, at the University of Frankfurt, a German named Max Wertheimer coined a phrase which was to become closely identified with Gestalt pyschology. Wertheimer's phrase was "The whole is greater than the sum of the parts." By this he meant that psychological concepts must be studied in the context of the total human experience of learning and that analysis of individual components in isolation led to inadequate explanations of learning. To illustrate this point Wertheimer used as an example the stroboscope, a device which when turned at a constant speed exposes a series of still pictures in such a way that apparent motion is produced. However when the elements of this perception (i.e., the set of

still pictures) are viewed individually, the total phenomenon of perceived motion is lost. The German word for wholes, patterns, and configurations is "Gestalt." Over the years the school of psychology which developed from the study of perception came to be known as Gestalt psychology.

The inventors of SC agree with the gestaltist emphasis on the importance of wholes of "gestalts" in human learning. However, they (i.e., the inventors of SC) disagree with the gestaltists' explanation of the way in which all learning occurs. To the gestaltists learning is equated with the perception of gestalts, a process which they call Insight. (Insight is described in greater detail later in this section.) Because sight is primary among our (i.e., human) five senses, the words "I see" have come to mean "I understand." The gestaltists, by so strongly emphasizing visual perception, have carried this tendency to the extreme belief that to have all component parts of a gestalt laid out before the learner's eyes is both necessary and sufficient for understanding to occur. SC maintains that a gestalt can best be understood by comprehending the individual component parts in their interrelationships and that this process involves more than just visual perception.

As defined by the inventors of SC, understanding is a process in which the learner must be actively engaged in "making sense" of the interrelationships of the component parts of the gestalt, or in SC terminology, the structure. To use Wertheimer's example of the stroboscope, the gestalt of apparent motion can best be understood by comprehension of the interrelation-

ships of the individual components of 1) the still pictures, and 2) the rate at which they are moved past a single viewing position. It is not sufficient merely to observe or perceive the phenomenon of apparent motion or to have the stroboscope "before one's eyes." One must comprehend the exact relationship between the individual parts in order to fully understand the principles of the phenomenon and how it can be produced on other occassions.

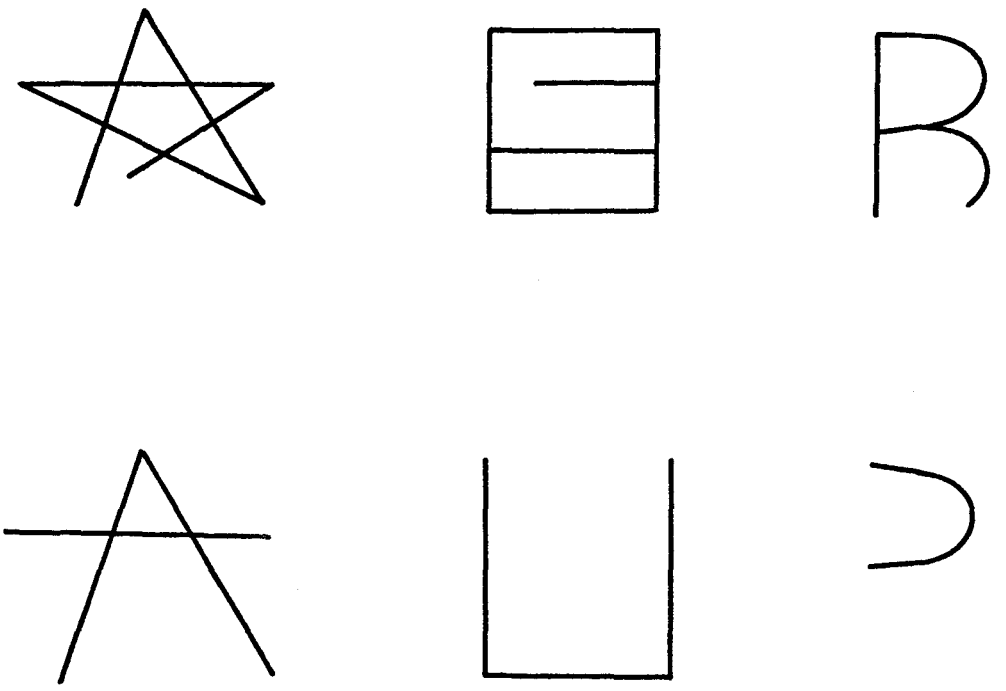
As mentioned earlier the concept central to the gestalt explanation of learning is Insight. In 1925 Wolfgang Kohler, a former student of Wertheimer, published a book entitled "The Mentality of Apes." In this book Kohler describes his experiments on the problem solving ability of apes. As Kohler saw it his task was to arrange the environment of the apes, by placing the necessary "tools" (i.e., boxes and sticks) in their cages and to make the learning task fractionally exceed the limit of the apes' set of skills. Kohler felt that such conditions would favor original discovery.

In one type of experiment Kohler arranged the apes' cages so that there were bananas overhead out of reach and a couple of boxes on the floor of the cage. In order to reach the bananas the apes had to stack one box on top of another and use them as a rough ladder. The apes solved the problem but not by the expected trial and error method. Instead the solutions often occurred when the apes were at rest, seemingly contemplating the problem. The solutions seemed to occur suddenly as if the apes finally understood the problem and "saw" the solution.

Kohler's explanation for this problem solving ability of

his apes was that they were able to see the problem as a whole. The boxes and sticks were finally perceived not as separate elements but they came together as a unified whole. Only when this reorganization of perceptions into a unified whole had occurred did the apes perceive the solution. The Gestalt term for the sudden perception of unified wholes is Closure, (see figure 6.)

Figure 6. The Gestalt Principle of Closure



After looking at the forms at the top of Figure 6 briefly, one sees them as complete. This perceptual tendency illustrates the principle of closure. The forms in the lower part of Figure 6 are too incomplete for closure to occur. This principle in terms of human learning is the tendency to want to finish discussions and activities, and to find solutions to problems. In other words people seek closure, (Postman and

Weingartner, 1969.)

The author of an SC Study Unit appears to arrange the learner's environment in much the same way as Kohler arranged his apes' cages. That is the author's concept map of his message is analogous to the upper figures in Figure 6, but they are complete and do not as yet have any gaps. The author "designs" the gaps into the Study Unit so that the learner can provide or achieve "closure" which is synonymous with having gained understanding. Details of how the author constructs the Study Unit in order to accomplish this task are described later in this chapter.

The term that SC uses to describe the principle underlying the construction of a Study Unit with gaps is Coalesence. Coalesence is used rather than closure because the latter is restricted to visual perception and a Study Unit involves much more than vision. Coalesence provides an explanation of the way in which the inventors claim a Study Unit enables a learner to understand the principles of a message or gestalt in contrast to rote memorization. Coalesence is defined as follows:

> " . . . Elements are said to be in coalesence when they lose their functional identify and acquire a new systematic identity . . . such that elements cannot be added or removed . . . the term coalesence refers specifically to the mode of togetherness of the totality," (Bortoft, 1970.)

For example, when one looks into a mirror the reflected image is the optical coalesence of the elements (i.e., the individual and the mirror) together into a whole. One cannot directly alter the image itself, one can only move one of the elements - the individual or the mirror. Thus the image of

that individual in the mirror is a totality to which elements cannot be added or removed without changing its "meaning," they are in coalesence. The difference between closure and coalesence is that closure deems it sufficient that the learner see the elements to understand the image, whereas coalesence requires that the learner "make sense" of the image by comprehending the interrelationships of the elements.

To put this in the context of a Study Unit let us assume that the learner is studying a unit on Optics and the particular principle being examined is Reflection. The learner is instructed to look into a mirror and observe his reflected image. The gestaltists would claim that this visual perception is sufficient to understand the principle of reflection. The inventors of SC however, maintain that the learner must first comprehend the functional interrelationships of the component parts in order to understand the principle of reflection and thus "make sense" of his reflected image. The learner must comprehend that the function of a mirror is to redirect light waves; he must comprehend how the rods and cones of his eyes encode light waves and enable his brain to organize them into meaningful patterns; he must comprehend that in order to have a reflected image it is essential to have light. In short, all of these elements interrelate functionally to form a system, the manifestation of which is the learner's reflected image. This is what SC means by coalesence and it is this that is the difference between merely observing a phenomenon and understanding the principles which underlie it.

One of the most important concepts in gestalt psychology is

that human beings learn by Insight. What do the gestaltists mean when they use this term? Insight has been characterized by several gestalt authors as follows: 1) dramatic suddenness, 2) the appearance of a complete solution with reference to the whole layout of the field (Kohler, 1957), 3) the solution of the problem precedes the actual execution of it (Osgood, 1960), 4) the solution is retained after a single trial, and 5) the solution is novel. It follows from these characteristics that insightful learning, at least as defined by the gestaltists, seems to exclude the possibility that learning may occur by trial and error. In other words, to the gestaltists, learning occurs on the first trial and does not require "building up" by a learning process. How do the gestaltists explain this phenomenon?

The gestaltists claim that understanding (i.e., in their terms the sudden perception of a gestalt in its totality) is based on a grasp of the inner relation of things to one another. "Relation" is further defined as an interconnection based on the inherent properties of the things themselves as opposed to connections based on a sequential following of one another or occurring together. Not only is the gestalt experienced but also it's "why" and "how" is felt. Thus it is assumed that gestalts are the atomistic elements by which all things are to be understood. Kohler articulates this assumption in his theory of Psycho-Physical Isomorphism whereby the sight of a triangle activates the cortex and the cortical process "mirrors" the structural characteristics of the triangle. Thus human beings do not have to build up a symbolic model of pheno-

mena by the processes of learning (i.e., categorizing, coding, association etc. . . .); instead all human beings have an inherent perceptual organization which needs only to be triggered by insight to understand the phenomenon which is being perceived. From this theory (i.e., Kohler's) it would follow that the "whole" of Optics is latent in a man's brain when he looks in a mirror or through a lens and that this "insight" (i.e., looking through a lens) should evoke all the principles of Optics and the man would understand all of them.

The inventors of SC acknowledge that some solutions to problems occur on a first trial basis with no apparent build up of a learning process. This is based on common experience rather than empirical evidence. However, if the metaphysical gestalt explanation of insightful learning is valid then it would appear that because this is an inherent faculty little can be done to modify it externally - that is it may not be trainable. In a similar sense Bennett describes an SC "creative event" as being innate and therefore probably not trainable. Bennett uses Beethoven's compositions as an example of what he (i.e., Bennett) means by an innate, artistic ability to "create." It is not the intention, nor is it within the scope, of this study to pass judgement on the validity of the various explanations of learning described, therefore it is sufficient to state, in this case, that SC and the gestaltists agree that some human learning is characterized by sudden, first trial, and novel solutions to problems. How then does SC account for this type of learning?

The SC four level model of thinking places insightful sol-

utions or creative events in the Creative level. The inventors of SC maintain that learning at this level is not directly trainable due to the innate nature of such learning. However, they do believe it may be possible to increase the strength and frequency of such events by maintaining a favorable psychological climate. It is for this reason that Study Units are constructed with gaps which the learner may bridge by bringing the elements of the message into coalesence. The inventors of SC realize that the learner may bridge these gaps in ways unforeseen by the author. In other words each learner is left free to "create" novel solutions for bringing elements of the message into coalesence. Although the inventors' explicit aim in their design of a Study Unit is to engage the learner at the Sensitive or Conscious levels, it is constructed in such a way as to allow and encourage the learner to engage in creative learning even though such events cannot be predicted or controlled.

DISCOVERY LEARNING

Discovery Learning is the most influential application of cognitive field theory in North America today. The foremost advocate of Discovery Learning is Jerome Bruner of Harvard University. It is possible that Bruner has become well known to educators because he is a prolific author who has devoted much of his writing to describing a technique of teaching based on principles of cognitive field theory. Bruner's approach to teaching is best summarized in his own words:

"To instruct someone in a discipline is not a matter of getting him to commit results to mind. Rather it is to

teach him to participate in the process (of learning) that makes possible the establishment of knowledge. We teach a subject not to produce little living libraries on the subject, but rather to get the student to think mathematically for himself, to consider matters as a historian does, to take part in the process of knowledge-getting. Knowing is a process not a product," (Bruner, 1966, p. 74.) (Italics mine.)

