THE INTERACTION OF ACHIEVEMENT ORIENTATIONS AND CONTENT

FAMILIARITY WITH HIERARCHICALLY STRUCTURED

PROGRAMMES

BY

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ABSTRACT

This study attempted to determine the interactive effects of learner characteristics with two differentially but hierarchically structured programmed instructional tasks. The learner characteristics chosen were a subjects' independence and conformance achievement orientations and his prior familiarity with the subject matter. The two programmed texts constructed for the experiment were, 'A Procedural Approach to Introductory Statistics' and 'A Behavioural Approach to Learning'. Both texts were written by the researcher. The point of task differentiation was based on the degree of arbitrariness in the sequence order of criterion competencies; the statistics programme being deemed to be more intrinsically structured and the learning theory programme more extrinsically structured.

The results indicated a differential effect of learner characteristic variables between treatments and across tasks. Further, the results indicated both ordinal and disordinal treatment interactions on the dependent measures of criterion achievement, sequence appropriateness and task-related achievement motivation. The effects of instructional treatments were indeed modified by the interaction of tasks and learner characteristics.

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CHAPTER I

INTRODUCTION

The problem posed by this study was to determine the inter-active effects of learner characteristics on two differentially, but hierarchically structured programmed instructional tasks.

It is generally acknowledged that there is no one best method of instruction for all students, and that methods of instruction should be differentiated in such a way as to maximize their compatability with the individual characteristics of the learner. Similarly, while it may be demonstrated that a particular instructional method suits a given student in one learning situation, it is not necessarily the case that the same method will suit the same individual in a different learning situation.

Approaches to Individualizing Instruction

Two broad approaches have characterized the study of individual differences relating to learning and educational practice. The first, described as a selective mode of education, is characterized by minimal variations in the conditions under which individuals are expected to learn. Here there are fixed and limited paths available for the individual to traverse, and success is highly related to the particular abilities that such paths emphasize. Individuals devoid of or deficient in the pre-requisite characteristics are progressively selected out of the system. The second, a learner-needs approach, is derived from a concern about the

different ways different individuals might learn best. This approach assumes that the educational environment can be adapted to a wide range of learner characteristics requiring a wide range and variety of instructional methods.

A long history of very good empirical evidence can be used to justify the selective approach to education. The psychometric tradition of the late 19th and early 20th Centuries, and particularly the work of Binet and his followers with the measurement of intelligence, demonstrated convincingly that these measures of individual difference were creditable predictors of school success. Even the subsequent de-emphasis of the concept of general intelligence in favour of tests of differential aptitude did not alter the general conclusion that given our present educational system, measures of the ability to manipulate and reason with numbers and words predicted to a reasonable degree the ability to successfully emerge from (a traditionally) rather uniform educational environment. The question of *which* learner characteristics are important in learning has invariably led to the reply: those characteristics which predict and facilitate achievement in a fixed learning system. Until very recently, rarely have attempts been made to determine whether there might be other ways of learning, and therefore, other kinds of appropriate learning environments.

The learner, or individual-needs approach (Hunt, 1974) is based upon the belief that alternate ways of learning can be adapted to, and maximally interact with, learner characteristics. These characteristics include, individual styles of thinking, characteristic levels of anxiety, experiential backgrounds, sex, prior content familiarity, achievement

orientations, and time to achieve mastery in learning. In contrast with the selective approach this approach attempts to hold achievement levels constant, and to allow learner attributes to vary. The interaction of attributes with learning environments may then result in a near zero correlation between traditional complex attribute variables, namely the intelligence quotient, aptitude and achievement (Stolurow, 1962; Camplese, McAvory, Kelvin, and Franklin, undated). The success of the adaptive interaction is seen as the extent to which the learner experiences a match between his specific abilities and interests, and the activities in which he engages.

Deficiencies in Previous Approaches at
Individualizing Instruction

Most attempts at developing individualized instructional systems has been primarily concerned with the analysis of subject-matter content, the definition of behavioural objectives, and the development of learning materials designed to enable 90 percent of the student population achieve 90 percent of the required performance. Rather than fostering individual differences, the effect has been to minimize individual differences in learner strategies and learner needs. For instance, most individualized 'mastery' systems require *ALL* students to progress through the *SAME* learning sequences, to achieve the *SAME* objectives, with the exception that errors invoke remediation loops for the learner. The only significant individualized feature of these systems is the *PACE* at which the learner achieves the objectives. For the fast student, the material is often too slow and repetitive, the responses called for, obvious, and the learning boring. The able student may well achieve the lesson objectives, but with a high probability that he will be 'turned off' about individualized instruction and more seriously, the subject that he is learning. The less able student fares no better. Under

traditional 'lock-step' instructional methods he is often left behind to wallow in his uncertainty and frustration. He is 'turned-off', because he has never had a chance to get 'turned-on'. But, even for the less able, the method of subject-matter presentation is often inappropriate, typically highly verbal; the learning objectives and evaluation measures, abstract and conceptualized, and seemingly unrelated to his cognitive background.

Although mastery instructional models have taught us much about the design of instructional materials, and have brought about dramatic increases in learning performance, insufficient attempt has been made to design instructional materials from the stand point of the individual learner. Explicitly, little has been done to interact instructional methods and materials with the variety of personal charact-eristics the individual brings to the learning situation.

Accepting the need to more systematically individualize instruction on a 'learner-needs' basis, two major questions become relevant to the problem. What learner characteristics or attributes are important in meaningful learning? How can instructional methods or treatments be adapted to interact with the particular needs of the individual?

Content Familiarity as an Attribute Variable

Instructional psychologists have long emphasized the importance of specifying student entry behaviour as a pre-requisite to the design and implementation of a learning programme. This information is generally used to determine the point-of-entry into the subject-matter for any given student. Armed with this pre-test data, the curriculum designer

then proceeds to build an instructional bridge that will span the gap between the point at which the student commences to demonstrate inadequate or inappropriate behaviour, to the place at which the desired terminal criterion behaviour can be performed. However, a pre-test involves the presentation of a series of discrete stimuli designed to evoke previously acquired behaviour. Incorrect responses provide little information on the non-availability of the desired behaviour. For instance, there is little way of telling whether a given error was the result of no previous experience with the subject-matter, interference during the process of acquisition, or diminution and obscurity of behaviour for a variety of reasons. Thus, the traditional pre-test alone may be of little value in determining appropriate presentation methods and instructional sequences for a given student.

It seems reasonable to suspect that a student's prior experience with a set of cognitive structures will have facilitiative effects in the attainment of related but different structures. In fact, Gagné (1970) suggests that the previously learned capabilities may enable a student to 'skip over' a particular subordinate skill and learn a more complex, higher ordered superordinate skill without it. In terms of learning efficiency, this could mean that when antecedent elements of a particular cognitive structure are present, related new structures could be learned much more easily than when no antecedent elements were present.

Achievement Orientations as an
Attribute Variable

There is considerable evidence to suggest that an individual's level of achievement orientation (often described as the need to achieve,

or achievement motivation) affects the efficiency of learning for that individual (Smith, 1970). Shrabble and Sassenrath (1970), have suggested that when programmed difficulty (as determined by the probability of success in scoring a frame correctly) is low, performance is maximized for persons low in achievement motivation. Similarly, when programme difficulty tasks are high, the performance of persons high in achievement motivation should be maximized. It seems likely, therefore, that students with high levels of achievement motivation, and who have the pre-requisite capabilities, but are either forced to study material they are familiar with, or to work through a study programme which is too slow and repetitive, might do poorer than persons with similar levels of achievement motivation, but provided with less repetitive, more challenging instruction. The reverse is contended for persons with low levels of achievement motivation and presented with similarly inappropriate treatments.

The Sequencing of Instruction

The notion of sequence has become a very important issue in the design of instructional materials. The practical necessity for dealing with sequence issues is an inescapable task for all teachers and has become even more critical to psychologists concerned with the individualization of instruction.

Opinions vary as to whether the teacher or learner should make the sequence decisions, and upon the importance of sequencing as a variable in instructional design. Theorists differ on the rationale upon which such decisions should be based, and research findings are not in agreement as to how much it matters which decisions are made, or who should make them.

Research in programmed instruction has focused a great deal

of attention on the role of the 'frame' (a small unit of information) as the key component in sequencing   (Tobias, 1973a). Such studies have examined the effectiveness of logical, random, and reverse order sequence conditions relative to time and posttest performance. Here too, much of the evidence has been contradictory, and has posed more questions than it has answered.

Learning Hierarchies as a Basis for
Instructional Sequence

With more flexible approaches being made in the design of programmed materials (Hunt, 1972), and a strong emphasis being placed upon the criticality of behavioural objectives in curriculum construction, an increasingly fashionable trend for instructional designers has been the use of a behaviourally-stated learning hierarchy. The change in emphasis has focused attention away from the specific stimulus-response properties of an instructional component, to the discrete pre-requisite behaviours of a task.

Gagné (1965) and others have stated that knowledge relevant to any given task can be considered as a set of subordinate capabilities or behaviours ascending to a terminal or criterion performance. A hierarchy of subordinate capabilities can be determined by asking of each task, "What would the individual have to know how to do in order to be able to achieve this performance, when only instructions are given?" (Gagné, 1968) This question is repeated for each subordinate competency, going down the hierarchy until a level is reached for which all behaviours are, without instruction, possessed by each individual in the group. Thus Gagné's theory summarized, asserts that the acquisition of criterion behaviour is dependent upon the acquisition of all

hypothesized subordinate behaviours.

Any given learning task may comprise a series of discrete criterion behaviours, often called the performance objectives. The sequencing of these objectives within a task may be determined to a greater or lesser degree by the inherent properties of the task itself. Where these properties reflect a logical highly sequenced pattern of behaviours the decisions concerning the *ordering* of objectives may be described as being *intrinsically* derived. As decisions relating to the sequence pattern become more arbitrary and external to the task, its sequence basis may be said to be *extrinsically* structured.

CHAPTER II

REVIEW OF THE LITERATURE

Attribute-Treatment Interactions

The long standing interest among psychologists in 'individual differences' has led in recent years to a good deal of speculation and research concerned with the identification of reliable patterns of interactions involving learner, task, and treatment variables. Cronbach (1957) names such patterns, 'Aptitude-Treatment Interactions'. Since then, this area of interest has variously been called, 'Trait-Treatment Interactions' (Hills, 1971), 'Attribute-Treatment Interactions' (Tobias, 1970a) and 'Attribute-Task-Treatment Interactions' (Tobias, 1970b; Rhetts, 1974). Whatever the term used, the goals are essentially the same; namely, the identification of learner-attribute characteristics through tests and other means, and the assigning of those students at random to one of the several treatments for the purpose of determining which attribute variables are compatible with which treatments.

An attribute variable may be defined as any measure of individual characteristic, such as scholastic ability, achievement orientation, amount of prior familiarity with a subject-matter content, or task related learning efficiency. The term 'treatment' may be defined in this context as the method, or methods in which the instructional environment is prepared and arranged. The interaction of attributes and treatments may be of two kinds; either ordinal or disordinal. An appreciation of the distinction between the two interactions may be made from figures 1 and 2.

Figure 1

Ordinal Interaction

A Treatment

B Treatment

Achievement outcome

Attribute

Figure 2

Disordinal Interaction

A Treatment

B Treatment

Achievement outcome
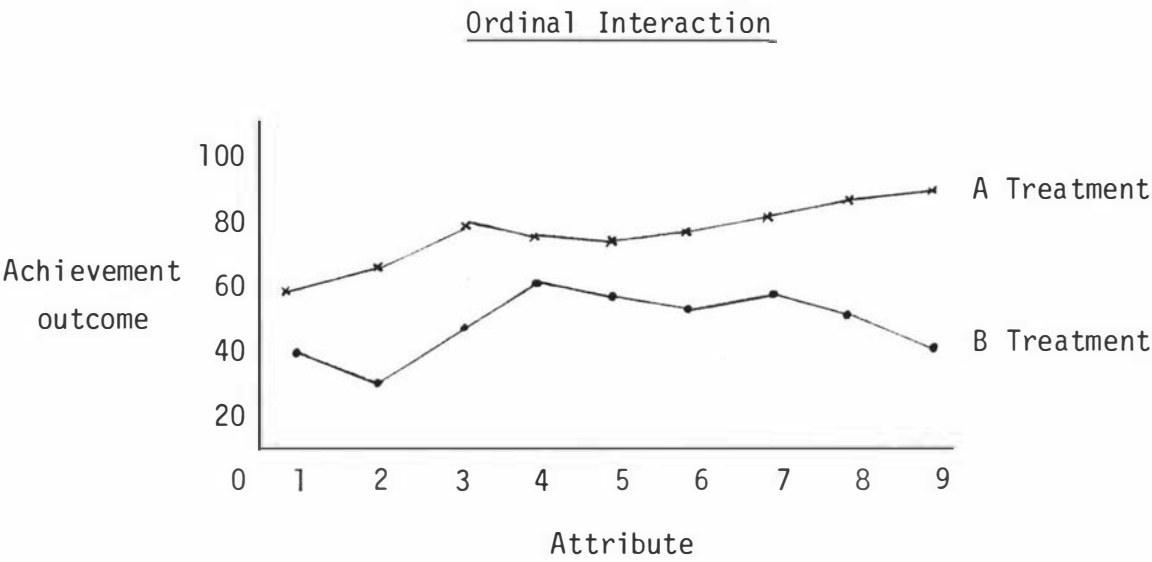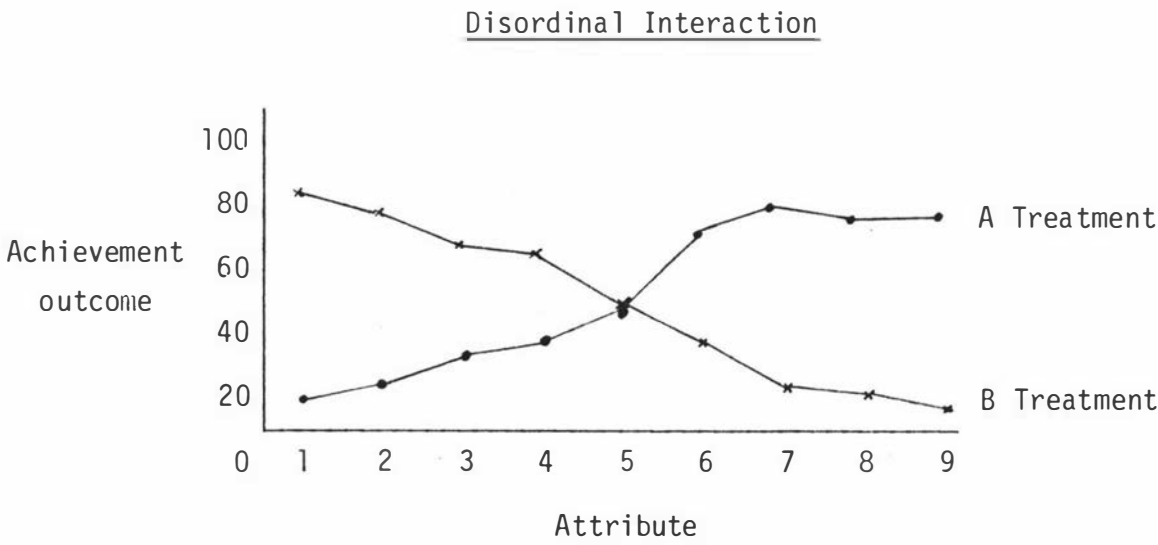
Attribute

An ordinal interaction is one in which a treatment is seen to be superior all along the attribute continuum, although the magnitude of difference may vary along the distribution. On the other hand, a disordinal interaction is one where the regression lines for the treatment intersect somewhere within the range of the attribute variable under investigation. A treatment that is superior for subjects at one end of the attribute continuum may prove to be inferior for others at the opposite end. It is interactions of this nature that many psychologists believe hold the key to the design of genuinely individualized instruction; the identification of learner characteristics and the selection of instructional treatments that interact with each attribute variable, maximally facilitating learning for every individual.

ATI's Involving Programmed Instruction

A large number of studies seeking Attribute-Treatment Interactions (ATI's) have involved the use of instructional programmes. The advantages of using programmed materials are quite obvious. The instructional treatments can be manipulated rigorously and yet inexpensively (Tobias, 1970). Most are constructed from behaviourally stated objectives and evaluated on a criterion-referenced basis (Popham and Husek, 1969). Achievement performance can be specifically related to instructional treatments, and variations in performance to variations in treatments.

Berliner and Cahen (1973) have suggested that although a large number of studies using various aspects of programmed instructional materials across vastly differing traits have been reported, the results remain ambiguous.

Cronbach and Snow (1969) and Bracht (1970) in two very extensive

reviews of ATI research found few attribute-treatment interaction effects to support the notion that treating an individual in one way will cause him to achieve at a higher level than if he were treated differently. Bracht (1970) believes that one of the reasons why disordinal interactions have not been identified in much of the research is that the analysis of interaction effects (between alternative treatments and attribute variables) has often been an after-thought, rather than a carefully planned part of the experiment. One of the few studies specifically designed to test the ATI hypothesis using programmed materials was that conducted by Ripple, Millman and Glock (1969). Using a four-factor analysis of variance design, rather than multiple regression analysis, they concluded that there were no significant interactions between selected learner attributes (anxiety, compulsivity, exhibitionism, and thinking style) and programmed versus conventional learning treatments. In a study by Tobias and Abramson (1971), support could not be found for the expectation that ATI's would be identified between achievement from programmed instruction, stress and debilitating anxiety, although an interaction was found between treatment and facilitating anxiety. However, the study did indicate that a subject's (S's) prior familiarity with the content could be a useful differentiating variable in the prediction of optimal instructional strategies and might be a more useful attribute measure than those traditionally employed in ATI investigations. Tobias's (1973b) follow-up study failed to find consistent interactions involving A-State anxiety and treatments. Koran (1971) designed an investigation to examine individual differences in learning from the inductive and deductive sequences of programmed material. She found that vocabulary test scores disordinally interacted with treatment conditions of programmed and criterion test time, but not with actual criterion test scores.

Bracht (1970) has observed that many ATI researchers have conceptualized the attribute-treatment interaction problem as a two-dimensional model; learner variables and some combination of task and treatment variables. Rhetts (1974) however, recommends that both treatment and task characteristics (singularly and jointly) can be expected to interact with learner characteristics, and has suggested that a three-dimensional model should be used. This approach of Attribute-Task-Treatment Interactions is very similar to that proposed earlier by Tobias (1970b).

Perhaps a key to the identification of disordinal interactions lies in the attention that ought to be paid to the selection of treatment and attribute variables. It is now some considerable time since Cronbach (1967) cautioned against the use of general aptitude measures as a source of interaction with instructional methods. These measures, he suggested would correlate with performance no matter what the instructional method. Although there has been evidence (Stolurow, 1964) to the contrary, namely, that with a well-sequenced programme, the correlation between general ability and achievement is zero, Cronbach's caution remains impressive. Accepting this position, what then should be the criteria for choosing attributes and treatments?

Undoubtedly, treatments should be selected for the different abilities they require for successful performance, including differentiations in intellectual skills, presentation media, and response requirements. Bracht (1970) has hypothesized that disordinal interactions are more likely to occur with two or more factorially simple attribute variables, than with more factorially complex ones. Variables with imputed factorial simplicity have substantial correlations with performance in only selected cognitive tasks, or have relatively low correlations with

more complex cognitive achievement. Simple attribute variables would include measures of specific abilities, interests, attitudes, personality traits, social, economic and educational status. Complex attribute variables would include measures of general ability and achievement such as intelligence tests. These factorially complex measures have provided little evidence to date that they are particularly useful as a means of differentiating alternative treatments for subjects in a relatively homogeneous age group.

ATI: Attribute Variable (a) Achievement Orientations

The characteristic of an 'achievement-orientation situation' is one in which the individual is responsible for the outcome of his performance; that outcome being expressed in success or failure. The individual is provided with immediate feed-back as to the success or otherwise of his efforts, with the situation containing some degree of uncertainty or risk (Atkinson and Feather, 1966).

Carney's (1966) research on the distinction between objective and projective measures of achievement motivation concluded that behaviour resulting from projective testing was derived in the same manner as that for objective testing. There was no inherent reason why objective measures could not provide valid measures of motivational differences. The principle difference between the two measurement techniques is that objective measures produce a relatively standardized stimulus situation which elicits relatively standardized behaviour, while projective techniques often produce non-standardized behaviour elicited by non-standardized extra-test factors. In a comparative analysis of two representative measures of these techniques; the California Psychological Inventory (objective), and the Thematic Apperception Test (projective), Carney reported that the size and

direction of the correlation between the two measures depended upon the sex of the subject, the sex of the instructor, the course content and the particular class in which the subject was enrolled. However, the mean absolute correlation was quite stable across these variables and indicated a population value for correlation between need-achievement (projective) and achievement orientations (objective) of .33.

Shrabble and Sassenrath (1970) demonstrated that a programmed instructional task conformed to the type of performance situation for which the model of achievement orientation is most relevant. In this situation, the subject is faced with an achievement task which provides him with immediate feed-back on his performance. Varying degrees of risk can be induced by varying programme frame and exercise difficulty levels. In this experiment it was possible to demonstrate interactive effects between individual differences in the desire to strive for success in achievement orientation situations, and item difficulty. The study found that on an easy programme (defined as one in which the probability of success through a sequence of frames approaches 100 percent) achievement should be maximized for persons low in achievement orientations. However, persons with high achievement orientations would more likely lose interest after the initial experience of success with a resulting decrease in achievement performance. The reverse seemed likely to apply for difficult programmes (where the probability of task success is less than 50 percent) in which subjects low in achievement orientations were likely to perform significantly poorer than those with high achievement orientations.

There is an increasing amount of evidence (Griffin and Flaherty, 1964; Golderg and Hase, 1967; Domino, 1968; Gough, 1969; and Domino, 1971) to suggest that the achievement orientation scales of the CPI; Achievement via Conformance (Ac), and Achievement via Independence (Ai) are useful

instruments for predicting academic achievement from differential
learning situations.   The Ac scale identifies those aspects of
motivation that facilitate achievement in settings where conforming
behaviour such as acceptance of regulations, and a high degree of
self-discipline, efficiency and responsibility in structured environ-
ments are rewarded.   The Ai scale on the other hand identifies those
motivational aspects that facilitate achievement in settings rewarding
independence, individuality, self reliance, and creative innovation,
particularly in less structured environments.

A study by Domino (1971) hypothesized that students high in
Ac or Ai, and who were taught in a manner consonant with their achieve-
ment orientation would perform better academically, and report greater
satisfaction than their peers who were taught in a manner dissonant
with their achievement orientation.   In an earlier study (1968) Domino
discovered that undergraduate students high in Ac did better in courses
where conformity was rewarded and subjects high in Ai were superior in
courses emphasizing independence.   Further, Ai was found to be better at
predicting achievement in tasks stressing independent thought than those
emphasizing rote learning.   His studies concluded that there was indeed
a very definite disordinal interaction between student achievement
orientation and teaching styles.   That is, subjects having an independent
achievement orientation performed better, and were more satisfied with
their instructional experience in unstructured course situations than
were students with a conforming achievement orientation.   Conversely,
students with a conforming achievement orientation had higher achievement
indices, and were more instructionally satisfied when learning in a
structured setting than were their independent achievement orientation
counterparts.

ATI's: Attribute Variables (b)   Content Familiarity

A number of researchers have investigated the content-
familiarity issue with programmed materials, usually in relation to
modes of responding. Tobias (1969) suggested that constructing
responses did not lead to superior achievement on materials with which
subjects have had prior experience, while achievement on technical,
unfamiliar material was superior when subjects constructed their
responses. He theorized that subjects who demonstrated little evidence
of content familiarity would evince superior achievement through overt
response modes than would those who had higher levels of prior familiarity.
Roderick and Anderson's (1968) earlier comparative research with high
school students using overt responses to the Holland and Skinner programme,
'The Analysis of Behaviour', (1961) versus covert responses to book-like
passages, found a similar differential in achievement that they ascribed
to the familiarity construct. Although Nuthall's (1968) study with four
different constructed response programmes designed to test for differences
associated with teaching strategies found no reliable effects for the
different teaching strategies, his conclusions did suggest that even with
only one response mode, familiarity remained an important variable.

Two studies have particular significance in the problem area
of this study. The first, an experiment by Abramson and Kagen (1973),
suggested that the inconsistent and inconclusive results of earlier
studies seeking attribute-treatment interactions may have resulted from
their failure to control for familiarity. Their findings clearly supported
the hypothesized presence of an ATI for achievement from programmed
instruction with prior familiarity, content material and response modes.
An unexpected finding in the investigation was that familiarization led
to lower achievement from a constructed response mode than did non-
familiarization. A possible explanation for this can be found in an

achievement motivation argument. High achievers already familiar with the subject-matter might have become bored with the learning programme when they were forced to respond to each frame, whether they knew the correct answers or not.

The second study (Tobias and Abramson, 1971), attempted to establish ATI's among anxiety, stress, response mode and familiarity of subject-matter on achievement from programmed instruction. They concluded that a subject's familiarity with content was a useful differentiating variable in the prediction of optimal instructional strategies. Moreover, their findings suggested that not only did content familiarity appear to be a more promising variable than response mode in the investigation of instructional strategies but that content familiarity could prove to be a more useful predictive variable than attribute measures hitherto employed in typical ATI investigations.

ATI's Treatments: Instructional Sequencing

Learning directed towards clearly specified goals or objectives must raise the question of the need to plan sequences of learning events. The need for such a progression in learning is obvious. The attainment of the desired learning cannot occur all at once, but must occur through a sequence of steps or learning events. The practical necessity for dealing with sequence issues is an inescapable task of every individual involved in instructional design. The decisions made will vary according to the various levels of specificity; whether it be curriculum planning, task or topic instructional design, or sequence analysis as in the construction of 'frames' in Skinnerian type programme instructional units.

Programmed learning has been a useful vehicle for examining the effects of instructional sequencing. Perhaps more than any other researcher, Skinner(1958) has demanded that rigorous attention be paid to the question of sequence in learning, and in particular, to the efficacy of small teaching steps in shaping behaviour. From this position, a large number of studies (Roe, Case, and Roe, 1962; Payne, Krathwohl and Gordon, 1967; Niedermeyer, Brown and Sulzen, 1969) attempted to assess the effect that order of presentation had on learning. The more usual method of these studies was to compare some unit of programmed instruction in its logical order, with other material in which the frames were presented in a random or 'scrambled' order. The only consistent finding in these studies was a 'no significant difference' conclusion; scrambling did not adversely effect criterion performance. These findings tended to suggest a pervasive flexibility and adaptability on the part of subjects somehow to bridge the gaps between items in a scrambled programme. Natkin and Moore (1972) hypothesized that the failure to observe sequence effects in earlier studies could have resulted from several artifacts of the material used, such as; the repetitious nature of many programmes (particularly Skinnerian); the employment of adjunctive questions in the frames; and the question of the adequacy of the sequences used in supposedly logically sequenced treatments.

The traditional approach to instructional sequencing has been based upon some sort of course content analysis resulting in the construction of matrix and flow-plan diagrams (Thomas, Davies, Openshaw, and Baird, 1963). However, the frequent lack of dependent relationships among objectives has led to a feeling (Esben, 1968) that such an analysis might reveal one sequence as being as good as another. This lack of dependent relationship among objectives points to the difficulty of attempting to sequence subject-matter content, rather than sequencing skill competencies supporting a defined behavioural task.

Instructional Sequencing: Learning Hierarchies

A learning hierarchy is a method of structuring intellectual skills in terms of task competencies. Much of the learning hierarchy research has been carried out by Gagné and his colleagues, (Gagné and Paradise, 1961; Gagné, 1962; Gagné, Mayor, Garstens and Paradise, 1962; Gagné and Staff, 1965). Descriptively, a learning hierarchy is a procedure in which inferences may be made about the subordinate competencies that should be learned prior to the next higher-ordered competencies until a criterion competency is achieved at the apex of the hierarchy.

Evidence for learning hierarchies has been well demonstrated. In the first of three major investigations, Gagné (Gagné and Paradise, 1961) used a programmed book to teach 118 subjects a hierarchy of 22 elements known than as 'learning sets', which led up to the task, 'Solving Linear Equations'. The number of subjects who learned the higher elements, without passing the lower elements was small, although not zero, as one might have expected if the hierarchy was perfectly correct. A second study by Gagné (Gagné, Mayor, Garstens and Paradise, 1962) followed by a third (Gagné and Staff, 1965), progressively lowered the number of exceptions to the postulated sequence of learning. White (1972) has postulated three reasons for the sequence exceptions; errors of measurement, delays in testing, and some obviously invalid connections.

Many attempts at validating learning hierarchies (Kolb, 1967-68; Olsen, 1968; Resnick, 1967; Resnick and Wang, 1969; Coleman, 1969), have been disappointing in that subjects have behaved in ways other than those proposed in the hierarchies. However, in most of these cases, the failure has stemmed from a weakness in hierarchical design which has provided explanations for the apparent failure of the

subjects. These weaknesses have included small sample sizes, imprecise
specification of component elements, use of only one question per
element, and placing tests at the end of the learning programme, or even
omitting such instruments altogether (White, 1972). There is no conclu-
sive evidence to negate the basic underlying premise for learning
hierarchies, and there is evidence of the almost ideal performance
(Gagné, Mayor, Garstens and Paradise, 1962). Further work by White
(1974) has led to a nine-stage procedure for validating learning
hierarchies and overcoming many of the weaknesses earlier studies revealed.
In summary, these stages include the following procedures:

1. Define the criterion performance in behavioural terms.

2. Derive the hierarchy by asking Gagné's question, "What
    must the learner be able to do in order to learn this
    new element, given only instructions?"

3. Check the reasonableness of the postulated hierarchy
    with subject matter specialists.

4. Develop plausible variations in subordinate competencies
    as a test of the precision of the originally postulated
    competencies.

5. Examine whether the invented variations do in fact
    represent different skills.

6. Construct an instructional programme for the competencies
    with a means of measuring student performance.

7. Try the instructional programme on a target population.

8. Analyse the results to see whether any of the postulated
    connections between competencies should be rejected.

9. Remove all rejected connections from the hierarchy.

General adherence to these very practical procedures for
constructing and validating a learning hierarchy may well remove many
of the reservations that instructional psychologists have held for them.

ATI Treatments: Tasks

The assumption that a variable predicting the performance of one type of task is equally predictive in another is very questionable. There is ample research evidence, particularly relating to the response-mode issue in programmed instruction, to suggest task related differentials in achievement. Tobias (1969) found that constructing responses led to superior achievement from a technical task in which subjects had had very little prior familiarity, but that on a different task where there was a high degree of prior familiarity there was almost no difference in achievement between those subjects who had constructed their responses and those who had read the material. Similar conclusions were found by Anderson and Roderick (1969), Daniel and Murdock (1968), Tobias and Abramson (1970), Abramson and Kagen (1973), and Rhetts (1974). The findings of these studies have clearly pointed to the need for, as Tobias (1970b) has suggested, incorporating the characteristics of the task as an additional variable in the design. It seems very likely that the learner characteristics which are significant in one task, may not be as significant in another. Similarly, an instructional treatment which significantly interacts with a learner characteristic in one content area, may not be as effective with the same characteristic in another subject area. The practical resolution of the attribute-task-treatment interaction question may well lie in the formulation of some type of taxonomic classificatory system.

CHAPTER III

THE PROBLEM

The intention of this study was to examine the interactive
effects of certain instructional treatments on learner characteristics.
Such a study, it was hoped, would lead to the formulation of responses
posed by Berliner and Cahen's (1973, pp 58-59) question "Given this set
of learner characteristics, what is the best way to tailor instruction
for this particular type of learner?"

A review of the literature suggested that the attribute
characteristics of achievement orientation and content familiarity might
be worth examining in relation to programmed instructional materials.
Further, in the light of frequent admonitions by researchers to include
learning tasks as an additional variable in attribute-treatment inter-
action analyses, at least two discrete tasks should be sought.

Attribute Variables

Achievement Orientations

The first attribute characteristic to be examined was the
construct of student achievement orientations.   As has previously
been mentioned, the California Psychological Inventory (CPI) compared
very favourably with the projective need-achievement measure, the
Thematic Apperception Test.

The CPI is an instrument developed out of an examination of
the setting in which the test was to be used, namely, the realm of
interpersonal behaviour. Because of this, the concepts
selected, were those which were alleged to occur in everyday social

living and arose from social interaction. These, Gough (1963) described as "folk concepts", attributes which were to be found in all cultures and societies and that possessed a direct and integral relationship to all forms of social interaction.

The eighteen subscales of the CPI may be grouped into four clusters, the third of which includes the achievement orientation scales of Achievement via Conformance (Ac) and Achievement via Independence (Ai). The original goal of the Ac scale was to assess the motivational personality factors associated with academic achievement in high school settings (Gough, 1953). It was originally named *Achievement*. However, as data accumulated from the use of the scale, it became increasingly evident that the underlying construct was one of a strong need for achievement coupled with a deeply internalized appreciation of structure and organization. Megargee (1972) suggests that the term 'conformance' was chosen to reflect this channelling of the need for achievement in a highly structured, though not necessarily a 'conformity' manner.

The Ac scale has been a particularly useful indicator of achievement in academic settings which have reflected a structured approach to learning. For this reason, it has been seen to more closely reflect indices of achievement in high school settings rather than universities where supposedly a greater learning emphasis is placed upon originality, creativity and intellectual independence (Gough, 1963).

In contrast, the Ai scale was devised to predict academic achievement in university and particularly undergraduate settings. The scale which had originally been dubbed the *Honour Point Ratio* was seen to predict achievement in settings where independence of thought, creativity and self-actualization were rewarded. In fact, many of the validational studies of the Ai reported significant correlations between Ai and

Grade Point Average, at times as high as .44 (Gough, 1964, 1969).

With the concern to develop programmed instructional treatments from differentially structured tasks, the Ac and Ai achievement orientation scales appeared to be useful instruments in this investigation. To this end a preliminary hypothesis was made to the effect that subjects high in Ac would have superior achievement indices in highly intrinsically structured tasks and further, would report greater satisfaction with learning from highly structured treatments. A similar hypothesis was posed for subjects high in Ai. These individuals would demonstrate superior achievement indices from more arbitrarily, extrinsically structured tasks, and would report greater learning satisfaction from less structured treatments than subjects without this attribute characteristic.

Content Familiarity

Evidence has been presented in Chapter II concerning the potential significance of content familiarity as an attribute variable. It was the intention of this study to examine two aspects of this construct; a subject's own estimation of his prior familiarity with a subject-matter field, and an objective measure of his mastery achievement. The former could be described as a subjective measure of content familiarity (SCF), and the later, objective content familiarity (OCF).

In order to obtain a subjective measure of CF an instrument along the lines of Adams's (1962) Attitude Self Rating Scale was needed to be developed. Unlike traditional attitude scales (Thurstone and Chave, 1929; Likert, 1932), a potential feature of such an instrument was the requirement for students to respond to imaginary behavioural statements in terms of *their* estimation of likely performance. Such an estimation could be recorded as a raw score figure or as a percentage

of a mastery performance. In other words, subjects could be presented with a series of behaviourally stated tasks or competencies to which they would be asked to assess how well they would probably perform. For instance, if a subject thought he could perform about half of a task domain, he could score his potential performance as being 50 percent.

The measure of objective content familiarity could be obtained by means of the more traditional pre or placement test. As a criterion-referenced instrument, the items in the test should be selected as representative samples of the domain of performance capabilities drawn from the elements of a learning hierarchy. Such an instrument should be designed not only to establish a content familiarity benchline, but also to provide subjects with a diagnostic service in identifying which elements in a hierarchy needed to be learned and which ones could be missed out.

Instructional Treatments

The advantages of using programmed instructional materials in an attribute-treatment interaction experiment have previously been mentioned in Chapter II. The fact that achievement performance can be so readily related to the specific characteristics of instructional treatments made this method of teaching an attractive proposition. Further, if learning hierarchies were to be used in the investigation, the programmed format appeared to be a very appropriate presentation vehicle.

The principle purpose of this study was not to provide further validatory evidence in support of Gagné's postulate that generalized intellectual skills are learned hierarchically. Evidence to this effect has already been demonstrated. Rather, the intention of the study was

to incorporate Gagné's theory on the structure of learning on an 'a priori' basis in order to: first, develop instructional sequences for the programmed treatments, and secondly, study the effects of instructional sequencing across tasks deemed to be in some way differentially structured. Nevertheless it was expected that the results of this investigation would provide further support for the concept of learning hierarchies in instructional design.

The differentiation of intellectual skills within the hierarchy could provide points of differentiation between instructional treatments along a continuum ranging from high structuredness to little structure. For instance, treatments which contained all the subordinate elements of the hierarchy would be described as being highly structured. On the other hand, treatments which contained only the criterion behaviours would be seen as being least structured.

Learning Tasks

One of the important issues to be examined in this study was the question of the generalizability of attribute characteristics across tasks. If this issue were to be pursued, some criterion was needed to be established for selecting tasks which could be said to be different. A point of differentiation which seemed to be closely related to the learning hierarchy issue was the question of content structure; the individual facts or substantive structure of a task, often termed verbalized knowledge. Gagné (1968) has distinguished this structure from the intellectual skills of a task which are learned hierarchically. Tasks may be said to be structured either intrinsically or extrinsically. That is, the sequence order of criterion competencies is determined either relatively intrinsically in terms of logical subject-matter constraints, or relatively extrinsically as these imposed constraints are reduced and the rank

ordering of competencies become more arbitrary.

Two tasks seemed appropriate exemplars of this differentiation. The first, a study of introductory statistics, culminating in the computation of standard deviations fell within the criterion of an intrinsically struct- ured task. The second, a study of behavioural learning theory appeared to be a similarly appropriate example of a task which was more extrinsically structured.