Bruner also emphasizes the importance of intuitive as opposed to analytic thinking.

"The emphasis in much of school learning . . . (is) upon the ability of the student to reproduce verbal . . . formulae . . ," (Bruner, 1960, p. 55.)

"In contrast to (schools' emphasis on) analytic thinking, intuitive thinking characteristically does not advance in careful, well-defined steps . . . usually intuitive thinking rests on familiarity with the domain of knowledge involved and with it's structure, which makes it possible for the thinker to leap about, skipping steps and employing shortcuts in a manner that requires a later re-checking of conclusions by more analytical means," (Bruner, 1960, p. 58.) (Italics mine.)

What is there about SC and the construction of a Study Unit that reflects or embodies Bruner's approach to teaching?

In the passages quoted above Bruner makes four points about his approach to teaching which are also embodied within SC, these points are:

1) Knowing is a process.

2) The learner must participate in the process.

3) The learner should simulate the cognitive processes of "experts" i.e., "consider matters as a historian does."

4) The structure underlying the subject matter is equally important as the subject matter for the learner to understand.

Specifically how are each of these points embodied in a Study Unit?

It follows from the way a Study Unit is constructed that the inventors of SC believe that knowing is a process. The aspect of a Study Unit which makes interaction with it a different learning process from a mechanical procedure for identifying "right" answers is, that the learner is forced to compose responses to challenges. The most common pathway through a Study Unit illustrates the cyclic nature of the learner's interaction with the parts of the Study Unit. The Discussion section acts as a "dialogue" between the author and the learner and illustrates the dynamic nature of this interaction. The challenges force the learner to the Sensitive and/or Conscious level of thinking. All of these aspects of a Study Unit are designed to force the learner to compose his own answers to problems in such a way that he is forced to use relatively sophisticated thinking and judgement. In effect it is the learner who determines the "right" answer to the problems. In order to accomplish this the learner must actively participate in the process which brings us exactly to Bruner's second point.

As Bruner observed, most schools emphasize the ability of

students to reproduce verbal formulae. In short, students are assessed on their ability to identify and repeat "right" answers. The criteria of "right" is determined by school authorities and students have little or no voice in the procedure. Bruner's position that it is important to teach students to participate in the learning process is based on the cognitive field theory principle that people "learn" the external environment only to the degree and in the ways which they perceive it to be relevant to themselves. Thus, according to cognitive field theory, unless a "right" answer is perceived to be relevant to the learner, he will not learn it. Bruner assumes that when learners truly participate in the learning process, and not merely as passive recipients of information, they will perceive much of the information as being relevant to them and will therefore learn. This assumption is implicit in the construction of a Study Unit. The learner participates in the learning process by composing his own responses, he participates in a dialogue with the author based on his responses, and he is participating voluntarily in the process by having accepted the challenge. These features of a Study Unit should leave no doubt that it is designed to aid and encourage the learner's active participation in the learning process, and is therefore in complete accord with Bruner's point.

The third point made by Bruner is the importance of teaching students to simulate the cognitive processes of "experts." The inventors of SC claim that SC is the first programmed technique that is designed in such a way that the learner reconstructs the author's cognitive process as he (i.e., the learner)

works his way through the Study Unit. This is accomplished by the author's construction of the Investigation and Response Matrix sections and what is entailed by the learner's method of response.

The first chore of the author is to define precisely what it is he wishes to convey to learners through the Study Unit. He does this by drawing a "concept map" which lists the facts, concepts, ideas, themes, etc. . . . which constitute the subject matter from his viewpoint. Next, when the map is complete, to the author's satisfaction, he begins to shape the material into challenges and matrix items. He isolates the main themes and their structuring principles because it is the perception of them which is essential to the learner's understanding of the subject matter. The challenges are designed to explore these main themes through the interrelationships of the facts. concepts etc. . . . contained within the matrix.

In order to build the matrix so that it is a semantically rich, random field of items the author must "destructure" his "concept map." The facts and concepts are taken from the map and placed in the matrix in random fashion. The items must be phrased so that there is no obvious indication that any item belongs, as part of a response, to a particular challenge. For example, grammatical form and tense must be uniform throughout the matrix. The author designs the challenge so that adequate responses will use all of the matrix items and overlap and interconnect with one another. Thus, the Challenges together with the matrix items will present the themes and organizing principles in such a way that the learner works with

the interrelationships and come to perceive the structure of the subject matter.

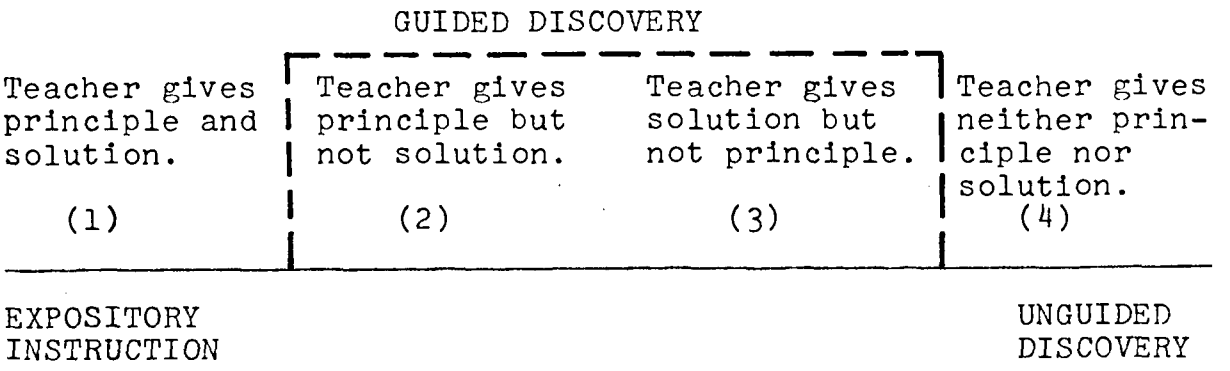
The learner's response is largely a reversal of the author's cognitive process of "destructuring" his concept map to develop the challenges and the matrix. The themes and structuring principles are embodied in the challenges and the learner comes to understand them by using the matrix items to compose a response to the challenges. The learner rebuilds the author's cognitive process in order to arrive at the structure of the subject matter, that is, what the author perceives that structure to be. In terms of Bruner's example, if an eminent historian had written a Study Unit (the inventors of SC do insist that authors of Study Units be subject matter experts or specialists) most learners who work through the unit will have "simulated" the cognitive process of the author, they will have "consider(ed) matters as a historian does."

It should follow from the discussion of the preceeding three points that the inventors of SC fully endorse Bruner's fourth point wherein he emphasizes the importance of teaching the structure underlying the subject matter. It would be redundant to restate the ways in which a Study Unit allows the learner to understand both structure and subject matter. However, it appears reasonable to conclude, based on the preceeding analyses, that the claim that SC is the first instructional technology to accomplish this task is justified.

In order to best examine the way in which Discovery Learning is translated into an instructional technology, it will be helpful to define precisely what is meant by the term Discovery

Learning. A precise definition of the term is important because there has been a great deal of confusion over whether learning by discovery refers to 1) a method of teaching, 2) a method of learning, or 3) something you learn. For this discussion the definition of discovery learning adopted is, "those teaching situations in which the student achieves the instructional objective with limited teacher guidance." Wittrock's scheme for classifying the amount of instructional guidance the teacher provides should clarify the preceeding definition.

Figure 7. Diagram based on Wittrock's Scale of Instructional Guidance. (DeCecco, 1968, p.464.)



Therefore, whenever the term Discovery Learning is used in this discussion it is to be regarded as what Wittrock defines as Guided Discovery (DeCecco, 1968, p. 464.)

There is ample research (Corman, Gagne and Brown, and Johnson and Stratton) which suggests that discovery learning is most effective when instructional guidance is present to some degree in the learning situation. By now the reader should be familiar enough with the construction of a Study Unit to realize that SC is most appropriate to the Guided Discovery range of Wittrock's scale, for neither does it define and present the

principles and solutions as is the case in the expository style of teaching, nor does it leave the learner totally on his own which is the unguided discovery approach.

Now let us examine the recommendations for applying discovery learning principles to teaching.

1) Establish a relaxed atmosphere.
2) Structure the discussion by presenting a provocative issue or question which will encourage the development of insight.
3) Once the discussion is underway, do your best to keep it on the track. Redirect digressions back to the original subject; question and analyze points made.
4) Keep in mind the importance of structure in promoting comprehension of new relationships.
5) Consider the possibility that the discovery method is most appropriate for bright, confident, highly motivated pupils and for topics which lack clear terminal behavior, (Biehler, 1971, pp. 192-200.)

1) Establish a Relaxed Atmosphere

For the discovery method to work properly, the students must operate in an atmosphere that is neither aversive or coersive. In order for learning to be effective, the individual must perceive the relationship of the information to himself. The discovery of such personal meaning is enhanced by a calm, supportive atmosphere. In discovery learning mistakes are not punished but are actually considered to be an essential part of learning.

There is some evidence (Whittington, 1974) which suggests

that the use of Study Units can help to create a relaxed atmosphere. In this study teachers who had used Study Units in their classrooms for some time gave several reasons why they felt the units had helped to create a relaxed atmosphere for their students. First, the units are individual exercises which reduced the students' fear of ridicule from their peers. With a Study Unit the students didn't have to risk appearing stupid by making mistakes in front of their classmates. Next, after the students became familiar with the Study Unit format many of them seemed really to enjoy it. For some of the students the Investigation and Response Matrix sections made the unit like "trying to solve a mystery" or "like working on a puzzle game." Another point made was that students are not penalized for making mistakes, rather by interacting with the Comments section the student is positively reinforced for correct answers and is directed to further comments or additional information if his answer shows an incomplete or inappropriate grasp of the problem. For example:

> "You appear to have grasped the most important elements of physical weathering in the erosion process. Do you think there may be an similarity in the process by which a waterfall undercuts the bedrock and the way ice forms an arete? Is it the same process? If you would like more information see Comment R." (Study Unit on "The Weathering of Landforms")

The grain of salt to be taken with these remarks is of course the constraints of time and curriculum requirements under which the teacher must operate. However, there appears to be nothing

inherent in a Study Unit that would prevent it from producing the desired discovery atmosphere.

2) Structure The Discussion

This is the heart of the discovery approach. The basic idea is to construct an environment in which coalesence (in SC terms) can occur. The techniques listed below are designed to enhance the probability that coalesence in a learning situation can occur.

- Emphasize contrast
- Encourage informed guessing
- Encourage participation
- Stimulate awareness
- Switch the subject matter
- Introduce disturbing data
- Allow mistakes

Previously the manner in which an SC unit encourages participation in the learning process, the way it encourages informed guessing (i.e., composing responses), and the way it does not punish mistakes was discussed. To restate the discussion would be redundant.

Stimulating awareness means to make the students conscious of the way in which they solve problems. Problem solving behaviours in this context are called strategies of learning (see Chapter I - different strategies used in responding.) While this is not an explicit aim of a Study Unit, the learner's responses can be charted and categorized and the learner made aware of how he tends to go about solving problems.

Contrast and disturbing data are similar techniques. The

former involves having students compare items or ideas, for example: the contrast between a public execution and killing an enemy in battle in a lesson on the morality of killing. The point is to present a dichotomy which must be reconciled by the student in relation to some of their commonly held beliefs. The chapter of this study on Arousal Theory discussed the value of conceptual conflict and described how a Study Unit makes use of contrast and disturbing data. Therefore, it follows that a Study Unit fulfills this recommendation of Discovery Learning.

The remaining technique is the subject matter switch which means to prepare a case and then require the student to play the devil's advocate. For example, present the case that government encroachment into the realm of private responsibility is not to be tolerated then ask the students to justify socialized medicine. This can be easily accommodated in a Study Unit by presenting a "biased" case in the Intention and Presentation and then posing problems in the Investigation in such a way that the student is forced to challenge the case as presented by the unit. This is merely a matter of the author utilizing a particular strategy to introduce conceptual conflict and represents no modification of the form of a Study Unit. The conclusion is obvious that the forte of a Study Unit is exactly what discovery learning recommends - structuring discussion.

3) Keep The Discussion On Track

In Guided Discovery learning a certain degree of control is implicit. While mistakes are regarded as part of the learning

process not all mistakes are productive. In a discussion the teacher must exercise judgement in order to control for unproductive or irrelevent digressions. However, in the grey area of tangential relevance one should keep in mind Bruner's comment that intuitive thinking characteristically does not advance in careful, well-defined steps. An additional point is the importance of the teacher as a model of intuitive behavior. If the teacher frequently makes informed guesses and then verifies them analytically, it seems reasonable to suppose that students are likely to emulate the teacher's habit of intuitive thinking. As Bruner puts it: "It seems unlikely that a student would develop or have confidence in his intuitive methods of thinking if he never saw them used effectively by his elders," (Bruner, 1960, p. 62.)

In this last sense SC falls short of the ideal for it cannot provide an animate model for the students to emmulate. It would be possible to write a unit so that the author displayed all of the erroneous guesses he made in the process of arriving at a final answer, but this would rob the learner of the opportunity to go his own way and make his own mistakes and would in effect negate the discovery factor of the unit. However, in the area of controlling the discussion a Study Unit fully meets the ideal, at least for a programmed application of discovery learning. The author rather than the teacher passes judgement on what type of digression is unproductive or irrelevant and by interaction with the Comment section the student is redirected to the topic at hand. This is one of the unique features of an SC unit.

4) <u>The Importance of Structure In Comprehending New</u>

Relationships

The aim is to impel students to reorganize their perceptions in a fairly definite way so that they grasp new relationships. The SC principle of coalesence emphasizes this idea. In an SC unit the tendency to strive for coalesence is accounted for by the author in his construction of the Study Unit. The author starts to build his structure in the Intention and Presentation sections. By the time a learner gets to the Investigation section the author has created a structure to the same degree of completion as those depicted in Figure 6 of this Chapter. Simply stated the author has constructed the environment in such a way that it is possible for a learner to perceive the "gestalt" if he works with the material. This is what Kohler did with the bananas, sticks and the apes' cages. The gap in the structure which is bridged by coalesence is left up to whatever strategy the learner chooses to employ. It is quite possible that the learner will achieve coalesence in a manner unforeseen by the author and thus enable the author to learn from the learner.

5) Discovery Learning May Not Be Appropriate For Everyone

The claim has been made that discovery learning can be used at all levels of education, ability, and subject matter. There is however, ample evidence to suggest that discovery learning is not so broadly appropriate. For example the research of Jean Piaget into the stages of cognitive development suggests that discovery learning may be inappropriate for very young children - i.e., children who are at the egocentric stage of speech. In addition in a classroom where discovery learning

is the norm, a low ability student may find it very discouraging not to make as many discoveries as his classmates. The type of subject matter would seem to be a limiting factor as well. Ideational topics such as literature and philosophy lend themselves naturally to discussion. Accumulated knowledge such as theoretical physics or astronomy do not lend themselves so readily to discovery learning particularly at advanced levels which are dependent upon mastery of more basic knowledge. However, discovery learning lends itself well to transmitting the fundamental skills upon which material at a higher level of abstraction is based. Bruner provides us with an example which should clarify the last statement.

> "Algebra which is a way of arranging knowns and unknowns in equations so that the unknowns are made knowable. The three fundamentals involved in working with these equations are commutation, distribution, and association. Once a student grasps the ideas embodied by these three fundamentals, he is in a position to recognize wherein 'new' equations to be solved are not new at all, but variants on a familiar theme," (Bruner, 1960, pp. 7-8.)

Discovery Learning is well suited to the acquisition of these fundamentals and they can certainly be made more interesting and relevant to the student by using the discovery approach. Once these fundamentals have been acquired it is reasonable to present the student with higher level abstractions such as the Quadratic Equation or the algebraic formula for the acceleration of a falling object due to gravitational force alone, and expect that he will be able to understand it.

Once the level of conceptualization has been reached, Formal Operations in Piagetian terms and Symbolic Representation in Brunerian terms, discovery learning may be inappropriate for a completely different reason - not everyone thinks alike. In a series of studies on conceptualization, Jerome Kagan (1964) has identified several distinct styles of conceptualization which appear to be relatively permanent and general traits. One set of styles he calls Impulsive and Reflective thinkers. Impulsive thinkers tend to emphasize quick answers whereas Reflective thinkers tend to ponder before speaking and are more concerned with giving a correct answer. Another set of styles he calls Analytic and Thematic thinkers. When exposed to a complex stimulus Analytic thinkers tend to note details whereas Thematic thinkers respond to the pattern as a whole. In relation to discovery learning Impulsive thinkers may find the pace too slow, or an Analytic thinker may be uncomfortable with an open-ended discussion but thrive on a frame by frame programmed lesson.

All of these considerations are pertinent to SC. Piaget's observations are, I think, a reasonable limiting case for existing SC format. Because a Study Unit is printed it necessarily deals in terms of language and printed symbols of mental abstractions. It would appear that use of Study Units below the level of what Piaget calls Formal Operations is inappropriate. It is entirely possible that a modified form of SC utilizing symbols, pictures, and diagrams could extend the range of applicability down into the level of Concrete Operations, but such modifications have not as yet been developed.[9]

In regard to Kagan's studies the only style of conceptualization that doesn't appear to be accounted for by SC is the Impulsive thinker. Such thinkers would probably go through the material at a pace that would surely relegate them to a superficial level of interaction. It is possible that the lack of the intangible social reinforcers for giving quick answers (e.g., appearing smart, getting attention etc. . . .) may result in an Impulsive thinker being forced to adopt another style of conceptualization. If this in fact occurs there is still nothing to suggest that the results would be beneficial, in fact it is equally reasonable to assume boredom or resentment will be the immediate result. For Reflective, Analytic, and Thematic thinkers a Study Unit should prove to be an appropriate technique. There is abundant time to think, there is a wealth of detail in each unit, and the underlying purpose of a unit is to enable the learner to understand or react to the pattern as a whole.

In summary the inventors of SC agree with the Gestalt principle "the whole is greater than the sum of the parts." Study Units are constructed to take advantage of the human tendency to seek closure although the SC term is "coalesence" and encompasses more then the gestalt term "closure." The inventors of SC disagree with the gestalt claim that <u>all</u> learning is accomplished by insight. However, the inventors of SC acknowledge that <u>some</u> learning which occurs shares some of the characteristics of insight, as defined by the gestaltists, and therefore constructed Study Units so as to encourage this type of learning even though they feel it cannot be trained. The

construction of a Study Unit embodies all of Bruner's four points about teaching: 1) knowing is a process, 2) the learner must participate in the process, 3) the learner should be taught to simulate the cognitive process of "experts," and 4) the importance of the structure which underlies the subject matter. Finally, five general discovery learning recommendations for teaching were discussed. It seems reasonable to conclude that the use of Study Units can: 1) create a relaxed atmosphere, 2) Study Units do structure discussion so as to encourage "insight," 3) Study Units provide control of digressions, and 4) Study Units do emphasize the importance of structure. The fifth point is concerned with the appropriateness of discovery learning for all learners. It was argued that the use of Study Units, in their present form, is inappropriate below the level of Formal Operations and that it appears to be inappropriate for persons described by Kagan as Impulsive thinkers.

The conclusion which is suggested by these points is that the claim that SC is a programmed technique which successfully embodies many principles or Cognitive Field Theory is justified. I would also add that this is a useful conclusion. This relatively easy translation of key SC terms and forms into cognitive field theory terms and forms suggests a manner of better considering SC - i.e., as technologizing in a much more controlled way many of the proposals of cognitive field theorists than even discovery learning. Simply from the point of view of fitting this rather unusual technique into the mainstream of educational research and teaching practice this is a signi-

ficant point.

NOTES - CHAPTER 4

9. This is not meant to imply that children at the level of Concrete Operations can not read, rather it is meant to draw attention to the results of Piaget's research which suggests that childrens' ability to deal with abstract ideas, concepts, etc. . . . is qualitatively different at the stages of Concrete and Formal Operations. I think that SC may ultimately prove most effective at the level of Concrete Operations because it would introduce children to a mode of inquiry (i.e., exploring the interrelationships of the component parts of structures) which is generally associated with synthetic thinking, at a stage of their mental development where "good habits" of analytical thinking can most easily be formed.

CHAPTER V

TRANSFER OF LEARNING

Implicit in learning theories is the assumption that what is learned in one situation can and will be used in other situations. Indeed without this potential for future utility learning would be futile. A great deal of research has been conducted in an effort to determine the effect previous learning has on current or subsequent learning, or in other words the way in which learning is transferred. In The Transfer of Learning, Henry Ellis provides a concise review and interpretation of such research and summarizes his analysis with several what he terms, "empirical" principles of transfer. These principles should, in his opinion, be considered by anyone interested in asking the question "What kind of training will result in the greatest positive transfer of learning?" The intention of this section is to determine if SC embodies any (or all) of the principles of transfer listed by Ellis and whether or not it is reasonable to conclude that Study Units are constructed in such a way that they provide learning situations which may result in positive transfer of learning for the individuals who use them.

The earliest attempt to explain transfer was the theory of Mental Discipline. The basic premise of this theory was that each person has a "mind substance" which is trainable. The origins of the first form of Mental Discipline theory, Classicism, can be traced to ancient Greece and as it evolved over the years it was argued that the "mind substance" was best trained by studying classical languages, philosophy, and other

subjects which we would now call the "liberal arts." The second form of Mental Discipline theory was termed "faculty psychology" for it argued that the mind was composed of "faculties" which were roughly analogous to muscles in that exercise tended to strengthen them. Some educators felt there was a cause and effect relationship between the "faculty" theory of transfer and the content of curriculum which led them to conclude that the best way to train the mind was to exercise it on hard intellectual work. Some extremists went so far as to suggest that the work should be distasteful as well as difficult for they felt this would exercise the faculty of "will." By the 19th century the curriculum was classical languages (Greek and Latin) and mathematics. The idea, in accordance with the Mental Discipline theory, was that these "hard" subjects would discipline the minds of learners and was therefore the best way to train minds.

Shortly after the beginning of the 20th century, experiments conducted in Europe and North America provided a severe challenge to the validity of the Mental Discipline theory. Perhaps the most damaging research was that conducted by Thorndike who compared the gain on intelligence test scores of students who had or had not studied the so called "disciplining" subjects. The results showed that there was no difference between the gain of students who had studied physical education, for example, and those who had studied Latin. Thorndike's study was so large (over 13,000 students) that the results could not be dismissed as being non-representative of the entire population. Other similar studies supported Thorndike's observations. In

the face of such overwhelming empirical evidence the validity of the "faculty" explanation of transfer of learning came to be regarded as very doubtful. Consequently, the study of Greek and Latin solely for the purpose of "exercising" the mind rapidly declined in North American secondary schools.

The Mental Discipline theory was to a large extent replaced by Thorndike's associationist theory which argued that if transfer is to occur the new learning situation must contain a predominance of elements which are identical to those found in the original learning situation. Disenchantment with Mental Discipline theory resulted in overreaction by educators who created a new curriculum based on the idea of social utility. Proponents of the so called social utility movement interpreted Thorndike's theory of Identical Elements in extreme fashion. They felt that if massive transfer of learning was limited to identical elements then there was a need to make school learning as nearly identical to real life as possible. An attempt was made to anticipate the skills most needed to prepare young people for adult life. The curriculum planners soon ran into problems. They found it was impossible to predict what several million young people were going to need in real life when individual differences were so great, backgrounds were so varied, and when they were going into such diverse careers as farming, nursing, and banking. The unfortunate result was a curriculum that was strictly practical, math students added grocery bills instead of working with geometrical proofs, and one in which the educational materials were presented in the context of the white, middle-class life

style. Predictably many students found unremitting practical studies boring and the millions of students who did not share in the white, middle-class life style found this version of "real life" bore little resemblance to the reality of their own existence once they left school. The difficulties of the social utility curriculum led to a great deal of confusion and dissatisfaction with the schools and resulted in widespread criticism of the educational system. The successful launching of Sputnik by the Russians provided the necessary catalyst for educators to answer their critics and to institute changes in the public school system in North America. Perhaps it was the goad of pride hurt by the Russian achievement in space more than a fundamental concern with educational practices but the result was by and large a rejection of the social utility curriculum.