An Attribute-Treatment Interaction Study

In order to examine the question of attribute-treatment inter- actions, it was proposed to construct and validate two differentially structured programmed tasks. For each task, three treatments would be developed by progressively reducing the availability of lower-ordered intellectual skills as determined by a hierarchical analysis of the criterion competencies. A fourth treatment group would be devised by allowing students to generate their own sequencing strategies, both vertically, through the hierarchical structure of each competency, and laterally across competencies. Thus, the basis of treatment differentiation would be determined either by the range of intellectual skills required in a treatment, or the ability of students to generate their own sequencing strategies.

Because questions relating to the appropriateness of treatments and levels of achievement motivation arising out of performing learning tasks are pertinent in studies of this nature, it seemed appropriate to consider expanding the traditional dependent measure of criterion achieve- ment to include indices of these additional factors. Accordingly, not only was a criterion-referenced measure of criterion performance sought, but also dependent measures of sequence appropriateness and task-related

achievement motivation. It was believed that these latter measures could be obtained through the administration of a student attitude questionnaire.

The determination of attribute-treatment interactions could be pursued by examining all independent variables on dependent measures separately for individual effects, and in combinations for interactive effects using multiple linear regression techniques (Cohen, 1968). In accordance with the suggestion of Kerlinger and Pedhauzer (1973) it was intended to analyse the independent variables as continuous data and to create treatment vectors for the treatment variable by effect coding the treatments using 1's, o's, 0 -1's.

Hypothesis To Be Tested

The general hypothesis of this study was that the effects of task characteristics would modify the interaction of learner attributes and programmed instructional treatments on criterion achievement, sequence appropriateness and task-related achievement motivation.

Specifically, for subjects in programmed treatments which were deemed to be either intrinsically structured (statistics) or extrinsically structured (learning theory) the following hypotheses were postulated:

1. Achievement orientations of conformance (Ac) and independence (Ai) were expected to differentially interact with the structuredness tasks and treatments on all dependent measures.

2. Measures of objective content familiarity (Test A) and the subjective content familiarity self rating scale (SRS) were expected to differentially interact with tasks and programmed treatments on all dependent measures.

3. Achievement orientations, content familiarity and
    instructional treatments were expected to have a
    three-way interacting effect on achievement and
    sequence appropriateness. However, the subject-
    ive measure of CF (SRS) was expected to be less
    effective with an intrinsically structured task,
    than one which was extrinsically structured.

Experimental Approach

To test the above hypotheses, it was necessary to develop two
hierarchically-structured programmed tasks. The differentiation of
intellectual skills provided the basis for constructing the tasks into
three distinct treatment modes:

Programme version A (PVA) - including learning levels 5, 6, 7
and 8

Programme version B (PVB) - including learning levels 7 and
8

Programme version C (PVC) - only learning level 8 (criterion
competencies)

A fourth treatment mode, programme version D (PVD), was
established by allowing subjects to generate their own instructional
strategy, with the aid if they wished of their placement test results.

A formative evaluation of these materials was required to
establish that they met the desired level of effectiveness.

In summary, the following major steps of work was planned.
1. Sequence instructional objectives for each programmed
    task to correspond with the order implied by the

competencies of a learning hierarchy.

2. Construct two instructional programmes to teach the competencies of the learning hierarchy.

3. Revise both programmes until the three treatment modes for each meet an 85/75 criterion of effectiveness with appropriate target samples.

4. Develop independent variable instruments.

5. Develop dependent variable instruments.

6. Conduct the experiment to test the hypotheses.

7. Evaluate the collected data and comment upon the findings.

CHAPTER IV

METHODS

Overview of the Procedures

In order to test the hypothesis that the effects of task characteristics would modify the interaction of learner attributes and programmed instructional treatments on criterion measures, four distinct stages of work were required: first, the preparation of instructional presentation materials , secondly, the development of independent and dependent evaluative measures , thirdly, the formative and summative evaluation of the learning materials, and measurement instruments and fourthly, the experimental administration. A summary of these four stages is presented in this overview. The remainder of the chapter provides added detail concerning specific tasks within each stage.

The first stage of the project concerned the identification of meaningful tasks that would provide appropriate learning experiences for students undergoing or interested in teacher training courses. A further requirement was that the materials could be in some way individually presented in the experimental administration. Because of the problem of generalizing educational research findings, it was decided that a second task should be added to the experiment, and that the contents of both tasks should be differentially structured, one intrinsically, and the other extrinsically. The two tasks chosen were the computation of standard deviations and an introduction to learning theory. Behaviourally stated objectives were then constructed detailing the performance to be demonstrated, the conditions under which the behaviour would be performed, and the standards of competency deemed acceptable. A programmed text form of presentation was selected as perhaps one of the most economical and satisfactory methods of individualizing instruction. Since there appeared

to be no programmes available to meet these objectives, it became
necessary to construct two programmed texts.

Both programmed tasks were modified by preparing three
presentation versions, the point of differentiation being the different-
iation of intellectual skills as evidenced by a learning hierarchy
analysis.

The second stage of the project called for the development of
independent and dependent measures. These included the construction of
objective measures such as placement tests, and post tests, and subjective
measures such as the Self Rating Scale. Two attitude questionnaires were
prepared which measured the appropriateness of the treatment sequence
and the level of task-related achievement motivation. Details of the
construction and validation of these measures will be provided later in
this chapter.

The third stage of the project was concerned with the formative
and summative evaluation of the learning materials. Here two objectives
were to be met. First, to develop effective instructional programmed
materials, and secondly, to determine the validity of the points of
differentiation in programmed treatments by identifying through placement
tests three levels of performance competency, subordinate (learning levels
5 to 8), ordinate (learning levels 7 and 8), and superordinate (learning
level 8). A formative evaluation for each treatment was then made to
determine whether each programmed version (PV) was capable of meeting a
pre-determined minimal standard of criterion performance for students
who evinced the appropriate behaviour in the placement tests.

On completing a draft of each programme, a series of trials
was conducted to gather feedback information on the effectiveness of

the programmes as instructional instruments. Initially, only Programmed
Version A for each task was tested on selected students. Once the
programme's technical accuracy had been established, sufficient copies
of the programme were prepared to enable field tests to be undertaken.
As a result of this formative evaluation three major revisions were
required on both tasks before an 85/85 criterion of effectiveness was
achieved (that is 85 percent of the trial validation sample achieving
85 percent or better of the performance requirements in each learning
level 8 criterion competency).

With the overall criterion of effectiveness achieved, the
task then was to establish whether students evincing one of the three
levels of performance competency on a placement test, could achieve
minimal mastery of the criterion achievement test (held to be 75 per-
cent) after learning from an appropriately selected programmed version.
Results of the formative evaluation are provided in Tables 6 to 9 in
Chapter 5.

Fourthly, the validated treatments of each of the two
programmed tasks were administered to the experimental subjects.
Students were free to select which of the two programmed tasks they
wished to study (if they were particularly energetic, they could do
both!), and once the decision was made, were randomly assigned to
one of four treatments. The summative and experimental results are
presented in Chapter 5.

Subjects

The cooperation was sought from a number of university and
tertiary institutions involved in teacher and tutor training. In the
Materials Evaluation phase of the project 144 students participated.

A final sample of 36 students was selected for the formative evaluation study. In the summative experiment a total sample of 330 students participated, 272 in the learning theory task and 218 in the statistics task, 160 students participated in both tasks.

Except where participation in the project became a mandatory course assignment (and this was the exception), the researcher was invited to address student classes, and after describing the overall aims of the project, called for volunteers. Students then selected the task they preferred to work on, and commenced the experiment.

Materials

From the outset of the study it was clear that no suitable learning programmes developed on the basis of Gagné's learning hierarchy were available. Thus, one of the major tasks of this project was to construct programmed instructional materials derived from a hierarchical analysis of pre-requisite competencies.

Task Selection

Three pre-requisites had to be considered before any programmes could be written. They were the nature of the tasks to be programmed, the structure method to be used in the analysis of content behaviours, and the exercise difficulty factor in the programmes.

With very few exceptions, subjects who participated in the experiment did so on a voluntary basis. As a means of inducement, subject areas were sought which were likely to be regarded by students as being advantageous to their educational studies. Thus, two tasks were selected, the first, dealing with the computation of elementary statistics culminating in the calculation and use of the standard

deviation statistic, and the second, an introduction to a behavioural approach to learning. Timetabling considerations placed a further constraint on subject area parameters. The length of programmed tasks needed to be limited to the extent that any treatment could be completed in either a morning or afternoon block session. This factor was particularly important as the experiment was conducted in a variety of teacher training institutions.

As has been stated elsewhere, in order to test for the differential effect of tasks on learner characteristics it was essential that a second task be developed, and that the structure of this task be different from that of the first. That is, whereas the selection and sequence order of objectives in the standard deviation programme could be said to have resulted from intrinsic and less arbitrarily derived decisions concerning its structure, the selection and order of objectives in the learning theory programme were much more arbitrarily derived.

The final consideration concerned overall programme difficulty. Some programme writers have attempted to achieve a 90/90 criterion on each programme frame. This results in the overall difficulty level of the programme being reduced to the absolute minimum. Justification for such a procedure is usually made on Skinnerian grounds that the shaping of appropriate behaviour should never be interrupted by the inclusion of inappropriate behaviour whose extinction might be considerably more difficult to achieve than the acquisition of the original behaviour. There are numerous inefficiencies in the design of such programmes (Hunt, 1972), and there was no intention to follow such a procedure in this case. Althoughan overall exercise error rate of 85/85 was sought, the superordinate or problem solving elements in each objective were explicitly designed to provide much more of an intellectual challenge than the more simple subordinate elements.

Thus, each objective contained a difficulty range that equated with that of the hierarchical complexity of intellectual skills. The apparent difficulty for a subject studying in a particular treatment was likely to be modified by the amount of pre-requisite learning material that was provided in his treatment.

Developing Learning Hierarchies

Gagné (1970) has defined a learning hierarchy as a means of identifying a set of intellectual skills that are ordered in a manner indicating substantial amounts of positive transfer from those skills of lower position to connected ones of higher position. Each level of such a hierarchy embodies an identifiable intellectual skill that is in fact the description of repertoires of behaviour that the individual is able to do with reference to his environment. Care is taken in distinguishing between intellectual skills and intellectual operations. In the learning hierarchy the structure of any topic, course, or discipline is described in terms of the intellectual skills - discriminating behaviour, concept forming behaviour, rule-governing behaviour, problem-solving behaviour that the individual needs to possess in order to perform the intellectual operations - to learn about, think about, or to solve problems in.

Each element of the hierarchy comprises a "box" or group of "boxes" which are statements of the intellectual operations which when achieved are evidence that the subject knows or can perform the type of operation required from him (Figures 4 and 5). This is the performance competency of the task or discipline. The description of the intellectual skills needed to perform that competency is the substance of the hierarchy and provides for the points of differentiation.

In this study a hierarchical analysis was made of each

behavioural objective along the lines of the construction and validating procedures suggested by White (1974). The analysis revealed that for each objective no more than the final 4 intellectual skills (Figure 3) in the hierarchy were required (stage 2 of White's 1974 validation procedure).

Figure 3: <u>Learning Hierarchy Intellectual</u>
<u>Skills</u>

Level 8   Problem-solving

Level 7   Rule-governing

Level 6   Concept-forming

Level 5   Disciminating

Intellectual skills below level 5 were found to be present in all the subjects drawn for the experiment, and therefore were omitted from the analysis.

The detailed operations within the "boxes" of the learning hierarchy represent the internal conditions of learning, that is, the competencies that are to be learned (the criterion performance), and the subordinate competencies that will need to be recalled when a new higher-ordered behaviour is being learned. No information is presented at this stage as to the external conditions of learning that will be required for these behaviours to be achieved. The "how" a particular individual is expected to come to learn a particular capability is the pertinent function in the design of a learning environment or the construction of a programme.

In order to prepare instructional presentation formats based upon a diminution of intellectual skills it was necessary to aggregate the the hierarchy into three categories of competencies; superordinate,

Figure 4

Learning Hierarchies for Statistics Task

OBJECTIVE 1

(1) 8.1 Determine the mean and standard deviation for distribution of computer data.

(1) 7.1 From a distribution of scores find Σx^2, $(\Sigma x)^2$ and N.

Enter values and work formula for S.D. with ungrouped data.

(1) 6.2 Find measure of central tendacy from a distribution of scores.

(1) 6.3 Find $(\Sigma x)^2$ and Σx^2 from a distribution of 6 cases.

(1) 6.4 Read a square root table and find $\sqrt{}$ of numbers 1 - 10.

(1) 5.2 Discriminate between "Σ" "x" and "N".

Figure 4: Continued

OBJECTIVE 2

(2) 8.1 Calculate the mean and standard deviation for a distribution of scores using the grouped data method.

(2) 7.1 Construct a frequency distribution table and determine the values.

(2) 7.2 Determine the values from a frequency distribution table and using a formula find the S.D. for grouped data.

(2) 6.1 Find the range, mid points and intervals for grouped data.

(2) 6.2 Find the mean from a frequency distribution table.

(2) 5.1 Draw up a frequency table, and using tallies find Σf and $(\Sigma f)^2$.

Figure 5: <u>Learning Hierarchies for Learning Theory Task</u>

<u>OBJECTIVE 1</u>

<u>Reinforcement</u>

```
┌─────────────────────────────────────┐
│ (1) 8.1  Describe procedures that    │
│          demonstrate how the         │
│          probability of desired      │
│          responses can be increased. │
└─────────────────────────────────────┘
                    ▲
┌─────────────────────────────────────┐
│ (1) 8.2  Provide responses which     │
│          could be successful in the  │
│          removal of undesired        │
│          behaviour for given         │
│          situations.                 │
└─────────────────────────────────────┘
                    ▲
┌──────────────────┐  ┌──────────────────┐  ┌──────────────────┐
│ (1) 7.3  Select  │  │ (1) 7.2  Identify│  │ (1) 7.1  Identify│
│ reinforcement-   │→ │ non-reinforcement│→ │ punishment-      │
│ rule students    │  │ -rule situations.│  │ rule situations. │
│ for given        │  │                  │  │                  │
│ examples.        │  │                  │  │                  │
└──────────────────┘  └──────────────────┘  └──────────────────┘
          ▲
┌──────────────────────────────────┐
│ (1) 6.1  Identify stimulus,       │
│ response and consequential        │
│ properties of behaviour.          │
└──────────────────────────────────┘
```

Figure 5: Continued

OBJECTIVE 2

Respondent and Operant Behaviour

```
┌──────────────────────────────┐
│ (2) 8.1  From 2 situations    │
│     discriminate between      │
│     operant and respondent    │
│     behaviour, and justify    │
│     choice.                   │
└──────────────────────────────┘
               ↑
┌──────────────────────────────┐
│ (2) 7.1  Classify given       │
│     behavioural statements    │
│     as either respondent or   │
│     operant.                  │
└──────────────────────────────┘
               ↑
┌──────────────────────────────┐
│ (2) 6.1  Identify the con-    │
│     cepts of respondent and   │
│     operant behaviour.        │
└──────────────────────────────┘
               ↑
```

```
┌──────────────────────┐        ┌──────────────────────┐
│ (2) 5.2  Distinguish  │        │ (2) 5.1  Distinguish  │
│     between overt and │        │     between learned   │
│     covert behaviour. │        │     and reflexive     │
│                       │        │     behaviour.        │
└──────────────────────┘        └──────────────────────┘
```

Figure 5: Continued

OBJECTIVE 3

The Technical Components of Conditioning

```
+------------------------------------------+
| (1) 8.1  Diagram the 4 technical         |
|     components of a conditioning         |
|     model.  Relate technical             |
|     teams to actual conditioning         |
|     situation.                           |
+------------------------------------------+
                    ^
                    |
+------------------+  +------------------+  +------------------+
| (1) 7.3 Recognize|  | (1) 7.2  Recognize|  | (1) 7.1  Recognize|
|  the uncondit-   |->|  the conditioned  |->|  the conditioned  |
|  ioned stimulus  |  |  stimulus.        |  |  response, paired |
|  and uncondit-   |  |                   |  |  to conditioned   |
|  ioned response. |  |                   |  |  stimulus.        |
+------------------+  +------------------+  +------------------+
          ^
          |
+----------------------------+
| (1) 6.1  Using S-R notation|
|     identify the concepts  |
|     of stimulus and response.|
+----------------------------+
```

Figure 5: Continued

OBJECTIVE 4

Writing a Behavioural Sequence

```
            ┌─────────────────────────────┐
            │ (4) 8.1  Write the behavioural │
            │     sequence for a given simple│
            │     task, using S-R notation.  │
            └─────────────────────────────┘
                          ▲
                          │
┌──────────────────────────┐      ┌──────────────────────────┐
│ (4) 7.2  Complete elements │      │ (4) 7.1  Using S-R notation│
│     of the "before" and    │─────▶│     complete the elements  │
│     "after" response       │      │     of a behavioural       │
│     situation model.       │      │     sequence.              │
└──────────────────────────┘      └──────────────────────────┘
                          ▲
                          │
┌──────────────────────────┐      ┌──────────────────────────┐
│ (4) 6.2  Distinguish       │      │ (4) 6.1  Distinguish       │
│     between a task, step   │─────▶│     between a response and │
│     and response.          │      │     situation.             │
└──────────────────────────┘      └──────────────────────────┘
```

OBJECTIVE 5

Establishing and Maintaining Behaviour

```
┌──────────────────────────────────────────────┐
│ (5) 8.1  Describe behaviour modification       │
│          procedures that might be useful       │
│          in eliminating inappropriate          │
│          behaviour                             │
└──────────────────────────────────────────────┘
                        ▲
```

```
┌─────────────────────────┐  ┌─────────────────────────┐  ┌─────────────────────────┐
│ (5) 7.1A  Identify two  │  │ (5) 7.1B  Apply "Shaping"│  │ (5) 7.1c Determine      │
│ principles of reinforce-│  │ principles to given      │  │ which Schedule of       │
│ ment relevent to        │  │ learning situations      │  │ Reinforcement are       │
│ establishing behaviour  │  │                          │  │ operating in given      │
│                         │  │                          │  │ situations              │
└─────────────────────────┘  └─────────────────────────┘  └─────────────────────────┘
```

```
                          ┌─────────────────────────┐
                          │ (5) 7.2B Identify 4     │
                          │ rules in "Shaping"      │
                          │ behaviour               │
                          └─────────────────────────┘
```

```
┌─────────────────────────┐  ┌─────────────────────────┐  ┌─────────────────────────┐
│ (5) 6.1A  Distinguish   │  │ (5) 6.1B  Recognize     │  │ (5) 6.1C Distinguish    │
│ between the concepts of │  │ examples of the         │  │ between the concepts    │
│ reinforcement and non   │  │ "Shaping" concept       │  │ of continuous and       │
│ or negative reinforce-  │  │                         │  │ intermittent schedules  │
│ ment in establishing    │  │                         │  │ of Reinforcement        │
│ behaviour               │  │                         │  │                         │
└─────────────────────────┘  └─────────────────────────┘  └─────────────────────────┘
```

OBJECTIVE 6

Attitudes and Motivation

> (6) 8.1 Assess a learning environment in terms of attitude modification and motivational management

> (6) 8.2 Given a learning task, state C-M properties that could be used in that task

> (6) 7.1A Identify 5 modelling characteristics operative in developing attitudes

> (6) 7.1B Define Contingency-Management contracts by identifying appropriate examples and justifying reasons

> (6) 7.2A Identify sources of attitude information

> (6) 7.2B Recognize and select from examples, instances of HPB and LPB

> (6) 7.2B Recognize the concept of "Preference"

> (6) 6.1A Recognize the concepts of "approach" and "avoidance" in attitude formation

> (6) 6.1B Check items as being contingent upon the other

> (6) 5.1B Descriminate between popular and behavioural uses of "reinforces" and "motivation

ordinate, and subordinate (Figure 6). These diminutive categories of
intellectual skills formed the basis of the programmed versions for
each task.

Figure 6: Categorization of Skills

Categorization	Skill	Programmed Version
SUPERORDINATE	{ Level 8 Problem-solving }	C
ORDINATE	{ Level 7 Rule-governing	B
SUBORDINATE	Level 6 Concept-forming	A
	Level 5 Discriminating	

        Two further points should be evident from an examination of
the Hierarchical Analysis of Objectives in Figures 4 and 5. The first
is that not every objective required a delineation of the hierarchy to
a base skill level of 5. In many cases, a higher level 6 was proven to
be adequate. Secondly, while a vertically organized, single chain of
capabilities was characteristic for most objectives, objectives 5 and 6
of the learning theory programme provided the possibility for both
vertical and lateral transfer between elements up to level 8. In the
programme directed versions (PVs A, B, and C) only a vertical transfer
was permitted - the lower elements being pre-requisite to discrete
higher-ordered behaviours. However, on the student directed versions
(PV D) both vertical and lateral transfer were permitted - the actual
decision resting with the individual student.

Constructing Instructional Programmes

        Having determined the internal conditions of learning, the
task now was to provide for the external conditions of learning so
that students could achieve the criterion competencies. That is,

programmes had to be designed to teach the objectives for all
specified students.

The author's research and experience with the development of
mathetics (Hunt, 1972) as a method of instructional programming led him
to apply some of the principles of this technique to the construction of
the statistics and learning theory programmes. Mathetics has previously
been defined (Gilbert, 1962) as the systematic application of reinforce-
ment theory to the analysis and reconstruction of complex behaviour
repertoires usually known as "subject-matter mastery", "knowledge",
and "skill".

Many of the explicit features of mathetics analysis - the
design of a prescription, development of a domain theory, the charact-
erization of the prescription, and the exercise design are implicitly
part of the instructional analysis of a learning hierarchy. The
operant span represents the basic element of behaviour change. It is
determined, not by "breaking the materials into small parts", but from
a behavioural prescription (such as the performance statements from the
hierarchy), asking the target student if he could perform the sequence
as a single act after reading or hearing instructions telling him what
to do.

Using the mathetics approach, a further analysis of the behavioural
prescription, or hierarchical competencies sought information on the
following sorts of instructional problems: the essential overt pro-
perties of the behaviour to be taught; the basic intellectual skills
required in order to perform the intellectual operations in the task;
the sequence in which the lesson would occur; a description of the
mediation that could be used to produce stimulus conditions adequate
to evoke responses required in the pre-requisite or criterion competencies

when these responses might not otherwise be forthcoming.

The culmination of these various analyses was the production
of two instructional programmed tasks (Appendix A and B). The first,
"Standard Deviations" comprized two objectives and the second "A
Behavioural Approach to Learning", comprized six. Both programmes
incorporated the large "exercise" instructional presentation unit,
rather than the traditional and smaller sized "frame". Evidence of
the learning hierarchy can be seen in the exercise notation system.
(Figure 7)

Figure 7: Programme Exercise Notational System

(1)	7	•	2
Objective	Learning		Exercise
number	level		number

Student response feedback was provided by requesting subjects
to check their answers on the next page. However, in level 8, criterion
exercises subjects were asked to turn to the back of the programme to
receive the knowledge of their result (KR). This variation in procedure
was introduced to reduce the likelihood of "peeking-ahead" in criterion
exercises, and to induce a little variety.

When designing the programme, particular attention was paid to
the response mode, that is, the manner in which the students would be
asked to actively respond to the programme. Amongst findings reported
by Tobias (1973a) was the possibility that in many programmes the pro-
duction of overt responses when compared with covert responses resulted

in no discernable difference with respect to achievement. The reason
is clear. Many of the programmes' frames were redundant; answers to
questions were quite obvious. In another finding he reported that a
programme's content modified the effectiveness of different response
modes, and in programmes dealing with difficult or unfamiliar material,
constructed responses (CR) led to superior achievement. An observation
of this researcher has been that in many programmes, particularly of a
linear nature, a large proportion of the responses required were not
integral to criterion attainment, and even where a case could be made
for their inclusion, many of the responses involved excessive effort on
the part of the learner. For example, identifying the function of a
process by writing down the *words* describing that function, instead of
ticking a statement descriptive of that function.

The other half of the response mode question has been that of
the efficacy of the knowledge of response (KR) on performance. Skinner
(1954) has drawn a direct analogy between the reinforcement procedure,
in which the behaviour of a hungry animal can be progressively shaped
by the provision of food rewards contingent upon the desired responses,
and the immediate confirmation of individual responses made by the human
learner to programme materials. However, as in the case of the response
mode issue, there have appeared in the literature many "no significant
difference" findings between reinforced and non-reinforced practice with
linear programmes having a low error rate, and "significant differences"
with programmes where responses have not been heavily prompted, and error
rates have been much higher. A conclusion might be that KR is valuable
only when the supporting material does not itself convey all the information.

In the present study, basic principles relating to CR and KR
were accepted, but modified occasionally according to task requirements,

and the need to induce variety into the programme. A variety of response modes was used, ranging from traditional constructed responses, overt ticks, multiple-choice to matching pairs and even the occasional covert checking. Immediate KR was the general rule (it was necessarily so as a measure of task achievement) and further justified because a reasonable level of task difficulty could be assumed for most students, particularly at the higher levels of the hierarchy.

Instructional Sequence (PVs)

The instructional treatment to be manipulated in this experiment was the sequence presentation or programmed version (PV) randomly assigned to each subject. As has previously been stated, the basis for sequence differentiation was the categorization of intellectual skills from the learning hierarchy into three classes of capability; superordinate (PV C), ordinate (PV B), and subordinate (PV A). The underlying rationale for such a categorization was that the amount of prior familiarity an individual might have with a content domain should effect the amount of information needed to achieve criterion performance. Subjects high in content familiarity should require significantly less instruction than subjects low in CF. Further, it is reasonable to expect that subjects high in CF but forced to undertake an instructional sequence already familiar to them, might in fact become bored with the subject-matter, and develop more negative attitudes to the task than an individual exposed to a more appropriate instructional sequence.

Two sequence orientations were developed for the experiment. The first, a teacher or programme directed sequence in PVs A, B, and C. That is, subjects randomly assigned to any one of the 3 sequences were required to progress through that sequence without any variation. This meant that each objective was taken in numerical sequence, and the point of entry into the programme was at the lowest hierarchical level of

competency appropriate to that particular PV assigned to a subject. No attention was paid to the appropriateness or otherwise of an individual's entry point.

A student directed sequence operated for PV D. To enable each student to make educated decisions on the sequence strategies he should choose, test A papers plus a marking key were returned. The subject was then asked to mark his test paper and to check off those competencies believed to have been previously acquired as evidenced by his performance on the test. By cross checking with the taught competencies in the programme, the subject was given a useful guide in determining which competencies should be studied in the programme, and which ones could be safely omitted because of prior experience. The decision on which competencies should be studied, rested completely with the subject. A competency scored "wrong" did not necessarily mean that the student would work through the appropriate instructional section in the programme. It might be that although a subject made an incorrect response to a question on the test, when he checked his response with the correct answer on the marking key, he could "see" why he was wrong. Therefore, although his performance on the test was incorrect, it could be sensible for him to omit studying the competency in the programme.

As well as the decision concerning which competencies should be studied in the programme, decisions were required as to the sequence of objectives to be studied, and the order in which the competencies would be learned, whether by vertical, lateral, or inverse order transfer. The only mandatory requirements placed on PVD subjects was that every level 8 criterion exercise in the programme be attempted, and that the subject keep a list of the order in which the competencies were studied so that an individual sequence path could be traced.

Description of Tests

A total of 10 tests were used in the study; The California
Psychological Inventory (CPI) as a measure of achievement orientations,
a Self Rating Scale (SRS) as a subjective measure of the subjects
estimate of content familiarity. Two objective placement tests (tests A),
two pre tests (tests B) and two identical posttests (tests C) as criterion
measures. All subjects were administered the CPI, SRS and test A,
followed by either a learning theory or standard deviation test B.
After completing the programme each student worked the final test C.
The experiment was completed for each task by administering a questionnaire
(QEA or QEB) to determine post instructional task-related achievement
motivation and the appropriateness of treatment sequencing. An explanation
of the purpose of each test, and how they were constructed is now presented.

California Psychological Inventory: The CPI is principally concerned
with the measurement of personality characteristics important for social
living and social interaction. To achieve this assessment 480 statements
have been composed yielding 18 sub-scales and raw scores which can be
coverted to standard scores and graphed on profile sheets. For the
purpose of this study only 2 of the sub-scales were used; achievement via
conformance (Ac) and achievement via independence (Ai).

The CPI was used as a self-administered test with subjects
being handed the 12-page test booklet and "True" or "False" scored
answer sheet. Subjects were asked to complete and hand back the test
within a week.

Self Rating Scale (SRS): This scale was devised along the lines of an
attitude scale developed by Adams (1962). Its purpose was to provide
a means of determining a subject's estimate of his familiarity with

the criterion competencies. Originally, this type of self rating
scale required the conceptualizing of attitudinal concepts in numerical
rather than verbal terms. In this case, the scale required an estimate
of performance competency by selecting a numerical value as representative
of the percentage of competency an individual might expect to obtain on
any given test item.

The scale was constructed by selecting 8 performance statements
from the objectives of each programme and asking a subject to estimate
how well he thought he might be able to perform each task. For each
task he was asked to rate his performance from 0 to 100 by ticking boxes
on a "tens" and "units" scale. If he thought he would do well on a task
he was asked to tick a box in the top half of the "tens" scale. If he
thought he would do poorly (because he knew little about the task) he
was asked to tick a box in the lower half of the scale. Then, to give
a precise percentage score, the subject was asked to tick a box on the
"units" scale. The numbers in these boxes represented units from the
tens box, and showed whether the performance estimate was likely to fall
nearer the top or bottom end of the "tens scale". The actual instructions
and items are contained in Appendix C.

The rationale for including this measure was that an actual
score from a performance item might provide very little information on
an individual's previous familiarity with that behaviour. A score of
zero may not mean that a subject has no prior familiarity, or knew
nothing about the particular competency. It may mean that he has for-
gotten, or become confused about an aspect or sequence of the task.
The instructional strategy needed to restore a previous capability is
likely to be quite different from that required to induce a completely
new behaviour.

<u>Placement Test A</u>:   The placement test was developed by examining the
learning hierarchies of both tasks and constructing test items from the
competency statements in levels 5, 6 and 7.   There were 4 items in the
standard deviation test, and 14 in the learning theory test.   Each
competency being measured was clearly identifiable through the test
item notation system.   (Figure 8)

Figure 8:   <u>Item Notation for Placement Tests (Test A)</u>
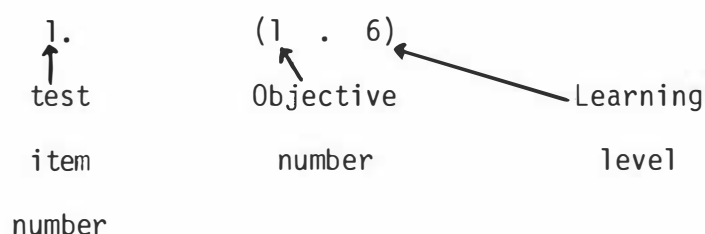
        The placement test was designed to serve a three-fold pur-
pose in the study.   First, it was an objective measure of the subject's
content familiarity with pre-requisite capabilities.   Secondly, inform-
ation from the test could provide the programme user (learning
supervisor) with information on the point of entry appropriate for
each student.   This facility was enhanced by the fact that each item
represented a similarly identified competency being taught in the
programme.   Further, as a measure of content familiarity it provided
an independent variable to be manipulated by treatment variables (the
PVs) the effects of which could be measured by the dependent variable
of criterion achievement (test C).   For instance, subjects high on CR
and who were randomly assigned to PV C were likely to perform better
on criterion measures than subjects low in CF and assigned to PV C.
Similarly, subjects high on CF and randomly assigned to PV A were
likely to have less positive attitudes on the appropriateness of the
programme sequence, than subjects low on CF and assigned to PV A.

Thirdly, the test provided the individual student with information on which competencies he had already acquired through previous experience, and therefore probably did not need to spend time on in the programme. This third purpose was intended to provide the basis for enabling subjects to decide which competencies they should study in PV D.

Pre and Posttest Measures (Tests B and C): The pre and identical post tests were used to evaluate criterion performance on each objective, that is, on each of the level 8 competencies. The pre test was administered to provide a base line measure so that the instructional effectiveness of a particular PV could be judged by using a gain score measure. The 3 items in the standard deviation criterion test, and the 6 items in the learning theory test were selected as representative samples of criterion behaviour from the performance competencies of the learning hierarchies. These were further stated as performance objectives in the front of each programmed booklet.

Because of the wide range in cognitive complexity between concepts and procedures in the standard deviation task, it was decided to introduce a weighting system into the marking of the test. The various weights accorded to each of the competencies are illustrated in Appendix D. There appeared to be no particular advantage in incorporating such a system with the learning theory test. Except for item 4 where the possible score ranged from 0 to 5, the structure of the sub-items within each item enabled a high degree of scoring objectivity.

Attitude Measures (QEA and QEB): An attitude measure was included in the research for two reasons. First, to see whether subjects who had been assigned to an appropriate PV had a more favourable attitude toward the instructional sequence than had subjects who had been assigned to inappropriate PVs. Secondly, to determine the effects of independent variables, such as learner characteristics and instructional

treatment on task related achievement motivation.

The attitude questionnaire was produced in identical parallel form, the only variation being the use of words such as "statistics" or "learning theory", when referring to one or other of the programmed tasks. The version appropriate to the standard deviation task was coded QEA, and learning theory QEB. The questionnaire was developed according to recommended Likert-type technique of questionnaire construction. There were 26 statements in all, 11 relating to the appropriateness of the subjects PV, (Sa) and 14 to task related achievement motivation.(Tam). A preference item was included at the end for subjects who had studied both programmes. Subjects were to respond to the statements along a 5-point continuum covering a 2-point positive and negative range on either side of a neutral mid point.

As a precaution against the "halo effect", and pattern respond-ing, two modifications to the questionnaire were made. First, the direction (left to right locationg of a + and - series of reactions) of favourable or unfavourable judgement was not the same for all the attitude statements. Secondly, the statement of reaction also varied from extreme statements at one end such as "Strongly agree", "All the time", "In every exercise", to extreme statements at the other end such as "Strongly disagree", "Never", and "In no exercise".

The attitude measure was administered after the subject had completed both the programmed text and test C. Instructions with the questionnaire made it a self-administering instrument. Favourable attitudes were scored above the median and unfavourable attitudes below the median for each attitude statement. A maximum favourable score of 55 could be obtained from achievement related statements. Statements from both sub-scales were interspersed throughout the questionnaire.

Statistical Design

Many studies in Trait-Treatment-Interactions have used analysis of variance (ANOVA) or multivariate analysis of variance (MANOVA) as the statistical models for detecting interactions. Cronbach and Snow (1969), Kropp, et al (1967), and others have argued that the use of regression models rather than ANOVA is a more effective approach for detecting interactions from data obtained in ATI studies. There are a number of suggested reasons. The regression approach, as compared to ANOVA, tends to decrease the error component in the analysis. It avoids the inefficient analysis procedure used in ANOVA, where continuous scores are reduced to a small number of groups or levels. Regression analysis conveniently allows the data analyst to use categorical information (such as the treatment vectors) and to create interaction terms to be tested in the analysis model by the use of cross products. (Berliner and Calen, 1973)

Directions to Subjects

Subjects were told that the experiment was concerned with various aspects of programmed instruction, particularly factors involved with the individualizing of instruction. Three procedural points were emphasized. First, subjects could take a break whenever they choose. Secondly, they were advised that when they made a response to an exercise question, they would be directed to check their answer at some place in the programme. If they were incorrect on their first attempt, they were to cross their answer as wrong. They were then free to figure out as best they could (if they so desired whey they were wrong. Thirdly, they were asked not to discuss the programme with anyone while they were working on it. If the

programme did not provide them with sufficient information to work the answer, they were not to ask their friends, or consult any other material.

Subjects who had been randomly assigned to programmed version D were given special instructions that read as follows:

"You have been given your placement test paper to help you study the programme as efficiently as possible.

The learning theory (standard deviation) programme that you are about to study is composed of 6 (2) objectives. You can look at them by turning to the second page of the programme. Each of the objectives has been divided into a number of hierarchically structured learning levels; from level 6 (in some cases 5) at the lowest or simplest level to level 8 at the highest or most complex learning level.

Your placement test reflects these levels. Look at the first item.

$$1 \qquad (\quad 1 \quad . \quad 6 \quad)$$

Item number   Objective number   Learning level

The same pattern follows for the rest of the test. The programme has a similar notation system, except that each learning level is divided into a number of exercises. For example:

$$(\quad 1 \quad) \qquad 7 \qquad . \qquad 1$$

Objective   Learning   Exercise

number   level   number

The reason for giving you your placement test is so that you can SKIP over those learning levels YOU THINK you already understand, and so make the study of the programme more efficient. You need study *only* those levels and exercises YOU feel unsure about.

Procedure:

1.   From the score sheet containing the correct answers, mark your placement test.

2.   Look at the results. If you got most items in any given level correct, or you think you understood them in any way, you may skip that section of the programme, and go on to a higher level IF YOU WISH.

<div align="center">HOWEVER</div>

3.   You must do every level 8 exercise of each programme.

4.   You must indicate ON the programme, where you have started, where you are going, and where you have come from, so that I can trace your study pattern later. For example, if you started the programme at exercise 7.1 of objective 1   (1) 7.1   , you should write "Starting Objective 1 here", at the top of the page. Suppose you couldn't understand something in the exercise, and you wanted to go back to an earlier one, such as 6.1, you should write at the top of the page, "From (1) 7.1 to (1) 6.1". You should follow the same procedure when skipping ahead.

Now open the programme, read the objectives and instructions (forget those which have been superceded by these special instructions), and start. Remember to note down the starting time!"

Procedures

Each individual was given a code number from a master list of code numbers and randomized PV letters. The code number was

printed on a card that was handed to $\underline{S}$s. Students were asked to use their code number at all times for purposes of identification.

First Session   The administration of each task took place over 2 sessions, and was conducted by the researcher.

In the first session, $\underline{S}$s were given a test booklet and answer sheet from the California Psychological Inventory. The general purpose of the CPI was explained in conjunction with the brief administration instructions of the test. $\underline{S}$s were told that they could take the CPI away with them and complete it in their own time.