This brief description of educational controversy illustrates two things; first, research can bring about changes in educational practices and, second, one extreme generalization can unsuccessfully replace another. Since Thorndike's early research on transfer more recent research has been conducted which suggests a much more optimistic view of the possibility of large scale transfer of learning through formal education. As Jerome Bruner describes it:

> ". . . Virtually all of the evidence of the last two decades on the nature of learning and transfer has indicated, that, while the original theory of Mental Discipline was poorly stated in terms of the training of faculties, it is indeed a fact that

> massive general transfer can be achieved by appropriate learning, even to the degree that learning properly under optimum conditions leads one to 'learn how to learn'," (Bruner, 1965, p. 6.)

The current educational process partially reflects this renewed optimism about the possibility of massive general transfer. The curriculum, to a certain degree, once again stresses theoretical subjects. This shift can be attributed to a realization that since it is impossible to predict the specific skills an individual will need once he leaves school, the best preparation is to give him some concepts and organizing principles, so that he can know what the world is like and some training in solving problems on his own. In essence this is what Bruner calls learning to learn.

In order to prescribe a technique for optimizing transfer it is necessary to become familiar with the results of research done to date on transfer of learning. In The Transfer of Learning, Henry Ellis provides a concise review and interpretation of such research. He summarizes his anlaysis with what he calls, several "empirical" principles of transfer. These principles provide the basis for the subsequent discussion of transfer and the way in which SC meets or fails to meet the conditions for maximum positive transfer of learning.

"Empirical" Principles of Transfer

Understanding and Transfer - Transfer is greater if the learner understands the general rules or principles which are appropriate in solving new problems.

Learning to Learn - Cumulative practice in learning a series

of related tasks or problems leads to increasing facility in learning how to learn.

Insight - Insight, defined behaviorally as the rapid solution of problems, appears to develop as a result of extensive practice in solving similar or related classes of problems.

Amount of Practice on the Original Task - The greater the amount of practice on the original task, the greater the likelihood of positive transfer; negative transfer is likely to occur following only limited practice on the original task.

Task or Stimulus Variety - In general, variety of tasks, or of their stimulus components, during original learning increases the amount of positive transfer obtained.

Mediated Transfer - Transfer can occur as a result of mediation due to the network of associative linkages between tasks.

Over-All Task Similarity - Transfer of training is greatest when the training conditions are highly similar to those of the ultimate testing situation.

Stimulus Similarity - When a task requires the learner to make the same response to new but similar stimuli, positive transfer increases with increasing stimulus similarity.

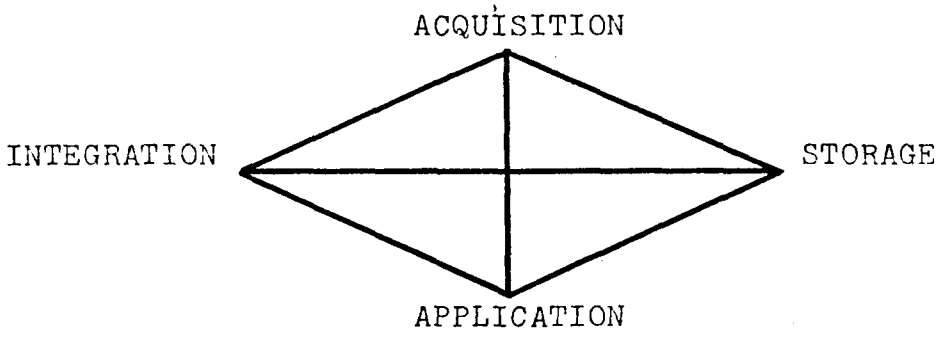
Response Similarity - When a task requires the learner to make a new or different response to the same stimuli, transfer tends to be negative and increases as the response becomes less similar, (Ellis, 1965, pp. 71-72.)

In order to subject something as complex as the phenomenon of

transfer to empirical examination it is necessary to select one very limited aspect at a time for study. When one reviews the research literature the unfortunate impression that transfer is a collection of discrete, linear, and discontinuous events is inescapable. This makes it difficult to form a comprehensive mental image of what transfer is and how it works. If one attempts to assemble the various "events," which have been the subject of research, into a unified structure a different and much more meaningful image of transfer emerges. The model described below (see Figure 8) is provided in order to emphasize the nature of transfer and to provide a logical framework of reference points so that events which have been studied in isolation from one another can be related to the entire structure of transfer.

Primarily transfer is a process. The stages of the model are merely parts of a heuristic device which is meant to convey the idea that the transfer process is dynamic, continuous, and is composed of elements that are interrelated in a non-linear fashion. Each and every one of these arbitrarily designated stages can interact simultaneously just as easily as they can occur individually. For example, a person who is familiar with locking a door by placing a bar across it would have little difficulty with a bolt lock the first time he encountered one. In this instance all of the stages, of the model, are employed simultaneously and the solution of the novel situation appears almost instantaneously with little effort. However, it is obvious that more complex situations require more time and greater effort and any one of the stages may be the

Figure 8. The Transfer Process



mode of operation engaged in apart from the others. For instance, when Watson and Crick finally developed their double helix model of DNA it represented the culmination of years of hard work. Prodigious amounts of information had to be acquired, this material also had to be stored in memory, and a great deal of time had to be spent analyzing the problem to be solved. While all stages of the transfer process may have been unconsciously interacting in the minds of Watson and Crick, long periods of time may have been spent consciously in only one particular stage and the successful application of previous learning to a novel situation took years instead of the virtually instantaneous solution of the bolt lock problem in the preceding example.

The stages of the model of transfer are briefly described as:

ACQUISITION

The conditions and content of the initial learning situation.

STORAGE

Conditions that affect memory and retention of acquired learning, conditions affecting retrieval of information.

APPLICATION

The process of analyzing the new situation and relating it to previous learning - i.e., problem solving.

INTEGRATION

The treatment of the new situation itself as a learning situation, the coding and dissemination of the new material to appropriate storage areas.

The first empirical principle in Ellis' summary stresses the importance of the learner understanding the general rules and principles appropriate to solving new problems. Does an SC Study Unit facilitate the learner's understanding of such rules and principles? The initial step in the preparation of a Study Unit is a task analysis by the author, in which he specifies what it is he wishes the learner to know when he (the learner) has completed the unit. The author draws a concept map that identifies the concepts, rules, and principles upon which the subject matter is based as he sees them. The author's job is now to present this material in a manner that is most effective in enabling the learner to comprehend it. The format of a Study Unit is consistent with the programmatic organizational guidelines developed by David Ausubel in his research on sequential transfer. The technique advocated by Ausubel is the utilization of "advance organizers," so called because they are presented to the learner in advance of the learning material itself. The organizers are presented at a higher level of abstraction, generality, and inclusiveness to provide the learner with what Ausubel calls "anchoring" ideas or in other words an intellectual framework upon which to organize the subject

matter of the material being studied.

The advantages of organizers, to the learner, is that they provide what Ausubel terms a subsumer which 1) gives the learner a general overview of material to be encountered later, and 2) provides organizing elements that are related to the particular content of the material which is to be encountered later. In one of his early studies Ausubel used a specially prepared passage on the metallurgical properties of plain carbon steel. He used two groups in his exeriment. The experimental group was given the benefit of advance organizers in the form of a written passage which they read prior to reading the passage on carbon steel.(the subject of the lesson.) Some of the major principles (organizers) taught prior to reading the passage on carbon steel were the major similarities and differences between metals and alloys; their respective advantages and limitations; and the reasons for making and using alloys. The control group received instead an introductory passage of historical material which lacked these advance organizers. Ausubel found that the advance organizers significantly improved the experimental groups' retention of the material on carbon steel. He concluded that a learner cannot acquire and retain higher-order principles unless he has already learned the component principles. He further concluded that advance organizers are best suited for the learning of factual material since abstract materials contain their own built-in organizers. Thus material which contains a substantial body of differentiated or factual content offers the best scope for the ideational scaffolding provided by advance organizers.

In a Study Unit the Intention section is the place where advance organizers are presented to the learner. Here, at a higher level of abstraction and generalization the significant concepts, rules, and principles are introduced and related to the material which is to be dealt with in the Study Unit. In Ausubel's carbon steel example the advance organizers would have been presented in the Intention section had Ausubel used the Study Unit format.

Because learners are being exposed to an entirely new field of knowledge, or to an unfamiliar branch of a familiar body of knowledge the component sections of a Study Unit are organized so as to be consistent with the principle of Progressive Differentiation. This means that the learner who is working his way through a Study Unit is being exposed to the material in a manner that corresponds to the way in which it has been suggested that knowledge is organized and stored in the human cognitive system. Such an approach makes two assumptions, 1) it is easier for the human mind to comprehend from the general to the particular instead of the reverse, and 2) that the human mind stores knowledge in hierarchies with the most inclusive ideas at the top where they encompass progressively differentiated propositions, concepts, and factual data.

In terms of the construction of a Study Unit the Intention section is encountered first for it represents the material at the highest level of abstraction and generalization. Next, the Presentation section contains more differentiated ideas and factual data at a lower level of abstraction, such as the material on carbon steel in Ausubel's experiment. Finally,

the Response Matrix contains the individual component parts of the over-all structure of the material being studied. The Investigation section requires that the learner utilize the matrix elements to build his own hierarchy of knowledge concerning the subject matter.

Therefore, in summary, a Study Unit facilitates a learner's understanding of general rules and principles in the following ways: 1) task analysis of the subject matter, 2) advance organizers, and 3) a format whose construction is consistent with the principle of Progressive Differentiation.

Another principle of transfer is "learning to learn," by which is meant cumulative practice in learning a series of related tasks. The experimental basis for this principle is Harlow's work on learning sets. In his experiments Harlow found that the subjects (monkeys) progressively improved their ability to learn object-quality discrimination problems. The important fact here is that the monkeys were exposed to multiple, though comparable, learning problems. Although a particular type of problem was frequently encountered the stimuli were always different. Therefore, in order to obtain a reward the monkeys could not rely on stimulus recognition but had to learn to identify the type of problem they were to solve. Harlow claimed this type of learning was learning how to learn efficiently and that it was a process that enabled the monkeys to solve problems by seeming insight and hypothesis rather than by trial and error. To describe this type of behavior Harlow coined the term "learning set," and emphasized that this sort of learning was a highly **predictable, orderly** process. However,

of what relevance is this information to a discussion of the way in which SC might aid a learner to learn?

Many years ago Dewey stressed the emptiness of "verbal knowledge," the all too human tendency to dismiss an idea by naming it. "What is it's name?" becomes a substitute for "How does it work?" SC makes a similar observation of human nature in it's so called "Law" of Mental Declension - namely that the human mind is lazy. While labelling is obviously indispensible in reducing a complex world to manageable size, such a tendency is dangerous when one is trying to understand a complex situation. To use Ausubel's example of carbon steel once again, if someone wished to dismiss it from a discussion a comment such as "Oh, all you mean is that it is an alloy" might commonly be overheard. The correct usage of the label is clearly meant to imply a full understanding of the subject. SC is designed to overcome the natural tendency of the mind to be lazy by requiring interaction on a level much deeper than label identification.

It is necessary to examine in greater detail the manner in which SC manages this deeper form of interaction. First, a Study Unit can be likened to Harlow's experimental design in that it exposes the learner to multiple, though comparable, learning problems. For instance in the Study Unit "Henry VII and Economics" the overall task is to:

> " . . . consider how far Henry's success was due to his particular genius as a business man, how he accumlated so much money during his reign and how he manipulated and spent it as a means to achieving his ambition."

This task is set in the Intention section and is followed by material in the Presentation section that will be the historical and factual material with which the learner will work in order to solve the task. Next, the learner is challenged by a series of problems he must answer.

Problem 2:

"One of Henry's most useful gifts was adaptability to circumstances and his capacity to exploit them to his own advantage. This is seen in the sheer opportunism by which he grabbed the throne, and in the ways he exploited the conditions and political organization which existed in the country once he was on the throne. What statements in the Response Matrix do you feel describe conditions or situations which he was able to exploit when he first came to power?"

Problem 3:

"Henry seems by nature to have been avaricious and displays the characteristics and attitudes of the ideal tycoon. The opportunism which brought Henry to the throne by means of a gamble that could have proved fatal we see in action at other times during his career as king. Allied to his opportunism, as causes or results, of it, are his meaness, his greed, his lust for power, his tendency towards "Depotism,' his ruthlessness in building up his wealth, his cunning in avoiding centres of opposition, etc. From the Response Matrix compose a group of statements which you feel best illustrates this side of Henry's opportunism in action."