The next test to be administered was the Self Rating Scale. Administration instructions were read to the $\underline{S}$s, and any questions raised, answered. This test took approximately 10 minutes to complete.

The final test to be administered was the placement tests A. Unless it was patently clear that $\underline{S}$s would only work on the one programmed task, both tests A were administered. The standard deviation test A was administered last, so that $\underline{S}$s with prior experience and needing time to work the computations did not hold up those $\underline{S}$s who had little experience and would finish the test quickly.

Second Session   The second session followed as close after the first as practical - normally about one week later. The $\underline{S}$'s code number was checked off against the PV list, and each individual was handed his programmed text. Printed procedural instructions were handed out, and $\underline{S}$s were asked to read them carefully. When

Ss had finished reading the instructions they were asked if they had any questions. At this point they were given test B, and its purpose as a competency-based indicator explained. Ss were then informed that as soon as they had completed the test they could commence the programme.

As Ss completed the learning programmes, they were handed a posttest (test C) and attitude questionnaire to complete. Text C had previously been explained to them as the measure for determining the amount of learning gained as a direct result of their study of the programme.

Ss who elected to work on the second programmed task followed exactly the same procedures as in the second session. Normally Ss undertook the second task one week later.

CHAPTER V

RESULTS

This chapter will present the results from the formative and summative evaluations of the learning materials and measuring instruments, followed by an analysis of the experimental data. These results will be presented in three separate sections.

Formative Evaluation

Independent Measures

The principal standardized independent measure in this study was the California Psychological Inventory (CPI). The means, standard deviations and correlation of the two sub-scales employed in this study, Achievement via Conformance (Ac) and Achievement via Independence (Ai) have been summarized in Table 1. An inspection of this table reveals comparative performance data between this study, and that of Gough's (1957) validation studies. The results are closer than one might have expected considering alleged differences in the social milieu between New Zealand and the United States. The slightly higher correlation of .46 in this study (Cf .39) can probably be attributed in large part to the relatively small sample size of 330. One can conclude that the underlying constructs of the two sub-scales under investigation have been interpreted by subjects in this study in much the same way as in the United States.

In Chapter 2 mention was made of Bracht's (1970) hypothesis that disordinal interactions were more likely to occur with factorially simple variables, rather than complex ones. Criticism was made of studies which employed factorially complex independent variables such

as indices of intelligence. Evidence of the factorial simplicity of these time sub-scales is well documented (Gough, 1957). Evidence of the independence of the sub-scales with intelligence is presented in Table 2. From a sample of 103 subjects in the summative administration correlations were obtained using the B.40 intelligence test to check this independence. The result indicated correlations between the B.40 and Ac and Ai of .16 and .28 respectively.

The previous chapter has described in detail the procedures used for constructing the Self Rating Scale and placement tests. As a test of the concurrent validity of the two measures correlation coefficients were obtained on both tasks. The results presented in Table 3 provide values of .69 and .70 for statistics and learning theory respectively. These correlational values were held to be acceptable.

Programmed Materials

A description of the procedures involved in the formative evaluation of the programmed materials has been presented in Chapter 4. Once the main programmed treatment (PVA) for each task had been revised to the stage that 85% of the validation sample of subjects were achieving a minimum performance of 85% from each level 8 exercise, the three programmed versions (PVs) for each task were submitted to a formative evaluation.

Students from two teacher training institutions were asked to complete placement tests in both statistics and learning theory. Items in the placement tests were derived from the performance competencies in each task's learning hierarchy, providing for a sample of competencies representing learning levels 5 to 7. Performance on the placement test was used as the basis for the appropriate selection of a sample of students to validate the 3 PVs (Table 4). A total

sample of 36 students, 12 for each PV were selected; subjects who performed approximately 75% or better on TA were selected to PVC; 45% to 75%, to PVB, and less than 45% to PVA. (The actual score range and upper percentage limits are presented in Table 4.) The means and standard deviation for test A and C (statistics) is presented in Table 5 and for test A and C (learning theory) Table 7. For the purposes of formative evaluation, a minimum mastery performance of criterion test C was required for each treatment group. This pre-requisite level of mastery was lower than that which is often characteristic of mastery learning with programmed materials (linear programmes often call for mastery levels as high as 90 to 95%). The justification for the 75% mastery level in this study was that the experiment required a greater degree of performance uncertainty than is usual with Skinnerian type programmes. For the statistics task an overall mastery level of 83% was achieved from all treatments, and for learning theory a performance of 78%. Although the performance level for treatment PVB learning theory (Table 7) was slightly below the criterion level (74%) the standard was so close that no further revision was deemed necessary.

A test of significance was made to see whether treatment differences existed (that is, whether students who were appropriately selected into hierarchically differentiated programmed treatments according to their placement tests performed equally well). The tests (Table 6 and 8) revealed no significant difference between treatments in criterion achievement

test C performance. So, it could be concluded that the three hierarchically structured programmes for each task were achieving the specified levels of instructional performance.

Dependent Questionnaire Measures

Two parallel form questionnaires were developed, QEA (statistics) and QEB (learning theory). The dependent measures administered through the questionnaire were task-related achievement motivation (Tam) and sequence appropriateness (Sa) for statistics and learning theory tasks. The tasks were administered to the same subjects after an interval of 4 weeks to obtain coefficients of stability. These are reported in Table 9. The retest reliability of Tam was .86 for statistics and .81 for learning theory and the Sa reliability was .94 and .74 respectively. The difference in Sa correlations between statistics and learning theory (remembering that virtually the same items were used for both tasks) probably reflects the underlying construct differences in each task. The statistic treatments were much more likely to provide subjects with stronger feelings on the appropriateness of instructional sequencing than learning theory.

TABLE 1

MEANS, STANDARD DEVIATIONS AND CORRELATIONS FOR

ACHIEVEMENT ORIENTATION MEASURES

Study	Variable	Mean	S.D.	r
Hunt N = 330 (NZ tertiary students)	Achievement via Conformance	26.3	4.4	
	Achievement via Independence	21.3	5.5	.46
Gough N = 1133 (US college students)	Achievement via Conformance	27.4	4.5	
	Achievement via Independence	20.9	4.2	.39

TABLE 2

CORRELATION COEFFICIENTS OF B40 WITH ACHIEVEMENT VIA

CONFORMANCE AND ACHIEVEMENT VIA INDEPENDENCE

Variables	N	r
B.40 and Ac	103	.16
B.40 and Ai	103	.28

TABLE 3

CORRELATION COEFFICIENTS FOR SELF RATING SCALES (SRS)

AND PLACEMENT TESTS (TEST A)

Task	Measure	N	r
Statistics	SRS and Test A	36	.69
Learning Theory	SRS and Test A	36	.70

TABLE 4

FORMATIVE EVALUATION: RANGE PARAMETERS FROM PLACEMENT TESTS (A) AS

DETERMINANTS FOR SELECTION TO PROGRAMMED VERSIONS

<u>Statistics</u>

Test A Score Range	% of Test Items	Programmed Version
0-7	0-44	PVA
8-12	45-75	PVB
13-16	76-100	PVC

<u>Learning Theory</u>

Test A Score Range	% of Test Items	Programmed Version
0-18	0-46	PVA
19-29	47-74	PVB
30-39	75-100	PVC

TABLE 5

FORMATIVE EVALUATION: MEANS AND STANDARD DEVIATIONS FOR STATISTIC

TASK

Test A

Treatment	Mean ($\bar{X}$)	S.D.	N
PVA	3.8	2.4	
PVB	9.9	1.3	12
PVC	15.1	1.0	

Test C

Treatment	Mean ($\bar{X}$)	S.D.	% of Mastery	N
PVA	19.9	3.6	80	
PVB	21.0	2.3	84	12
PVC	21.6	2.5	86	

TABLE 6

ANALYSIS OF VARIANCE OF CRITERION ACHIEVEMENT SCORES IN FORMATIVE

EVALUATION OF STATISTICS TASK

Source	df	MS	F
Between groups	2	16.02	1.79
Within groups	33	8.96	

Note:

* $p < .05$
** $p < .01$
Otherwise F is not significant

TABLE 7

FORMATIVE EVALUATION: MEANS AND STANDARD DEVIATIONS FOR LEARNING

THEORY TASK

Test A

Treatment	Mean ($\bar{X}$)	S.D.	N
PVA	14.3	2.9	
PVB	23.4	3.2	12
PVC	33.6	3.0	

Test C

Treatment	Mean ($\bar{X}$)	S.D.	% of Mastery	N
PVA	23.4	2.6	78	
PVB	22.2	4.5	74	12
PVC	24.5	3.6	82	

TABLE 8

ANALYSIS OF VARIANCE OF CRITERION ACHIEVEMENT SCORES IN FORMATIVE

EVALUATION OF LEARNING THEORY TASK

Source	df	MS	F
Between groups	2	17.53	1.36
Within groups	33	12.86	

Note:

* p<.05
** p<.01
Otherwise F is not significant

TABLE 9

TEST-RETEST CORRELATION COEFFICIENT FOR TASK-RELATED ACHIEVEMENT

MOTIVATION (Tam) AND SEQUENCE APPROPRIATIVENESS (Sa)

Task	Measure	N	r
Statistics (QEA)	Tam	22	.86
	Sa	22	.94
Learning Theory (QEB)	Tam	22	.81
	Sa	22	.74

Summative Evaluation

In the summative administration a total sample of 330
subjects participated, 218 in the statistics and 272 in the learning
theory task. Of this sample, 160 subjects completed both tasks.
For the purposes of reporting the results, data from the statistics
task will be examined first, followed by the learning theory task.
Any significant similarities or differences between tasks will then
be discussed.

Summative Data

Table 10 provides details of the means and standard
deviations of statistic task measures, and Table 11, similar
details for the learning theory task. As would be expected with
a randomly selected sample, the size of the summative means
on the criterion achievement tests in both tasks were smaller
than the size of the summed means for treatments in the formative
evaluation on the same measures. However, although the difference
was statistically significant (t = 2.9 p<.01 statistics; t = 6.0
p<.01 learning theory) the actual magnitude was modest. For the
statistics task the sum of the formative mean was 20.8, and the
summative mean 19.1. The magnitude of differences was greater in
the learning theory task with a formative mean of 23.4 and a
summative mean of 20.5.

A summative analysis of programmed treatments was conducted
for both tasks with the results being presented on Tables 12 and 13. A
treatment x measure analysis of variance (ANOVA) was performed for each
variable in both tasks to determine the presence of treatment differences.
Only on the independent statistics variable Test B, did a very moderate
difference occur (F=2.9, p<.05). With that one exception, there were no

TABLE 10

MEANS AND STANDARD DEVIATIONS FOR STATISTICS TASK MEASURES

Measure	Mean	S.D.	N
Achievement via Conformance (Ac)	26.1	5.2	218
Achievement via Independence (Ai)	21.2	6.2	218
Self Rating Scale (SRS)	39.4	28.5	218
Test A	8.3	4.5	218
Test B	8.0	5.9	218
Test C	19.1	5.4	218
Sequence Appropriateness Sa QEA	33.2	5.9	218
Task-related Achievement Motivation (Tam)	48.3	7.1	218

TABLE 11

MEANS AND STANDARD DEVIATIONS FOR LEARNING THEORY MEASURES

Measure	Mean	S.D.	N
Achievement via Conformance (Ac)	26.1	4.4	272
Achievement via Independence (Ai)	21.2	4.8	272
Self Rating Scale (SRS)	52.5	18.1	272
Test A	20.9	4.6	272
Test B	7.5	4.0	272
Test C	20.5	6.0	272
Sequence Appropriateness (Sa QEB)	32.3	5.2	272
Task-related Achievement Motivation (Tam)	48.0	6.8	272

TABLE 12

SUMMATIVE EVALUATION: ANALYSIS OF VARIANCE OF PROGRAMMED

TREATMENTS IN STATISTICS TASK

MEASURES	TREATMENTS								F
	PVA		PVB		PVC		PVD		df 3; 214
	$\bar{X}$	S.D.	$\bar{X}$	S.D.	$\bar{X}$	S.D.	$\bar{X}$	S.D.	
Ac	26.2	4.3	27.5	6.9	25.1	4.8	25.6	4.2	2.0
Ai	20.9	4.5	22.6	8.7	21.1	6.5	20.2	3.6	1.4
SRS	41.7	27.6	37.8	29.3	39.9	28.6	37.6	29.3	.3
Test A	8.5	5.1	7.8	4.5	9.1	4.4	7.8	4.0	.9
Test B	7.7	6.1	7.8	5.7	9.8	6.2	6.4	4.8	2.9*
Test C	20.5	4.5	19.8	4.6	15.7	6.7	20.9	3.5	13.0**
Sa QEA	35.4	5.7	33.4	4.6	29.0	6.1	35.6	4.4	18.8**
Tam QEA	48.9	6.2	47.7	7.8	47.4	7.6	49.7	6.6	1.2

Note:

*   p<.05
** p<.01
Otherwise F value is not significant.

TABLE 13

SUMMATIVE EVALUATION: ANALYSIS OF VARIANCE OF PROGRAMMED

TREATMENTS IN LEARNING THEORY TASK

| MEASURES | TREATMENTS | | | | | | | | F |
| | PVA | | PVB | | PVC | | PVD | | df 3; 214 |
	$\bar{X}$	S.D.	$\bar{X}$	S.D.	$\bar{X}$	S.D.	$\bar{X}$	S.D.	
Ac	26.4	5.4	25.9	4.5	25.7	3.8	26.3	3.9	.3
Ai	22.1	7.0	20.7	4.1	20.9	3.8	21.2	3.8	1.0
SRS	50.5	16.6	55.0	17.6	52.0	18.4	52.5	19.8	.7
Test A	20.5	4.7	20.9	4.2	21.1	4.6	21.0	5.1	.3
Test B	6.9	3.9	7.7	4.3	7.4	4.0	8.2	3.8	1.3
Test C	22.0	4.4	22.0	5.2	15.4	6.2	23.1	4.6	33.7**
Sa QEB	33.4	5.1	33.4	3.7	28.5	4.5	34.3	5.2	23.1
Tam QEB	47.4	7.8	47.7	6.8	48.1	6.7	48.9	6.0	.6

Note:

* $p < .05$
** $p < .01$
Otherwise F value is not significant

significant treatment differences on the independent variables.

Experimental Evaluation

The general hypothesis of this study was that the effects of programmed instructional treatments on the dependent measures would be modified by the interaction of learner attributes.

Following the preliminary summative analysis (1 way ANOVA) a multiple regression stepwise procedure described by Nie, Hull, Jenkins, Steinbrenner, and Bent (1975) was used for each treatment (Appendix F). The procedure was made to allow for the estimation of the percentage of variance contributed independently by any variable adjusted for the effects of all other variables. Each variable was seen to have contributed at some stage a major proportion of the variance on the dependent measures. However, that contribution was widely differentiated according to programmed treatments and tasks.

Statistics Results

Table 14 describes the interactive effects of the attribute variables achievement via conformance and self rating scale on instructional treatments and dependent measures. All the main effects were highly significant ($p < .01$) except for the treatment variable on task-related achievement motivation. A significant attribute interaction for conformance and subjective content familiarity occurred on Test C and Tam. However, the only treatment-interaction effect was SRS with Tam. When the subjective content familiarity measure was replaced in the regression equation by the objective Test A (Table 15), similar main effects for criterion achievement and sequence appropriateness were in evidence. But the only main effect for task-related achievement motivation was the conformance attribute ($F = 14.70$, $p < .01$). No attribute interactions

were apparent (Cf Ac and SRS). The effect of introducing Test A into the regression analysis was to produce a treatment interaction with that and the conformance variable on criterion achievement.

Table 16 describes the effects of the independence attribute, SRS, and treatments on each of the dependent measures. The significance of the main effects appear to be very similar to that of conformance and SRS in Table 14. However, a differential effect between conformance and independence is evident in all four tables. The significance level of achievement via independence was reduced to 5 percent in contrast to the 1 percent significance for the conformance orientation. There was no interaction between the independence attribute and content familiarity on any of the dependent variables, although there was a small treatment interaction with Ai and the dependent task-related achievement motivation. The magnitude of this interaction remained unaffected by the kind of content familiarity variable introduced in the regression analysis. Perhaps the most interesting result from Table 16 was the strong attribute x attribute treatment interaction which occurred on both the criterion achievement test, and sequence appropriateness.

The introduction of the objective content familiarity measure into the equation (Table 17) produced some contradictory results. The significance of Ai as a main effect on Test C and Sa QEA disappeared altogether. Similarly, content familiarity as a main effect ceased to be significant on Tam. However, as with Ac, the inclusion of Test A produced a content familiarity x treatment interaction on criterion achievement.

Already from these four tables some trends were becoming evident to the extent to which the hypotheses could be supported. Attribute x treatment interactions were confirmed for the independence achievement

orientations on Test C and task-related achievement motivation, and in a two-way interaction with the self rating scale on the same dependent measures. When the conformance attribute was introduced to the analysis the only treatment interaction to occur was on the criterion achievement measure with objective content familiarity. The effect of Ac was less powerful than Ai and was restricted to Test C. There were no single achievement orientation x treatment interactions for sequence appropriateness. Hypothesis 1 could be partially supported in relation to the statistics task. The objective measure of content familiarity, Test A, produced an attribute x treatment interaction on only the criterion achievement measure. Similarly, the only subjective familiarity x treatment interaction occurred on task-related achievement motivation. Hypothesis 2 could only be supported in two out of six possible occasions. A triple attribute x attribute x treatment interaction was confirmed with the independence and self rating scale attributes on criterion achievement and sequence appropriateness. This triple interaction with the self rating scale on the statistics task supported the contention of Hypthesis 3. No interactions between conformance and content familiarity measures were found for any of the dependent variables.

Following the suggestions of Berlin and Cahan (1973), the interaction data are presented in both tables and figures. Table 18 shows the means and standard deviations by treatments for the independent variables which have been dichotomized into high and low values for the purpose of pictorial representation in the figures. Similarly, Table 19 shows the means and standard deviations of the dichotomized Ai variable by treatments on the two independent measures where the interaction was found to be significant.

Figure 9 is a representation of the interactions resulting from plotting the means attained on Test C for subjects high and low on the

two achievement orientation measures, conformance and independence.
With the least structured treatment, PVC, the differential effect of
the AO measures was minimal. But an ordinal interaction pattern
between the high structure, teacher prescribed treatment (PVA), and
student generated sequence (PVD) on Test C with the conformance attribute
changed to a disordinal pattern with the independence variable. Subjects
low in independence performed better on the criterion test when they were
assigned to the high structure treatment than did subjects assigned to
the student directed sequence. However, the region of significance for
the low Ai students was small. Subjects assigned to the moderately
structured treatment PVB produced very similar performance indices to
that of the PVA group with the same attribute characteristics. Those
low in independence performed better than students with higher indices
of the same attribute. When the PVB treatment was analysed in terms of
the conformance attribute, a decline in performance could be observed
between subjects high in this achievement orientation, and those who were
low. Thus, except for the least structured treatment, there was definite
support for the contention that achievement orientations modified treat-
ment effects on the criterion measure.

The only achievement attribute to significantly interact with
treatments on task-related achievement motivation was independence (Figure
10). Here a typical disordinal interaction pattern was evident between
the moderately structured PVB and both the student generated, and least
structured teacher directed treatments. Subjects whose independence was
high, reported the greatest task-related achievement motivation when
studying statistics via the least structured method. Subjects with the
same achievement characteristics reported the lowest task-related
achievement motivation when they were assigned to the moderately structured
instructional method. However, with the same moderately structured learn-
ing environment, but with low levels of independence, higher indices of

task-related achievement motivation were reported than for either the low structure or student generated treatments. Only students with low independence and assigned to the highest structured PVA treatment reported greater task-related achievement motivation. Low content structure or student directed instructional sequencing appeared to be inappropriate learning methods for students who were low in independence achievement.

A disordinal treatment interaction pattern is evident between the student generated PVD treatment, and all the other teacher directed treatments in Figure 11. Subjects who had reported little knowledge of the subject-matter before studying statistics and who were permitted to develop their own instructional strategies reported higher task-related achievement motivation than did those whose subjective assessment of their knowledge had been greater (Figure 11). The levels of task-related achievement motivation reported by the three teacher directed treatments corresponded to their subjective assessment of prior content familiarity. Subjects who had reported high levels of content familiarity also reported high levels of task-related achievement motivation. The low structured PVC treatment suffered the severest negative effect from SRS. Subjects whose familiarity report was high in this treatment were at the conclusion of the experiment highly motivated towards the subject-matter. But subjects whose familiarity report was low concluded the experiment with little desire to further their experience in the study of statistics. They had had enough!

A characteristically negative relationship between high objective content familiarity - high criterion achievement and low content familiarity - low criterion achievement is depicted in Figure 12. A disordinal type interaction was in evidence for three of the treatments; student generated, high and moderately structured teacher directed

programmes. That is, three of the treatments were found to intersect in such a way as to provide for superior achievement for individuals at one end of the content familiarity continuum while being inferior for others at the opposite end. For subjects with high levels of objective content familiarity the moderately structured programme PVB facilitated the best criterion achievement performance. But for students with little or no prior familiarity with statistics, the student generated PVD sequence appeared to be the best instructional method. The relationship of the least structured treatment, PVC was ordinal to the other programmed versions and was the least facilitative of all, regardless of an individual's prior familiarity.

There were significant triple interactions (Figure 13) on the criterion achievement test for subjects both high and low in achievement via independence and in subjective content familiarity (SRS). Both extremities of the independence continuum produced a treatment x subjective content familiarity interaction. The attribute interaction on the least structured treatment (PVC) on Test C remained relatively stable for subjects at either extremities of the independence continuum. However, a characteristic disordinal interaction did occur for subjects low in independence. Subjects in the student generated sequence PVD disordinally interacted with each teacher sequenced treatment, producing the greatest range of interest with the moderately structured PVB. Those students who were low in their subjective estimate of content familiarity and assigned to PVD produced the highest levels of criterion achievement. When the dependent variable examined was sequence appropriateness (Figure 14) the main effect of the independence orientation was the increment in the reported treatment satisfaction over subjects lower in that attribute. This effect produced an ordinal interaction between treatments for those high in independence. However, there was a change in the ranked order of reported sequence appropriateness between the student generated sequence, PVD and the highest structured treatment PVA. As one might expect, subjects who were high in

independence and assigned to the student sequence treatment reported the
greatest treatment satisfaction. However, students with the lowest levels
of independence in the same treatment reported less satisfaction than did
students in the highest structured teacher-sequenced treatment. The interacting
effect of subjective content familiarity with independence achievement was
mainly ordinal for all treatments, except for a small disordinal region of
interest for subjects who had a conbination of high subjective content
familiarity and low independence and who had been assigned to the student
generated or moderately structured programmes. Otherwise all subjects who
reported high prior familiarity with statistics also reported greater sat-
isfaction with the type of instruction they had been assigned to, and those
who had indicated little or no prior familiarity similarly reported less
treatment satisfaction.

Learning Theory Results

Tables 20 and 21 describe the effects of achievement via conformance
and the subjective and objective content familiarity measures on each of the
three dependent variables. Conformance was a significant main effect on all
of the dependent variables. The treatment effects were significant on all but
task-related achievement motivation. The objective Test A measure was a
significant main effect on criterion achievement and sequence appropriateness,
but not on task-related achievement motivation. Finally, the subjective self
rating scale was only a significant main effect on Test C (Table 21). The
only significant attribute x treatment interaction was Test A on the criterion
achievement test. In fact, this was the only instance of a content
familiarity attribute interacting with treatments on the learning theory
task. These results suggested that neither conformance, nor subjective measures
of content familiarity were particularly useful predictors in an extrinsically
structured task such as learning theory.

An almost identical main effect pattern resulted when the
independence achievement measure was introduced to the regression
analysis (Tables 22 and 23). However, unlike conformance, independence

TABLE 14

SUMMARY OF MULTIPLE LINEAR REGRESSION OF ACHIEVEMENT VIA CONFORMANCE,

SELF RATING SCALE AND STATISTICS PERFORMANCE DATA

Effect	df	Test C		Sa QEA		Tam	
		Prop. of variance	F	Prop. of variance	F	Prop. of variance	F
Achievement via Conformance (A)	1	.03	11.36**	.05	15.99**	.06	15.19**
Self Rating Scale (B)	1	.18	62.81**	.12	40.65**	.02	5.72**
Treatments (C)	3	.14	16.31**	.18	13.55**	.02	1.53
A x B	1	.02	5.29**	.00	a	.02	5.52**
A x C	3	.02	2.51	.01	1.30	.02	1.72
B x C	3	.01	a	.00	a	.03	2.67*
A x B x C	3	.01	a	.01	1.16	.01	a

Note:

a. F values less than 1 not shown.
*   p<.05
** p<.01

TABLE 15

SUMMARY OF MULTIPLE LINEAR REGRESSION OF ACHIEVEMENT VIA CONFORMANCE,

TEST A AND STATISTICS PERFORMANCE DATA

Effect	df	Test C		Sa QEA		Tam	
		Prop. of variance	F	Prop. of variance	F	Prop. of variance	F
Achievement via Conformance (A)	1	.03	12.11**	.05	15.80**	.06	14.70**
Test A (B)	1	.16	58.07**	.06	20.90**	.01	2.68
Treatments (C)	3	.18	22.23**	.22	23.81**	.02	1.63
A x B	1	.01	1.86	.00	a	.01	1.73
A x C	3	.03	3.31*	.01	1.43	.02	1.70
B x C	3	.03	4.22**	.01	a	.02	1.39
A x B x C	3	.00	a	.02	1.89	.02	1.85

Note:

a.   F values less than 1 not shown
*   p<.05
**   p<.01

TABLE 16

SUMMARY OF MULTIPLE LINEAR REGRESSION OF ACHIEVEMENT VIA INDEPENDENCE,

SELF RATING SCALE AND STATISTICS PERFORMANCE DATA

Effect	df	Test C		Sa QEA		Tam	
		Prop. of variance	F	Prop. of variance	F	Prop. of variance	F
Achievement via Independence (A)	1	.02	6.59**	.02	6.67**	.02	4.70*
Self Rating Scale (B)	1	.22	59.47**	.17	53.99**	.03	7.12**
Treatments (C)	3	.08	8.79**	.08	8.91**	.04	a
A x B	1	.00	a	.00	a	.00	a
A x C	3	.02	2.10	.00	a	.04	3.07*
B x C	3	.01	a	.00	a	.02	1.34
A x B x C	3	.04	4.70**	.08	8.46**	.01	a

Note:

a. F values less than 1 not shown
* $p < .05$
** $p < .01$

TABLE 17

SUMMARY OF MULTIPLE LINEAR REGRESSION OF ACHIEVEMENT VIA INDEPENDENCE,

TEST A AND STATISTICS PERFORMANCE DATA

Effect	df	Test C		Sa QEA		Tam	
		Prop. of variance	F	Prop. of variance	F	Prop. of variance	F
Achievement via Independence (A)	1	.01	2.97	.01	1.81	.02	4.48*
Test A (B)	1	.17	63.71**	.08	24.80**	.02	3.57
Treatments (C)	3	.19	23.26**	.23	24.22**	.02	1.65
A x B	1	.01	1.85	.00	1.22	.00	a
A x C	3	.03	4.05**	.00	a	.05	3.75*
B x C	3	.04	4.27**	.01	a	.01	a
A x B x C	3	.00	a	.00	1.22	.01	a

Note:

a. F values less than 1 not shown
*. $p < .05$
** $p < .01$

TABLE 18

MEANS AND STANDARD DEVIATIONS FOR HIGH AND LOW ACHIEVEMENT VIA CONFORMANCE, ACHIEVEMENT VIA INDEPENDENCE, SELF RATING SCALE

AND TEST A ON STATISTICS PERFORMANCE DATA

Variable	Treatment	N H	N L	Test C High $\bar{X}$	S.D.	Test C Low $\bar{X}$	S.D.	Sa QEA High $\bar{X}$	S.D.	Sa QEA Low $\bar{X}$	S.D.	Tam High $\bar{X}$	S.D.	Tam Low $\bar{X}$	S.D.
Achievement via conformance	PVA	26	16	21.1	3.4	19.0	6.1	37.5	4.7	32.6	4.6	51.0	4.9	46.0	5.9
	PVB	25	17	20.2	4.9	18.7	5.0	33.4	4.6	32.5	4.7	49.8	6.2	45.1	10.2
	PVC	19	22	18.4	6.0	13.2	7.1	31.5	7.4	27.6	4.8	50.3	8.9	45.0	6.7
	PVD	14	12	22.3	2.4	20.3	3.8	35.8	2.3	35.7	6.0	51.6	4.5	45.7	9.3
Achievement via independence	PVA	16	20	20.5	4.7	21.0	3.5	35.3	6.5	35.5	5.3	50.0	4.4	48.6	7.4
	PVB	13	10	20.2	4.8	20.3	5.1	33.5	5.2	33.1	6.4	46.3	10.1	48.0	3.4
	PVC	12	18	19.1	5.2	12.9	7.4	30.9	6.6	27.7	6.3	53.9	6.7	43.1	6.0
	PVD	8	12	22.8	2.5	20.5	2.7	35.9	5.8	35.6	3.6	53.1	5.6	46.8	6.7
Self Rating Scale	PVA	25	18	22.8	1.5	18.2	5.7	38.6	3.6	33.2	7.0	50.1	4.4	48.6	8.2
	PVB	19	17	21.4	3.8	16.7	5.0	35.9	4.3	31.4	4.0	50.3	5.4	45.9	6.5
	PVC	17	18	19.2	5.4	11.6	7.0	30.7	6.3	25.4	6.3	51.8	8.1	44.6	6.1
	PVD	11	12	21.3	2.9	18.9	3.7	37.7	4.6	34.3	3.6	48.3	8.2	50.5	6.7
Test A	PVA	25	27	22.6	1.8	18.6	5.2	37.7	4.3	33.9	6.6	50.1	5.1	48.7	7.0
	PVB	16	21	21.7	3.8	17.4	5.0	36.6	3.8	32.0	4.2	49.3	6.6	46.5	6.9
	PVC	26	17	19.0	5.4	10.6	6.4	31.4	6.0	26.5	6.0	47.8	8.1	43.8	5.7
	PVD	13	20	21.9	2.6	19.7	4.3	36.1	6.1	34.7	3.7	49.4	7.8	50.5	6.5

TABLE 19

MEANS AND STANDARD DEVIATIONS FOR SUBJECTS HIGH AND LOW IN ACHIEVEMENT VIA INDEPENDENCE AND SELF RATING

SCALE ON STATISTICS TASK, TEST C AND Sa QEA

Variable	Treatment	N H	N L	Test C High SRS $\bar{X}$	Test C High SRS S.D.	Test C Low SRS $\bar{X}$	Test C Low SRS S.D.	Sa QEA High SRS $\bar{X}$	Sa QEA High SRS S.D.	Sa QEA Low SRS $\bar{X}$	Sa QEA Low SRS S.D.
High Ai	PVA	6	5	24.0	1.3	18.6	5.5	38.3	4.8	32.6	8.1
	PVB	6	2	21.0	5.0	18.5	7.8	36.0	5.0	31.5	2.1
	PVC	6	2	21.2	5.0	13.5	6.4	34.2	6.0	26.5	7.7
	PVD	2	4	23.0	6.4	20.7	3.5	45.0	5.2	36.7	3.4
Low Ai	PVA	6	9	22.3	1.6	20.1	4.5	39.7	2.7	33.8	6.4
	PVB	3	3	22.3	3.8	15.7	7.5	38.0	6.6	27.3	4.6
	PVC	3	10	20.7	0.6	10.8	8.1	32.3	5.1	25.9	7.2
	PVD	6	2	19.5	2.7	20.5	2.1	36.5	4.3	32.5	3.5

STATISTICS TASK
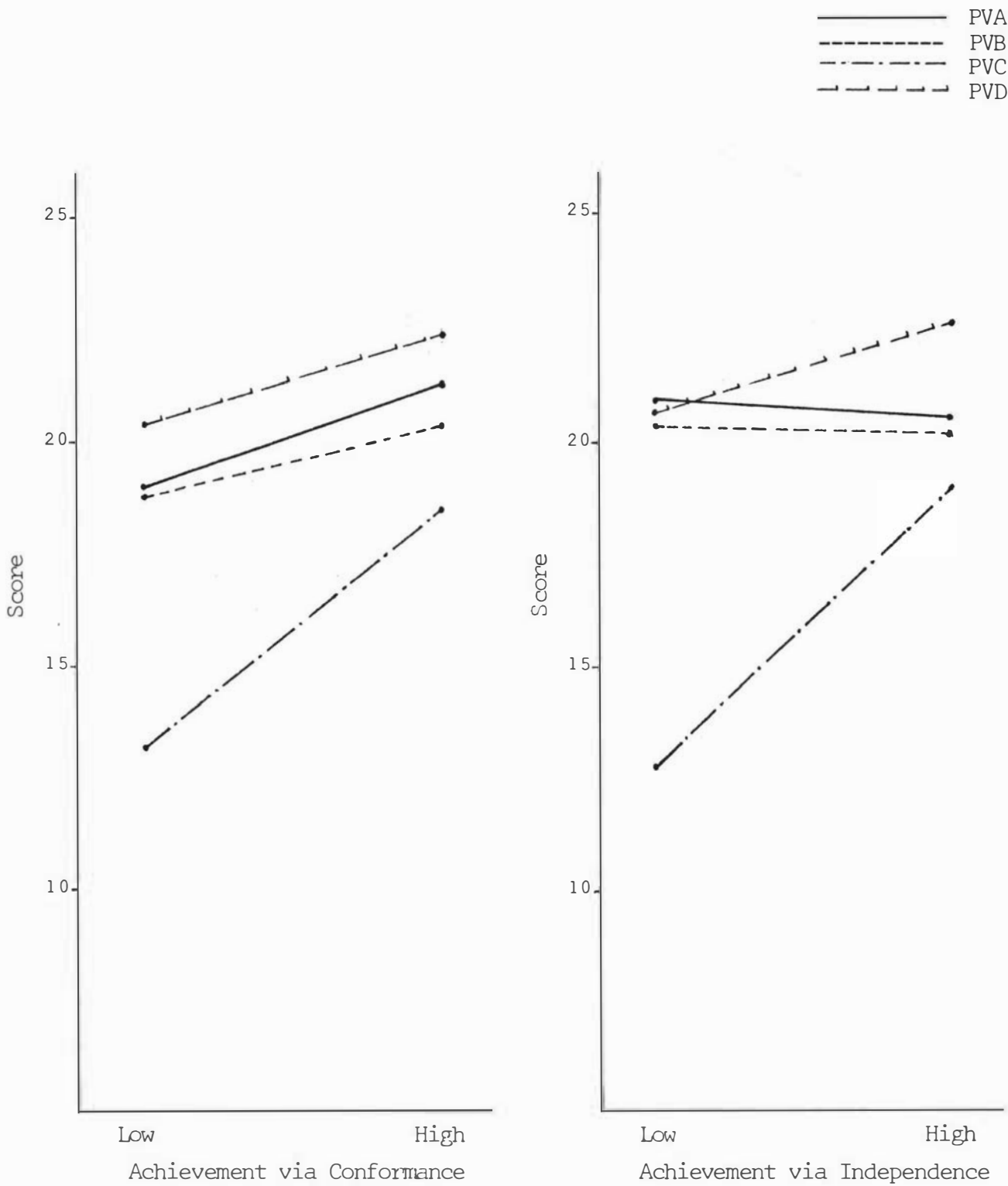
Figure 9: Mean scores attained on test C statistics task for subjects high and low on achievement via conformance and achievement via independence
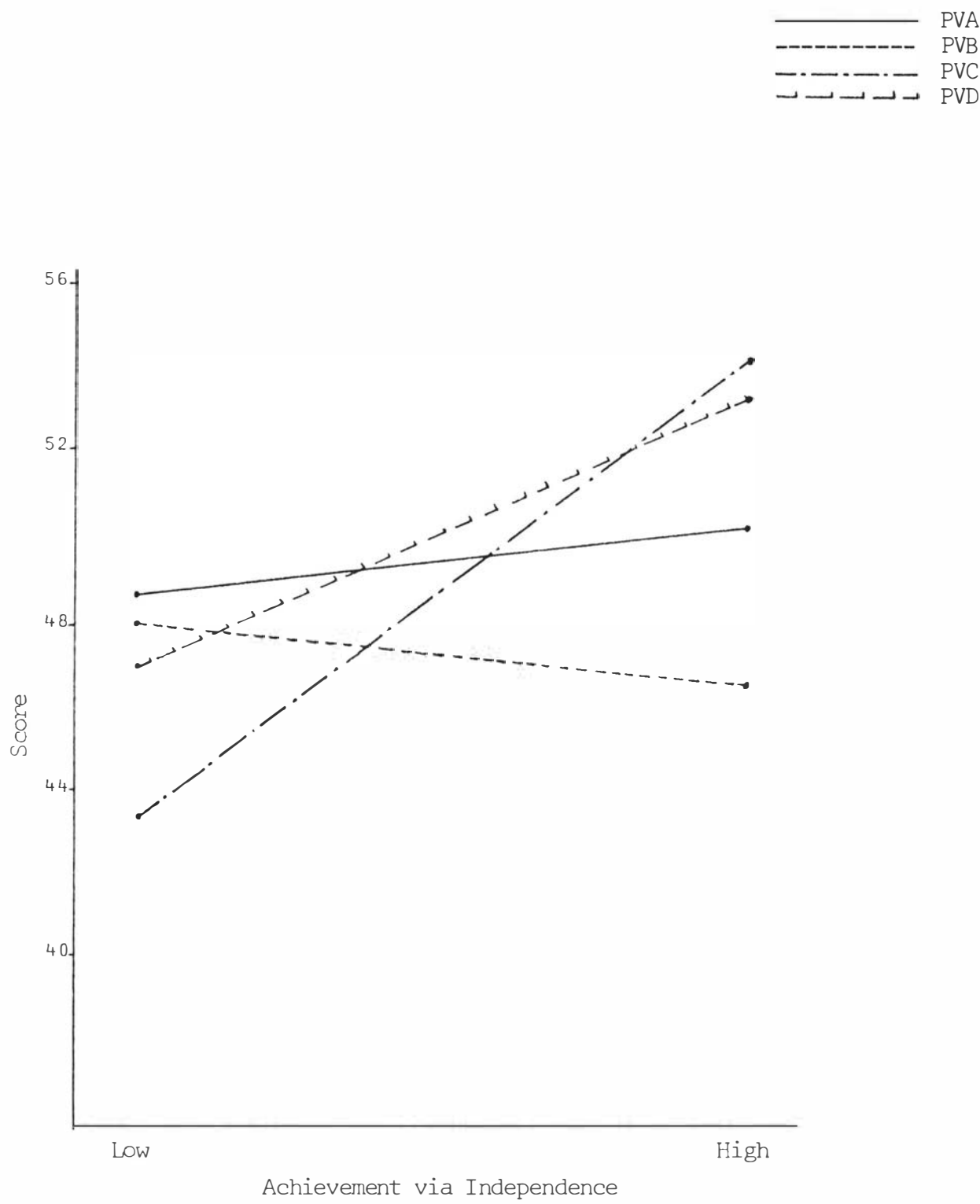
STATISTICS TASK