In order to answer these problems the learner must compose

an answer using the elements of the Response Matrix. When one is forced into this mode of Response it is difficult to compose a meaningful and coherent answer by making only a labelling response such as "Henry was successful because he was a shrewd businessman." The learner must become actively engaged with the material in order to compose his response. This is a process involving discrimination, evaluation, critical judgement, and the mental effort needed to organize an answer. This is the same process that Harlow describes as characterizing the process leading to the formation of learning sets, or in other words learning how to learn.

Interaction with a Study Unit also embodies several of the other principles mentioned in Ellis' summary. From the Response Matrix of the Henry VII unit it can be seen that some elements are common to more than one problem. Since some of the elements of the matrix are relevant to more than one problem they may be seen as elements of related problems. Due to this interelatedness the elements of the matrix may be said to perform a mediative function. In fact the entire matrix may be viewed as a field of mediating elements. This aspect of the Response Matrix makes it consistent with the principle of mediated transfer which states that transfer can occur as a result of mediation due to the network of associative linkages between tasks.

Another of Ellis' principles indicates that transfer is encouraged by a variety of tasks, or their stimulus components, during original learning. If the task, as defined in the Intention section, is taken to be the over-all task and each

Figure 9. Response Matrix From Henry VII and Economics

RESPONSE MATRIX

He allowed his servants to use extortinate methods in his name. 1.	He extended the use of Justices of the Peace. 2.	He twice revised the Book of Rates. 3.	He tried to force a trade treaty on the Archduke of Burgundy. 4.
He circumvented the Exchequer which was a stronghold of baronial influence. 5.	He continually invested in land. 6.	He claimed and collected all his rights as 'Fuedal' Overlord. 7.	He negotiated the 'Intercursus Magnus' in 1496. 8.
He increased the revenues from the Royal Courts. 9.	He called Parliament as rarely as possible. 10.	He fostered trade; England being an island, London a Port, and water the easiest means of communication. 11.	He kept ecclesiastical sees 'vacant' for as long as possible. 12.
He checked nearly every item in his account book. 13.	He blackmailed the King of France to buy him off in 1492. 14.	He meticulously levied the Tunnage and Poundage due to the King. 15.	He was willing to sell pardons, wardships and even ecclesiastical office. 16.
He scrupulously paid back his early debts. 17	He kept out of European wars as far as possible. 18.	He founded the Chamber to handle his financial business more efficiently. 19.	He 'farmed out' royal lands to ensure a steady income. 20.

problem in the Investigation section taken to be a stimulus component of the over-all task, an SC unit is once again found to be consistent with a principle of transfer. Each of the problems takes the learner through the materials but in each case from a different perspective. The learner is thus exposed to the material in a variety of ways. This leads us to

yet another principle of transfer embodied in the format of a Study Unit.

This principle stresses the idea that the greater the amount of practice on the original task the greater the liklihood of positive transfer. The entire cyclical process by which a learner works his way through a Study Unit gives the learner considerable practice with the original task. The transferable content of this experience is twofold: 1) an understanding of the topic and the factual material contained within it, and 2) having learned to learn or in other terms the skill of inquiry. The question of "how much practice is enough" needs to researched thoroughly but some informal observation, (Bortoft, 1970) suggests that people who have used SC over a period of years have found their problem solving ability increased, which implies a transfer of what has been termed in this discussion learning to learn.

Among other results of Harlow's work on learning sets was the fact that the shape of the subjects' learning curves approached linearity. Curves of similar form have been described as indicators of "insightful learning." Insight, defined behaviorally as the rapid solution of problems seems positively affected by extensive practice in solving related classes of problems. As is clear from the discussion of SC and Insight in Chapter 4 of this study, Insight is defined in SC terms as something that cannot be directly trained. From the preceding discussion in this section it should also be equally clear that a Study Unit utilizes solution of related problems as its format. In light of the research summarized by Ellis, in particular Harlow's

work on "insight," it appears that it may be possible to train Insight, albeit indirectly. However, it is important to keep in mind that Bennett was referring to "creative events" and not "insight" when he observed that there was no evidence to suggest that "creativity" was trainable. The two terms have been presented contiguously in this study because they share some defining characteristics. But, in relation to Harlow's observations, the format of a Study Unit and its emphasis on continuous practice in the solution of related classes of problems, appears in my view to be entirely consistent with this principle of transfer. Regardless of whether or not a consensus exists on whether or not the terms "creative events" and "insight" mean the same thing, it is reasonable to conclude that if Harlow's observations are correct then the construction of a Study Unit does provide an environment in which the incidence of insightful solutions to problems may be increased.

Another of Ellis' principles maintains that the ultimate testing situation should be as nearly identical as possible to the original learning situation. This means, on the academic level, that if learners study using the SC format they should be tested using the same format. At another, and perhaps more significant level, SC may be of great relevance to learners. In the earlier part of this section the attempts of the proponents of the social utility movement to analyze the necessary life skills of young people was described. Because of the type of problem solving skill required by an SC Study Unit, it is possible that the most nearly identical testing situation is life outside the school system. Few problems in life can be

solved by simple one answer, linear solutions. Most problems in life are complex, non-linear, and have alternative solutions each of which has different consequences for the decision maker. To effectively cope with life an individual must have developed a faith in his own judgement, his own faculty of critical analysis, his own sense of discrimination, and have had practice in solving complex situations. All of these abilities are required for successful interaction with a Study Unit and for this reason perhaps it is this skill which will prove most relevant and transferable to that ultimate testing situation, daily living.

The remaining two principles, Stimulus Similarity and Response Similarity, are provided for in the SC technique in such a manner that positive transfer is encouraged. While the learner is responding to a variety of stimuli his response, in essence, is the same - namely that of composing an answer by selecting a set of elements from the Response Matrix. While the elements of which the answer is composed may vary greatly, the behavioral response is still the same. In short, SC varies the stimuli but holds the response constant, the condition that is described as encouraging positive transfer.

Therefore, to summarize, SC has been described as being consistent with the empirical principles listed by Ellis as affecting positive transfer of learning. Transfer was desceibed as a dynamic process with four stages. The remainder of the section was spent examining the relationship of a Study Unit to each principle of transfer. The final conclusion to be drawn from the discussion presented in this section is that a Study Unit embodies all of the empirical principles listed by

Ellis. Furthermore, it is reasonable to assume, that because these principles are embodied in the SC techniques that consistent, long-term practice with Study Units may result in positive transfer of learning. If this is true then it seems likely that transfer of particular skills could be facilitated by the use of SC materials. There are general problems in designing a method of measuring the amount and/or type of transfer, but Ellis' work might well provide a basis to develop tests of SC's potential for encouraging transfer.

CHAPTER VI

DISCUSSION

SUMMARY

The purpose of this study was to make Structural Communication, a new instructional technology, more accessable to people who might well be interested in its practical benefits and also might make its claims of instructional success available to empirical evaluation. Due to the idiosyncratic nature of SC's development, and due to its origin in a rather esoteric context, what little literature was available was in a "language" which was unfamiliar to North American researchers in communications, psychology, and education. Thus there was a need for a "translation" of SC's language into frames of reference common to North America.

To accomplish this task the inventors' ideas of learning were examined, by a comparative analysis, in relation to selected, contemporary North American theories of or perspectives on learning. The perspectives on learning with which SC was compared were selected because they were generally accepted by a fairly large proportion of researchers in these fields, and if not accepted at least understood and frequently found useful as a means of conceptualizing some parts of their inquiries.

Chapter I described the form and rationale of SC as an instructional technology.

Chapter II compared SC with Linear Programming, B. F. Skinner's instructional technique based on the results of his research in behavioral psychology.

Chapter III examined SC in relation to Arousal Theory, and

in particular the work of D. O. Hebb and D. E. Berlyne.

Chapter IV compared SC with Discovery Learning, an instructional technique based on Cognitive Field Psychology. The work of Jerome Bruner was cited due to his position as a generally acknowledged leading advocate of the technique.

Chapter V examined SC in relation to Henry Ellis' work on the transfer of learning.

RECOMMENDATIONS

One of the aims of this study was to suggest aspects of SC that could productively be examined empirically. The following list of such items is based on two premises; 1) SC's general claims, when examined from the perspectives taken in this study, seem at least plausible in most cases, and 2) comparative testing of instructional techniques to date has been rather unproductive and the results inconclusive. The conclusion I have drawn from this is that further comparative testing (i.e., with SC) would not be the best use of time and energy. Rather, research efforts should be devoted to development of the SC technique.

However, there is a distinction to be made between the types of questions raised by this list of recommended items for empirical study. Some questions are very general, that is, while they are perhaps empirically testable, such testing would be very difficult and I doubt that any clear answer is possible given current conditions in our educational system. The other type are more practical questions for which it appears there are no final or absolute answers but would be useful to the development of SC. For example, my own informal observations (Whitt-

ington, 1974) of SC materials in use in English schools enabled me to make several suggestions to SC authors preparing new material, which they incorporated into the Teacher's Guides. Whether or not my suggestions represent real improvements remains to be seen, but the point is that even informal and unsophisticated research can provide sufficiently clear answers to guide sensible practice in the use and development of SC.

General Questions:

1. Is it possible to produce "good" Study Units using a team approach (i.e., subject matter expert(s) and an SC expert) or is a Study Unit a work of "art?" This is a useful question for the answer affects the cost of producing Study Units. If the SC author is an "artist" and his skills are not trainable then there are probably relatively few persons who can write Study Units and preparation is therefore probably expensive. However, if Study Units can be produced by a collaborative effort the time and expense of preparation should be competitive with existing materials.

2. Is SC appropriate to all types of subject matter? It is not clear to me whether Study Units can be written on poetry and physics, for example, with an equal degree of effectiveness. Perhaps SC is inappropriate for simple vs complex systems, or closed vs open systems.

3. Can SC successfully accommodate all cognitive styles? If not, to which cognitive styles is it appropriate? Kagan's classification of cognitive styles might be used as the basis of such research.

4. Does the use of SC material facilitate the transfer of

particular skills?

5. Is delayed feedback (i.e., the SC "dialogue") more effective than immediate feedback?

6. Does long term use of SC materials improve synthetic thinking?

7. Do the elements of the Response Matrix create "conceptual conflict?" If the items of the matrix are designed with Berlyne's idea of Collative Variables in mind and if "conceptual conflict" is in fact created by the matrix items, then this may yield some insight into the way in which programmed material may provide learners with motivation to learn.

Practical Questions:

1. Age Level - It appears that in its present form the Study Unit is inappropriate below the level of Formal Questions. However, with research on modifications in form and language it may be possible to extend the use of SC materials down into the level of Concrete Operations. This is of potential value because "good" habits of analytic thinking could most easily be formed before the stage of Formal Operations.

2. Effect of Teachers - In my study (Whittington, 1974) I observed that the teacher definitely affected the success of the students' use of SC material in several ways. For example, teachers who thought of the matrix as a complex multiple choice test were inevitably dissappointed with their students' performance. The teacher's mode of leadership was also very influential. Teachers who were very directive or authoritarian generally found that their students got poor results with SC materials. Conversely, teachers who understood the SC format and were less

directive reported a high level of satisfaction with the performance of their students on the SC materials. Therefore, a way should be developed to "educate" teachers who plan to use SC materials about the nature of SC material itself and the ways in which their leadership style can affect their students.

3. Student Orientation - In the same study (Whittington, 1974) I also observed that while students readily took to the SC materials for individual study they required practice with the SC "way of thinking" before they could work together effectively in study groups. A student orientation on group dynamics would no doubt reduce the time required for the students to become comfortable with the group mode of interaction with SC materials.

4. Presentation Section - This part of the Study Unit can certainly be improved. With the sophistication and variety of audiovisual technology a much more visual mode of presenting the material to be examined in the Study Unit could be developed which would not entail any loss of information. A Study Unit could also be adapted to other media forms for instance films, plays, simulations on videotape.

5. Assessment - There is a wealth of possibities for a new and significant method of testing thinking by using matrices and challenges. To date the best way to test for a thorough understanding of a subject has been the essay test. The obvious drawbacks of this type of test are the subjective evaluation and the amount of time consumed in reading each response. Using the SC matrix system each item of the matrix could be weighted and tests for items included or omitted; relevant, irrelevant, and/or mutually exclusive; tests for cohesiveness of the res-

ponse etc. . . . could be developed and perhaps scored with computer assistance. The result would be an objective test that also gives a measure of the strategy used to compose the response as well as the quality (i.e., cohesiveness) of that response, (see Smith and MacInthosh, 1973.)

CONCLUSION

In this study the most limited form of SC (i.e., the Study Unit) has been the subject of examination. My conclusion in regard to the Study Unit is that the general claims, when examined from the perspectives taken in this Study, seem at least plausible in most cases, and rarely are they unsupportably outrageous.

However, because of some of the questions raised above; type of subject matter, age level, cognitive style etc. . . . I believe Study Units have a limited place in the educational system. The most appropriate use of Study Units is self-directed learning such as the correspondence courses of England's Open University. I think Study Units are the best form of programmed instruction where it is desired to encourage synthetic thinking and understanding. Another use for Study Units is operational instructions. For example, imagine a company has just drafted a major policy change and it is imperative that all managers thoroughly understand the details and impact of the new policy. A Study Unit could be prepared using the new policy as the subject matter and sent to all managers for individual study.

More important perhaps, is the area to which I think Study Units are inappropriate - the public school system, K-12. My main objections to Study Units at this level are; 1) they are

not significantly different from standard textbooks, 2) they do not allow for student input other than making a response, 3) the author tests for "right" answers by his criteria of adequate understanding, 4) there is no way to "teacherproof" SC material, and 5) they may be too limited (i.e., age level, cognitive style etc. . .) to be used as classroom texts. I shall briefly discuss each of these objections.

First, because the Study Units are printed and bound like regular books they look like standard textbooks. This in itself is not significant but some teachers seem to find it irresistable not to use the Investigation and Response Matrix sections as ready made tests or as homework assignments. I observed this practice in England and where it occurred the students resisted using the Study Units and the potential value of the units for spontaneous inquiry was nullified.

Perhaps my main objection is that the Study Unit allows for no student input other than making a combinatorial response. There are no blank squares in the matrix for student ideas or suggestions nor could the Comments section give any feedback on them if blank squares were provided. This does tend to make the Study Unit closed and restricts, in my opinion, student creativity.

This leads to my next objection, that the author really does test the learner for "right" answers. In a programmed form of instruction this is inevitable and I appreciate the fact that SC gives the learner more scope than other forms of programmed instruction (ommitting of course computer assisted systems.) However, my objection is that the impression one gets from a

Study Unit is that one is free to compose his own response and is not going to be judged by what the author believes to be the right answer. At least in Linear Programming it is blatantly obvious that the learner is to supply someone else's idea of the right answer. This is covert in a Study Unit and I think that a false expectation of freedom to respond is more harmful than being forced to be responsible for a predetermined response.

Next, the Study Unit (as any other instructional technique) is subject to abuse and misuse by the teacher. As long as the teacher has the power to determine the manner in which he will use the Study Unit they will often be misused.

Finally, each classroom contains a group of diverse, individual children. Study Units have not yet been refined to the point that they can be used with equal effect by a diverse group of students. It appears to me that the most appropriate classroom use of Study Units is as a resource library for self-directed individual learning.

If these observations seem unduly pessimistic about the future of SC in the school system this is not the case. All of the above comments and observations have been concerned only with one form of SC, the Study Unit. However, in general, I am quite impressed with the potential of other forms of SC for use in the school system. From my first hand experience in England I think that the most promising form of SC is the small group form. There are several reasons for my enthusiasm. First, SC gets the group quickly into the topic. Next, it keeps the group on track and controls unproductive digressions. The SC process ensures that all of the group resources (i.e., the group members) are

utilized. For school study groups this process has many benefits. It encourages co-operation and gives students experience with group problem solving. The input is virtually all from the learners. The teacher becomes much more a facilitator than a leader. The SC process prevents dominant personalities from controlling the group. It also ensures that timid personalities are not overlooked. This form encourages, indeed thrives on, the exchange of ideas, views, and perceptions with one's peers. In short it is, I think, the most promising form of SC for educational purposes.

In summary my conclusions are; 1) the general claims in regards to Study Units seem at least plausible, 2) Study Units have limited use in our educational system, 3) Study Units are virtually inappropriate for grades K - 12, and 4) that the SC small group form has the most potential for use in the public school system.

GLOSSARY

AUTHOR:

A person(s) who is "expert" in a subject matter area and is responsible for the construction of a Study Unit. In comparison with CAI or Linear Programming an SC author is analagous to a programmer.

AUTOMATIC:

The lowest level of the SC four level model of thinking. The Automatic level is characterized by operations that are below the threshold of mental awareness. For example habits, or skills that were acquired consciously (i.e., driving a car, or walking) but no longer require conscious mental effort when in operation.

CHALLENGE:

A challenge is an obstacle placed, intentionally or by accident, in the line of activity that can be overcome only by increased determination and generally by a higher intensity of mental operation. Thus "challenge" is the SC term for "shock" (i.e., external stimulus) which raises the learner's level of mental operation to a higher one when he works with a Study Unit. In a Study Unit the challenges are respresented by the problems of the Investigation section. An SC challenge is a shock which makes an appeal to the intelligence of the learner within the context of a program of constructive work.

CHALLENGE, PRINCIPLE OF:

The principle of challenge is the counterpart of the so

called Law of Mental Declension, for it asserts that it is possible to use the self-assertive instinct in man to overcome his mental laziness.

COALESENCE:

"Elements are said to be in coalesence when they lose their functional identity and acquire a new systematic identity . . . such that elements cannot be added or removed . . . the term coalesence refers specifically to the mode of togetherness of the totality," (Bortoft, 1970.) Coalesence is roughly analogous to the Gestalt term "closure." However, coalesence is used in SC to indicate that, to the inventors of SC, understanding involves more than visual perception only, of the elements of a problem in physical proximity to one another. Thus, unlike the Gestaltists, the inventors of SC do not equate seeing with understanding. The additional requirement for understanding, at least in SC terms, is that the learner "make sense" of the elements of a problem, which he may be perceiving visually, by comprehending the interrelationships of the elements.

COMMENTS:

The Comment section is the segment of a Study Unit where the dialogue between author and learner occurs. The comments themselves are the author's response (i.e., thoughts, observations, and suggestions) to the set of Response Matrix items that have been selected by the learner as the answer to a challenge.

COMPOSE:

In SC use of this term connotes the process of making a combinatorial response, that is it requires the learner to select a set of items from the Response Matrix and combine them to create a single coherent response.

CONCORDANCE:

Concordance is a psychological factor involved in an act of interpersonal communication. Concordance stems from the independent judgement of people and is not a matter of learning in the ordinary sense. Many human situations involving communication depend not on people memorizing the information given but on reaching a consensus on the meaning to be given that information. Concordance is the term which connotes mutual agreement on the meaning of information in an act of interpersonal communication.

CONSCIOUS:

A level of the SC four level model of thinking. Characteristic features of mental operations on the Conscious level are understanding, hypothesis formation, original - as distinct from creative - thinking, and impartial judgement. Thinking at this level is synthetic as distinct from associative.

CREATIVE:

The highest of the SC four level model of thinking. It is characterized by spontaneity, surprise, and the lack of any ratiocinative process. At this level an individual who is the author of a creative event is unable to

identify any conscious cognitive process that led to the event, it is an act of true discovery.

CREATIVE EVENT:

This term describes an event which is based on an innate artistic ability to create. For example, there is no doubt that formal training was helpful for Mozart, but training alone cannot account for his genius for composition. Mozart had an innate ability for creative musical composition. The moment of inspiration in each of Mozart's compositions would be described, in SC terms, as a creative event.

DECONDITIONING:

It has been noted that it is a tendency of the human mind to operate at the lowest levels of mental operations unless something occurs to raise the level of attention. Under conditions of minimal attention, learners tend to "read" their own mental associations without bothering to verify them. In other words people tend to react to new information by preconceptions, stereotypes, or habitual impressions. There is increasing evidence that associations acquired under conditions of low interest and lower mental operations requires a severe "shock" to "break open" the pattern of association. It is the process of "breaking open" associations by administering "shocks" in a constructive program of activities that SC calls deconditioning.

DIALOGUE:

Dialogue as used in SC refers to programmed interaction

between author and learner in a Study Unit. The learner composes his response to a challenge by selecting a set of items from the Response Matrix. He then tests his response by using the Discussion Guide which routes the learner to the appropriate author's comment. The comments provide feedback from the author which is based on the learner's particular response.

DISCUSSION GUIDE:

The Discussion Guide is the tool for analyzing the learner's responses and directing him to the author's comment(s) which is appropriate. The analysis takes the form of routing tests for inclusion or omission of essential items. The author analyzes his own formal logic and then uses it as his guideline to construct the Discussion Guide. The first tests are designed to catch omissions of essential items and inclusions of irrelevant items. The other tests are for coherence of the response, that is does the response contain items which are mutually exclusive or does it contain so many irrelevant items that the response does not display an acceptable level of discrimination and judgement.

INTELLIGIBLE CONTENT:

SC suggests that every situation has a structure having both a knowable and also an intelligible content. The intelligible content is the theme. This distinction is similar to that made between the letter and the spirit of the law. The letter is information, but the spirit

must be grasped by an act of intelligence. The letter is bound to a pattern of behavior, whereas the spirit allows creative action. For example, a judge may dismiss a case in which a defendant could be convicted under the letter of the law but such a conviction would be unjust under the spirit of the Law. To set aside a case such as this the judge must understand the intelligible content of the law.

INTENTION:

The section of a Study Unit which introduces the subject matter and describes the behavioral objectives. In general it serves to orient the learner to the content and context of what the author intends for the learner to learn from the Study Unit.

INVESTIGATION:

This section contains the challenges which require the learner to organize the subject matter - as represented by the matrix items - into coherent answers which demonstrate his grasp of the material. Each challenge represents a different perspective on the subject matter and requires different combinations of the matrix items.

KNOWABLE CONTENT:

SC suggests that each situation has a structure having a knowable and also an intelligible content. The knowable content is the information concerning the structure. It is analagous to the letter of the law as distinct from the spirit of the law (see Intelligible Content.)

KNOWLEDGE:

SC maintains that knowledge and understanding are closely related but not identical terms. In SC use knowledge is equated with information. Knowledge is the content of a framework or schemata. The inventors of SC claim that knowledge can be acquired passively in contrast to understanding which requires participation in an action. For example, the inventors of SC maintain that one can acquire the letter of the law (i.e., the statutes, articles, etc. . .) and still not acquire the spirit of the law. In other words it is possible to "know law" and yet not "understand law."

"LAW OF MENTAL DECLENSION"

Basically, this "law" merely states that the mind is lazy and that it requires an external stimulus in order to raise the level of mental operation. The "law" makes two suggestions about stimuli and the mind:

1) To communicate with the lower levels of the mind the stimulus should be minimal and repetitive.

2) To communicate with the higher levels of the mind the stimulus should be maximal and unique.

LEARNER:

An arbitrary term which I have used throughout this study to distinguish a user of a Study Unit from the author. Synonyms such as student, respondent, or interactor are perfectly valid but I felt that the author - learner pair of terms was the most concise

and clear.

PRESENTATION:

The section of a Study Unit that contains the body of facts, data, statements etc. . . . that comprises the theme and subthemes of the subject matter which the learner is to acquire or learn.

RESPONSE MATRIX:

The section of a Study Unit which contains an array of items that restate the component parts of the main theme in a condensed form. The matrix is a symbolic map of the theme consisting of phrases presented in a random manner - i.e., without indicating how the matrix items may be organized to make sense. The matrix is the common vocabulary for the dialogue between author and learner.

SC FOUR LEVEL MODEL OF THINKING:

This is not a formal model, rather it is an heuristic device which was developed to facilitate discussion of research data that suggests several qualitatively different types or levels of thinking exist. The SC "model" is in fact a continuum. Neither the boundaries nor the levels are meant to be construed as mutually exclusive or rigid. In fact, the inventors of SC maintain that an individual may be simultaneously engaged at all four levels at a given instant.