Figure 10:   Mean scores attained on task-related achievement
motivation statistics task for high and low subjects on
achievement via independence
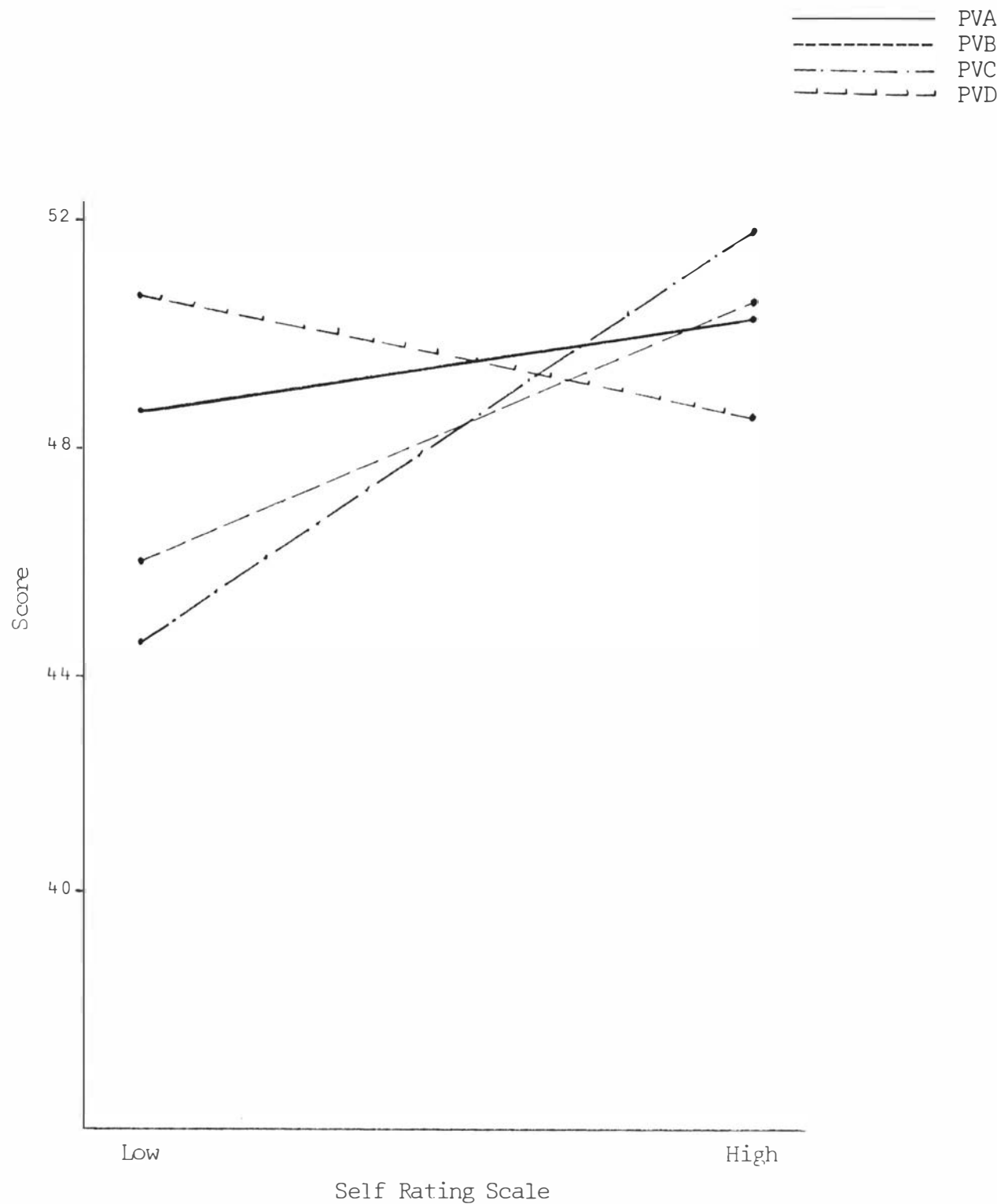
STATISTICS TASK

Figure 11: Mean scores attained on task-related achievement
motivation statistics task for high and low
subjects on self rating scale

STATISTICS TASK
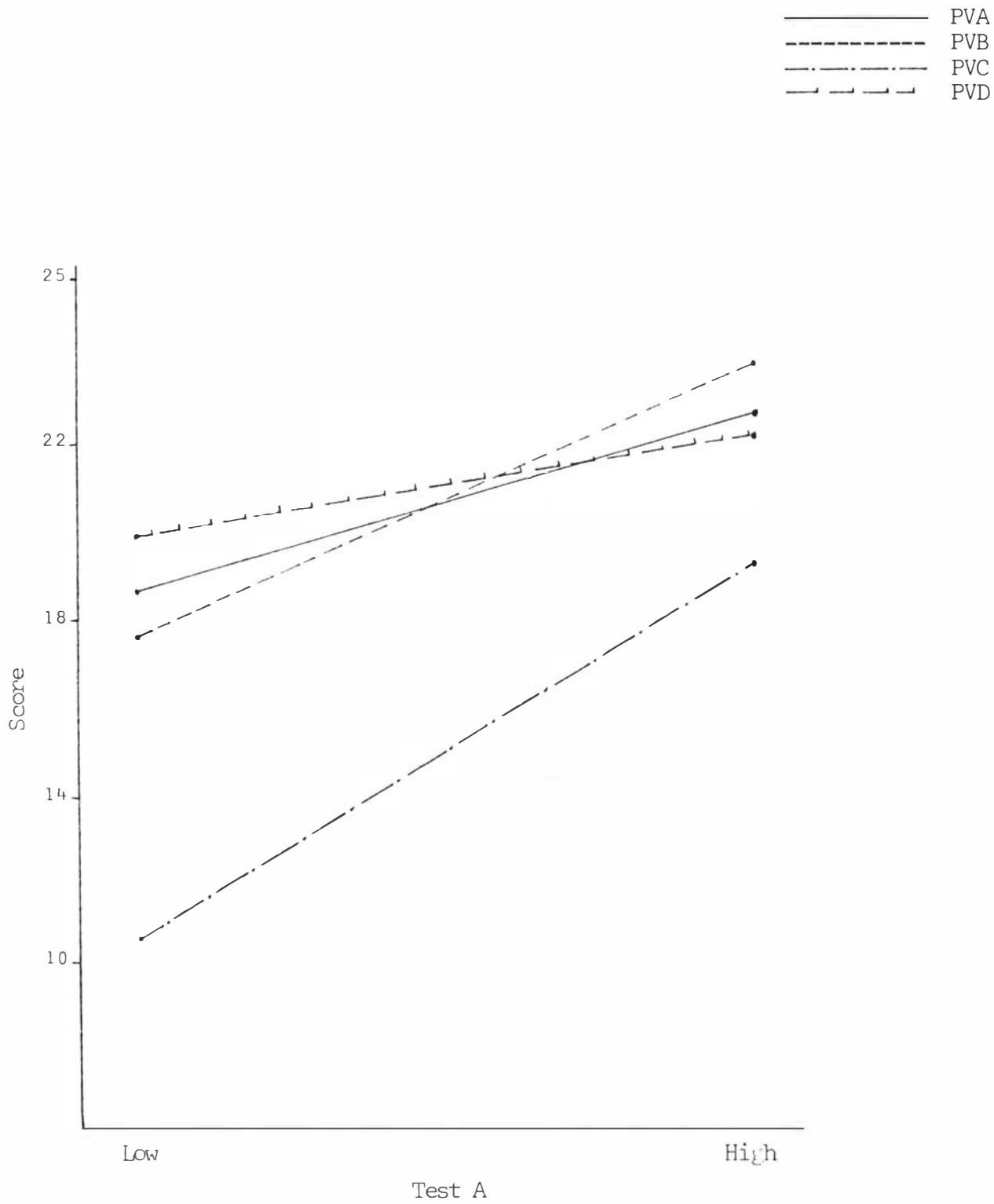
Figure 12: Mean scores attained on test C statistics task
for high and low subjects on test A

STATISTICS TASK
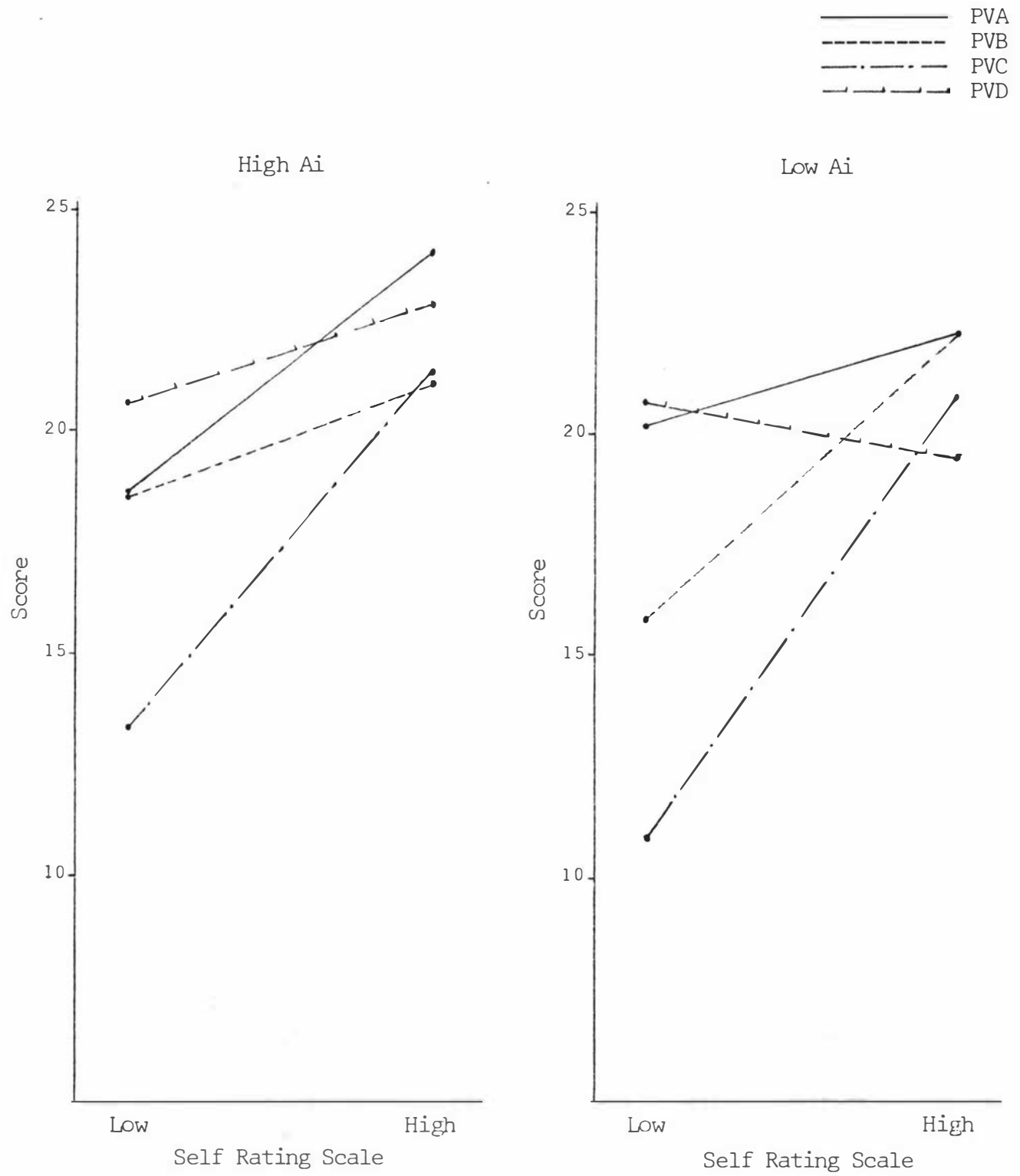
Figure 13: Mean scores attained on test C for subjects high and low in achievement via independence and self rating scale on the statistics task

STATISTICS TASK
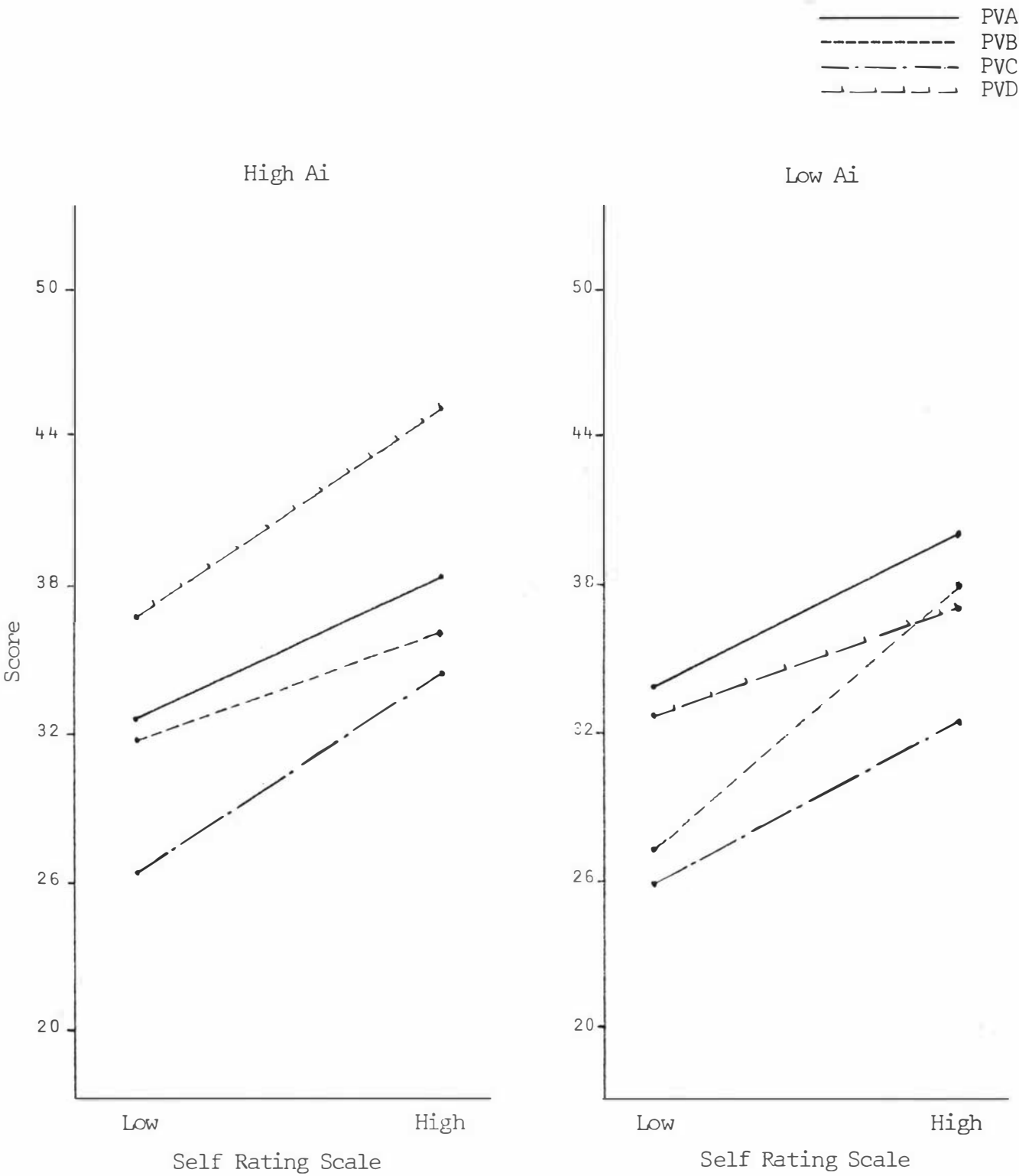
Figure 14:   Mean scores attained on sequence appropriateness for subjects
             high and low in achievement via independence and self rating
             scale on the statistics task

significantly interacted with programmed treatments on the criterion
test measure. Again, unlike the regression analysis with conformance
there was no indication that either of the content familiarity attributes
would interact with treatment variables. Perhaps the most interesting
results to emerge from Table 23 were the significant triple attribute x
attribute x treatment interactions for each of the dependent measures.
For two of them, Test C and sequence appropriateness, the interaction
was highly significant. (F=26.30, p<.01, respectively.)

The means and standard deviations for the learning theory data
are presented in the same manner as for the statistics task. Table 24
presents the independent measures dichotomized into high and low values
across all treatments and for each dependent variable. Table 25 describes
the data involved in the triple interaction of independence, Test A and
instructional treatments. Again, wherever significant interactions
occurred, the data were graphed and presented in figures.

Figure 15 presents the ordinal independence x treatment
interaction for subjects' performance on the criterion achievement test.
Subjects who were assigned to the student sequenced treatment PVD
demonstrated an ordinally superior performance in relation to all
other programmed groups. For the teacher directed treatments there
appeared to be a direct relationship between the amount of programme
structure and the ability to facilitate criterion achievement. The
greater the structure the better the criterion performance. Independence
modified this treatment effect to the extent that high independence
resulted in superior performance.

When the objective content familiarity attribute was examined
in relation to the same dependent measure a disordinal interaction (Figure
16) resulted between PVA and PVB, and within a much smaller range of

interest between PVA and PVD. Subjects who performed poorly on Test A found the high-structured, teacher directed PVA the most facilitative instructional method. However, for subjects whose prior familiarity with the learning theory subject-matter was high the student sequenced or moderately structured programmes were the most appropriate methods for achieving the criterion objectives.

Figures 17 to 19 graphically describe the 3 three-way inter- actions between independence achievement, Test A and instructional treatments on the dependent measures. Subjects high in independence and assigned to the student directed treatment demonstrated a superior ordinal relationship to all other treatments on Test C. In fact, that superiority was enhanced for those subjects whose knowledge of learning theory was minimal. The practical significance of the disordinal interaction between the high and moderately structured treatments was minimal. However, for subjects whose achievement independence was low, a much more significant disordinal interaction was demonstrated between the student generated and high structured treatments. Those students with high levels of prior familiarity performed better on the PVD treat- ment, but with low familiarity they learned more through the high structured programmed version. Regardless of independence levels, subjects assigned to PVC performed poorest of all treatments. Even so, the independence achievement attribute modified the criterion performance by about 5 points uniformally along the content familiarity continuum.

The interaction of independence and objective content familiarity on the sequence appropriateness variable (Figure 18) resulted in a disordinal interaction for the high, moderate and student sequenced treatments at both ends of the independence continuum. Students with high levels of independence and who know a lot about learning theory reported the greatest satisfaction with their learning method when they

had been assigned to the moderately structured programme. Interestingly
enough, those students with high independence but with little prior know-
ledge reported the greatest satisfaction from the high structured PVA
rather than the student sequenced treatment as might have been expected.
In fact the high independence - low content familiarity students assigned
to PVA gave a stronger endorsement to the appropriateness of their
instructional method than any other treatment group regardless of their
prior familiarity or independence attributes.

The attribute x treatment interaction for subjects with low
independence, resulted in a similar treatment effect as that reported
for students at the high end of the independence continuum. However, the
range of significance was much larger for those students who had previously
demonstrated high familiarity with the topic. Subjects assigned to the
moderately structured programme reported the greatest treatment satisfaction,
but those assigned to the highest structured PVA found that programme not
nearly as satisfactory. In a similar manner to the high independence
students, those with low subject-matter familiarity gave the highest ratings
for sequence appropriateness to the PVA programme. This high structured
approach to teaching learning theory seems to have been regarded as the
most satisfying method for students with little or no background knowledge.

In the same way as it influenced criterion achievement, low
independence tended to depress the overall ratings given by students
to the appropriateness of their treatments. However, the one exception
to this observation was the least structured treatment PVC. The levels
of independence which characterized students assigned to this treatment
appeared to have little influence on the way in which they regarded the
appropriateness of their instructional method.

The final pair of profiles (Figure 19) depict disordinal

interactions for all experimental treatments and for subjects at either end of the independence continuum. The region of significance was greatest for those subjects with low independence achievement orientations. The principal effects of the independence and familiarity attributes appeared to be two-fold. Post experimental task-related achievement motivation was depressed in all treatments when subjects came to the learning situation with low levels of independence. When their prior familiarity with the subject-matter was also limited, all treatments, except for the moderately structured PVB, dramatically enhanced their motivation towards the topic.

Students who were assigned to the moderately structured programme and who already knew a lot about the subject, reported the highest levels of task-related achievement motivation, regardless of their levels of independence. But those students assigned to the same treatment, knowing little about the subject beforehand, concluded the experiment with the least amount of motivation. Conversely, the students who were assigned to the self-sequencing treatment, and who had commenced the experiment with little or no knowledge about learning theory, reported the highest levels of task-related achievement motivation when they had finished working through the programme.

It is interesting to note the ordinal relationship between the least and most structured programmes. Regardless of the level of independence, PVC was superior to PVA in facilitating motivation to the task. When independence was high, prior familiarity had little effect in modifying task-related motivation in the highly structured method. But when independence was low, the effect of content familiarity (as with all other treatments) was much more significant.

TABLE 20

SUMMARY OF MULTIPLE LINEAR REGRESSION OF ACHIEVEMENT VIA CONFORMANCE, SELF

RATING SCALE AND LEARNING THEORY PERFORMANCE DATA

Effect	df	Test C		Sa QEB		Tam	
		Prop. of variance	F	Prop. of variance	F	Prop. of variance	F
Achievement via Conformance (A)	1	.04	17.89**	.02	8.26**	.08	24.89**
Self Rating Scale (B)	1	.03	10.16**	.00	1.60	.00	a
Treatments (C)	3	.26	34.72**	.20	22.31**	.01	a
A x B	1	.01	2.12	.00	a	.01	2.74*
A x C	3	.00	a	.00	a	.01	1.19
B x C	3	.01	1.01	.01	1.10	.00	a
A x B x C	3	.01	a	.01	a	.01	1.43

Note:

a. F values less than 1 not shown
* p<.05
** p<.01

TABLE 21

SUMMARY OF MULTIPLE LINEAR REGRESSION OF ACHIEVEMENT VIA CONFORMANCE,

TEST A AND LEARNING THEORY PERFORMANCE DATA

Effect	df	Test C		Sa QEB		Tam	
		Prop. of variance	F	Prop. of variance	F	Prop. of variance	F
Achievement via Conformance (A)	1	.04	19.35**	.02	8.72**	.08	24.89**
Test A (B)	1	.06	23.93**	.03	10.98**	.00	a
Treatments (C)	3	.27	39.18**	.20	24.46**	.01	a
A x B	1	.00	a	.00	a	.00	a
A x C	3	.00	a	.00	a	.01	1.14
B x C	3	.03	3.70*	.02	2.23	.00	a
A x B x C	3	.00	a	.00	a	.02	2.27

Note:

a. F values less than 1 not shown
* p<.05
** p<.01

TABLE 22

SUMMARY OF MULTIPLE LINEAR REGRESSION OF ACHIEVEMENT VIA INDEPENDENCE,

SELF RATING SCALE AND LEARNING THEORY PERFORMANCE DATA

Effect	df	Test C		Sa QEB		Tam	
		Prop. of variance	F	Prop. of variance	F	Prop. of variance	F
Achievement via Independence (A)	1	.06	25.98**	.04	12.75**	.07	22.32**
Self Rating Scale (B)	1	.02	9.99**	.00	1.42	.00	a
Treatments (C)	3	.26	36.88**	.20	22.89**	.01	a
A x B	1	.00	a	.00	a	.00	a
A x C	3	.03	3.99**	.00	a	.02	1.82
B x C	3	.00	a	.01	a	.01	a
A x B x C	3	.01	1.72	.01	a	.00	a

Note:

a. F values less than 1 not shown
*   p<.05
** p<.01

TABLE 23

SUMMARY OF MULTIPLE REGRESSION OF ACHIEVEMENT VIA INDEPENDENCE, TEST A

AND LEARNING THEORY PERFORMANCE DATA

Effect	df	Test C		Sa QEB		Tam	
		Prop. of variance	F	Prop. of variance	F	Prop. of variance	F
Achievement via Independence (A)	1	.06	25.53**	.03	12.15**	.07	22.58**
Test A (B)	1	.04	18.26**	.02	8.00**	.00	a
Treatments (C)	3	.11	16.40**	.04	5.29**	.01	a
A x B	1	.00	a	.00	a	.00	a
A x C	3	.02	3.64*	.01	a	.02	1.66
B x C	3	.01	2.05	.01	1.28	.01	a
A x B x C	3	.18	26.30**	.17	20.94**	.02	2.67*

Note:

a. F values less than 1 not shown
* $p < .05$
** $p < .01$

TABLE 24

MEANS AND STANDARD DEVIATIONS FOR HIGH AND LOW ACHIEVEMENT VIA CONFORMANCE, ACHIEVEMENT VIA INDEPENDENCE,

SELF RATING SCALE AND TEST A ON LEARNING THEORY PERFORMANCE DATA

	Treatment	N H	N L	Test C High $\bar{X}$	S.D.	Test C Low $\bar{X}$	S.D.	Sa QEA High $\bar{X}$	S.D.	Sa QEA Low $\bar{X}$	S.D.	Tam High $\bar{X}$	S.D.	Tam Low $\bar{X}$	S.D.
Achievement via conformance	PVA	24	19	23.4	4.3	20.4	4.0	34.4	5.2	33.1	5.4	49.7	7.3	43.3	7.9
	PVB	22	23	22.9	5.1	19.8	6.0	33.5	4.2	33.5	3.2	48.9	6.5	45.0	6.1
	PVC	31	28	16.3	6.3	13.8	6.0	28.7	4.9	27.0	2.9	50.1	6.0	44.6	6.8
	PVD	26	18	23.3	5.0	21.8	4.6	34.0	4.7	32.5	3.2	49.1	7.0	46.8	5.8
Achievement via independence	PVA	20	18	23.8	3.4	20.7	3.8	34.5	5.4	31.9	5.3	52.1	6.0	44.1	6.9
	PVB	21	16	23.2	4.5	19.3	6.7	35.6	2.3	32.1	4.1	50.9	6.8	42.6	6.5
	PVC	24	22	18.7	6.7	12.0	4.9	29.8	5.8	27.6	4.9	51.3	8.2	44.9	6.0
	PVD	25	16	25.3	2.9	21.4	4.8	35.8	5.7	33.4	4.4	51.3	7.2	46.7	4.2
Self Rating Scale	PVA	19	19	23.2	4.5	20.6	4.6	34.6	5.5	33.1	4.4	48.4	7.4	46.2	9.5
	PVB	22	14	23.0	5.8	22.5	3.1	33.5	3.4	34.0	3.8	48.5	7.0	48.9	6.1
	PVC	26	19	15.6	6.0	13.2	6.0	26.9	4.2	27.3	4.1	45.5	5.8	48.4	5.9
	PVD	23	20	24.9	3.1	22.0	5.9	35.7	5.8	33.2	6.3	48.8	6.5	48.7	6.6
Test A	PVA	22	26	21.6	5.1	21.7	4.0	33.6	4.9	34.1	5.9	46.5	8.4	47.3	7.0
	PVB	23	22	24.0	5.2	20.4	5.2	34.9	2.9	32.1	4.5	50.3	6.6	46.4	7.2
	PVC	28	29	19.4	4.5	12.2	5.8	29.6	4.1	27.6	3.5	40.1	7.0	48.3	5.0
	PVD	24	20	24.4	3.3	21.4	5.5	35.3	5.3	32.5	5.6	49.0	5.9	50.5	4.7

TABLE 25

MEANS AND STANDARD DEVIATIONS FOR SUBJECTS HIGH AND LOW IN ACHIEVEMENT VIA INDEPENDENCE

AND TEST A ON LEARNING THEORY PERFORMANCE DATA

| Variable | Treatment | N | | Test C | | | | Sa QEB | | | | Tam | | | |
| | | H | L | High Test A | | Low Test A | | High Test A | | Low Test A | | High Test A | | Low Test A | |
				$\bar{X}$	S.D.	$\bar{X}$	S.D.	$\bar{X}$	S.D.	$\bar{X}$	S.D.	$\bar{X}$	S.D.	$\bar{X}$	S.D.
High Ai	PVA	6	3	24.5	2.2	23.7	1.5	35.0	4.2	38.3	7.6	49.3	7.9	49.3	2.9
	PVB	11	2	24.2	4.6	24.5	3.5	35.8	2.0	36.0	2.8	52.1	7.8	48.0	2.8
	PVC	11	3	20.3	4.4	15.3	10.7	30.1	5.9	27.7	6.4	51.5	6.9	50.7	5.0
	PVD	12	3	25.2	2.9	26.3	3.8	35.3	5.7	37.3	9.1	51.3	6.5	56.0	1.0
Low Ai	PVA	3	8	19.7	4.6	20.6	3.9	30.3	1.5	32.6	6.7	40.3	11.7	44.4	5.3
	PVB	3	8	18.3	10.7	18.0	6.3	36.0	3.6	30.6	3.6	47.7	3.1	41.1	7.3
	PVC	6	9	15.8	5.4	9.6	3.4	29.3	1.2	27.8	4.6	41.3	5.8	46.6	6.2
	PVD	3	5	23.0	1.0	18.4	5.6	33.0	4.3	31.4	3.2	43.3	3.5	49.2	3.1

LEARNING THEORY TASK
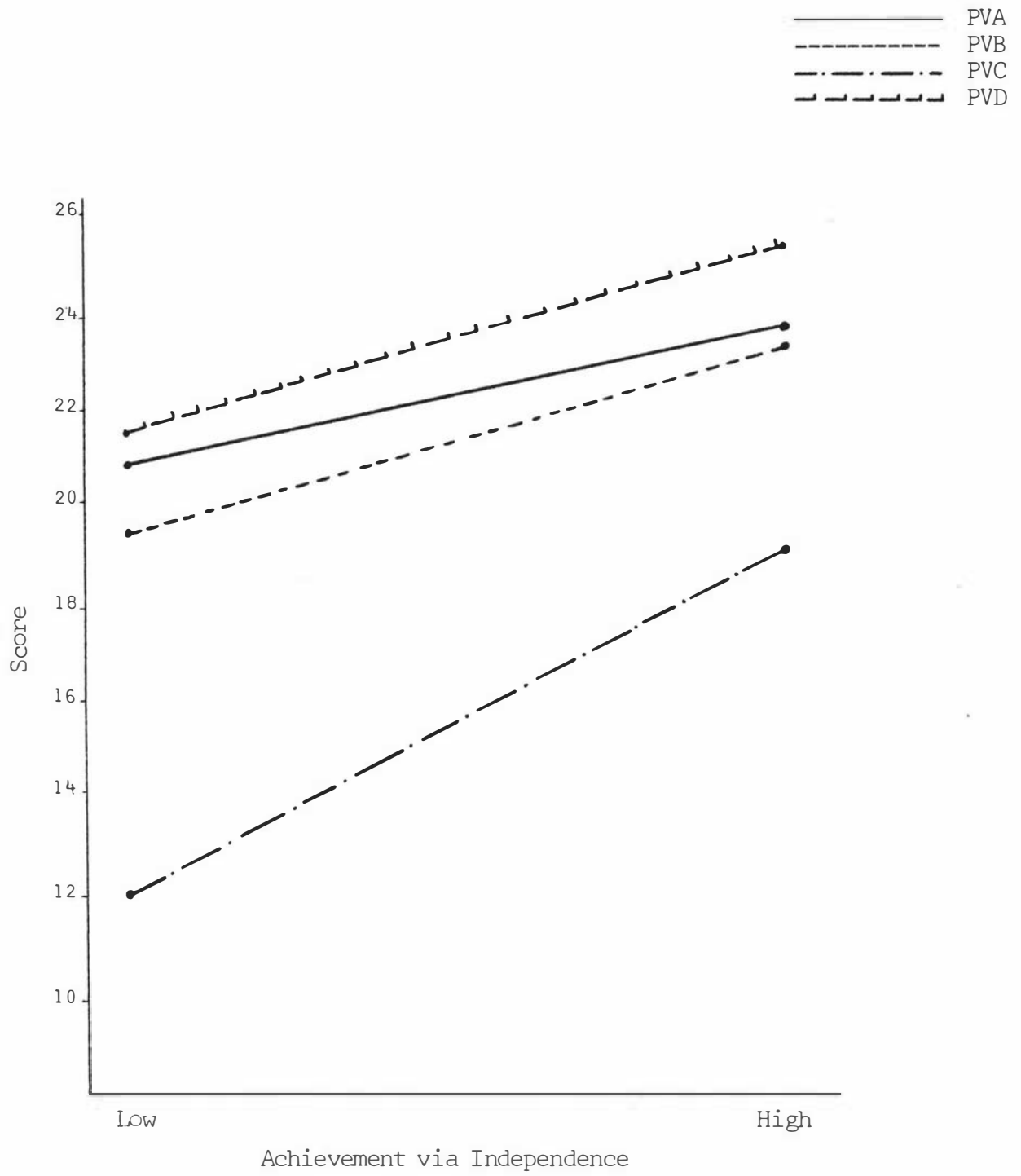
Figure 15: Mean scores attained on test C learning theory
task for high and low subjects on achievement
via independence

LEARNING THEORY TASK
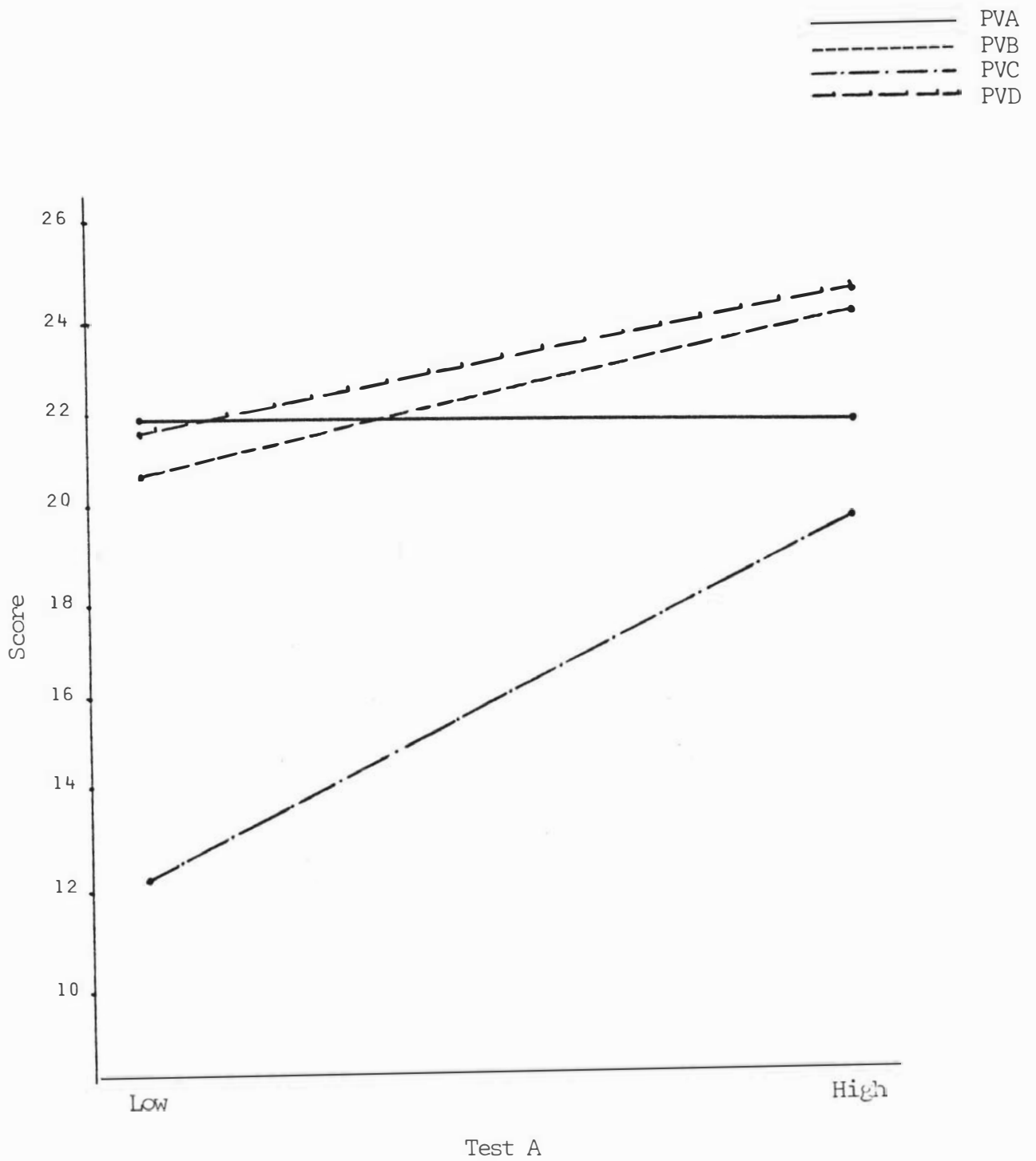
Figure 16: Mean scores attained on test C learning theory
task for high and low subjects on test A