SC PRINCIPLE OF STRUCTURE:

The principle adopted by the inventors of SC is that all situations with which human beings must deal, are

organized structures. Human behavior is not merely instinctive, but a very adaptive combination of foresight and hindsight. The inventors of SC claim that "human behavior is successful to the extent that it corresponds to the patterns of the situation, both internal and environmental." Thus according to the inventors of SC, human beings recognize and understand situations to the extent that they have a well-defined structure.

SENSITIVE:

One of the levels of the SC four level model of thinking. The Sensitive level is one of limited awareness and the mental activity is primarily associative. Logical thinking, experimentation, self-expression (verbal and symbollic), adaptive and purposive activity are all possible on the Sensitive level without recourse to any other level.

SHOCK:

A shock is an external stimulus which gains the attention of the subject individual momentarily. A shock is a stimulus that may or may not have any positive intention or result. A shock is unexpected. Another feature is that it is not possible to "make sense" of the stimulus involved - i.e., it is not possible to assimilate the stimulus into established frames of reference, instead new frames of reference must be developed or old frames of reference modified.

STRUCTURAL COMMUNICATION (SC):

The phrase Structural Communication was coined by the inventors of SC in an effort to provide a descriptive label for their technique. Structural Communication is the copy-righted name for the technique which is the subject of this study. The phrase was meant to convey the idea that SC transmits understanding of situations through discussion and/or investigation of their underlying structures. My personal opinion is that in this aim the inventors of SC have been unsuccessful and have formally adopted a label which is confusing and ambiguous, rather than descriptive.

STRUCTURAL HOMOLOGY:

The SC technique is based on the hypothesis that the knowable and the intelligible components of a structure are homologous though not identical. Homology, in this context, means that there is basic correspondence of essential elements even though there is a qualitative distinction. For example, an airplane wing is designed in accordance with the theory of aerodynamics. However, the description of the functional mechanism (i.e., the wing) will not convey the aerodynamic principles upon which it's design was based. Thus, to understand the "structure" of an airplane, one must describe the functional mechanisms of which it is built (i.e., the knowable content) as well as the principles which underlie the design of these component parts (i.e., the intelligible content.)

STUDY UNIT:

This is the name of the form that the programmed instruction application of the SC technique takes. It is a printed form similar in external appearance to a standard textbook. However, the internal "text" is organized into six sections which are called:

1) Intention
2) Presentation
3) Investigation
4) Response Matrix
5) Comments
6) Viewpoints

SUBJECT MATTER:

As used by SC the term "subject matter" means the information content of a Study Unit. Facts, data, statements, quotations etc. . . . in fact all of the material which the learner will be exposed to within a Study Unit are described by the term "subject matter." The author may present this material in virtually any form he may choose; textual material, films, pictures, plays, field trips, etc. . . .

UNDERSTANDING:

SC makes a distinction between knowledge and understanding. In a sense it is the distinction between "knowing what" and "knowing how," but only to a degree because it is possible to know how to do something without understanding it. SC suggests that understanding requires an insight that goes beyond what is

actually known. The inventors of SC also propose that understanding, requires participation in an action. Another aspect of understanding is that it tells one what one can do with his knowledge, how it can be used and where to find useful knowledge. Understanding, in SC use, can be viewed as the upper limit of transferability of training.

VIEWPOINTS:

The section of a Study Unit in which the author explicitly discusses his biases, critical points, and his overall view of the material. The Viewpoints provide the learner with points of view other than those of the author and plays a final integrative role for the summation of the main theme of the Study Unit.

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APPENDIX

POINTS AND CONCLUSIONS OF THE COMPARATIVE ANALYSIS

In Chapters 2-5, SC was compared and examined in relation to several different theories or perspectives of learning. In each of the chapters points of similarity or disparity were identified and a conclusion reached. The following list is a summary, by individual chapters, of the points examined and the conclusions reached.

Chapter II- Linear Programming

Areas of Agreement:

1. Schools are inefficient learning environments.
2. Instruction should be individualized.
3. Programmed techniques should be non-aversive.
4. Learning experiences should be "structured."
5. Skinner's general requirements for programmed instruction are valid.
6. Programmed instruction should provide a "dialogue."

Areas of Disagreement:

1. Basic objectives.
2. Definition of learning.
3. Definition of learning efficiency.
4. Validity of immediate reinforcement in all learning situations.
5. Validity of scheduling of reinforcement for all learning situations.
6. Use of the term "dialogue."
7. Use of the term "individualizing."
8. Use of the phrase "composing a response."

9. Reducing the learning process to small discrete steps.

Chapter III - Arousal Theory

1. SC, Hebb, and Berlyne agree that "thinking" exists and that models of thinking provide a valid heuristic device for theories of learning.
2. There is an optimal level of arousal for learning which varies with the task.
3. An SC challenge forces the learner to this optimal level and maintains it.
4. The elements of the Response Matrix create conceptual conflict.
5. Composing a response to an SC challenge reduces the conceptual conflict.
6. A Study Unit is constructed so as to motivate the learner to learn.

Chapter IV - Discovery Learning

1. The whole is greater than the sum of the parts.
2. Not all learning occurs by insight.
3. Study Units are designed to take advantage of the human tendency to seek closure.
4. The construction of a Study Unit embodies Bruner's 4 points about teaching.
5. Study Units can create a relaxed atmosphere.
6. Study Units do structure discussion so as to encourage "insight."
7. Study Units provide control of digressions.
8. Study Units emphacize the importance of structure.

9. In their present form, Study Units are inappropriate below the stage of Formal Operations.

10. Study Units are inappropriate for people with cognitive styles that Kagan terms Impulsive Thinkers.

Chapter V - Transfer of Learning

1. A Study Unit facilitates a learner's understanding of general rules and principles in the following ways: 1) task analysis of the subject matter, 2) advance organizers and 3) a format which is consistent with the principle of Progressive Differentiation.

2. Study Units have the potential to aid learners to learn by a process involving discrimination, evaluation, critical judgement and the mental effort needed to organize an answer.

3. The elements of the Response Matrix may be said to perform a mediative function due to their interrelatedness.

4. The challenges of the SC Investigation section are consistent with Ellis' principle of variety of the stimulus component of tasks.

5. The cyclical nature of a learner's interaction with a Study Unit conforms to Ellis' principle that the greater the amount of practice on the original task the greater the liklihood of positive transfer.

6. It is reasonable to conclude that if Harlow's observations - i.e., that insightful solutions to problems seem positively affected by extensive practice in solving related classes of problems - are correct then it is reasonable to conclude that the construction of a Study Unit provides an

environment in which the incidence of insightful solutions to problems may be increased.

7. Ellis maintains that the ultimate testing situation should be as nearly identical as possible to the original learning situations. Because of the type of problem solving skill required by a Study Unit, it is possible that the most nearly identical testing situation is life outside the school system.

8. A Study Unit varies the stimuli but holds the learner's response constant, the condition that Ellis describes as encouraging positive transfer.

APPENDIX II

Study Unit 6 *

THE MERCHANT ADVENTURERS

INTENTION

In this Study Unit we leave the political scene and look instead at English trade and how it affected, and was affected by, the economy of this country and of Europe. While the economic life of the country followed its course alongside and continually interconnected with the political story, it has different highlights, crises and disruptions. The deaths of kings, which tended to be climactic moments in the political history of the country, were often quite irrelevant to the flow of the economy.

This Study Unit has the title **The Merchant Adventurers**. The Fellowship, or Company, or Merchant Adventurers was formally created in 1486 and consisted of those London merchants who controlled the profitable cloth trade with Flanders. We will see how the fluctuations in trade affected this powerful and wealthy group, and how the changes were reflected in their attitudes and activities.

We will follow the story of English trade into the turbulent days of the 1550s, and take a brief look beyond at the great expansion of markets which took place during the reign of Elizabeth I.

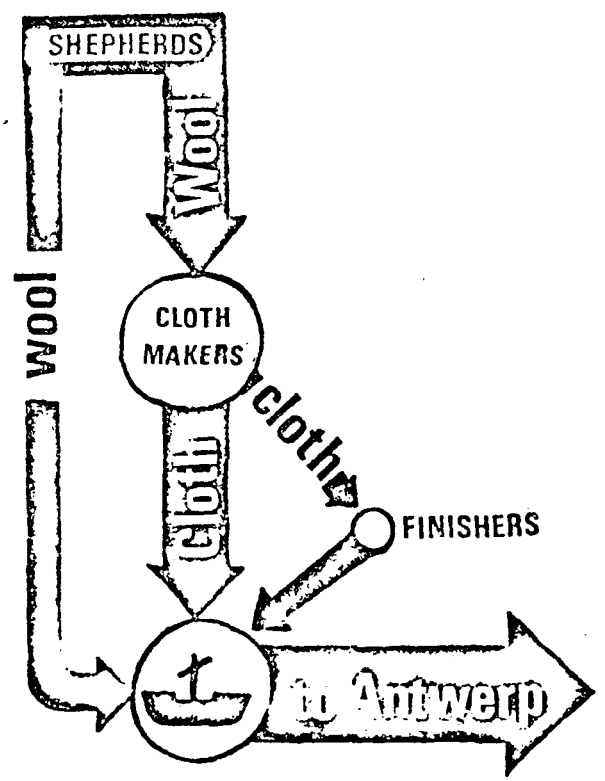
PRESENTATION

The cloth trade. Throughout the Middle Ages the main English export had been wool. English wool was the best in Europe and had been highly prized on the Continent, where it had formed the raw material for the great cloth industries of Flanders and Northern Italy. But during the century and a half before Henry VII came to the throne, England had been developing a cloth industry of its own. By Henry VIII's reign, the English carried about ten times more cloth than raw wool in the great twice or thrice yearly shipments to the fairs in and around Antwerp.

The cloth was sold in lengths—officially 24 yards long, but often quite a bit longer. There was really little standardization despite official attempts to impose it. Besides the woollen cloth which made up the bulk of the exports, there were a variety of other different sorts and qualities of cloth; light kerseys, coarse "dozens", friezes, and the northern "cottons" which were much cheaper materials.

The growth of the cloth trade throughout the first half of the sixteenth century was steady and, until the boom following the debasement of the coinage, which we will consider later, just short of spectacular. Early in Henry VII's reign about 50,000 lengths of cloth per year were exported. By the last years of Henry VIII's reign about 120,000 were taken over to Antwerp, and even more were sold during the boom years.

To feed this cloth industry, it had been estimated there were three sheep to every person in England. The trade in cloth was an easy and profitable one and consequently it grew steadily, until the whole



* This Unit is taken from a series of 9 on Tudor England.

economy was heavily dependent on the sheep. A large proportion of the population relied on the state of the wool and cloth trade for their livelihood: from shepherds to those involved in the cloth industry, from cloth-dealers to the Merchant Adventurers.

The wool travelled from the backs of the sheep to be made up into cloth by either workshops in the towns controlled by the guilds, or, as was more and more frequently the case, by individual workers in the country outside the guild restrictions. Those outside the towns and guild control were able to work with just the needs of the markets in mind. The guilds tried to ensure that the cloths made up by their workers were then "finished" (dyed and made up into articles of clothing) by other members who were traditionally involved in "finishing" processes. The trouble was that foreigners had little respect for English "finishing" and much preferred to buy raw cloth. Thus the country workers found that the cloth-dealers who bought up cloths around the country for delivery to Blackwell Hall—the Merchant Adventurers' headquarters in London—preferred to buy from them, because they were not restricted by guild regulations and were quite happy to produce unfinished cloths.

The government too tried to ensure that English "finishers" should work on English cloths before they were taken abroad, and laws were passed at regular intervals to prevent too big a proportion of unfinished cloths being exported. The merchants, who knew what their markets wanted, simply ignored the legislation.

From Blackwell Hall the cloths would be carried across the North Sea by the Merchant Adventurers, or by men they hired, and taken to the fairs around Antwerp. There they would be laid out on specific days and buyers from all over Europe would come to look them over. The wool which started on the back of an English sheep might finish up on the back of almost anyone in Europe.

Profits were good for the Merchant Adventurers. Their money was made on the sale of their cloths abroad. They made little on the goods they sometimes bought in Antwerp and re-sold in England. During the 1520s and 1530s the average profit seems to have worked out at between 15 and 25 per cent. This meant that a man could expect to double his money in four or five years.