LEARNING THEORY TASK
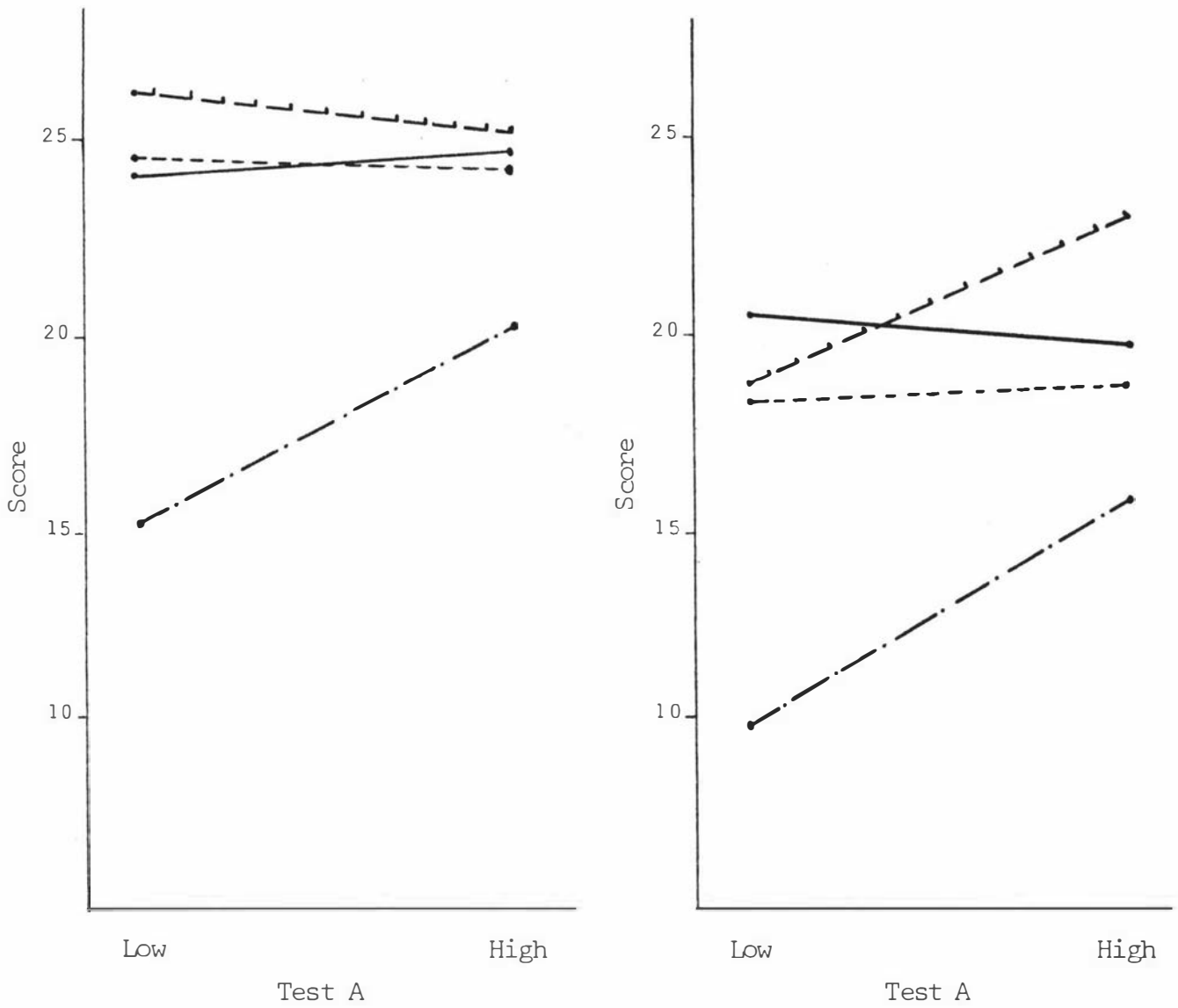
Figure 17: Mean scores attained on test C for subjects high and low in achievement via independence and test A on the learning theory task

LEARNING THEORY TASK
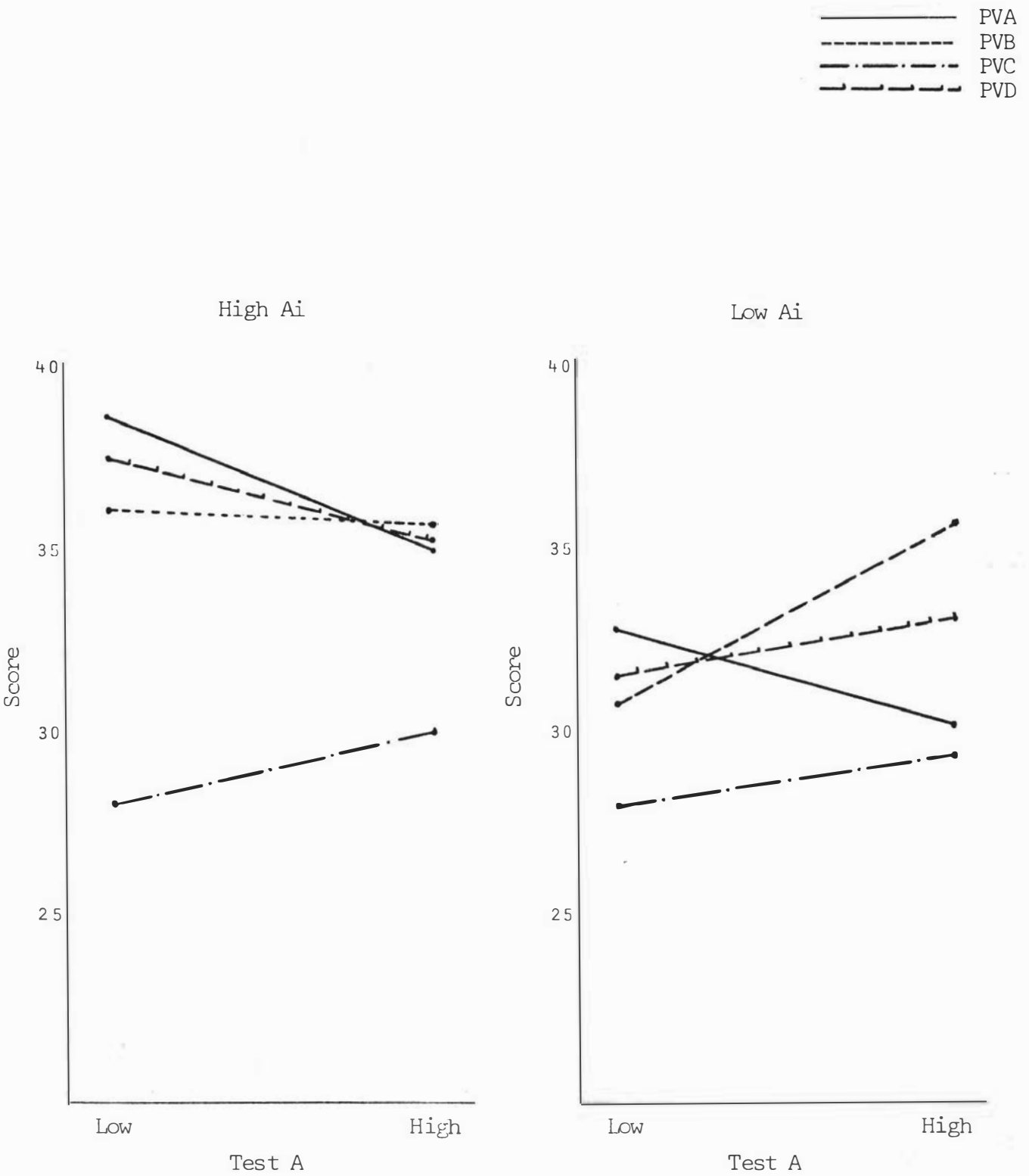
Figure 18: Mean scores attained on Sa QEB learning theory task for high and low subjects on test A via independence

LEARNING THEORY TASK
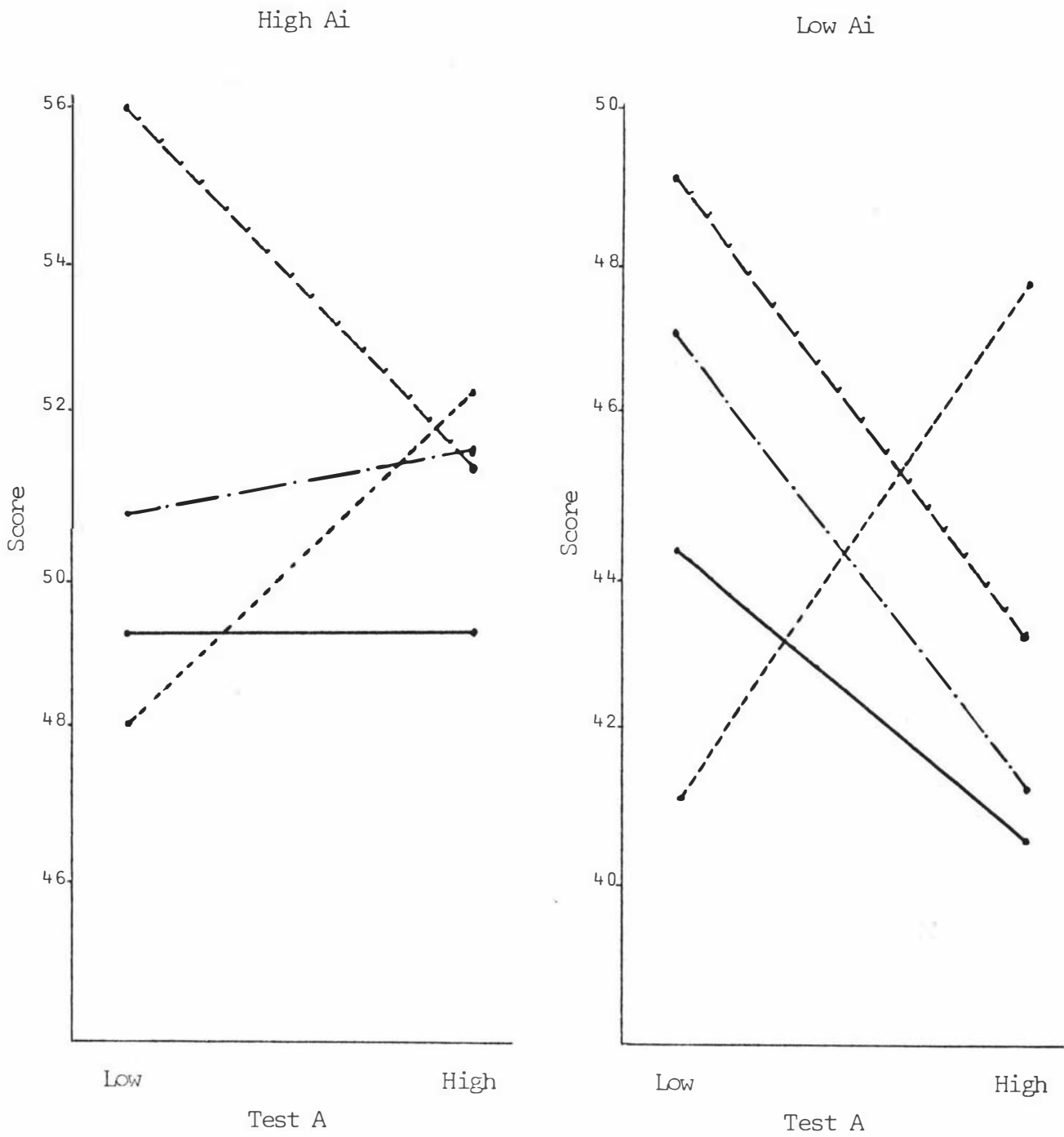
Figure 19: Mean scores attained on Tam for subjects high and low in achievement via independence and test A on the learning theory task

<u>Summary</u>

The effects of task characteristics modified the interaction of learner attributes and programmed instructional treatments on the dependent measures. However, not all of the effects were of the magnitude or direction expected. In the learning theory task, the independence achievement orientation resulted in a significant treatment interaction only on criterion test C. Conformance was not significant at all on the extrinsic task. In contrast in the statistics task, both conformance and independence provided significant treatment interactions on the criterion achievement measure.

Independence also resulted in a significant treatment interaction on the task-related achievement motivation variable. The general finding to emerge from both tasks was that high achievement orientations resulted in superior criterion performance, with the exception that those with low independence and assigned to the high or moderately structured programmes performed better than their colleagues in the same treatments, but who had higher levels of this achievement attribute. With one exception (subjects working from the student-sequenced learning theory programme and who had low independence, performed marginally worse than students with the same attributes in the high structured teacher sequenced programme), subjects assigned to the student sequenced learning theory programme performed best on the criterion achievement test, regardless of their level of prior familiarity. With the teacher sequenced treatments a definite relationship was apparent; the more the programme was structured the better the criterion test performance.

Hypothesis 1 could be accepted only in part. Treatment effects had modified achievement orientations to the extent that only conformance interacted with programmed treatments on the statistics task. Similarly, independence, although interacting with both statistics and

learning theory treatments on criterion achievement, was the only achievement orientation to interact with task-related achievement motivation, and only on the statistics task.

The second hypothesis had proposed that students' objective and subjective ratings of their prior familiarity would differentially interact with tasks and treatments on all dependent measures. This contention was realized only to a very minor degree. The objective measures of content familiarity were responsible for treatment inter- actions on both tasks but only on criterion test C. The subjective self rating scale was even less promising with only a marginally significant treatment interaction on the task-related achievement motivation measure. The subjective rating could have been expected to significantly interact with treatments on the criterion performance variable, especially in view of the large main effects and triple attribute x attribute x treatment interaction on that variable. But apparently a student's rating of his potential performance in both intrinsic and extrinsically structured content areas provided little predictive information on which of these four programmed methods would most facilitate learning. The rating scale did however, provide some information on which method would enhance further motivation towards studying statistics; namely, low structured treatments were most facilitative for students with high ratings, and moderately structured programmes more facilitative for those with low ratings.

The third hypothesis contended an attribute x attribute treatment interaction on all dependent measures: the self rating scale interacting with the intrinsically structured task, and test A with the extrinsically structured one. This hypothesis was confirmed for the learning theory task. A triple independence x test A x treatment interaction occurred with the criterion achievement test, sequence

appropriateness and task-related achievement motivation. On the statistics task, the hypothesis was confirmed for two of the three dependent measures. Independence interacted with the self rating scale on criterion achievement and sequence appropriateness. However, the surprise in the statistics task was that it was independence rather than conformance that interacted with content familiarity. It could have been expected that the high structured nature of the statistics task might have been more conducive to a conformance orientation. This was not the case. Even so, it is interesting to note that the treatment most facilitative of criterion achievement for students with high independence on the statistic task, regardless of their prior familiarity, was the student sequenced programme. In contrast in the learning theory task, only those students who reported low familiarity and were high independence achievers found that this method helped them to learn best.

Gagné's general postulation of the ordered relation of intellectual skills within task competencies was confirmed. However, this study demonstrated that the exact ordering of instructional treatments derived from such a hierarchy would be modified by the interaction of attribute characteristics such as achievement orientation and content familiarity. For example, students whose estimation of their performance in statistics was low, but whose achievement independence was high, profited most from a student generated instructional sequence, rather than a method which taught the entire hierarchy.

CHAPTER VI

DISCUSSION AND RECOMMENDATIONS FOR FUTURE RESEARCH

Discussion

Although the concept of individualized instruction has become popular in recent years, it is probably true that by far the greater proportion of educators who profess commitment to this pedagogical approach conceptualize it in terms of a method of varying instruction to suit the *rate* of an individual's learning. In fact, many protagonists of programmed instruction have conceptualized learner characteristics exclusively in terms of a temporal dimension; how long will it take each individual to achieve mastery? Such an undimensional premise is naive. A more promising strategy might be to conceptualize individualized instruction as a dynamic three-way interactive process involving learner attributes, instructional methodologies and task characteristics. The purpose of this study has been to commence the formulation of a set of precepts capable of verification by empirical research.

Attribute Characteristics

The term aptitude or attribute has traditionally been associated with the cognitive domain. As it has already been pointed out there is little reason to expect that variables such as scholastic aptitude or intelligence will be particularly useful measures in predicting which strategy or instructional method will be optimal in attaining an instructional outcome. Thus, Tobias (1970) and others have preferred to use the term "attribute" as connoting a wide range of personological variables.

In this study four attribute variables were examined in relation to instructional strategies and task characteristics. These were the achievement orientations of conformance and independence, and objective

and subjective indices of prior familiarity. Earlier studies (Domino, 1968; 1971) had suggested that the differentiated achievement orientations of conformance and independence would facilitate learning in situations where these attributes were rewarded. So it was expected that students whose personalities were characterized by, and whose orientation was towards, academic work emphasizing the importance of diligence, and prescribed orderedness, would profit most from treatment methods which rewarded these attributes in a task situation which emphasized logical structure. Conversely, students of an independence achievement orientation, reflecting a creative, innovative rational approach to academic work would find rewarding a more interprelative task, presented in a student-generated sequencing method. Although encouraging trends were in evidence, the results were not as decisive as one might have hoped. As expected, conformance interacted with treatments in the intrinsically structured statistics task, but was found to be an unimportant characteristic in the extrinsically structured situation. The independence attribute was not nearly as decisive, although the magnitude of the interactions were in the anticipated directions. Independence was most significant when interacting with the learning theory treatments. Only when in combination with the objective content familiarity measure did this attribute show a significant level of interaction.

What do we conclude from these achievement orientations when they are examined in relation to programmed instructional strategies? Conformance, the scale originally devised by Gough to assess the motivational and personality factors associated with academic achievement in high school settings, was a useful predictor of criterion achievement at a tertiary level of instruction when programmed methods had been constructed from a learning task which was characterized by an intrinsic structure. This finding was expected. However, the manner in which this attribute interacted with treatments in an ordinal way was not expected. Neither

had it been anticipated that the student generated sequencing strategy would be the most facilitative instructional method at all points along the attribute continuum. Since conformance emphasizes structuredness, the most highly structured instructional strategy could have been expected to be a superior method for enabling students to achieve criterion performance. When the outcomes of the learning task became less logical or predictable as in the case of learning theory, conformance as a predictive learner characteristic was negligible.

On the other hand, independence, the scale devised by Gough to predict achievement in tertiary education settings, and particularly in under-graduate courses in psychology, appeared to be much more robust in terms of the intrinsic-extrinsic nature of task structures. As one may have expected, because of the underlying construct of the attribute, students with higher independence orientations performed optimally under conditions where the onus for the degree of instructional support was left to them. This finding was particularly true in the learning theory situation. It was also true in the statistics task although the strength of the relationships was not as consistent. An interesting finding in this task was that students with low independence found that the highly structured programmed method was much more facilitative than any other approach. The explanation for this finding may be in the descriptors often associated with low independence, such as "cautious", "egotistical", and "fearful". It may be that these individuals also have a strong motive to avoid failure. Such a personality construct might well profit from a highly supportive learning environment in which the possibilities for failure are greatly reduced.

The general tenor of Tobias's (1976) contention that the higher the level of prior achievement, the lower the instructional support required to accomplish instructional objectives was confirmed, but with some

reservations. In the learning theory task an attribute x treatment interaction did result in the manner predicted by Tobias. Subjects with high levels of prior familiarity profited most from a method in which they could choose the degree of prerequisite support required. On the other hand, students with low familiarity demonstrated superior achievement after they had completed a highly structured programme. But this inverse relationship between prior achievement and instructional support was not as clearly evidenced in the statistics task. In fact, it appeared that almost the reverse was true. Students high in statistical competency profited most from the moderately structured programme, and students low in the same ability performed best under the student generated sequence programme. Although this finding provided one instance of support for the experiment's second hypothesis; namely, that prior familiarity would differentially interact on instructional tasks, it did not support the contention of Tobias (1976) that familiarity might invoke similar instructional strategies in a variety of content areas. However, this apparent contradiction may be more imaginary than real. The overall confidence in statistical competency amongst even those students who demonstrated a degree of familiarity with the subject-matter was not high. This might explain why the moderately structured, rather than low structured, programme optimized achievement for students with prior familiarity. But that the low familiarity students found best the instructional method in which they could choose the amount of supportive structure they needed is more difficult to explain. One explanation might be however, that in the statistics task, students with low familiarity found optimal an instructional situation in which *they* chose a high degree of supportive help. . In other words, it is possible that for these low familiarity students, and in a low confidence situation, the student generated sequence treatment was used in its most highly structured form.

It was a little surprising to find that the only triple interactions of achievement orientation, content familiarity and treatments in both tasks occurred with the independence attribute. In light of the conformance construct an interaction could have been expected with subjective content familiarity in the statistics task. This did not eventuate. Instead a pattern of interactions developed even more dissonant with Tobias's (1976) predictions. Students with a high independence disposition and with a high familiarity self-report found optimal the instructional treatment providing maximal instructional support. A similar facilitating preference was found for students low in independnece, except that the moderately structured programme was seen to be as effective as the high structured method. The minimal supportive treatment was seen to be superior for these individuals than the self-sequencing method. Students with low familiarity self-reports found that regardless of their levels of independence, the self-generated sequencing approach assisted them in achieving the instructional objectives better than any other method. This finding is consistent with that of the undimensional content familiarity x treatment interaction result, and further suggests the modifying influence of achievement orientations.

In the learning theory situation, the results tended to conform much more closely to the expected treatment patterns. Subjects high in familiarity, regardless of achievement dispositions profited most from the student sequenced methods. But for students devoid of content experience, the modifying effect of achievement orientations was more apparent. High independence students, the "creative self-actualizers", received greatest assistance to criterion achievement when they could generate their own sequencing paths. The low independence achievers, often identified as the high anxious, cautious students in academic settings, demonstrated that a highly structured instructional method was the optimal learning environment for them. Thus, it may be unwise

to invoke the low familiarity-high instructional support relationships for students who evince high independence in academic achieving situations. A further corollary of these findings is the suggestion that the interpretation of the familiarity construct as a discrete rather than interactive multi-attribute characteristic should be made with caution. However, in the light of the paucity of evidence to date, much more research is needed to examine the generalizability of this relationship.

A further caveat from this research is the general practice of defining levels of prior familiarity by traditional objective pretest methods. Evidence has been shown, particularly with an intrinsically structured task, that objective familiarity measures may not be the most suitable indices to interact with achievement orientation variables. Only the subjective familiarity measure in concert with independence was found to have any predictive ability in discerning the optimal teaching strategies for the statistics course. With learning theory, the reverse was true. The interactions of independence achievement and objective content familiarity provided the best means for predicting the optimal teaching strategy. The conclusion that can be made from this observation is that if levels of prior achievement or familiarity are to be examined in relation with other attribute traits so as to enhance the prediction of optimal instructional strategies, greater care will be needed in determining *how* these familiarity indices have been observed. Methods other than the traditional objective pretest may be appropriate in certain content areas. What tasks would more appropriately be measured by less traditional familiarity measures such as self rating scales and familiarity sensitizing programmes will need to be the subject of further experimental investigations.

Tasks and Treatments

Two tasks were incorporated in this study to determine whether the effects of attribute characteristics would be constant. The hypothesis

to the effect that attribute variables would differentially interact with differentially structured tasks must be accepted. This effect was particularly evident in relation to the students' report on the adequacy of their instructional treatment. High independence achievers in the statistics task preferred the student generated sequencing method, regardless of their perceived prior familiarity. Low independence achievers similarly preferred the high structured programme at all points along the content familiarity continuum. These preferences were not generalized to the learning theory task. Here treatments were far more susceptible to the effects of prior familiarity. Students who had demonstrated prior competency in the subject reported a greater preference for the moderately structured programme, and those with little or no previous knowledge indicated that a highly structured learning programme was more appropriate to their instructional needs. In this task, the effect of independence on treatments was reflected in the strength of appropriateness accorded to the same treatments, rather than a differential determination of treatments in relation to the level of independence. This finding was in line with the general hypothesis of the study; namely that where the characteristics of criterion competency are different, the effects of the interactions between learner attributes and instructional methods will also be different. The task for future research will be to determine whether within the classes of task differences, as for example intrinsically as opposed to extrinsically structured content domains, generalizable attribute x treatment precepts can be established.

Finally, the results of the interaction between independence and familiarity on task-related achievement motivation have important ramifications for teachers and instructional designers. The general conclusion demonstrated that the higher the structuredness of treatments, the lower the task-related achievement motivation. In other words, although

highly structured learning conditions may well faciliatate achievement
in mastery learning situations, the experience may in the long run reduce
the probability that a student's motivational locus will become increasingly
intrinsically centred. If one of the aims of education is to develop
within the individual a desire to learn for learning's sake, then any
instructional method which inhibits this development must be viewed with
concern. The protagonists of 90:90 criterion programmed instruction
may ultimately be doing a disservice to education.

Recommendations for Future Research

This study is further confirmation of the growing evidence
that individual differences have a real effect on learning. Such
evidence does not deny the existence of demonstrable similarities or
seemingly universal characteristics of human nature. Rather it suggests
that, *in addition*, individuals vary in many potentially significant ways.
The pressing problem for instructional psychologists is to identify those
stable characteristics which are both (a) typical of individuals, and
(b) related to performance differences on learning tasks.

The problem will best be solved by a closer analysis of the
interaction between an organism and its environment. Although decades
of debate have been spent on the nature-nurture controversy, one of the
few consistent findings to emerge is that neither variable can be
ignored. More studies involving individual difference characteristics
as positive elements (as opposed to "error variance") are needed if
generalizable laws about instruction are to be found. This study has been
an attempt to attend to the following sorts of questions:

1. For a given learning task, what learner characteristics
   are associated with significantly different levels of
   performance on that task? For example, are such factors
   as age of the learner, sex, preference for visual or

auditory modes, attitudes to authority desire for order, interest in abstract ideas etc., related to pupil achievement levels?

2. Are qualitative differences in a given learner characteristic associated with disordinal treatment interactions? For example, do individuals with characteristically high levels of anxiety perform better in a highly structured learning situation than individuals with characteristically lower levels of anxiety?

3. Are learner-characteristic effects constant across tasks, or are they task specific? For example, are the effects of high achievement motivation as important in learning graphic art, as they may be in language?

4. Can differences in performance be eliminated (partially or completely) by changing or modifying the instructional environment?

Responses to these questions based upon solid empirical evidence will undoubtedly lead us much closer to realizing the goal of individualizing instruction appropriate to the needs and interests of every learner.

APPENDIX A

STANDARD DEVIATIONS (PROGRAMMED TEXT)

STANDARD
DEVIATIONS

Programmed Text

PERFORMANCE OBJECTIVES

This programmed course in statistics has been designed specifically for people who are about to be involved in the analysis of educational and psychological measurements such as test data.

At the conclusion of each objective, you will have the knowledge and skills to complete the following tasks:

1. (a) Recognise and descriminate between the following symbols

$$\Sigma$$

$$X$$

$$N$$

 (b) Calculate from ungrouped data the following measures of central tendency:

mean

median

mode(s)

 (c) Compute the standard deviation from an ungrouped distribution of scores.

2. (a) Construct a frequency table and calculate the mean from grouped data.

 (b) Compute the standard deviation from grouped data.

INSTRUCTIONS

You have possibly completed a PLACEMENT TEST prior to looking at this programme. If you have, go straight to the instructions *"Using the Placement Test with the Programme"* which follows further on.

If you *have not* worked through a placement test you can commence working on the first Exercise of the programme. You will find each page headed with this type of notation

$$(1) \qquad\qquad 5 \qquad\quad \cdot \qquad\quad 1$$

Objective	Learning	Exercise
Number	Level	Number

The bracketed number denotes the *objective* (1 to 4); the digit to the *left* of the decimal point, the *learning level* (5 through to 8 in an ascending hierarchy), and the digit to the *right* of the decimal point, the *exercise* number for each learning level. Start at (1) 5.1, that is, objective 1, level 5, Exercise 1.

From time to time you will be asked to make a response to a question, or complete a problem. Write in the answer on the programme. You may *look back* over previous work if you need to, but *do not* look *ahead* to the answer. Only when you've made your response, or finished the problem, should you turn the page and check your answer.

USING THE PLACEMENT TEST WITH THE PROGRAMME

The objectives in this programme have been hierarchically structured
into 4 learning levels; 5 through to 8. Your placement test reflects
these levels. Look at the first item in the test:

$$1 \qquad (\; 1 \quad . \quad 6 \quad)$$

| Item Number | Objective Number | Learning Level |

The same pattern follows for the rest of the test. The programme
has a similar notation system, except that each learning level has been
divided into a number of exercises.

For example:

$$(\quad 1 \quad) \qquad 7 \quad . \quad 1$$

| Objective | Learning level | Exercise number |

Having completed and marked your placement test you may use this
information to help you decide which learning levels you need to study,
and which ones you can safely skip over. Before you start a new
objective in the programme, check your performance on the learning
levels for that particular objective from the placement test. If you
got all the items in that level wrong, the chances are that you will
need to work through the exercises for that level in the programme.
If you got the items correct, the chances are that you have previously
mastered the material and you can skip over that level. If you only
got a few items correct in a particular level, *you* must decide whether

you need to work through the exercises in the programme, or whether you can skip over them. Use the placement test in this way for each objective, it will make your study of the programme much more efficient. However, you should work the problems in each objective level 8, checking your answers with those at the back of the programme.

If you make an error, go back over the previous exercise and see if you can figure out why you are wrong. Often, it will be a case of bad arithmetic!

Check your placement test for the first objective, and start the programme. Best of luck!

G.J.F. HUNT

STANDARD DEVIATION

(Ungrouped Data)

Introduction

Whenever we are confronted by a spread of scores after administering a test, it is highly desirable to be able to extract some meaning from them!

For instance, if we gave two tests, and found that the *mean* or average for both was 50, could we say that pupil performance on both tests was the same?

Look at two such tests illustrated on a frequency polygon.
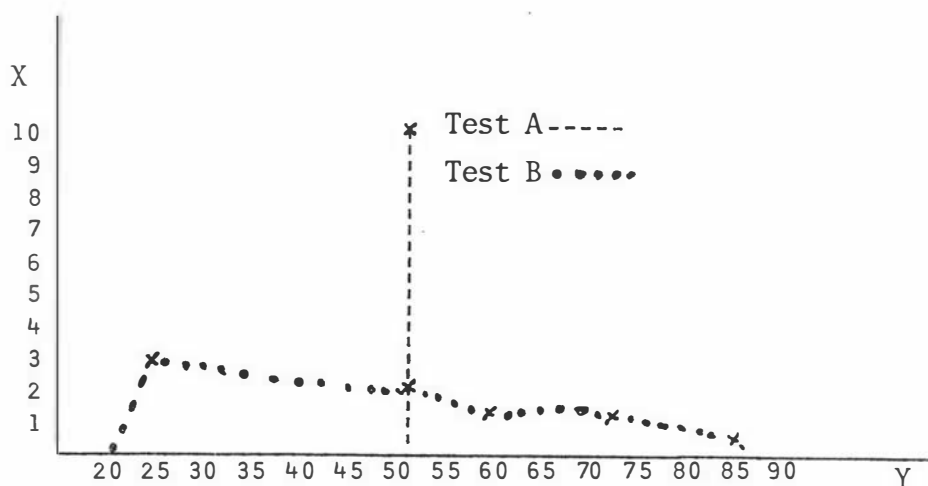
Question:

In what way are the scores on the two tests different?

_____

_____

CHECK YOUR ANSWER WITH OURS

ON THE NEXT PAGE

Answer to (1) 5.1. Your answer should be something like this. No, Test A has no spread of scores, while test B has a wide spread of scores. In actual fact, Test A has a *standard deviation* of 0, and Test B, a standard deviation of 53.2. But we're getting a little ahead of ourselves!

---

(1) 5.2

Before we go much further, we should check on a few symbols and concepts.

Σ = "sigma", or, "the sum of"

X = Measure of a variable; a score, etc.

N = Number of scores, cases, etc., in a distribution

Here is a distribution of scores.

X

10
9
8
6
5
4
3
2
2
1

1. What is ΣX? _____

2. What is N? _____

CHECK YOUR ANSWERS

Answers to (1) 5.2

      1. ΣX is the "sum of scores", or 50

      2. N is the number of cases, in this case, 10.

(1) 6.1   <u>MEASURES OF CENTRAL TENDENCEY</u>

Normally, when we wish to describe a set of scores to someone,
there are initially at least 2 notions we want to convey.

1. Where the scores appear to *center* or *group together*
   on the scale used.

2. *How far* the scores *spread out* from the center of
   the score distribution.

• The first notion concerns the concept of CENTRAL
  TENDENCY, that is, how the scores *center* or *group*
  together.

• The second notion concerns the concept of VARIABILITY,
  that is, the *spread of scores* from the center of the
  distribution.

We will shortly look at one measure of variability, the standard
deviation.

(1) 6.2

There are 3 measures of *central tendency*.

- THE MEAN $(\overline{X})$ the arithmetic *average* of a set of data

    Formula: $\overline{X} = \dfrac{\Sigma X}{N}$

- THE MEDIAN   the mid point in a set of ranked scores; that is, the point which divides the scores into an upper and lower half

- THE MODE   the most frequently occuring score in a distribution

---

Check these <u>examples</u>:

- THE MEAN   X   Formula: $\overline{X} = \dfrac{\Sigma X}{N} = \dfrac{20}{5} = 4$

                 5
                 4
                 7
                 3
                 1

- THE MEDIAN   X 2 3 5 ⑧ 9 10 12

                 The median is 8; 3 scores are in the upper half, 3 in the lower half.

         BUT   X 5 6 7 ⟨9 11⟩ 12 12 14

                 There is no score that actually divides the upper and lower halves. In this case the median is found by taking the *two middle* scores (9 11), adding them (20) and dividing by 2, (10). This is the median. It is a *statistical point* which may or may not be an *actual* score.

(1) 6.2b

- THE MODE

        a. 2 3 3 4 5 8 9   The mode here is 3

        b. 14 15 17 17 17 18 19 19 19 20   Here
            there are two modes, 17
            and 29. This is a BIMODAL
            distribution.

From this distribution of scores, find these things:

			X
1.	ΣX	_____	25
2.	N	_____	14
3.	$\overline{X}$	_____	13
4.	Median	_____	12
5.	Mode	_____	12
			12
			9
			8
			7
			5
			5
			5
			4
			3
			1

CHECK YOUR ANSWERS

Answer to (1) 6.2b

1. X   = 135
2. N   =   15
3. X̄   =   9
4. Median = 8
5. Mode = 12, 5

---

(1) 6.3

Now that we have looked at measures of central tendency, we can
look at the procedures for computing a measure of variability;
the standard deviation. But first, a few more technical concepts.

- SUM of SCORES *SQUARED* $(\Sigma X)^2$
- SUM of *SQUARED* SCORES (ΣX^2)

(REMEMBER: To find the *square* of a number - simply multiply
the number by itself. Eg 4^2 = 16= 4x4)

A	B
X	X²
9	81
7	49
5	25
4	16

$\Sigma X = 25$ ΣX^2 171

$(\Sigma X)^2 = 625$

If we add column A, we get the *sum of scores* ΣX, 25. If we square
the answer, we get the SUM OF SCORES *SQUARED* $(\Sigma X)^2$, or 625.

In column B we square each individual score from column A - these
become *squared scores*. To obtain the sum *of squared scores*, all we need
do is to add column B ΣX^2 = 171.

(1) 6.3b

● To obtain the SUM OF SCORES SQUARED, simply add the scores and square the total.

● To obtain the SUM OF SQUARED SCORES, square each score and add them together.

From these figures:

1. Find the sum of scores squared $(\Sigma X)^2$ _____

2. Find the sum of squared scores ΣX^2 _____

A	B
X	X^2
10	___
9	___
9	___
8	___
5	___
4	___

CHECK YOUR ANSWERS WITH OURS

Answer to (1) 6.3b

1. $(\Sigma X)^2$ = 2025

2. ΣX^2 =   367

The square root of any given number is that number which when multiplied by itself equals the original number. For example, the square root of 16 ($\sqrt{16}$) is 4, since the product of 4 x 4 = 16.

If you have an electronic calculator (with a square root operation), determining the square root is simple. All you do is press the $\sqrt{}$ button. If not, you can easily work out the value from a table of square roots. We've incorporated such a table in this programme to help you. Check the location of the table at the back of the programme and then turn back here.

To find the square root of a number, let's say 1.32;

1.   Locate the value in the left hand column (1.3)

2.   Find the second decimal place value in the top row (2)

3.   The intersection of the row and column is the square root.

SQUARE ROOTS OF NUMBERS 1—10

	0	1	2	3	4	5	6	7	8	9	Differences								
											1	2	3	4	5	6	7	8	9
1·0	1·000	1·005	1·010	1·015	1·020	1·025	1·030	1·034	1·039	1·044	0	1	1	2	2	3	3	4	4
1·1	1·049	1·054	1·058	1·063	1·068	1·072	1·077	1·082	1·086	1·091	0	1	1	2	2	3	3	4	4
1·2	1·095	1·100	1·105	1·109	1·114	1·118	1·122	1·127	1·131	1·136	0	1	1	2	2	3	3	4	4
1·3	1·140	1·145	1·149	1·153	1·158	1·162	1·166	1·170	1·175	1·179	0	1	1	2	2	3	3	3	4
1·4	1·183	1·187	1·192	1·196	1·200	1·204	1·208	1·212	1·217	1·221	0	1	1	2	2	2	3	3	4
1·5	1·225	1·229	1·233	1·237	1·241	1·245	1·249	1·253	1·257	1·261	0	1	1	2	2	2	3	3	4
1·6	1·265	1·269	1·273	1·277	1·281	1·285	1·288	1·292	1·296	1·300	0	1	1	2	2	2	3	3	4
1·7	1·304	1·308	1·311	1·315	1·319	1·323	1·327	1·330	1·334	1·338	0	1	1	2	2	2	3	3	3
1·8	1·342	1·345	1·349	1·353	1·356	1·360	1·364	1·367	1·371	1·375	0	1	1	1	2	2	3	3	3
1·9	1·378	1·382	1·386	1·389	1·393	1·396	1·400	1·404	1·407	1·411	0	1	1	1	2	2	3	3	3
2·0	1·414	1·418	1·421	1·425	1·428	1·432	1·435	1·439	1·442	1·446	0	1	1	1	2	2	2	3	3
2·1	1·449	1·453	1·456	1·459	1·463	1·466	1·470	1·473	1·476	1·480	0	1	1	1	2	2	2	3	3
2·2	1·483	1·487	1·490	1·493	1·497	1·500	1·503	1·507	1·510	1·513	0	1	1	1	2	2	2	3	3
2·3	1·517	1·520	1·523	1·526	1·530	1·533	1·536	1·539	1·543	1·546	0	1	1	1	2	2	2	3	3
2·4	1·549	1·552	1·556	1·559	1·562	1·565	1·568	1·572	1·575	1·578	0	1	1	1	2	2	2	3	3
2·5	1·581	1·584	1·587	1·591	1·594	1·597	1·600	1·603	1·606	1·609	0	1	1	1	2	2	2	3	3
2·6	1·612	1·616	1·619	1·622	1·625	1·628	1·631	1·634	1·637	1·640	0	1	1	1	2	2	2	3	3

4.   If the value has more than 2 decimal places, ADD the value in the *difference* column to the intersected value.

Example: $\sqrt{1.937}$ = 1.389 + 3 = 1.392

(1) 6.4

Using the tables of square root at the back of the programme, find these values:

1. $\sqrt{7.4}$ ___

2. $\sqrt{2.36}$ ___

3. $\sqrt{9.874}$ ___

CHECK YOUR ANSWERS CAREFULLY

Your answers to (1) 6.4

1. 2.720   If you had 2.653, you were finding the   7.04. You
             should have looked for 2.70 in the left hand column,
             and 0 in the top row. Check it again.

2. 1.536

3. 3.143   If you had 3.142, you've forgotten to add the
             difference value for the third placed decimal, in
             this case + 1.

                        IF YOU'RE STILL NOT SURE GO

                        BACK TO (1) 6.4 AND STUDY

                        THE PROCEDURES AGAIN.

(1) 7.1   THE STANDARD DEVIATION

(Ungrouped Data)

The standard deviation is a statistical method used to determine the DISTANCE of SCORES from the MEAN in a distribution. It describes the VARIABILITY of scores in a distribution.

Let's look at the procedure for obtaining the standard deviation of ungrouped data.

The formula we shall use is

$$ s = \sqrt{\frac{\Sigma X^2}{N} - \left(\frac{\Sigma X}{N}\right)^2} $$

Where   s   =   The standard deviation of a sample.

ΣX^2 =   The sum of squared scores.

$(\Sigma X)^2$ =   The sum of the scores squared.

N   =   The number of cases (scores) in the distribution.

From the raw scores below, find:

1. ΣX _____

2. ΣX^2 _____

3.   N   _____

Column A	Column B
X	_____
12	
11	
11	
10	
9	
7	
5	

CHECK YOUR ANSWERS

Answer to (1) 7.1   You should have this:

	A	B
	X	X^2
	12	144
	11	121
	11	121
	10	100
	9	81
	7	49
	5	25

1. ΣX = 65

2. ΣX^2 = 641

3.   N = 7

If you made a mistake; (a) Check your multiplication, especially for column B.

(b) Check your addition.

Now we can enter the values on our formula, and work it out.

$\Sigma X = 65$

$\Sigma X^2 = 641$

$N = 7$

THE FORMULA $s = \sqrt{\dfrac{\Sigma X^2}{N} - \left(\dfrac{\Sigma X}{N}\right)^2}$

WORK IT OUT
LIKE THIS

$\sqrt{\dfrac{641}{7} - \left(\dfrac{65}{7}\right)^2}$ $(9.29)^2 = 86.30$

Start here

A

DIVIDE

C   TAKE QUOTIENT B

AWAY FROM A

B

DIVIDE and then
find the square
of the answer

D.   Find the square root.

E.   (D) is the standard deviation.
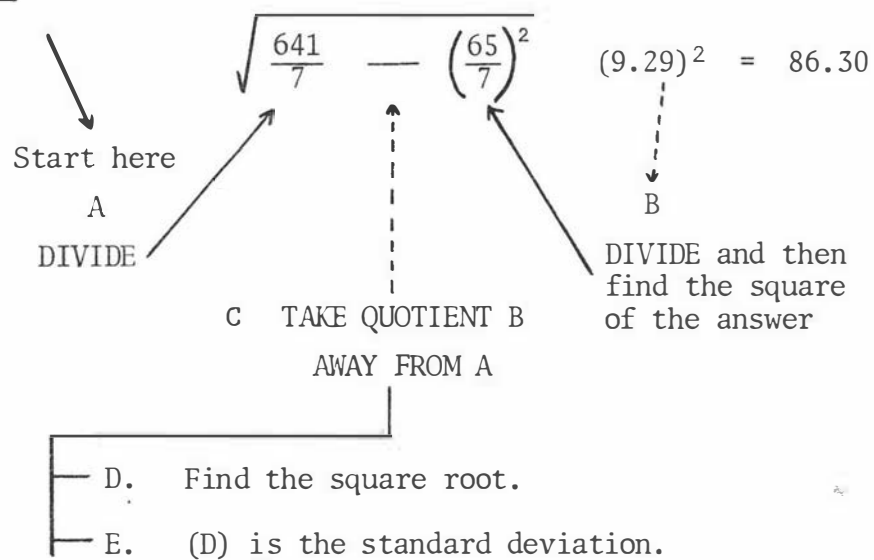
A. 91.57

B   86.30

C. 5.27

D. 2.30

E. The standard deviation; s = 2.30

(1) 7.3

Now find the standard deviation for these test scores.

A   B

X   —

21
19
16
16
14
13
12
 9

1. FIND THE VALUES

    a. ΣX _____

    b. ΣX^2 _____

    c. N _____

2. THE FORMULA

$$s = \sqrt{\frac{\Sigma X^2}{N} - \left(\frac{\Sigma X}{N}\right)^2}$$

Start here

A   C   B

DIVIDE   TAKE QUOTIENT B   DIVIDE and then
        AWAY FROM A   find the square
                            of the answer

3. ENTER THE VALUES $\quad = \sqrt{\dfrac{\underline{\quad}}{\underline{\quad}} - \left(\dfrac{\underline{\quad}}{\underline{\quad}}\right)^2}$

4. WORK IT OUT LIKE THIS

    A. Divide _____

    B. Divide _____

    C. Takeaway _____

    D. Square root _____

    E. (D) is the standard deviation. _____

Use the opposite page to work your calculations.

WHEN YOU'VE FINISHED, COMPARE

YOU ANSWER WITH OURS.

Answer to (1) 7.3

A	B
X	X^2
21	441
19	361
16	256
16	256
14	196
13	169
12	144
9	81

1. a. 120

    b. 1904

    c. 8

2. $$s = \sqrt{\frac{1904}{8} - 225} \qquad \sqrt{\frac{1904}{8} - \left(\frac{120}{8}\right)^2}$$

3. A. 238

    B. 225

    C. 13.00

    D. 3.60

    E. s = 3.60

IF YOU HAVE MADE AN ERROR, GO BACK OVER

(1) 7.1 and (1) 7.2.   CHECK WHERE YOU

WENT WRONG.

(1) **7.4**

Here are the scores from a test in arithmetic:

A

X

15
12
10
9
8
6
3
2

Remember to:

1. Find
    a. ΣX ____
    b. ΣX^2 ____
    c. N ____

2. Complete the formula. $s = \sqrt{\dfrac{\Sigma X^2}{N} - \left(\dfrac{\Sigma X}{N}\right)^2}$

3. A. Divide _____
   B. Divide _____
   C. Take away _____
   D. Square root _____
   E. (D) is the standard deviation. _____

CHECK YOUR ANSWER WITH OURS

Your answer to (1) 7.4 should look like this:

A	B
X	X^2
15	225
12	144
10	100
9	81
8	64
6	36
3	9
2	4

1. a. 65

    b. 663

    c. 8

2. $$s = \sqrt{\dfrac{663}{8} \quad ---\quad 66.10}$$

3. A. 82.88

    B. 66.10

    C. 16.78

    D. 4.10

    E. s = 4.10

(1) 8.1   <u>THE STANDARD DEVIATION</u>

<u>USING UNGROUPED DATA</u>

A teacher obtained the following set of scores after administering
a test of comprehension.

23   19   16   16   14   10   8   7   5   2

He then wanted to know, (a) what was the average score for the
test, and (b), the average distance of individual scores from the
mean.

To obtain this information, he needed to compute (a) a mean for
the distribution, and (b) a standard deviation.

You obtain the information he sought, by using these formulas.

(a) $\overline{X} = \dfrac{\Sigma X}{N}$

(b) $s = \sqrt{\dfrac{\Sigma X^2}{N} - \left(\dfrac{\Sigma X}{N}\right)^2}$

1.   Determine the mean of the distribution.   _____

2.   Determine the standard deviation of the
     distribution.   _____

MAKE ANY CALCULATIONS YOU NEED ON THE

OPPOSITE PAGE

WHEN YOU'VE WORKED YOUR ANSWERS OUT, COMPARE THEM WITH

THE CORRECT ANSWERS IN THE APPENDIX, AT THE BACK OF THE PROGRAMME.

STANDARD DEVIATION

(Grouped Data)

(2) 5.1   FREQUENCY TABLES

When we are dealing with a large number of scores, such as from a class test, etc., it is very often more convenient to summarize the scores in some way.

One way to summarize a set of scores is to set up a FREQUENCY TALLY. This is done by placing a "tally" mark (1) opposite the number representing the score each time it occurs. For example, in a distribution of scores, the 3 occurs 2 times, so we would put 2 tally marks (11) opposite 3. When we get to 5 tallies, the fifth tally bands them like this THH. Each band of 5 tallies is represented in this way.

Tallies are hard to estimate at a glance, especially when there are a lot of them. To summarize them, the tallies are counted and a *frequency* figure entered. When we do this, we are constructing a FREQUENCY TABLE, like this.

X	Tally	Frequency
3	THH 1	6
5	11	2
7	THH	5

(2) 5.1b

Draw up a frequency table for these scores:

X 80 65 65 75 65 60 65 70 70 65 60 65 70 75 70

X	Frequency Tally	Frequency (f)
___	_____	___
___	_____	___
___	_____	___
___	_____	___
___	_____	___

(2) 5.2

Frequencies can be summed and squared in much the same way as we summed and squared raw scores earlier.

From your answer in (2) 5.1b 1;

1. Find Σf _____

2. Find $(\Sigma f)^2$ _____

CHECK BOTH YOUR ANSWERS

Answer to (2) 5.1b

X	Frequency Tally	Frequency (f)
80	1	1
75	11	2
70	1111	4
65	~~1111~~ 1	6
60	11	2

Answer to (2) 5.2

1. 15

2. 225

Because of the range and number of scores that teachers and researchers are faced with, it is very often necessary to group the scores into class INTERVALS and set up FREQUENCY DISTRIBUTION.

We will examine the procedure for doing this by taking a set of figures from a current affairs test.

$$36 \quad 48 \quad 22 \quad 66 \quad 18 \quad 55 \quad 55 \quad 64 \quad 72 \quad 62$$
$$88 \quad 97 \quad 44 \quad 53 \quad 54 \quad 61 \quad 62 \quad 75 \quad 55 \quad 58$$
$$57 \quad 89 \quad 62 \quad 47 \quad 36 \quad 53 \quad 69 \quad 75 \quad 80 \quad 56$$

Procedure

1.   The first step is to determine the *range* (R) of the distribution; the highest score (X_H) minus the lowest score (X_L), plus 1.

$$R = (X_H - X_L) + 1, \text{ or } (97 - \underline{\quad}) + 1 = \underline{\hspace{2cm}}.$$

(Complete the equation for the range)

2.   Next we need to sort the data into groups of scores. We call each group of scores an *Interval*, and the distance between the lowest and highest value in that interval, the *size* of the interval. It is generally accepted that there should be between 10 and 20 intervals in a distribution. If there are less than 10, the groupings tend to be too coarse, resulting in inaccuracies. If there are more than 20, the work becomes laborious.

Once the range has been determined, you can by trial and error, divide numbers into the range to arrive at a figure that will give you between 10 and 20 intervals. Often denominators of 10, 5, or 3 are useful. Suppose we had a range of 70; 5 divides into 70 14 times, giving us 14 intervals for the distribution (well within our limits of between 10 and 20 intervals).

Answer to (2) 6.1   Range = 80   (97 - 18) + 1 = 80

---

(2) 6.1b

Our range is 80, so let's choose an interval size of 5 (80 ÷ 5 = 16).

16 fits nicely into the number of intervals we want (between 10 and

20). An interval size of 10 would have given us too few, (only 8) and

3, too many (about 26).

3.   There is one more thing you should note about the interval size

(abbreviated "i"), that is, locating the MID POINT of

the interval. You can think of it as the median of the interval. If

our interval was 50-54, the mid point would be 52   (50   51   (52)   53   54).

4.   How do we start constructing intervals? A good idea is to let the

bottom interval begin with:

     a.   A multiple of the interval size (5 in this case), and ;

     b.   include in the size the lowest score.

     In our example, we could start with the interval 15-19, since 15

is a multiple of 5, and the interval contains the lowest score, 18.

The next higher interval will be 20-24, the next 25-29, and so on.

                    MAKE SURE YOU UNDERSTAND THIS EXERCISE BEFORE

                    YOU GO ON. YOU MAY NEED TO READ (2) 6.1 A

                    COUPLE OF TIMES. IF YOU THINK YOU'RE READY

                    TURN THE PAGE AND GO ON.

(2) 6.1c

Here are our test scores

36	48	22	66	18	55	55	64	72	62
88	97	44	53	54	61	62	75	55	58
57	89	62	47	36	53	69	75	80	56

From these figures, set up a frequency distribution showing the following information. (A) 16 intervals. (B) the mid points for the intervals, (C) the tallies, (D) the frequencies. Remember, the frequency column (f) is the summary of the number of scores occuring in each interval.

A	B	C	D
Intervals	Mid points	Tallies	f
___	___	___	___
___	___	___	___
___	___	___	___
___	___	___	___
___	___	___	___
___	___	___	___
___	___	___	___
___	___	___	___
___	___	___	___
___	___	___	___
___	___	___	___
___	___	___	___
___	___	___	___
___	___	___	___
___	___	___	___
___	___	___	___

Start here   15-19 ↑

CHECK YOUR ANSWER

Your answer to (2) 6.1c should look like this:

A Intervals	B Mid points	C Tallies	D f
95-99	97	1	1
90-94	92		0
85-89	87	11	2
80-84	82	1	1
75-79	77	11	2
70-74	72	1	1
65-69	67	11	2
60-64	62	~~1111~~	5
55-59	57	~~1111~~ 1	6
50-54	52	111	3
45-49	47	11	2
40-44	42	1	1
35-39	37	11	2
30-34	32		0
25-29	27		0
20-24	22	1	1
15-19	17	1	1

IF YOU MADE A MISTAKE, CHECK YOUR FIGURES CAREFULLY

(2) 6.2   THE MEAN

One final point before going on to compute the standard deviation.
How do you work out the mean of a distribution when your data is
grouped?

The procedure is very simple.

PROCEDURAL STEPS

1.   Set up a frequency distribution table as you have been shown.

2.   Take the mid point of one of the intervals as an arbitrary
     reference point, and in column D, score that deviation (x')
     value 0 (that is, it is the starting point and therefore has
     no deviation value). For every interval above the reference
     point give a positive value from +1 upwards, and every value
     below, a negative value from -1 down.

3.   Multiply each frequency by its deviation value to obtain the
     frequency deviation (column E) for each interval.

4.   Sum the plus and minus frequency deviation values to obtain
     $\Sigma fx'$.

5.   Divide this by N.

6.   Multiply the answer (4) by i.

7.   Add the value of the mid point to the obtained product (6).

HERE IS THE FORMULA

$$X = M' + \frac{\Sigma fx'}{N} \quad (i)$$

        Where M' = arbitrary reference point (the mid point that you
                   have selected).

            i = the size of the interval

              LOOK AT THE STEPS IN RELATION TO THE FORMULA

(2) 6.2b

Look at this example:

A	B	C	D	E
		f	x´	fx´
140-144	1111	4	6	24
135-139	1	1	5	5
130-134	11	2	4	8
125-129	1	1	3	3
120-124	TIII 111	8	2	16
115-119	TIII 11	7	1	7 +63
* 110-114	TIII 1	6	0	0
105-109	TIII	5	-1	-5
100-104	11	2	-2	-4
95-99	111	3	-3	-9
90-94		0	-4	0
85-89	1	1	-5	-5 -23

1. The mid point 112 from the interval 110-114 has been selected as the arbitrary reference point.

2. The mid point is given a deviation (x´) value of 0, and the deviation column (D) completed.

3. Columns C and D are multiplied to obtain a frequency deviation fx for each interval. The plus and minus frequency deviations are summed and Σfx obtained (63-23 = 40).

4. These values are now placed in the formula.

$$\bar{X} = M´ + \frac{\Sigma fx´}{N} \quad (i)$$

$$= 112 + \frac{40}{40} \quad (5)$$

$$= 112 + 1 \times 5$$

$$= 117$$

(2) 6.3

Here is a partially completed frequency distribution table. Find the
mean for this grouped data:

A	B	C	D	E
		f	x´	fx´
70-74	1	1		
65-69	1	1		
60-64	111	3		
55-59	11	2		
50-54	THH 11	7		
45-49	THH 1	6		
40-44	THH	5		
35-39	11	2		
30-34	11	2		
25-29	1	1		

1. Select a mid point _____, and complete columns D and E (the
    deviations, and frequency deviations).

2. State the interval size _____.

3. Find $\Sigma fx´$ _____.

4. Place the values in the formula:

$$\bar{X} = M´ + \frac{\Sigma fx´}{N} \quad (i)$$

$$= \underline{\ } + \frac{\underline{\quad}}{\underline{\quad}} \times \underline{\ }$$

5. Give your answer for $\bar{X}$ _____.

CHECK YOUR ANSWER

Your answer for (2) 6.3 should look like this.

A	B	C	D	E
		f	x'	fx'
70-74	1	1	5	5
65-69	1	1	4	4
60-64	111	3	3	9
55-59	11	2	2	4
50-54	~~THH~~ 11	7	1	7 +29
45-49	~~THH~~ 1	6	0	0
40-44	~~THH~~	5	-1	-5
35-39	11	2	-2	-4
30-34	11	2	-3	-6
25-29	1	1	-4	-4 -19

1. We selected the mid point 47 (the interval 45-49).

2. The size of the interval was 5.

3. $\Sigma fx' = 10$.

4. The values in the formula:

$$\overline{X} = 47 + \frac{10}{30} \times 5$$

$$= 47 + .333 \times 5$$

$$= \underline{48.67}$$

CHECK YOUR CALCULATIONS

IF YOU GOT THIS WORNG

(2) 7.1   <u>COMPUTATION OF THE STANDARD DEVIATION</u>

<u>USING GROUPED DATA</u>

When the interpretation of a distribution of scores requires the computation of the standard deviation, it is often the case that the number of scores, and range of distribution are of sufficient magnitude to necessitate the grouping of the data in a way which makes its computation more manageable.

Here are the steps to work through in determining the standard deviation of grouped data.

<u>PROCEDURAL STEPS</u>

1.   Construct a frequency distribution and determine the basic values.

A	B	C f	D x'	E fx'	F fx'^2
95-99	1	1	9	9	81
90-94		0	8	0	0
85-89	11	2	7	14	98
80-84	1	1	6	6	36
75-79	11	2	5	10	50
70-74	1	1	4	4	16
65-69	11	2	3	6	18
60-64	~~1111~~	5	2	10	20
55-59	~~1111~~ 1	6	1	6 +65	6
50-54	111	3	0	0	0
45-49	11	2	-1	-2	2
40-44	1	1	-2	-2	4
35-39	11	2	-3	-6	18
30-34		0	-4	0	0
25-29		0	-5	0	0
20-24	1	1	-6	-6	36
15-19	1	1	-7	-7 -23	49

$\Sigma fx' = 42 \quad \Sigma fx'^2 = 434$

a.   Select an arbitrary reference point, in this case the mid point 52.

b.   Calculate deviations from the reference point.

c.   Obtain the frequency deviation for each interval and find the $\Sigma fx'$.
Watch the signs! Here, we get 42.

(2) 7.1b

d. Multiply the x′ and fx′ columns to get $\Sigma fx'^2$, (column F.)
    The values are now all positive (multiplication of like
    signs). This is the frequency times squared deviations.
    You can get the same result by squaring each deviation
    in column D, and multiplying each with its frequency in
    column C. To obtain $\Sigma fx'^2$, add the frequency squared
    deviations of column F. For this distribution, $\Sigma fx'^2 = 434$.

2. Now place these values in the formula for the standard
    deviation, grouped data.

THE FORMULA $s = i \sqrt{\dfrac{\Sigma fx'^2}{N} - \left(\dfrac{\Sigma fx'}{N}\right)^2}$

3. WORK IT OUT $= 5 \sqrt{\dfrac{434}{30} - \left(\dfrac{42}{30}\right)^2} \leftarrow \left[(1.4)^2 = 1.96\right]$
    LIKE THIS

    Start here
        A
      DIVIDE   B
                        C   DIVIDE and then
              TAKE QUOTIENT B   find the square
              AWAY FROM A   of the answer

    D. Find the square root of C.
    E. Multiply value (D) by i (the interval size).
    F. Value (E) is the standard deviation.

Here are the worked values:

    A. 14.47
    B. 1.96
    C. 12.51
    D.   3.54
    E. 17.68
    F. The standard deviation; s = 17.68

                CHECK THE CALCULATIONS YOURSELF
                    BEFORE GOING ON.

(2) 7.2

Now calculate the standard deviation from this frequency distribution.

A	B	C	D	E	F
		f	x´	fx´	fx´²
80-84	1	1			
75-79	1	1			
70-74	1	1			
65-69	1111	4			
60-64	1111	4			
55-59	1111 11	7			
50-54	1111 1	6			
45-49	1111 1	6			
40-44	1111 1	6			
35-39	111	3			
30-34		0			
25-29	1	1			

1. Complete the construction of the table above.

    a. Select a mid point as arbitrary reference point. _____

    b. Complete column of deviations.

    c. Complete frequency deviations column, find $\Sigma fx´$. _____

    d. Complete frequency squared deviations, find $\Sigma fx´^2$ _____

2. Place the values in the formula:

$$s = i\sqrt{\frac{\Sigma fx´^2}{N} - \left(\frac{\Sigma fx´}{N}\right)^2}$$

$$= \sqrt{\frac{}{} - \left(\frac{}{}\right)}$$

3.
Work the values

A. Divide _____

B. Divide _____

C. Take quotient B from A _____

D. Find the square root of (C) _____

E. Multiply value (D) by i _____

F. s = _____

CHECK YOUR ANSWERS

Your answer to (2) 7.2 should look like this:

A	B	C	D	E	F
		f	x´	fx´	fx´²
80-84	1	1	6	6	36
75-79	1	1	5	5	25
70-74	1	1	4	4	16
65-69	1111	4	3	12	36
60-64	1111	4	2	8	16
55-59	~~1111~~ 11	7	1	7 +42	7
50-54	~~1111~~ 1	6	0	0	0
45-49	~~1111~~ 1	6	-1	- 6	6
40-44	~~1111~~ 1	6	-2	-12	24
35-39	111	3	-3	- 9	27
30-34		0	-4	0	0
25-29	1	1	-5	- 5 -32	25

1. a. In our case 52.

    c. $\Sigma fx´$ = 10.

    d. $\Sigma fx´^2$ = 218.

2. $s = 5\sqrt{\dfrac{218}{40} - .0625}$

3. A. 5.45

    B. .0625

    C. 5.387

    D. 2.321

    E. 11.60

    F. The standard deviation = 11.60

IF YOU MADE A MISTAKE CHECK OVER

YOUR CALCULATIONS; YOU MAY NEED

TO LOOK OVER THE EXAMPLES IN

(2) 7.1 AGAIN.

(2) 8.1   THE STANDARD DEVIATION

GROUPED DATA

The standard deviation is probably one of the most widely used statistics in educational and psychological research. It is a measure of the average distance of individual scores in a distribution from the mean.

The following scores were derived from a test in statistics.

```
98 96 94 90 87 83 83 83 81 80
80 79 79 79 79 79 78 78 76 75
75 75 74 71 68 65 65 64 60 59
59 58 57 53 53 52 49 47 42 37
```

1. A. Construct a frequency distribution table.

B. State the interval size.   _____

C. State your selected mid point.   _____

2. A. Put in the values for the equation.

$$\bar{X} = M' + \frac{\Sigma fx'}{N} \ (i) \qquad = \quad \underline{\quad} + \frac{\underline{\qquad}}{\underline{\quad}} \ (\underline{\quad}) \ '$$

B. Determine the mean using the grouped data method.

3. A. Put in the values for the equation.

$$s = i\sqrt{\frac{\Sigma fx'^2}{N} - \left(\frac{\Sigma fx'}{N}\right)^2} \qquad = \quad \underline{\quad}\sqrt{\frac{\underline{\quad}}{\underline{\quad}} - \left(\frac{\underline{\quad}}{\underline{\quad}}\right)}$$

B. Calculate the standard deviation
    using grouped data.   _____

TURN OVER THE PAGE TO
MAKE YOUR CALCULATIONS.

(2) 8.1b

A	B	C	D	E	F

YOU MAY ALSO USE THE PAGE OPPOSITE TO

MAKE ANY OF YOUR CALCULATIONS ON.

Your answer to (2) 8.1 should look like this.

1. A

A	B	C	D	E	F
		f	x´	fx´	fx´^{2}
95-99	11	2	6	12	72
90-94	11	2	5	10	50
85-89	1	1	4	4	16
80-84	̶1̶1̶1̶1̶ 1	6	3	18	54
75-79	̶1̶1̶1̶1̶ ̶1̶1̶1̶1̶ 1	11	2	22	44
70-74	11	2	1	2 + 68	2
65-69	111	3	0	0	0
60-64	11	2	-1	-2	2
55-59	1111	4	-2	-8	16
50-54	111	3	-3	-9	27
45-49	11	2	-4	-8	32
40-44	1	1	-5	-5	25
35-39	1	1	-6	-6	36
				- 38	
				Σfx´ = 30	Σfx´^{2} = 376

1. B. (in this case, i = 5)
    C. Mid point = 67 (interval 65-69).

2. A. $\bar{X} = 67 + \frac{30}{40} \times 5$

    B. $\bar{X} = 70.75$

3. A. $5\sqrt{\frac{376}{40} - .5625}$

    B. s = 14.87

IF YOU HAVE MADE A MISTAKE
CHECK YOUR FIGURES CAREFULLY.
MOST ERRORS ARE DUE TO EITHER
FAULTY DIVISION OR MULTIPLICATION
OR BOTH. MAKE YOUR CORRECTIONS
AND GO ON TO THE LAST PROBLEM.

(2) 8.2

The following scores were derived from a comprehension test.

> 16 37 43 43 50 32 5 28 43 15
> 25 34 40 43 43 34 40 45 38 6

1. Calculate the mean using the grouped data method. _____

2. Calculate the standard deviation from the grouped
    data. _____

NOTE:

You will need to:

    a.   Rank the scores.

    b.   Construct a frequency distribution table.

    c.   State the interval size

    d.   Determine a mid point.

A	B	C	D	E	F

COMPARE YOUR ANSWERS WITH OURS AT
THE BACK OF THE PROGRAMME

A P P E N D I X

APPENDIX

TABLE 1

SQUARE ROOTS OF NUMBERS 1—10

	0	1	2	3	4	5	6	7	8	9	Differences								
											1	2	3	4	5	6	7	8	9
1·0	1·000	1·005	1·010	1·015	1·020	1·025	1·030	1·034	1·039	1·044	0	1	1	2	2	3	3	4	4
1·1	1·049	1·054	1·058	1·063	1·068	1·072	1·077	1·082	1·086	1·091	0	1	1	2	2	3	3	4	4
1·2	1·095	1·100	1·105	1·109	1·114	1·118	1·122	1·127	1·131	1·136	0	1	1	2	2	3	3	4	4
1·3	1·140	1·145	1·149	1·153	1·158	1·162	1·166	1·170	1·175	1·179	0	1	1	2	2	3	3	3	4
1·4	1·183	1·187	1·192	1·196	1·200	1·204	1·208	1·212	1·217	1·221	0	1	1	2	2	2	3	3	4
1·5	1·225	1·229	1·233	1·237	1·241	1·245	1·249	1·253	1·257	1·261	0	1	1	2	2	2	3	3	4
1·6	1·265	1·269	1·273	1·277	1·281	1·285	1·288	1·292	1·296	1·300	0	1	1	2	2	2	3	3	4
1·7	1·304	1·308	1·311	1·315	1·319	1·323	1·327	1·330	1·334	1·338	0	1	1	2	2	2	3	3	3
1·8	1·342	1·345	1·349	1·353	1·356	1·360	1·364	1·367	1·371	1·375	0	1	1	1	2	2	3	3	3
1·9	1·378	1·382	1·386	1·389	1·393	1·396	1·400	1·404	1·407	1·411	0	1	1	1	2	2	3	3	3
2·0	1·414	1·418	1·421	1·425	1·429	1·432	1·435	1·439	1·442	1·446	0	1	1	1	2	2	2	3	3
2·1	1·449	1·453	1·456	1·459	1·463	1·466	1·470	1·473	1·476	1·480	0	1	1	1	2	2	2	3	3
2·2	1·483	1·487	1·490	1·493	1·497	1·500	1·503	1·507	1·510	1·513	0	1	1	1	2	2	2	3	3
2·3	1·517	1·520	1·523	1·526	1·530	1·533	1·536	1·539	1·543	1·546	0	1	1	1	2	2	2	3	3
2·4	1·549	1·552	1·556	1·559	1·562	1·565	1·568	1·572	1·575	1·578	0	1	1	1	2	2	2	3	3
2·5	1·581	1·584	1·587	1·591	1·594	1·597	1·600	1·603	1·606	1·609	0	1	1	1	2	2	2	3	3
2·6	1·612	1·616	1·619	1·622	1·625	1·628	1·631	1·634	1·637	1·640	0	1	1	1	2	2	2	2	3
2·7	1·643	1·646	1·649	1·652	1·655	1·658	1·661	1·664	1·667	1·670	0	1	1	1	2	2	2	2	3
2·8	1·673	1·676	1·679	1·682	1·685	1·688	1·691	1·694	1·697	1·700	0	1	1	1	1	2	2	2	3
2·9	1·703	1·706	1·709	1·712	1·715	1·718	1·720	1·723	1·726	1·729	0	1	1	1	1	2	2	2	3
3·0	1·732	1·735	1·738	1·741	1·744	1·746	1·749	1·752	1·755	1·758	0	1	1	1	1	2	2	2	3
3·1	1·761	1·764	1·766	1·769	1·772	1·775	1·778	1·780	1·783	1·786	0	1	1	1	1	2	2	2	3
3·2	1·789	1·792	1·794	1·797	1·800	1·803	1·806	1·808	1·811	1·814	0	1	1	1	1	2	2	2	2
3·3	1·817	1·819	1·822	1·825	1·828	1·830	1·833	1·836	1·838	1·841	0	1	1	1	1	2	2	2	2
3·4	1·844	1·847	1·849	1·852	1·855	1·857	1·860	1·863	1·865	1·868	0	1	1	1	1	2	2	2	2
3·5	1·871	1·873	1·876	1·879	1·881	1·884	1·887	1·889	1·892	1·895	0	1	1	1	1	2	2	2	2
3·6	1·897	1·900	1·903	1·905	1·908	1·910	1·913	1·916	1·918	1·921	0	1	1	1	1	2	2	2	2
3·7	1·924	1·926	1·929	1·931	1·934	1·936	1·939	1·942	1·944	1·947	0	1	1	1	1	2	2	2	2
3·8	1·949	1·952	1·954	1·957	1·960	1·962	1·965	1·967	1·970	1·972	0	1	1	1	1	2	2	2	2
3·9	1·975	1·977	1·980	1·982	1·985	1·987	1·990	1·992	1·995	1·997	0	1	1	1	1	2	2	2	2
4·0	2·000	2·002	2·005	2·007	2·010	2·012	2·015	2·017	2·020	2·022	0	0	1	1	1	1	2	2	2
4·1	2·025	2·027	2·030	2·032	2·035	2·037	2·040	2·042	2·045	2·047	0	0	1	1	1	1	2	2	2
4·2	2·049	2·052	2·054	2·057	2·059	2·062	2·064	2·066	2·069	2·071	0	0	1	1	1	1	2	2	2
4·3	2·074	2·076	2·078	2·081	2·083	2·086	2·088	2·090	2·093	2·095	0	0	1	1	1	1	2	2	2
4·4	2·098	2·100	2·102	2·105	2·107	2·110	2·112	2·114	2·117	2·119	0	0	1	1	1	1	2	2	2
4·5	2·121	2·124	2·126	2·128	2·131	2·133	2·135	2·138	2·140	2·142	0	0	1	1	1	1	2	2	2
4·6	2·145	2·147	2·149	2·152	2·154	2·156	2·159	2·161	2·163	2·166	0	0	1	1	1	1	2	2	2
4·7	2·168	2·170	2·173	2·175	2·177	2·179	2·182	2·184	2·186	2·189	0	0	1	1	1	1	2	2	2
4·8	2·191	2·193	2·195	2·198	2·200	2·202	2·205	2·207	2·209	2·211	0	0	1	1	1	1	2	2	2
4·9	2·214	2·216	2·218	2·220	2·223	2·225	2·227	2·229	2·232	2·234	0	0	1	1	1	1	2	2	2
5·0	2·236	2·238	2·241	2·243	2·245	2·247	2·249	2·252	2·254	2·256	0	0	1	1	1	1	2	2	2
5·1	2·258	2·261	2·263	2·265	2·267	2·269	2·272	2·274	2·276	2·278	0	0	1	1	1	1	2	2	2
5·2	2·280	2·283	2·285	2·287	2·289	2·291	2·293	2·296	2·298	2·300	0	0	1	1	1	1	2	2	2
5·3	2·302	2·304	2·307	2·309	2·311	2·313	2·315	2·317	2·319	2·322	0	0	1	1	1	1	2	2	2
5·4	2·324	2·326	2·328	2·330	2·332	2·335	2·337	2·339	2·341	2·343	0	0	1	1	1	1	1	2	2