All this growing prosperity, however, was precariously based. It depended almost entirely on the sale of a single commodity—cloth—in a single market, and if anything went wrong with that market, or with the commodity, the whole economy would be in trouble. This is just what happened.

The trade might have continued in its dull, routine and profitable way had it not been for the dramatic effects of the rise in prices which was being felt all over Europe, and Henry VIII's debasements of the currency which brought the English economy to the brink of chaos.

The company and politics. A "merchant adventurer" was one who traded with foreign parts. The Company of Merchant Adventurers, formed at the beginning of the reign of Henry VII, consisted of those men who controlled the cloth trade. Their aim in forming the Company was to ensure that no merchant not belonging to their Company should get any of the profits from trading in cloth. They tried to keep out other merchants by fixing the fee for membership so high that none of the less wealthy merchants from ports outside London (known as "outports") could afford to pay it. Henry VII had to intervene and reduce the fee, but in so doing he acknowledged the right of the Company to charge one. There was some justification for a reasonable fee, because the Company had to pay for the upkeep of various offices and centres in London, and others in Antwerp. (London dominated the cloth trade, as it dominated all foreign trade by this time. All the other ports together handled only about one-tenth as much trade as London.) As well as the Company's need to finance various offices it was absolutely necessary to have a strong organization to back up commercial ventures at that time. The individual merchant stood little chance of surviving against the trading organizations—like the German Hanseatic League in the Baltic, or the Venetians in the Mediterranean—and a trader putting into a port which a trading organization felt was "theirs" might find himself negotiating by cannon.

(continued)

[There are a further 3 - 4 pages of PRESENTATION which I will omit.]

INVESTIGATION

Problem 1

During the first half of the sixteenth century, the Merchant Adventurers' Company became one of the most powerful and influential groups in England. They controlled the lucrative cloth trade with Antwerp on which much of England's growing prosperity depended. Their relationship with the government was usually close, and they were respected and considerately treated by even the highest in the land. Their wealth and pride were such that they added considerably to the pomp and splendour of state occasions.

Consider why this Company and its members should have achieved such a position of wealth and power in sixteenth-century society. Why did it all happen?

Using the RESPONSE INDICATOR, construct a picture of those factors which were favourable to the growth in power and wealth of the company.

Problem 2

The fortunes of the Merchant Adventurers' Company to some degree prospered and then waned in response to external conditions. It is difficult to see how far the Company's fortunes also depended on the dynamism and energy of its members.

Assume that you are trying to argue that the Company was never really very adventurous. Consider what factors you would use to prove your case. (If you think they were really adventurous try nevertheless to construct an argument which you might have to answer in order to make your case.)

Use the RESPONSE INDICATOR to construct an argument which suggests that the Merchant Adventurers were not really very adventurous.

Problem 3

When the trade in cloth became more settled after the disturbances of the early 1550s, the Merchant Adventurers' profits continued to come in steadily, but the central theme of the story of English trading history moves to the broader stage of the world's oceans. With the extension of English trade—in area, and variety of goods carried—the Merchant Adventurers' Company's fortunes were imperceptibly but surely in decline. The late 1540s mark the highpoint of the Company's profits, and its trade turnover never again came up to the level of those years of boom.

Consider why this should have been so. What led to this decline?

Use the RESPONSE INDICATOR to explain why their fortunes declined during the latter half of the century.

Problem 4

As mentioned in **Problem 3**, after the 1550s the central theme of the story of English trade moves away from the single contact with Antwerp and its great fairs, through which English cloth had travelled to all parts of Europe. English ships were soon thereafter calling into ports around the Baltic, the Mediterranean, Africa, the Americas, and a little later, India and the Islands of the Pacific.

Consider the causes for this tremendous expansion of activity. Why was there such a sudden break-out from the patterns of trading which had been practised earlier?

Use the RESPONSE INDICATOR to explain why there should have been such a burst of new trading activities after 1551.

RESPONSE INDICATOR

Increasingly often interlopers ignored the Merchant Adventurers' monopoly and traded in cloth with the Continent. **1**	English seamen hoped for the good luck of the Spaniards in finding silver and gold. **2**	Parliament backed up the Merchant Adventurers' claim to control the sale of cloth abroad. **3**	Money was available in London, to back risky expeditions. **4**
Henry VIII debased the coinage. **5**	Some foreign trading organizations were weakening. **6**	Trade with the Continent was disrupted by wars of religion, and the Spaniards' destruction of Antwerp. **7**	Henry VII negotiated the "Intercursus Magnus". **8**
The Merchant Adventurers' monopoly was withdrawn. **9**	Some of the new trading ventures reaped enormous profits. **10**	The Merchant Adventurers introduced "stints". **11**	It was "outport" merchants who first traded with the Americas. **12**
In 1485 the customs tax on cloth was only 3 per cent of the cloth's value. **13**	The price rise affected the Continent more strongly than England at first. **14**	Steps were taken to repair the damage done to the coinage by Henry VIII. **15**	The Merchant Adventurers had to pay heavily for the privileges granted to them in Elizabeth I's reign. **16**
The formation of the joint-stock companies offered a new means of financing trading expeditions. **17**	The Merchant Adventurers continually appealed to the Government for protection against competitors. **18**	By trying to sell undersized cloths during the boom years, the Merchant Adventurers damaged their reputation abroad. **19**	The Merchant Adventurers controlled nearly all the cloth passing through the port of London. **20**

I [4 and 6] A = If you included in your response 4 and 6, read Comment A.

(0 = omitted)

DISCUSSION GUIDE

Problem 1

1. I [4 and 6] A
2. I [11 and 18] B
3. O [3 or 8] C
4. O [13 or 20] D
5. O [5 or 14] E
6. I [any three or more of 1, 2, 7, 9, 10, 12, 15, 16, 17 and 19] F

Problem 2

1. I [19] G
2. O [4] H
3. O [3 and 18] I
4. O [12] J
5. O [11 or 20] K
6. I [any three or more of 1,2,5,6,7, 8, 9, 10, 13, 14, 15, 16, 17 and 19] F

Problem 3

1. I [5] L
2. O [any two or more of 1, 4, 10, 12 and 17] M
3. O [11 and 19] N
4. O [9 or 16] O
5. O [7 or 15] P
6. I [any three or more of 2, 3, 6, 8, 13, 14, 18 and 20] F

Problem 4

1. O [any three or more of 3, 5, 7, 18 and 20] Q
2. O [4, 15 or 17] R
3. O [2, 6 or 10] S
4. I [any three or more of 1, 8, 9, 11, 12, 13, 14, 16 and 19] F

DISCUSSION COMMENTS

A

I would exclude both of these items from my response because they refer mainly to the period when the Company's fortunes were in decline. There may well have been money available for investment in trade during the early part of the century, and the profits from investment in the cloth trade certainly drew a great deal of it, thus helping its growth, but the London–Antwerp "milk-run" could hardly be classed as a risky expedition. Nor was the slow decline of foreign trading organizations during the early period really of great benefit for the Merchant Adventurers' Company. There is, however, a sense in which both these items could be used to develop your picture of the reasons for the growth of the Company. It depends on how you interpret them.

B

It is difficult to assess how far government "protection" for the Merchant Adventurers was effective especially at a time when the government largely lacked the means to enforce its rulings. There were court cases against men who trespassed on the Company's monopolies, but such cases do not seem to have been a great discouragement, in that shortly afterwards the same men can be found "interloping" again.

The Company's attempts to protect their own markets by introducing "stints" to ensure a steady but not too great supply in the markets (thus keeping the prices up) was again of questionable value. The markets were capable of considerable expansion, as they had proved during the boom years,

and it is possible that with a more adventurous policy they might have been able to sell a lot more cloth.

C

In these times, when peace and order were easily and often disrupted, trading was a hazardous occupation. For regular trading relations between countries it was thought necessary to have powerful and well-organized companies in charge of the operation. And as trade also benefited the King whose subjects grew wealthy from it, wise monarchs were careful to help their merchants. Henry VII was particularly noted for the help he gave to the Merchant Adventurers' Company, which, with the cooperation of Parliament, ensured that they were able to control the valuable English cloth trade, on which the Company's fortunes depended. While there were obviously limits to the value of government help in this period, especially in areas where the government largely lacked the means to enforce its rulings, I think that it was really useful to the Company and certainly helped their growth.

D

When the Merchant Adventurers had gained a virtual monopoly over all the cloth passing through London—which carried nearly ten times as much trade as all the other English ports put together—their fortunes were assured. The Staplers' Company, which traded in wool, had been powerful and wealthy throughout the Middle Ages, and had paid for its prominence and political support from the government, by increasingly heavy taxes on its cloth. In fact by the end of the fifteenth century the taxes were crippling the trade. The cloth trade, however, suffered no such disadvantage, paying a mere 3 per cent of its value on passing through the customs. I think both these factors are essential to understanding why the Company achieved the early success it did.

E

Though England felt the effects of a rise in prices throughout the early sixteenth century, it was less marked—until Henry VIII's debasements—than on the Continent. This left the English traders at an advantage. When the English coinage was debased the trader's position was even more favourable. I think these are both very important in explaining the growth of the Merchant Adventurers' Company. If you do not understand why these two items should have helped English traders read again the section in the PRESENTATION entitled "The price rise and debasements".

F

All these statements I have interpreted as more or less irrelevant to the problem as I see it. It might be that you have seen a connection which I thought too indirect to comment on, or perhaps you have not understood exactly what the problem is concerned with. It may be that you have confused the time scale, or included causes rather than effects, or effects rather than causes, or it may be that the connection you have seen is a perfectly good one which has escaped me. Whatever the reason, if you re-read the problem and the relevant part of the PRESENTATION, you should in most cases be able to work out why the statements you included are not discussed specifically.

G

I would tend to exclude this because it seems to me not necessarily a sign of unadventurousness. Though when combined with their past activities and their flooding of the single market without any attempts at diversifying their products, then I suppose it might be possible to use it to build a picture of the Company's unadventurousness.

H

Perhaps it is a little unfair to try to brand the Merchant Adventurers as unadventurous because they did not use any of their profits from the London-Antwerp cloth trade to invest in voyages of adventure, or more daring attempts to trade with different markets. I tend to think that item **4** is a form of condemnation however, because the world's markets were opening up and the prospects of profit from distant and exotic markets were tremendous—for those with the courage to try.

(continued)

[I have omitted the remaining DISCUSSION COMMENTS.]

You will have gathered that I don't have much admiration for the adventurousness of the Merchant Adventurers. It seems to me there were tremendous opportunities available at that time for men with the means to sail the seas to indulge any spirit of adventure they might have. Whole new continents were being discovered and opened up, fabulous wealth was available to those who were ready to take risks in the vast stretches of oceans which were being discovered (and were found to lead NOT to the edge of the world or to hell).

Try to imagine how it must have appeared to a man of the sixteenth century. Suddenly the world expanded; more than doubled in size. New wonders were reported in London, and talked about in the taverns. Slaves were shown off around London as though they were strange creatures. The conquests of the Spaniards and Portuguese were discussed with envy, and probably half disbelief. Unimaginable hoards of gold and jewels were dragged from the ancient civilizations of South and Central America. Great things were happening and being done. And the Merchant Adventurers, who had money, ships, tradable commodities, ploughed solemnly to and fro across the Channel on the London–Antwerp milk-run.

Perhaps this is a little unfair. After all they were on to a good thing. Guaranteed profits of 15–25 per cent were not to be passed up for dangerous risks. But it does seem that their greed for those easy profits outweighed any sense of adventure they might have had. At the beginning of the century a Venetian wrote of those English merchants that they were so greedy for the profits they made in Antwerp, that even if their fathers were hanged at Antwerp gate they would crawl between their legs to get to the town's markets.

It was the west country sailors who showed real imagination and adventure. The Hawkins family (William the father, John the more famous son, and Richard the grandson), Drake, and perhaps the most creative, gallant and truly adventurous of them all, Walter Raleigh, laid the foundations for England's great seafaring tradition. The actual exploits of these men read like a tremendous adventure story. You should be able to find plenty of material on Hawkins's and Drake's voyages and fights along the Spanish Main. Try to find also *That Great Lucifer* by Margaret Irwin. It is an imaginative account of Raleigh's life and adventures. Raleigh seems to me to be one of the most attractive figures in England's history.