SQUARE ROOTS OF NUMBERS 1—10

	0	1	2	3	4	5	6	7	8	9	Differences								
											1	2	3	4	5	6	7	8	9
5·5	2·345	2·347	2·349	2·352	2·354	2·356	2·358	2·360	2·362	2·364	0	0	1	1	1	1	1	2	2
5·6	2·366	2·369	2·371	2·373	2·375	2·377	2·379	2·381	2·383	2·385	0	0	1	1	1	1	1	2	2
5·7	2·387	2·390	2·392	2·394	2·396	2·398	2·400	2·402	2·404	2·406	0	0	1	1	1	1	1	2	2
5·8	2·408	2·410	2·412	2·415	2·417	2·419	2·421	2·423	2·425	2·427	0	0	1	1	1	1	1	2	2
5·9	2·429	2·431	2·433	2·435	2·437	2·439	2·441	2·443	2·445	2·447	0	0	1	1	1	1	1	2	2
6·0	2·449	2·452	2·454	2·456	2·458	2·460	2·462	2·464	2·466	2·468	0	0	1	1	1	1	1	2	2
6·1	2·470	2·472	2·474	2·476	2·478	2·480	2·482	2·484	2·486	2·488	0	0	1	1	1	1	1	2	2
6·2	2·490	2·492	2·494	2·496	2·498	2·500	2·502	2·504	2·506	2·508	0	0	1	1	1	1	1	2	2
6·3	2·510	2·512	2·514	2·516	2·518	2·520	2·522	2·524	2·526	2·528	0	0	1	1	1	1	1	2	2
6·4	2·530	2·532	2·534	2·536	2·538	2·540	2·542	2·544	2·546	2·548	0	0	1	1	1	1	1	2	2
6·5	2·550	2·551	2·553	2·555	2·557	2·559	2·561	2·563	2·565	2·567	0	0	1	1	1	1	1	2	2
6·6	2·569	2·571	2·573	2·575	2·577	2·579	2·581	2·583	2·585	2·587	0	0	1	1	1	1	1	2	2
6·7	2·588	2·590	2·592	2·594	2·596	2·598	2·600	2·602	2·604	2·606	0	0	1	1	1	1	1	2	2
6·8	2·608	2·610	2·612	2·613	2·615	2·617	2·619	2·621	2·623	2·625	0	0	1	1	1	1	1	2	2
6·9	2·627	2·629	2·631	2·632	2·634	2·636	2·638	2·640	2·642	2·644	0	0	1	1	1	1	1	2	2
7·0	2·646	2·648	2·650	2·651	2·653	2·655	2·657	2·659	2·661	2·663	0	0	1	1	1	1	1	2	2
7·1	2·665	2·666	2·668	2·670	2·672	2·674	2·676	2·678	2·680	2·681	0	0	1	1	1	1	1	1	2
7·2	2·683	2·685	2·687	2·689	2·691	2·693	2·694	2·696	2·698	2·700	0	0	1	1	1	1	1	1	2
7·3	2·702	2·704	2·706	2·707	2·709	2·711	2·713	2·715	2·717	2·718	0	0	1	1	1	1	1	1	2
7·4	2·720	2·722	2·724	2·726	2·728	2·729	2·731	2·733	2·735	2·737	0	0	1	1	1	1	1	1	2
7·5	2·739	2·740	2·742	2·744	2·746	2·748	2·750	2·751	2·753	2·755	0	0	1	1	1	1	1	1	2
7·6	2·757	2·759	2·760	2·762	2·764	2·766	2·768	2·769	2·771	2·773	0	0	1	1	1	1	1	1	2
7·7	2·775	2·777	2·778	2·780	2·782	2·784	2·786	2·787	2·789	2·791	0	0	1	1	1	1	1	1	2
7·8	2·793	2·795	2·796	2·798	2·800	2·802	2·804	2·805	2·807	2·809	0	0	1	1	1	1	1	1	2
7·9	2·811	2·812	2·814	2·816	2·818	2·820	2·821	2·823	2·825	2·827	0	0	1	1	1	1	1	1	2
8·0	2·828	2·830	2·832	2·834	2·835	2·837	2·839	2·841	2·843	2·844	0	0	1	1	1	1	1	1	2
8·1	2·846	2·848	2·850	2·851	2·853	2·855	2·857	2·858	2·860	2·862	0	0	1	1	1	1	1	1	2
8·2	2·864	2·865	2·867	2·869	2·871	2·872	2·874	2·876	2·877	2·879	0	0	1	1	1	1	1	1	2
8·3	2·881	2·883	2·884	2·886	2·888	2·890	2·891	2·893	2·895	2·897	0	0	1	1	1	1	1	1	2
8·4	2·898	2·900	2·902	2·903	2·905	2·907	2·909	2·910	2·912	2·914	0	0	1	1	1	1	1	1	2
8·5	2·915	2·917	2·919	2·921	2·922	2·924	2·926	2·927	2·929	2·931	0	0	1	1	1	1	1	1	2
8·6	2·933	2·934	2·936	2·938	2·939	2·941	2·943	2·944	2·946	2·948	0	0	1	1	1	1	1	1	2
8·7	2·950	2·951	2·953	2·955	2·956	2·958	2·960	2·961	2·963	2·965	0	0	1	1	1	1	1	1	2
8·8	2·966	2·968	2·970	2·972	2·973	2·975	2·977	2·978	2·980	2·982	0	0	1	1	1	1	1	1	2
8·9	2·983	2·985	2·987	2·988	2·990	2·992	2·993	2·995	2·997	2·998	0	0	1	1	1	1	1	1	2
9·0	3·000	3·002	3·003	3·005	3·007	3·008	3·010	3·012	3·013	3·015	0	0	0	1	1	1	1	1	1
9·1	3·017	3·018	3·020	3·022	3·023	3·025	3·027	3·028	3·030	3·032	0	0	0	1	1	1	1	1	1
9·2	3·033	3·035	3·036	3·038	3·040	3·041	3·043	3·045	3·046	3·048	0	0	0	1	1	1	1	1	1
9·3	3·050	3·051	3·053	3·055	3·056	3·058	3·059	3·061	3·063	3·064	0	0	0	1	1	1	1	1	1
9·4	3·066	3·068	3·069	3·071	3·072	3·074	3·076	3·077	3·079	3·081	0	0	0	1	1	1	1	1	1
9·5	3·082	3·084	3·085	3·087	3·089	3·090	3·092	3·094	3·095	3·097	0	0	0	1	1	1	1	1	1
9·6	3·098	3·100	3·102	3·103	3·105	3·106	3·108	3·110	3·111	3·113	0	0	0	1	1	1	1	1	1
9·7	3·114	3·116	3·118	3·119	3·121	3·122	3·124	3·126	3·127	3·129	0	0	0	1	1	1	1	1	1
9·8	3·130	3·132	3·134	3·135	3·137	3·138	3·140	3·142	3·143	3·145	0	0	0	1	1	1	1	1	1
9·9	3·146	3·148	3·150	3·151	3·153	3·154	3·156	3·158	3·159	3·161	0	0	0	1	1	1	1	1	1

Square roots

SQUARE ROOTS OF NUMBERS 10—100

	0	1	2	3	4	5	6	7	8	9	Differences								
											1	2	3	4	5	6	7	8	9
10	3·162	3·178	3·194	3·209	3·225	3·240	3·256	3·271	3·286	3·302	2	3	5	6	8	9	11	12	14
11	3·317	3·332	3·347	3·362	3·376	3·391	3·406	3·421	3·435	3·450	1	3	4	6	7	9	10	12	13
12	3·464	3·479	3·493	3·507	3·521	3·536	3·550	3·564	3·578	3·592	1	3	4	6	7	8	10	11	13
13	3·606	3·619	3·633	3·647	3·661	3·674	3·688	3·701	3·715	3·728	1	3	4	5	7	8	10	11	12
14	3·742	3·755	3·768	3·782	3·795	3·808	3·821	3·834	3·847	3·860	1	3	4	5	7	8	9	11	12
15	3·873	3·886	3·899	3·912	3·924	3·937	3·950	3·962	3·975	3·987	1	3	4	5	6	8	9	10	11
16	4·000	4·012	4·025	4·037	4·050	4·062	4·074	4·087	4·099	4·111	1	2	4	5	6	7	9	10	11
17	4·123	4·135	4·147	4·159	4·171	4·183	4·195	4·207	4·219	4·231	1	2	4	5	6	7	8	10	11
18	4·243	4·254	4·266	4·278	4·290	4·301	4·313	4·324	4·336	4·347	1	2	3	5	6	7	8	9	10
19	4·359	4·370	4·382	4·393	4·405	4·416	4·427	4·438	4·450	4·461	1	2	3	5	6	7	8	9	10
20	4·472	4·483	4·494	4·506	4·517	4·528	4·539	4·550	4·561	4·572	1	2	3	4	6	7	8	9	10
21	4·583	4·593	4·604	4·615	4·626	4·637	4·648	4·658	4·669	4·680	1	2	3	4	5	6	8	9	10
22	4·690	4·701	4·712	4·722	4·733	4·743	4·754	4·764	4·775	4·785	1	2	3	4	5	6	7	8	9
23	4·796	4·806	4·817	4·827	4·837	4·848	4·858	4·868	4·879	4·889	1	2	3	4	5	6	7	8	9
24	4·899	4·909	4·919	4·930	4·940	4·950	4·960	4·970	4·980	4·990	1	2	3	4	5	6	7	8	9
25	5·000	5·010	5·020	5·030	5·040	5·050	5·060	5·070	5·079	5·089	1	2	3	4	5	6	7	8	9
26	5·099	5·109	5·119	5·128	5·138	5·148	5·158	5·167	5·177	5·187	1	2	3	4	5	6	7	8	9
27	5·196	5·206	5·215	5·225	5·235	5·244	5·254	5·263	5·273	5·282	1	2	3	4	5	6	7	8	9
28	5·292	5·301	5·310	5·320	5·329	5·339	5·348	5·357	5·367	5·376	1	2	3	4	5	6	7	7	8
29	5·385	5·394	5·404	5·413	5·422	5·431	5·441	5·450	5·459	5·468	1	2	3	4	5	5	6	7	8
30	5·477	5·486	5·495	5·505	5·514	5·523	5·532	5·541	5·550	5·559	1	2	3	4	4	5	6	7	8
31	5·568	5·577	5·586	5·595	5·604	5·612	5·621	5·630	5·639	5·648	1	2	3	3	4	5	6	7	8
32	5·657	5·666	5·675	5·683	5·692	5·701	5·710	5·718	5·727	5·736	1	2	3	3	4	5	6	7	8
33	5·745	5·753	5·762	5·771	5·779	5·788	5·797	5·805	5·814	5·822	1	2	3	3	4	5	6	7	8
34	5·831	5·840	5·848	5·857	5·865	5·874	5·882	5·891	5·899	5·908	1	2	3	3	4	5	6	7	8
35	5·916	5·925	5·933	5·941	5·950	5·958	5·967	5·975	5·983	5·992	1	2	2	3	4	5	6	7	8
36	6·000	6·008	6·017	6·025	6·033	6·042	6·050	6·058	6·066	6·075	1	2	2	3	4	5	6	7	7
37	6·083	6·091	6·099	6·107	6·116	6·124	6·132	6·140	6·148	6·156	1	2	2	3	4	5	6	7	7
38	6·164	6·173	6·181	6·189	6·197	6·205	6·213	6·221	6·229	6·237	1	2	2	3	4	5	6	6	7
39	6·245	6·253	6·261	6·269	6·277	6·285	6·293	6·301	6·309	6·317	1	2	2	3	4	5	6	6	7
40	6·325	6·332	6·340	6·348	6·356	6·364	6·372	6·380	6·387	6·395	1	2	2	3	4	5	6	6	7
41	6·403	6·411	6·419	6·427	6·434	6·442	6·450	6·458	6·465	6·473	1	2	2	3	4	5	5	6	7
42	6·481	6·488	6·496	6·504	6·512	6·519	6·527	6·535	6·542	6·550	1	2	2	3	4	5	5	6	7
43	6·557	6·565	6·573	6·580	6·588	6·595	6·603	6·611	6·618	6·626	1	2	2	3	4	5	5	6	7
44	6·633	6·641	6·648	6·656	6·663	6·671	6·678	6·686	6·693	6·701	1	1	2	3	4	4	5	6	7
45	6·708	6·716	6·723	6·731	6·738	6·745	6·753	6·760	6·768	6·775	1	1	2	3	4	4	5	6	7
46	6·782	6·790	6·797	6·804	6·812	6·819	6·826	6·834	6·841	6·848	1	1	2	3	4	4	5	6	7
47	6·856	6·863	6·870	6·877	6·885	6·892	6·899	6·907	6·914	6·921	1	1	2	3	4	4	5	6	7
48	6·928	6·935	6·943	6·950	6·957	6·964	6·971	6·979	6·986	6·993	1	1	2	3	4	4	5	6	6
49	7·000	7·007	7·014	7·021	7·029	7·036	7·043	7·050	7·057	7·064	1	1	2	3	4	4	5	6	6
50	7·071	7·078	7·085	7·092	7·099	7·106	7·113	7·120	7·127	7·134	1	1	2	3	4	4	5	6	6
51	7·141	7·148	7·155	7·162	7·169	7·176	7·183	7·190	7·197	7·204	1	1	2	3	4	4	5	6	6
52	7·211	7·218	7·225	7·232	7·239	7·246	7·253	7·259	7·266	7·273	1	1	2	3	3	4	5	6	6
53	7·280	7·287	7·294	7·301	7·308	7·314	7·321	7·328	7·335	7·342	1	1	2	3	3	4	5	5	6
54	7·348	7·355	7·362	7·369	7·376	7·382	7·389	7·396	7·403	7·409	1	1	2	3	3	4	5	5	6

SQUARE ROOTS OF NUMBERS 10—100

	0	1	2	3	4	5	6	7	8	9	Differences								
											1	2	3	4	5	6	7	8	9
55	7·416	7·423	7·430	7·436	7·443	7·450	7·457	7·463	7·470	7·477	1	1	2	3	3	4	5	5	6
56	7·483	7·490	7·497	7·503	7·510	7·517	7·523	7·530	7·537	7·543	1	1	2	3	3	4	5	5	6
57	7·550	7·556	7·563	7·570	7·576	7·583	7·589	7·596	7·603	7·609	1	1	2	3	3	4	5	5	6
58	7·616	7·622	7·629	7·635	7·642	7·649	7·655	7·662	7·668	7·675	1	1	2	3	3	4	5	5	6
59	7·681	7·688	7·694	7·701	7·707	7·714	7·720	7·727	7·733	7·740	1	1	2	3	3	4	5	5	6
60	7·746	7·752	7·759	7·765	7·772	7·778	7·785	7·791	7·797	7·804	1	1	2	3	3	4	4	5	6
61	7·810	7·817	7·823	7·829	7·836	7·842	7·849	7·855	7·861	7·868	1	1	2	3	3	4	4	5	6
62	7·874	7·880	7·887	7·893	7·899	7·906	7·912	7·918	7·925	7·931	1	1	2	3	3	4	4	5	6
63	7·937	7·944	7·950	7·956	7·962	7·969	7·975	7·981	7·987	7·994	1	1	2	3	3	4	4	5	6
64	8·000	8·006	8·012	8·019	8·025	8·031	8·037	8·044	8·050	8·056	1	1	2	2	3	4	4	5	6
65	8·062	8·068	8·075	8·081	8·087	8·093	8·099	8·106	8·112	8·118	1	1	2	2	3	4	4	5	6
66	8·124	8·130	8·136	8·142	8·149	8·155	8·161	8·167	8·173	8·179	1	1	2	2	3	4	4	5	5
67	8·185	8·191	8·198	8·204	8·210	8·216	8·222	8·228	8·234	8·240	1	1	2	2	3	4	4	5	5
68	8·246	8·252	8·258	8·264	8·270	8·276	8·283	8·289	8·295	8·301	1	1	2	2	3	4	4	5	5
69	8·307	8·313	8·319	8·325	8·331	8·337	8·343	8·349	8·355	8·361	1	1	2	2	3	4	4	5	5
70	8·367	8·373	8·379	8·385	8·390	8·396	8·402	8·408	8·414	8·420	1	1	2	2	3	4	4	5	5
71	8·426	8·432	8·438	8·444	8·450	8·456	8·462	8·468	8·473	8·479	1	1	2	2	3	4	4	5	5
72	8·485	8·491	8·497	8·503	8·509	8·515	8·521	8·526	8·532	8·538	1	1	2	2	3	3	4	5	5
73	8·544	8·550	8·556	8·562	8·567	8·573	8·579	8·585	8·591	8·597	1	1	2	2	3	3	4	5	5
74	8·602	8·608	8·614	8·620	8·626	8·631	8·637	8·643	8·649	8·654	1	1	2	2	3	3	4	5	5
75	8·660	8·666	8·672	8·678	8·683	8·689	8·695	8·701	8·706	8·712	1	1	2	2	3	3	4	5	5
76	8·718	8·724	8·729	8·735	8·741	8·746	8·752	8·758	8·764	8·769	1	1	2	2	3	3	4	5	5
77	8·775	8·781	8·786	8·792	8·798	8·803	8·809	8·815	8·820	8·826	1	1	2	2	3	3	4	4	5
78	8·832	8·837	8·843	8·849	8·854	8·860	8·866	8·871	8·877	8·883	1	1	2	2	3	3	4	4	5
79	8·888	8·894	8·899	8·905	8·911	8·916	8·922	8·927	8·933	8·939	1	1	2	2	3	3	4	4	5
80	8·944	8·950	8·955	8·961	8·967	8·972	8·978	8·983	8·989	8·994	1	1	2	2	3	3	4	4	5
81	9·000	9·006	9·011	9·017	9·022	9·028	9·033	9·039	9·044	9·050	1	1	2	2	3	3	4	4	5
82	9·055	9·061	9·066	9·072	9·077	9·083	9·088	9·094	9·099	9·105	1	1	2	2	3	3	4	4	5
83	9·110	9·116	9·121	9·127	9·132	9·138	9·143	9·149	9·154	9·160	1	1	2	2	3	3	4	4	5
84	9·165	9·171	9·176	9·182	9·187	9·192	9·198	9·203	9·209	9·214	1	1	2	2	3	3	4	4	5
85	9·220	9·225	9·230	9·236	9·241	9·247	9·252	9·257	9·263	9·268	1	1	2	2	3	3	4	4	5
86	9·274	9·279	9·284	9·290	9·295	9·301	9·306	9·311	9·317	9·322	1	1	2	2	3	3	4	4	5
87	9·327	9·333	9·338	9·343	9·349	9·354	9·359	9·365	9·370	9·375	1	1	2	2	3	3	4	4	5
88	9·381	9·386	9·391	9·397	9·402	9·407	9·413	9·418	9·423	9·429	1	1	2	2	3	3	4	4	5
89	9·434	9·439	9·445	9·450	9·455	9·460	9·466	9·471	9·476	9·482	1	1	2	2	3	3	4	4	5
90	9·487	9·492	9·497	9·503	9·508	9·513	9·518	9·524	9·529	9·534	1	1	2	2	3	3	4	4	5
91	9·539	9·545	9·550	9·555	9·560	9·566	9·571	9·576	9·581	9·586	1	1	2	2	3	3	4	4	5
92	9·592	9·597	9·602	9·607	9·612	9·618	9·623	9·628	9·633	9·638	1	1	2	2	3	3	4	4	5
93	9·644	9·649	9·654	9·659	9·664	9·670	9·675	9·680	9·685	9·690	1	1	2	2	3	3	4	4	5
94	9·695	9·701	9·706	9·711	9·716	9·721	9·726	9·731	9·737	9·742	1	1	2	2	3	3	4	4	5
95	9·747	9·752	9·757	9·762	9·767	9·772	9·778	9·783	9·788	9·793	1	1	2	2	3	3	4	4	5
96	9·798	9·803	9·808	9·813	9·818	9·823	9·829	9·834	9·839	9·844	1	1	2	2	3	3	4	4	5
97	9·849	9·854	9·859	9·864	9·869	9·874	9·879	9·884	9·889	9·894	1	1	2	2	3	3	4	4	5
98	9·899	9·905	9·910	9·915	9·920	9·925	9·930	9·935	9·940	9·945	0	1	1	2	2	3	3	4	4
99	9·950	9·955	9·960	9·965	9·970	9·975	9·980	9·985	9·990	9·995	0	1	1	2	2	3	3	4	4

Square roots :

ANSWERS

Level 8 Exercises

APPENDIX

Answer to (1) 8.1

1.   The Mean = 12

2.   The standard deviation = 6.32

> - If you were wrong, check your calculations,
>   especially your multiplication and division.
> - If you were *correct*, go to exercise (2) 5.1,
>   'Frequency Tables'.

APPENDIX

Your answer to (2) 8.2 with a class interval of 5 should be:

1. $\overline{X}$ = 33.3

2. s = 12.4

    If you chose an interval of 3, your answer will be:
    $\overline{X}$ = 32.6 and s = 12.7. If your answers approximate
    those values, put yourself on the back, or whatever,
    because you can now calculate the mean and standard
    deviation of a distribution using grouped data.

APPENDIX B

A BEHAVIOURAL APPROACH TO LEARNING (PROGRAMMED TEXT)

A BEHAVIOURAL APPROACH
TO LEARNING

Objectives For This Programme

At the conclusion of this lesson you should be able to:

1. Describe how the probability of a desired response can be increased.

2. Discriminate between respondent and operant forms of behaviour.

3. Diagram the four technical components of a conditioning model, and relate them to examples.

4. Write a behavioural sequence for a given simple task.

5. Describe the procedures for establishing and maintaining desired behaviour.

6. Describe the procedures for developing attitudes and enhancing motivation in learning, particularly in a Contingency-management situation.

————————/————————

The application of these objectives will enable you to:

1. Increase the probability that your students will be able to make the responses you specify.

2. Increase the probability that they will continue to perform the behaviour you have established.

3. Increase the probability that they will cease to perform undesired behaviour.

4. Develop an orderly classroom strategy in which the student will increasingly become responsible for establishing and maintaining desirable behaviour.

Introduction

This programmed lesson concerns people: You, and the people you must influence in your job as a teacher or instructor. Specifically, it is about BEHAVIOUR and how your behaviour, whether in the form of writing a programme, preparing lesson plans, or just interacting in a "live" situation, can INFLUENCE theirs.

The term "behaviour" as it is used in psychology does not mean "good behaviour" or "bad behaviour". It is a term used to indicate a *description* of observable acts, and the events in the mind which "cause" the observable acts.

Behaviour psychology is based on the premise that all behaviour has a cause and the CONSEQUENCES *following* behaviour influence its recurrence. As such, "learning-through-life" can be described as changes in behaviour that occur as a result of experience.

Occasionally, we will use examples of animal behaviour. Don't be "turned off". They are used merely to illustrate the concepts and procedures being taught.

This is an introductory lesson. It has been designed particularly for people whose task it is to interact with, and positively influence other people. That is, especially people involved in teaching, but also just about everyone. All of us at some time influence someone.

iii

Instructions

You have possibly completed a PLACEMENT TEST prior to looking at this programme. If you have, go straight to the instructions *"Using the Placement Test with the Programme"* which follows further on.

If you *have not* worked through a placement test you can commence working on the first Exercise of the programme. You will find each page headed with this type of notation
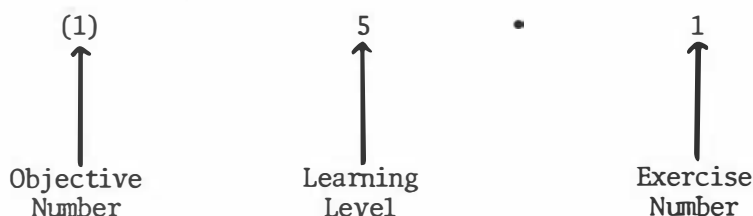
The bracketed number denotes the *objective* (1 to 6); the digit to the *left* of the decimal point, the *learning level* (5 through to 8 in an ascending hierarchy), and the digit to the *right* of the decimal point, the *exercise* number for each learning level listed in ascending order. Start at (1) 6.1, that is, objective 1, level 6, Exercise 1.

From time to time you will be asked to make a response to a question, or complete a problem. Write in the answer on the programme. You may *look back* over previous work if you need to, but *do not* look *ahead* to the answer. Only when you've made your response, or finished the problem, should you turn the page and check your answer. The answer to all criterion level 8 exercises are found at the back of the programme.

Using the placement test with the programme

The objectives in this programme have been hierarchically structured into 4 learning levels; 5 through to 8. Your placement test reflects these levels. Look at the first item in the test:

$$1 \qquad (\; 1 \quad \bullet \quad 6 \;)$$

Item Number   Objective Number   Learning Level

The same pattern follows for the rest of the test. The programme has a similar notation system, except that each learning level has been divided into a number of exercises.

For example:

$$(\; 1 \;) \qquad 7 \quad \bullet \quad 1$$

Objective   Learning level   Exercise number

Having completed and marked your placement test you may use this information to help you decide which learning levels you need to study, and which ones you can safely skip over. Before you start a new objective in the programme, check your performance on the learning levels for that particular objective from the placement test. If you got all the items in that level wrong, the chances are that you will need to work through the exercises for that level in the programme. If you got the items correct, the chances are that you have previously mastered the material and you can skip over that level. If you only got a few items correct in a particular level, *you* must decide whether

you need to work through the exercises in the programme, or whether you can skip over them. Use the placement test in this way for each objective, it will make your study of the programme much more efficient. However, you should work the problems in each objective level 8, checking your answers with those at the back of the programme.

If you make an error, go back over the previous exercise and see if you can figure out why you are wrong.

Check your placement test for the first objective, and start the programme. Best of luck!

Graham J.F. Hunt

REINFORCEMENT

(1) 6.1

Human behaviour is pretty complex. Without its complexity, novels and movies dramatising it, and life itself, would be very dull. Like most complex things, behaviour can be broken down into its simple properties. We're going to examine some of these properties so that we can become more competent in managing the complex new behaviours we wish to impart to our students.

Here are three short sketches:

A. Joe Smith is a psychology student. He is interested in getting the primative flatworm planarian to contract its body at the moment he flashes a light. He starts the experiment by giving the flatworm a mild electric shock everytime he turns on the light. Eventually, the flatworm learns to contract its body the moment the light is turned on, and in the absence of any shock being given.

B. Two year old Suzy is an inquisitive child who likes to pick up and touch everything within her grasp. There are some objects that could make this dangerous. For instance, she is told not to touch the top of the electric stove because sometimes it is hot. However, her exploratory enthusiasm gets the better of her, and she touches it when its hot. Her fingers get burnt as she sharply withdraws her hand. She doesn't touch the stove anymore.

(1) 6.1 (CONT.)

C. Marjorie Bagghoff is a mother of three. Sometime ago, while
    shopping in a large departmental store, it caught fire.
    Fifteen people were burnt to death, and many dozens were
    seriously injured. Marjorie was lucky. Though partially
    overcome by smoke, but with the help of a fireman, she was
    carried to safety with little apparent injury. But Marjorie
    now can't stand the sight of fire and smoke, even from a
    barbeque. Whenever she sees a flame the old dread and
    panick returns and she becomes quite hysterical.

    Each of these stories has three things in common:
    1. There is something which *causes* some form of
        behaviour to *occur*. This we call the STIMULUS.
    2. There is evidence of some form of *activity* or
        behaviour. This we call the RESPONSE.
    3. The subject in each case suffered the CONSEQUENCES
        of that behaviour, *and so affected the future
        occurance of similar or associated behaviour.*

Now:

A. 1. What were the *stimuli* in the first story? _____
    2. What was the *response* in the second story? _____
    3. What were the *consequences* of behaviour in each of the three
        stories?
        a. _____
        b. _____
        c. _____

        CHECK YOUR ANSWERS ON THE NEXT PAGE.

(1) 6.1 (CONT.)

Answers A. 1. light and shock
            2. withdrawl of hand
            3. a. Flat worm has learned to contract its body
                    in the presence of light.
                b. Suzie learned not to touch the stove.
                c. Marjorie Bagghoff had a fear of fire.

We can now make a rule:

> The CONSEQUENCES following a behaviour affect the
>
> PROBABILITY that the RESPONSE will RECUR.

For example, a golfer *changes* his grip from overlapping
to interlocking. How straight and how far the ball goes increases
or decreases the probability that he will use the new grip again.

B. 1. In the golfer example, if the ball goes straight and far,
        is the *probability* of using the new grip increased or
        decreased?   _____

    2. If he hooks or slices, is the probability
        increased or decreased that he will use
        the new grip?   _____

    3. Do you think the following statement is
        true?   _____

            "If CONSEQUENCES following a behaviour
            are *favourable*, the behaviour that
            produced the favourable results is
            strengthened (made more likely to
            recur)".   _____

CHECK YOUR ANSWERS

Answers: (1) 6.1: B. 1. Increased
                        2. Decreased
                        3. Yes! true

(1) 7.2   <u>REINFORCEMENT</u>

When a person makes any sort of response to another, there are four things that can be done about it.

1.	REINFORCE IT:	Provide consequences which *increase* the probability that the response or behaviour will recur.
2.	PUNISH IT:	Provide consequences which are *unfavourable* to the performer.
3.	DO NOTHING:	Neither provide favourable or unfavourable consequences.
4.	NEGATIVELY REINFORCE IT:	Increase the probability of desired behaviour by providing the means for the *individual to terminate* a mild aversive situation resulting from the undesired behaviour.

Examined in a little greater depth, the rules are:

• Reinforcing behaviour *INcreases* the likelihood that the previous behaviour will recur. The consequences of that behaviour have in some way been pleasureable, or satisfied the individual.

• Punishment has VARIED and UNPREDICTABLE *long term* effects on behaviour. While punishment may be immediately effective, and certainly involves less time and energy than alternatives, it tends to have these disadvantages:

    - Leads to emotionalism on the part of the recipient (becomes defensive, often still at variance with the desired behaviour).

    - Leads to a generalized avoidance of the situation.

    - Frequently produces "avoidance" and related undesired behaviours. Is unreliable and should be avoided in teaching.

• Doing nothing, or *non-reinforcing* (using the extinction principle),

DEcreases the likelihood that the previous behaviour will recur. Non-reinforcement requires that you arrange conditions in a way that the individual receives no rewards following the undesired behaviour. The consequences of the behaviour are *neutral* to the individual. ALL reinforcement, not just part of it, must cease if this principle is to work. It can be difficult to operate, and takes time.

(1) 7.2b

- Negative reinforcement *DEcreases* the likelihood that the previous undesired behaviour will recur, by providing the *individual* with the means of *terminating* a mild aversive situation immediately upon the demonstration of the desired behaviour. Example: Your 5 year old is shouting and being overly boisterous in the lounge while you are entertaining guests. You tell him to *go outside* the room and only come back when *he* decides to behave more normally.

- Negative reinforcement differs from punishment, especially in the operation of the third of these three rules:

    1. The individual must know what behaviour is expected of him.

    2. He is capable of performing the desired behaviour.

    3. He is free to terminate the aversive situation (being sent out of the room) whenever he chooses to demonstrate the desired behaviour.

NOTE ALSO:

    1. THE AVERSIVE SITUATION SHOULD FIT THE BEHAVIOUR TO BE CHANGED.

    2. THE AVERSIVE CONDITION SHOULD BE EASY FOR THE INDIVIDUAL TO TERMINATE WHEN HIS BEHAVIOUR IMPROVES.

READ THIS EXERCISE VERY CAREFULLY.

YOU MAY NEED TO READ IT AGAIN.

(1) 7.2c

State each as being an example of Reinforcement (R), Punishment (P), Non-reinforcement (Non R), or Negative reinforcement (Neg R).

1. Teacher says, "Write that word 20 times". _____

2. "No one goes to lunch until it is absolutely quiet in this room". _____

3. "Your essay is good. I'll give you an 'A' for it". _____

4. Agreeing not to listen to any one who calls out, instead of raising their hand. _____

CHECK YOUR ANSWERS

Your answer to (1) 7.2c

1. Punishment

2. Negative reinforcement

3. Reinforcement

4. Non-reinforcement

---

(1) 7.1

In general, behaviours get reinforced in one of two ways.

1. The behaviour is followed by, or has produced a favourable stimulus (consequence).

2. The behaviour *removes* an aversive (unpleasant) stimulus.

For each situation below, first write whether it describes Reinforcement (R), Punishment (P), Non-reinforcement (Non R), or Negative reinforcement (Neg R). Then write "I" if the action taken increases the likelihood of performance; "D" if it *decreases* the likelihood of repetition of the act; or a "?" if the results are unpredictable.

1. Bob comes to school dirty. Teacher chastises him in front of the class. ___ ___

2. Bob comes to school dirty. Teacher sends him to the Principal. ___ ___

3. Bob comes to school dirty. Teacher is really friendly to him, but says nothing about his dress; hopes he might get the hint. ___ ___

4. Teacher asks class for personal neatness at the start of each day. Susan turns up dirty. Teacher favourably comments on each child's neatness; Susan receives no comment. ___ ___

5. Next day Susan comes to school with clean shoes, but rest of appearance is as before. Teacher comments favourably on shoes, and suggests she work on the rest.

6. Says mother to daughter, "I'm sorry but from now on I'm going to have to turn you down when you bring a boyfriend home for supper without phoning first to see if it's convenient".

CHECK YOUR ANSWERS

Your answers to (1) 7.1

1. P   ?

2. P   ?

3. Non R   ?/D It may decrease his untidyness over a period
                  of time, particularly if a positive relation-
                  ship develops with the teacher.

4. Neg. R   D

5. R   I

6. Neg. R   D   (Decreases the likelihood that she will con-
                  tinue to bring her boyfriend home for supper
                  without phoning first.)

(1) 8.2   <u>REINFORCEMENT</u>

When a person makes any sort of response to another, there are four things that can be done about it.

1. REINFORCE IT

2. PUNISH IT

3. DO NOTHING (Non-reinforce it)

4. NEGATIVELY REINFORCE IT

In the following examples, a teacher is presented with the problem of removing undesired behaviour. Answer these questions by ticking your choice.

1. The class is misbehaving. They are noisy and fighting. The teacher yells at the class, the noise subsides for a moment.

_____ a. The teacher applied a punisher to the behaviour.

_____ b. The teacher reinforced the behaviour.

_____ c. The teacher non-reinforced the behaviour.

2. The class is unruly. The teacher dismisses the class. This is an example of:

_____ a. Application of punishment by the teacher.

_____ b. Presentation of reinforcement to the children.

_____ c. Presentation of negative reinforcement to the children.

TURN THE PAGE AND KEEP GOING!

(1) 8.2b

3. The class is unruly. The teacher dismisses the class.

    _____ a. The class is more likely to be unruly again because it was reinforced by being dismissed.

    _____ b. The class is more likely to be unruly again because non-reinforcement was applied.

    _____ c. The class is less likely to be unruly again because the teacher negatively reinforced the desired behaviour.

4. The class is unruly. The teacher dismisses the class to get some peace.

    _____ a. The *teacher's* behaviour of dismissing them when they are unruly is reinforced.

    _____ b. The *teacher's* behaviour of dismissing them when they are unruly is non-reinforced.

    _____ c. The *teacher's* behaviour of dismissing them when they are unruly is negatively reinforced.

5. The class is unruly. The teacher dismisses them when they are quiet. This is an example of:

    _____ a. Non-reinforcement

    _____ b. Punishment

    _____ c. Negative reinforcement

Answers to (1) 8.2

1.	a	4.	a
2.	b	5.	c
3.	a		

---

(1) 8.1

By all accounts (I.Q., and achievement tests, etc.,) John is bright.
He is an avid philatelist. Your collection of stamps is pretty
good too, and includes a couple of rare ones. John, however, shows
no interest in succeeding in quadratic equations. His whole progress
in this area of mathematics seems likely to be in jeopardy.

Your job is to tutor John in quadratic equations, and get him
"up to the mark".

1. What reinforcing agency could you use to get him started in
    quadratic equations again? _____.

2. If you told him that his stamp collection would be confiscated
    indefinitely, what effect on John's learning would this have?

    _____.

3. If you simply ignore John's disinterest in maths, and discuss
    stamps. What would this be equivalent to in terms of
    Reinforcement Theory? _____.

4. You tell John that you cannot discuss his stamps until he works
    the first exercise. This is an example of _____.

5. The immediate knowledge of correct responses in learning
    is *(tick one):*
    a. Negatively reinforced stimulus   [ ]
    b. Reinforced stimulus   [ ]
    c. Non-reinforced stimuls   [ ]

CHECK YOUR ANSWERS AT

THE BACK OF THE PROGRAMME

RESPONDENT AND OPERANT BEHAVIOUR

(2) 5.2

We began this programmed lesson by saying that the term "behaviour" in psychology meant, "a description of *observable* acts, and the events in the *mind* which 'cause' the observable acts."

If you look at that statement carefully you will see that there are two types of behaviour.

1.	Overt	*Observable* behaviour - what you can actually see.
2.	COvert	*Inferred* behaviour - behaviour that you *cannot* actually see, but which you can infer as happening from the overt behaviour it produces.

For example:

To *memorize* the letter sequence A Z L M O R T is an act of covert behaviour. To repeat *verbally* AZLMORT unassisted is overt behaviour.

State what sort, if any, are these behaviours:

1. Reading aloud _____

2. Ringing of an alarm clock _____

3. Hearing the ringing of an alarm clock _____

4. Shutting off the alarm _____

5. Feeling patriotic _____

6. Saluting the New Zealand flag _____

CHECK YOUR ANSWERS

Answers to (2) 5.2	1. Overt	4. Overt
	2. none	5. Covert
	3. covert	6. Overt

---

(2) 5.1

As people who are involved (or about to be involved) in the instructional process, we are most interested in. LEARNED BEHAVIOUR - both the OVERT events and the predisposing COvert events. For the purposes of this lesson we'll define LEARNED behaviour as "ALL ACTIONS WITH WHICH AN INDIVIDUAL IS NOT BORN WITH, NOR WHICH ARE A RESULT OF NORMAL PHYSIOLOGICAL DEVELOPMENT."

Summarized, we can say that overt or covert behaviour can be either:

1. LEARNED

2. REFLEX - Unlearned, or automatic

If a doctor taps your knee with a hammer, you'll automatically (reflexively) kick your leg. This is the knee jerk. You were never taught how to do it. It's simply a *reflex* , unlearned reaction.

Which of these is NOT a simple reflex action. *(Tick the one that is not.)*

1. Heart beat [ ]   2. Talking [ ]   3. Eye blink [ ]

Answer to (2) 5.1   2.   (Talking is a learned behaviour, not a reflex.)

---

(2) 6.1

Psychologists, like most other groups of people who discover things, are prone to giving technical names to their discoveries - seemingly in the interests of maintaining confusion!

> Here are two such technical names:
>
> 1.   RESPONDENT BEHAVIOUR
>
>   Reflexive behaviour is technically termed RESPONDENT behaviour - that is, the *response* is *automatically forced* or *elicited* from the individual as a result of the stimulus situation. (breathing, in the presence of air; a knee-jerk in response to a knee tap)
>
> 2.   OPERANT BEHAVIOUR
>
>   Voluntary behaviour, whose recurrence has been increased by the occurence of a reinforcing stimulus is called OPERANT behaviour. The occurence or *emittion* of this sort of behaviour is determined by the *voluntary will* of the individual. It does NOT occur automatically (would that it did!), and there is no particular stimulus that will guarantee that the desired response (called an operant) will occur.

We will see later how efficient learning depends upon the operant reinforcement of a collection of responses that a learner gradually acquires, which hopefully leads to his mastery of a repetoire of responses called the criterion (or desired) behaviour. However, we're getting ahead of ourselves; back to reality!

(2) 6.1b

Check these important statements:

- Reflexive (unlearned) responses are RESPONDENT.
- Respondent responses are usually the result of some specific stimulus (eg. the hammer blow).
- Respondent behaviour forms the primitive base of learning.

Operant behaviour is *not* automatic (if it were, teachers would be out of business - and probably a lot of their students happier, and maybe, some of them better for it!)

An operant response may or may not "operate" or occur in any given situation. It is the teacher's job to *increase the probability* that it will.

Operant behaviour is the typical behaviour of human beings.

State which of these characteristics are true of *respondent* learning. *Tick either T or F*.

a. Responses are made automatically to a stimulus   T   F

b. No particular stimulus will consistently elicit

    the response   T   F

c. The most usual type of learning in the classroom   T   F

State which of these characteristics are true of *operant* learning.

a. Produce reflexive responses to given stimuli   T   F

b. Only certain of the total number of responses

    made will be reinforced   T   F

c. Is characteristic of complex behaviour   T   F

CHECK YOUR ANSWERS

Answers to (2) 6.1b

1. a. T   2. a. F

    b. F   b. T

    c. F   c. T

(2) 7.1   RESPONDENT AND OPERANT BEHAVIOUR

Overt and Covert behaviour can be divided into two basic categories; RESPONDENT and OPERANT behaviour. This categorization is based upon whether a behaviour has been acquired automatically as the result of a specific stimulus, or occurs voluntarily, and can be predicted to recur if the behaviour outcomes have in some way been perceived as satisfactory to the individual.

Classify each of the following statements as examples of respondent or operant behaviour. Write "O" for operant, and "R" for respondent.

1. A knee-jerk-when-tapped   _____

2. Saying "4" in response to 2 + 2 =   _____

3. Blinking in the daylight after coming
    out of a movie   _____

4. You get an electric shock; your
    heart beat races   _____

5. Shedding tears from a cinder in your
    eye   _____

6. Shedding tears during a sad movie   _____

7. Defining jet propulsion   _____

8. Putting your foot on the break to a
    red traffic signal   _____

CHECK YOUR ANSWERS

(2) 8.1   RESPONDENT AND OPERANT BEHAVIOUR

Here are two stories involving respondent and operant behaviour.
Read them carefully and then answer the questions.

A.   The well known American psychologist, John B. Watson, used
     to report an experiment in which a nine-month-old infant called
     Albert served as the subject. Initially, Albert was shown a
     tame white rat, which at first sight to the child aroused
     only mild curiosity. Later the rat was shown to him again,
     only this time the sight of the rat was accompanied by the
     shrill clang of a hammer hitting a piece of steel. The noise
     frightened Albert and made him cry. The experiment was
     repeated several times. Soon, everytime Albert saw the rat,
     he cried.

B.   Another noted American psychologist, B.F. Skinner, used a
     favourite experiment with children. The child was asked to
     go into a darkened room, but was not told to do anything in
     particular. In one corner of the room stood a candy dispensing
     machine operated by a pull lever. Normally the child would
     enter the room and make random responses like touching the
     walls, furniture, sitting down, talking to himself, and by
     chance, pulling the lever. Immediately this response was
     made, the machine dispensed a piece of candy. The child would
     pull the lever again and be further rewarded. On subsequent
     occasions the child would enter the room and go immediately
     to the machine and pull the lever.

1.   What was the stimulus or stimuli (object or situation) in each story?
     A. _____   _____
     B. _____

(2) 8.1b

2. What response was made to the stimulus/stimuli of each story?

    a. _____

    b. _____

3. Give the name of the behaviour that each story is an example of.

    a. _____

    b. _____

4. Justify your answer for 3.

    a. _____

    _____

    b. _____

    _____

CHECK YOUR ANSWERS

AT THE BACK OF THE PROGRAMME

THE TECHNICAL COMPONENTS

OF CONDITIONING

(3) 6.1-2

We have already seen that behaviour can be either overt, or covert, and that behaviour in psychology means a description of observable acts, and the events in the mind which "cause" the observable acts.

We can also view behaviour as activity which is made up of RESPONSES. We have just seen that these responses can be either respondent or operant. If we tried to define a response we could say that it was "THE SMALLEST MEANINGFUL UNIT OF BEHAVIOUR, BEING EITHER OVERT OR COVERT."

Logically, although certainly not always apparent, a response "belongs" to a stimulus or situation. Usually, the situation "causes" the response to occur, although again, this may not at the time be too self evident.

Here are some stimuli and responses. Label them "S" or "R" as appropriate.

A.   1.   Open the door   _____

     2.   Solving a problem   _____

     3.   Seeing traffic conjestion   _____

     4.   Say "No!"   _____

     5.   Smile   _____

     6.   Feel nauseated   _____

CHECK YOUR ANSWERS

Answers to (3) 6.1-2   A   1. R   4. R

                                        2. R   5. R

                                        3. S   6. You may give either S or R or both. You are right on all accounts. We shall look at this in greater detail later.

B.   Now write the alternative to those given in the previous exercise. That is, write the stimulus to the response given, or vice versa, and bracket your answer as either S or R.

1. _____

2. _____

3. _____

4. _____

5. _____

6. _____

COMPARE YOUR ANSWERS WITH OURS

Your answers to (3) 6.1-2 could look something like these:

1. Hear knock (S)

2. Given problem (S)

3. Take alternate route (R)

4. Hearing "Will you?" - or a whole multitude of stimuli! (S)

5. A pretty face (S)

6. (a) Having earlier eaten something a "bit off" (S)

    (b) Being sick (R)

(3) 7.1-3   THE TECHNICAL COMPONENTS OF

CONDITIONING

If we wished to define behaviour in its smallest unit we could say
that it was "SOME RESPONSE PRODUCED BY A STIMULUS".

This could be technically defined as:

$$S - R$$

and we wanted to get the same response to a different stimulus.

$$\begin{array}{c} S \\ {}_{} R \\ S \end{array}$$
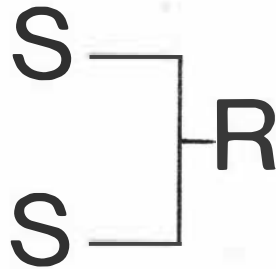
We can call this operation *classical* or *respondent conditioning*.
Conditioning forms the basis of changing simple learning (behaviour)
in the form of S-R connections, to more complex learning.

Have you read the story of Ivan Pavlov and his slobbering dog?
You have! (You haven't?)

(3) 7.1-3b

Actually, Pavlov was one of the first people to systematically investigate the process of conditioning, particularly respondent conditioning.

By chance he noted that the approaching footsteps of a dog's master was sufficient to make the dog salivate in anticipation of being fed, even though food had not been seen. This observation formed the basis of his experiment. He would try to pair the *response* salivation to a *new* stimulus not normally associated with either food, or the dog's master; namely, the sound of a tuning fork. By a simple operation the salivary duct of the animal was exposed so that the number of drops of saliva that the dog secreted could be gathered and measured. Now the experiment could begin.

The sight of meat powder automatically *caused* the dog to salivate. Immediately prior to the meat powder being presented, the tuning fork was sounded, resulting in the *sight* of the meat powder and the *sound* of the tuning fork occuring almost simultaneously. This connection, the presentation of the two stimuli and the salivation response was repeated a number of times. Eventually, the meat powder was taken away. The tuning fork was sounded and the dog salivated.

Now note what had happened:

- The initial automatic *unconditioned response* resulted from the dog's sight (or smell) of the meat powder. The meat powder was an unconditioned stimulus (UCS) to that response.

(3) 7.1-3c

Eventually the initial or unconditioned response (UCS),
the salivation, was *transferred* from the smell of the
meat (the unconditioned stimulus - UCS) to the sound of
the tuning fork.

As soon as the *sound* of the tuning fork had the ability
to cause the *same* or similar response from the dog
(salivation) as did the smell of the meat (the UCS) the
effect of the sound could be said to be a *conditioned*
stimulus (CS) to that response.

The initial response from the animal had now been
CONDITIONED to occur in response to the conditioned
stimulus, or tuning fork sound. This response was a
conditional response (CR).

Each time the tuning fork sound (CS) the animal automatically
salivated (CR). The respondent conditioning was complete.

You may need to read this through carefully a few times,
particularly if you're feeling rather confused. The diagram may
help you unravel the mystery.

(From Yerkes and Morqulis, 1909)

CONDITIONED

UNCONDITIONED

Sound of
tuning fork

sight/smell of meat

Salivation   Salivation

CS   UCS ——————————————— UCR ———— CS
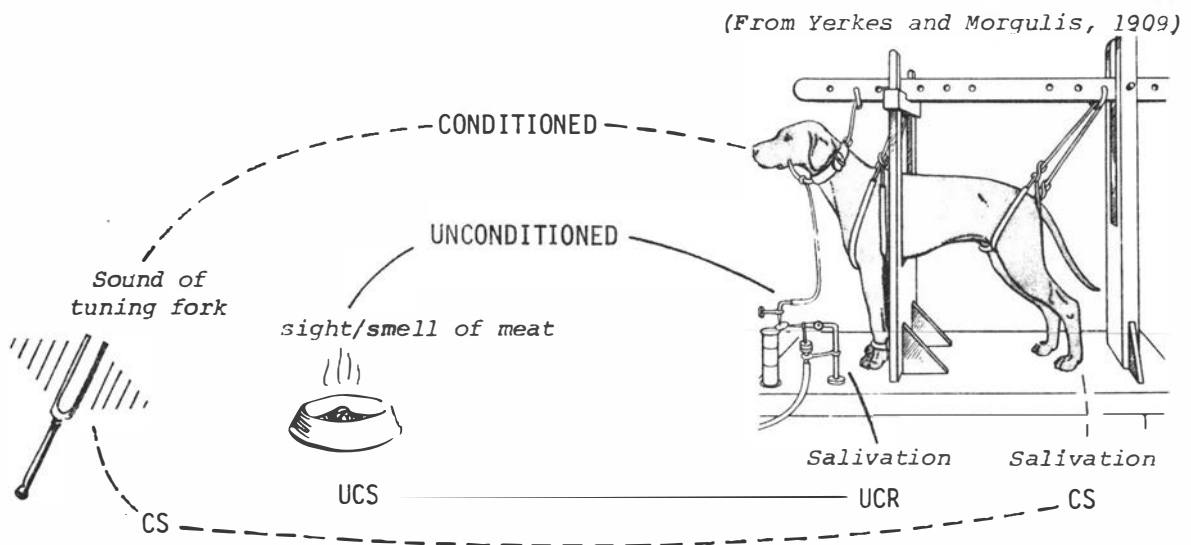
(3) 7.1-3d

Tick the one you think correct. Your answers should be related to the stimulus or response elements underlined.

1. The experimental worm *contracts* to an electric shock.

    A. Conditioned response   [   ]
    B. Unconditioned response   [   ]

2. A bright light and *electric shock* are presented to the worm simultaneously. The worm contracts.

    A. Conditioned stimulus   [   ]
    B. Unconditioned stimulus   [   ]

3. A *bright light* is presented to the worm. The worm contracts.

    A. Conditioned stimulus   [   ]
    B. Unconditioned stimulus   [   ]

4. Rat shown to baby at the same time that *shrill noise* is sounded. *Baby cries.*

    A. Conditioned response   [   ]
    B. Unconditioned response   [   ]

5. The *rat* is shown to baby. The baby immediately begins to cry.

    A. Conditioned stimulus   [   ]
    B. Unconditioned stimulus   [   ]

6. The rat is shown to baby. The
    baby immediately begins to *cry*.

                                        A. Conditioned response
                                        B. Unconditioned response

CHECK YOUR ANSWERS

Answers to (3) 7.1-3d

1. B   4. B

2. B   5. A

3. A   6. A

(3) 8.1   THE TECHNICAL COMPONENTS

OF CONDITIONING.   (BEHAVIOUR MODIFICATION)

Behaviour can be defined in its smallest unit as *Some response produced by a stimulus*. When we wish to pair an individual's existing response to a new stimulus, or situation, the *process* that brings about this change in an individual's behaviour is called *conditioning*, or BEHAVIOURAL MODIFICATION. The result is that *unconditioned* stimuli and responses become *conditioned* stimuli and responses.

Here is a story:

Baby Joanne is scarred of dogs. Every time she *sees* one, she screams and becomes terrified. Her mother Claudia has read Dr Spock, even his revised editions. She doesn't want Joanne to have any hang-ups. She knows they can lead to trouble later.

Claudia decides to try some behavioural modification techniques. She sits Joanne in the play pen and brings the family mongrel into the nursery. Immediately prior to the dog being brought into the room, Joanne is fed some chocolate (probably not good for baby's first teeth, Mum figures - but then, first teeth get a second chance - fixing hang-ups may not!) Joanne eats the chocolate and after a while stops crying. The next time Joanne sees the dog brought into the room, she is fed some more chocolate (she has a real liking for it!), and the dog is brought a little closer. She sucks her chocolate, views the dog apprehensively, but soon stops crying. The conditioning process continues. Later she is taken out of her play pen, the dog is brought into the room, and

(3) 8.1b

chocolate is given. This time there are no tears. Finally, NO chocolate is given. The dog is brought into the room and allowed to roam freely. No tears now from Baby Joanne. She's quite happy and plays with the dog.

This conditioning really works, thinks Claudia.

The four conditioning components in this story are:

"CR"   conditioned response

"CS"   conditioned stimulus

"UCR"   unconditioned response

"UCS"   unconditioned stimulus

Below is a model of the conditioning process that was used in the story.

1. Name each of the conditioning components by filling in the blanks. Use the abbreviations, eg. "CR".

(   ) ---------- (   ) JOANNE (   ) ----- (   )

Stimulus Components   Response Components
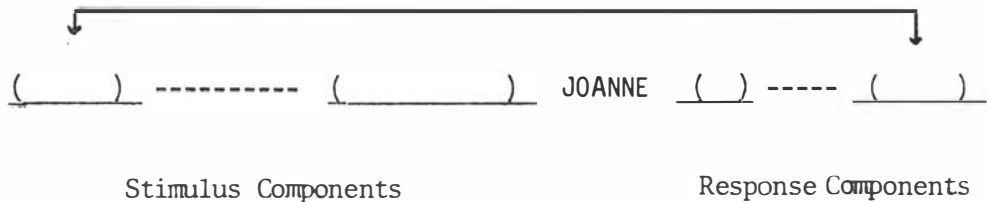
2. Now name the *actual* stimulus and response components that the symbols in question 1 stood for.

(   ) ---------- (   ) JOANNE (   ) ----- (   )

CHECK YOUR ANSWERS

AT THE BACK OF THE PROGRAMME

(4) 6.2   <u>WRITING A BEHAVIOURAL SEQUENCE</u>

We have QUALIFIED behaviour as being either respondent or operant, overt or covert. We have taken a quick look at the operations of simple conditioning. We haven't yet broken down behaviour into its constituent parts, or, in other words, QUANTIFIED it.

For the purpose of this programme, behaviour can be quantified into three hierachically ascending levels.

TASK:	A group of steps "belonging to each other", which have a definite beginning and end.
STEP:	A smaller component of the task. As we have already seen, there are two kinds, overt and covert.
RESPONSE:	The smallest meaningful unit of behaviour making up a step. There can be overt and covert responses.

This is just a rough guide to help our thinking about the quantity of a given behaviour. There may be subtasks which are "greater" in size than a step but less than a task, etc.

For example:-

One *task* might be "solving a long division problem."

One *step* in that problem is "Set up the problem."

One *response* of that step is "Write down the demoninator."

(4) 6.2b

Do these:

1. Write some overt STEPS of this task:

    "Shaving with a safety razor."   (Or, if you prefer, "Putting on make-up.")

2. Write some overt *responses* of this step "Lather face", or putting on "moisturizer".

3. Give the name of the *task* to which the steps below belong:

        a.   heat frying pan
        b.   pour in oil/fat
        c.   crack egg in pan
        d.   turn egg over (if required)
        e.   pick egg out of pan
        f.   place on plate

<div align="center">CHECK YOUR ANSWERS</div>

Answers to (4) 6.2b

1. Yours may differ, but here are ours:

a. wash face	a. put on moisturizer
b. lather face	b. foundation
c. pick up razor (put in blade - depending on the model).	c. eye shadow
	d. eye liner
d. shave	e. mascara, or false eye lashes
	f. lipstick

2.
a. squirt lather in hand	a. shake bottle
b. spread on left cheek	b. pour onto palm of hand
c. spread on right cheek	c. place on finger tips
d. spread on upper lip	d. dot on chin, cheeks and forehead
e. spread on chin	e. spread over face and into skin

3. "frying eggs"

---

(4) 6.1

We've already seen that all behaviours are made up of RESPONSES. When we talk about behaviour we may be talking about a single response, or a group of responses which "belong to each other" (step or task).

The most common difficulty people have in describing and analysing behaviour is confusing a response with a situation or the thing that logically belongs to the response.

For example, the following pairs of items each contain a response and situation which "belongs to it."

RESPONSE	SITUATION "BELONGING" TO IT
1. Push door bell	Ringing of door bell (after R)
2. Pick up pencil	The pencil (before R)
3. Eye blink	Bright sun-light (before R)
4. Yawn	Sleepiness (before R)
5. Step on brake	Car stops (after R)
6. Step on brake	Red light (before R)

(4) 6.1b

Remember, a response IS behaviour, and behaviour IS an activity - even though it may be covert or change the situation. Look at items 1 and 5 in the examples.

Below are sets of items "belonging to each other".

1. Label the part of the set that is the response with the letter "R".

2. Label the situation that belongs to the response in each set either as "B" if the situation comes *before* the response, or "A" if it comes *after* the response.

1. a. Pull down the shades   _____

    b. Bright sunlight shut out   _____

2. a. View of next room   _____

    b. Open the door   _____

3. a. "31 divided by 7"   _____

    b. Child writes:

        7 $\overline{\smash{)}\ 31}$ _____

    c. 7 $\overline{\smash{)}\ 31}$ written   _____

    d. Child thinks:
        "Seven won't go
        into three".   _____

CHECK YOUR ANSWERS WITH OURS

Answers to (4) 6.1b

1. a. R   2. a. A   3. a. B

   b. A   b. R   b. R

                                     c. A

                                     d. R

(4) 7.2   <u>WRITING A BEHAVIOURAL SEQUENCE</u>

One thing you probably will have gathered by now is that a
key to predicting and dealing with human behaviour involves
determining *what happens* AFTER *a response is made* by a
person.

However, the "situation-that-comes-BEFORE-a-response",
is also important in dealing with human behaviour.

Let's illustrate both positions this way:

SITUATION THAT   SITUATION THAT

COMES *BEFORE* ────────────→ THE RESPONSE   COMES *AFTER*

Sunlight in   Eyes don't

eyes   ────────────→ Pull down the shade   hurt
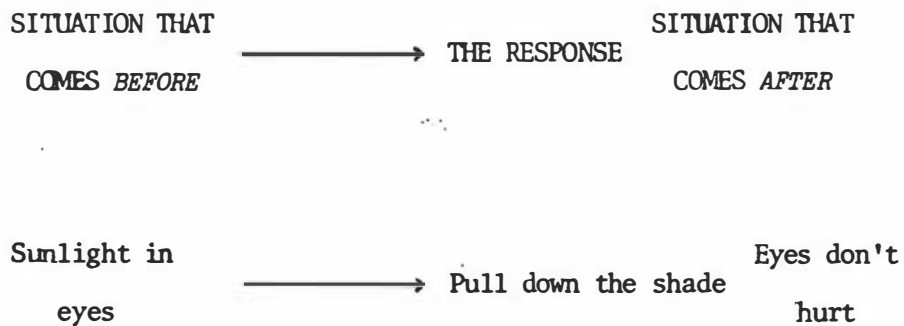
(4) 7.2b

For each sequence below, predict the missing element. Write in the
box the BEFORE situation, the probable RESPONSE, or the probable
AFTER situation.

1. Piece of lemon ─────────→ Bite into ─────────→ [   ]
                                lemon

2. Knock on ─────────→ Open ─────────→ [   ]
      door   door

3. Ignition ───→ [   ] ─────────→ Engine
      slot   starts

4. [   ] ─────────→ Pull up ─────────→ Fish
                        line   landed

COMPARE YOUR ANSWERS

WITH OURS

Answers to (4) 7.2b   Compare your answers with these.

1. Sour taste   2. Caller is seen   3. Turn key

4. Tug on line

---

(4) 7.1

In the model, "Situation before - Response - Situation after", that
we've just looked at, we can give technical names to the three
elements.

Situation *before* is the OCCASIONING STIMULUS (S^O)

The behaviour that is *occasioned* is the RESPONSE (R)

The situation *after* is the RESULTING STIMULUS (S^R)

In a behavioural sequence the resulting stimulus (S^R)
may in turn become the occasioning stimulus (S^O) for
another response. We write it S^{RO}.

Making a response on the *occasion* of some stimulus, and the *resulting*
stimulus produced by, or following the response is the basic unit of
behaviour on which all description and analysis is built.

As a rule we represent the simplest behaviours in a single straight
sequence called a BEHAVIOURAL (S-R) CHAIN.

AN EXAMPLE:

S^O ——————→ R S^{RO} ——————→ R

closed   push door   view of   walk
 door   open   room   in

(4) 7.1b

Complete the sequence for this behavioural chain, "Obtaining cigarettes from a vending machine". Name the technical elements in the sequences, e.g., S^O, etc.

1. ___ ⟶ ___ • ___ ⟶ ___

Cigarette vending machine   Put coins in slot   Sound of coins dropping

___

2. ___

Cigarette in mouth

___

Match in hand

• ___ ⟶ ___

Touch match to cigarette

___ ⟶ ___

Burning cigarette and match

COMPARE YOUR ANSWERS

WITH OURS

Our answers for (4) 7.1b

1.   R S^R

       Pull knob or   Cigarettes
       push button   appear

2.   R S^{RO} ———————————— R

      Strike   Burning   Blow out match.
      match   match   (It's OK if you
                                       said "inhale".)
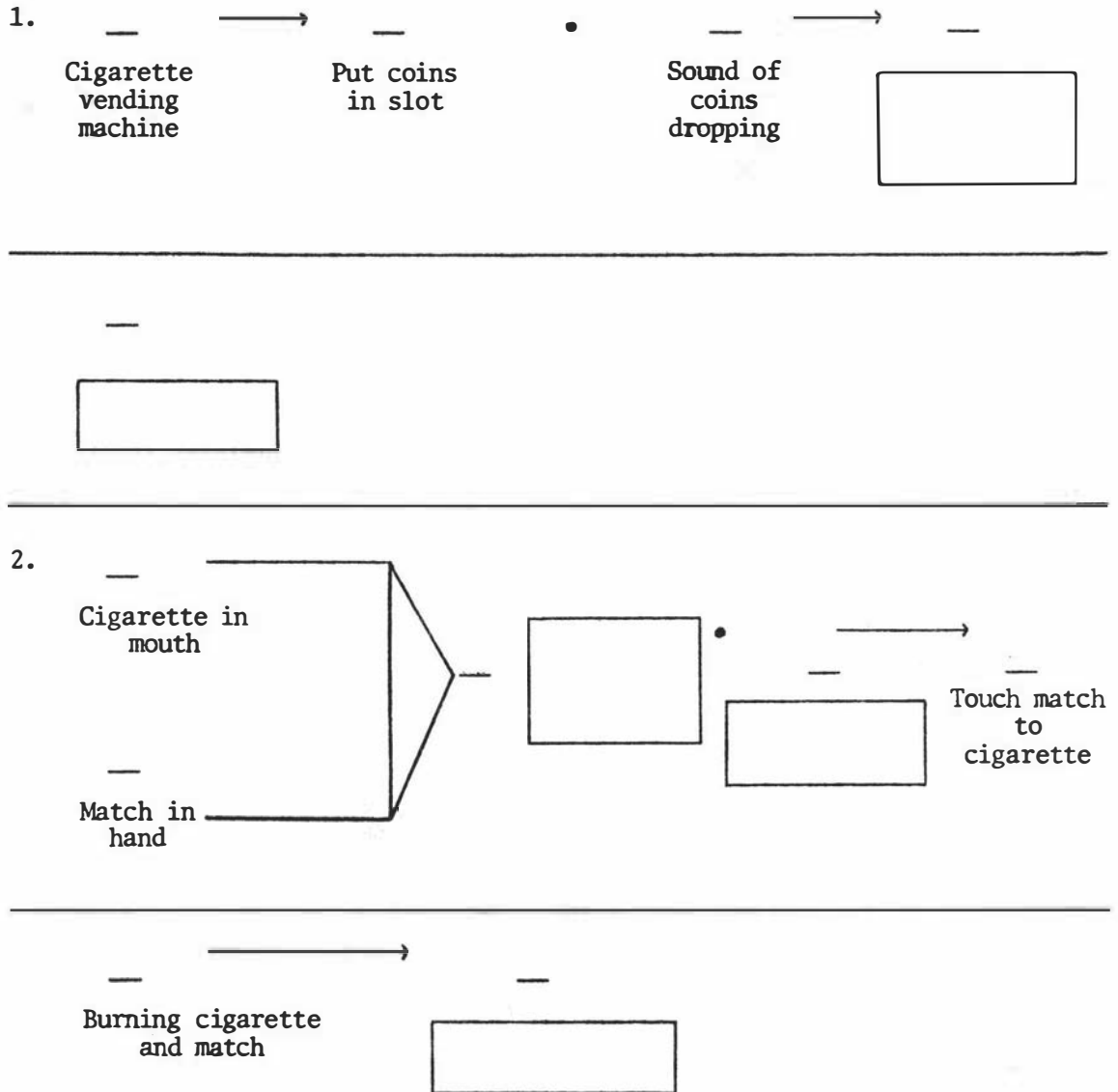
(4) 8.1   WRITING A BEHAVIOURAL SEQUENCE

The distinction between stimulus situations, "S^R" and "S^O", and the responses, "R", they occasion is very important. Bringing responses under the control of particular stimuli is one definition of learning. In analysing behaviour (as you must if you are to intelligently plan to bring about changes in behaviour), you must be able to discriminate between the response, and the *change* that it makes on the environment (the new stimulus that follows the response).

Using these terms, R, S^R, S^O, write out a behavioural chain for the task, "Writing out a cheque".

The steps should include:

a.   Write the date.

b.   Write the name of payee.

c.   Write the sum to be paid.

d.   Check figures and words.

e.   Sign the cheque.

You may add any other variations you feel necessary. Start it on the next page.

(4) 8.1b

We suggest you start:

Cheque book
open   **?**
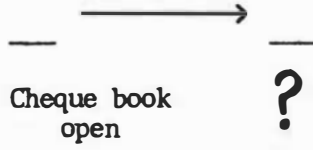
CHECK YOUR ANSWERS AT THE BACK

OF THE PROGRAMME.

(5) 6.1A   <u>ESTABLISHING BEHAVIOUR</u>

Behaviour is made up of responses. It follows that we must bring about
DESIRED responses if we wish to establish a particular *desired* behaviour,
and EXTINGUISH those responses which are contrary (undesired) to the
behaviour we are establishing.

We have already seen that there are four possible outcomes following
a response a person might make: REINFORCE, PUNISH, NON-REINFORCE, and
NEGATIVELY REINFORCE.

To ESTABLISH new behaviour, these two rules apply.

- REINFORCE successive approximations of the *desired* behaviour.
- NON-REINFORCE, or NEGATIVELY REINFORCE *inappropriate* and *not*
  wanted behaviour.

  - Punishment is unpredictable, and can be dangerous.
    It is often rewarding to the *punisher*, but does
    not necessarily produce the long-term benefits
    desired.

Obvious?
Well, may be, but how often do we violate these rules? Aren't
"punishers" often used both as *"motivators"* for desired behaviour,
and *"eliminators"* of undesired behaviour?

.

(5) 6.1Ab

You're a primary school teacher. John has a bad habit of talking in class without always raising his hand. Which behaviour on your part is most compatible with the behaviour management principles you've learned so far?

   _____ 1. Say, "Raise your hand, John", each time he speaks out.

   _____ 2. Ignore him everytime he speaks out; acknowledge him everytime he raises his hand.

   _____ 3. Call on John when he speaks out, since you don't want to extinguish participation.

CHECK YOUR ANSWER

Answer to (S) 6.1Ab   2

(5) 7.1A   <u>ESTABLISHING BEHAVIOUR</u>

To ESTABLISH desired, or new behaviour, we must REINFORCE successive approximations of the desired behaviour, and non-reinforce or negatively reinforce inappropriate (undesired) behaviour.

There are two things you should remember about establishing behaviour:

Reinforcement is more effective the SOONER it follows the desired behaviour.

For reinforcement to be effective, it must be clearly *connected* to the desired behaviour.

In other words, if reinforcement is to be MOST effective, it must occur as soon as possible after the individual has performed the appropriate behaviour (or approximation of that behaviour). The performer should be able to see the reinforcer clearly associated with the behaviour that "caused" the *favourable consequence*.

Does this always happen?

Check the situation which is more compatible with Reinforcement Theory in each pair below.

1.   _____ a.   End of term test.
2.   _____ b.   Daily evaluation of work.

(5) 7.1Ab

2.   ___a. Praise for good work "on the spot".

      ___b. Prize for many good performances at end of year/course

3.   ___a. Handing back marked test papers at end of day.

      b. Return of marked papers at end of term.

CHECK YOUR ANSWERS

51

Answers to (5) 7.1A

1. b
2. a
3. a

(5) 6.1B   SHAPING NEW BEHAVIOUR

We have already seen how operant behaviour works - how it involves rein-
forcing any successive approximation of appropriate behaviour until the
final (criterion) behaviour is achieved.

The behaviour we want the learner to be able to perform is called
the CRITERION PERFORMANCE. It's the behaviour we want to *see* at the *end*
of the learning situation, and performed to the standard of excellence
that we require. How we determine that standard of competency is another
matter altogether.

It's foolish to imagine that in every instance a learner will be
able to perform the criterion behaviour "right-off". This would be the
exception, rather than the rule. Instead, the behaviour of the learner
can be S-H-A-P-E-D to the criterion by applying reinforcers at ever
increasing demands for better and better performance. There is a real
analogy here to the potter who *shapes* from a ball of clay, a fine and
exquisite object. Our job as teachers is to shape from a vast array of
possible responses, the intricate pattern of behaviour that go to realising
the goals of education, whatever they maybe deemed to be.
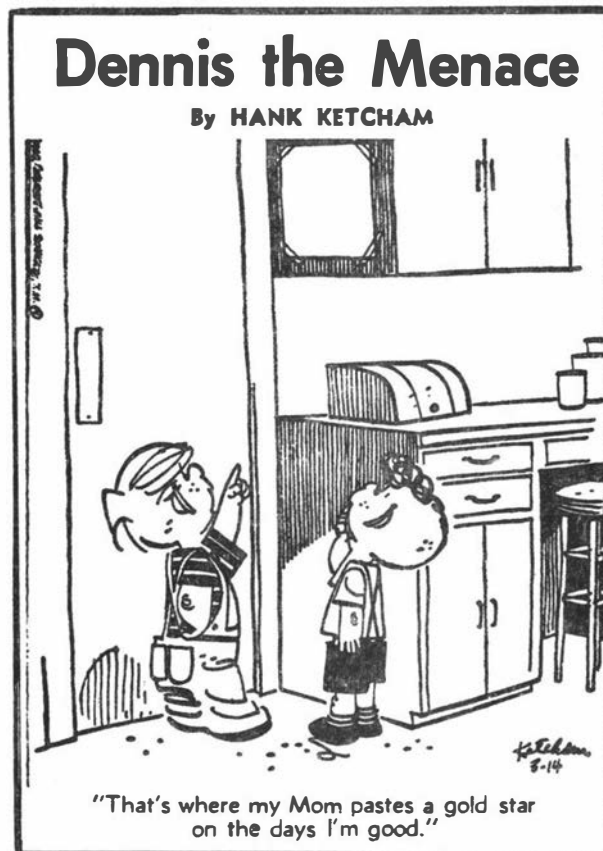
REWARD SUCCESSIVE
IMPROVEMENTS
INSTEAD OF WAITING
FOR PERFECT
BEHAVIOUR

"That's where my Mom pastes a gold star on the days I'm good."

From: J.D. & H.B. Krumboltz, CHANGING CHILDREN'S BEHAVIOUR, Prentice
       Hall, New Jersey, 1972.

(5) 6.1Bb

Tick those which you think are examples of "shaping".

1. Bill says he's discouraged and hates arithmetic because teacher
   always says his answers are wrong, even though he claims he
   knows what he is doing.   [ ]

2. Burt's small ball handling is poor. He seems to have a "thing"
   about catching tennis balls. Even before one is thrown in his
   direction he knows he will drop it. His teacher decided to help
   him by giving him practice catching a basket ball for 10 minutes
   each day. "You're doing well", she called. Next she tried him
   on large rubber balls. He picked that up well too. Tomorrow
   she'll try him on smaller rubber balls.   [ ]

3. Learn to tie shoe laces. Start with tightening the finished
   bow. Then form the bow. Join the two ends. Hold the two ends. [ ]

4. "The assignment is very clear. I want each of you to read
   about the legislative system of New Zealand and one other
   country, identify the differences and similarities and
   write a report suggesting the effect on the political systems
   that the different features have".   [ ]

CHECK YOUR ANSWERS

Answers to (5) 6.1Bb

1. 2

2. (A practised backward chained sequence.)

(5) .7.3B   SHAPING NEW BEHAVIOUR

The application of Reinforcement Theory to the acquisition of *new behaviour*, requires that reinforcement is made CONTINGENT upon the student making *successive approximations* of the appropriate behaviour until the criterion performance has been achieved. The new behaviour is established by reinforcing successive approximations in a process called "shaping".

Two rules:

1. Reinforce every *successive approximation* of the desired behaviour.

2. Pre-requisite skills and knowledges should be mastered before attempting to perform more complex behaviour.

OK, here are the basic steps for shaping behaviour.

FIRST	- Reinforce *any* effort that approximates the criterion.
THEN	- *Withold* reinforcement if no better performance is made from the first approximation.
THEN	- Reinforce the *next higher* level of performance that moves closer to the criterion.
CONTINUE	- To reinforce gradual levels of performance, and non-reinforce, or negatively reinforce *previous* levels (where the performer slips back) until the behaviour is established to the criterion performance).

Suppose you wish to train a rifleman to fire a rifle at a target accurately. First you will need to identify the rifle, the position he will be firing from, and define what you mean by accurately. Of course, you will need to tell him what target it is you wish him to shoot at, the range, and any other conditions that might affect his accuracy. Then, the rule is to "begin where he is (has he ever held a rifle in his hand before?), and move toward criterion performance in successive approximations by selective application and witholding of reinforcement".

(5) 7.2Bb

		YES	NO
1.	Would you reinforce every shot your rifleman made?	[ ]	[ ]
2.	Praise him only when he achieved criterion performance?	[ ]	[ ]
3.	Keep praising him after each shot in the hope that this will encourage him to do better?	[ ]	[ ]
4.	Yell at him after every bad shot?	[ ]	[ ]
5.	Tell him he's blind?	[ ]	[ ]
6.	Say, "Much better", after an improved shot?	[ ]	[ ]
7.	Say, "You're doing fine", after his performances haven't improved?	[ ]	[ ]

CHECK YOUR ANSWERS WITH

OURS

Answer to 7.2Bb

1. No

2. No

3. No

4. No

5. No

6. Yes

7. No

(5) 7.1B

(A) Suppose you are a physical education instructor. You are trying
to get your basket ball team to "Shoot foul shots better". You
specify criterion as "5 out of 7 attempts". You decide to use
"Get a drink", (particularly if it's a hot day) and "Good" as
reinforcers. Use the principles of reinforcement for establishing
behaviour in this situation.

1. John on his first attempt in practice makes 3 out of 7.
   What do you do?
   _____ a. Nothing
   _____ b. Say "Good"
   _____ c. Say, "3 out of 7 isn't good enough".

2. The next time it's John's turn to practise foul shots, he
   makes 3 out of 7 again. What do you do?
   _____ a. Nothing
   _____ b. Say, "Get a drink".
   _____ c. Say, "3 out of 7 isn't good enough".

(5) 7.1Bb

3. The third time John practises, he makes 4 out of 7.

    What do you do?

    _____ a. Nothing

    _____ b. Say, "Get a drink".

    _____ c. Say, "4 out of 7 isn't good enough".

4. The fourth time John practises, he makes 4 out of 7.

    What do you do?

    _____ a. Nothing

    _____ b. Say, "Get a drink".

    _____ c. Say, "4 out of 7 isn't good enough".

5. The next time he makes 5 out of 7. What do you do?

    _____ a. Nothing

    _____ b. "Good"

    _____ c. "Try to get 6 out of 7".

    ----

6. Write the order (by numbering 1, 2, 3) that these tasks should
    be taught in the teaching of reading.

    _____ a. Pronounces total printed words composed of sequences
               of consonant-vowel combinations according to regular
               rules.

    _____ b. Reproduces orally presented single syllables.

    _____ c. Reproduces orally presented words and word
               sounds of several syllables in length.

CHECK YOUR ANSWERS

Answers to (5) 7.1Bb (A)

1. "b"   (Reinforce any approximation toward criterion.)
2. "a"   (Unless improves upon previous performance, withold
            reinforcement.)
3. "b"   (Reinforce next level toward criterion.)
4. "a"   (Same as for number 2.)
5. "b"   (Even though you may be tempted to say "try to get 6",
            this is over your criterion level.)
6. 1b, 2c, 3a. Each task is pre-requisite to the next higher level.

(B)

You've seen an example of *shaping* behaviour through the principles
of reinforcement. See if you can recognise the four procedures from
this list. Check off *only* those which are statements of shaping
behaviour.

1. ☐ Reinforce any effort that approximates the criterion
       of the desired behaviour.

2. ☐ Reinforce any response the learner makes; gradually
       he will begin to approximate the desired behaviour.

3. ☐ All subsequent responses should be reinforced.

4. ☐ Withold reinforcement if no better performance is
       made after the first approximation.

5. ☐ Reinforce the next higher level of performance that
       moves closer to criterion.

6. ☐ Continue reinforcing behaviour that exceeds the
       criterion.

7. ☐ Punish all behaviour that does not approximate the
       desired behaviour.

8. ☐ Continue to reinforce gradual levels of performance
       and non-reinforce previous levels until the behaviour
       is established to criterion.

CHECK YOUR ANSWERS

Answers to (5) 7.1Bb (B)

1; 4; 5; 8.

(5) 6.1C   MAINTAINING BEHAVIOUR

One of the basic tenets of Reinforcement Theory is that responses produce reinforcers (that is, the effect of the response on the individual is either going to make him want to do it again, or stop him doing it.) The *pattern* of reinforcement given to a learner is going to affect the quality and quantity of the behaviour being established and maintained. This pattern, which is called a SCHEDULE OF REINFORCEMENT, may either be continuous or intermittent.

In every day life, it is very difficult to find situations where, once a behaviour has been established, it is maintained by being *continuously* reinforced. The gambler does not win every time he places a bet. The athlete does not win every race he enters, nor the lawyer every case he defends. Continuous reinforcement of behaviour is the *exception* rather than the rule with *established* behaviour. In fact, the continuous reinforcement of established behaviour can have negative effects; to know that you're right all the time can become very boring. A very real problem that writers face in preparing programmed instructional materials.

As a new behaviour becomes established, the need for continuous reinforcement is reduced, and a pattern of INTERMITTENT reinforcement (whereby some responses are reinforced, and not others), emerges.

Suggest whether continuous or intermittent Schedules of Reinforcement could be appropriate in these situations.

1. Teaching chess to your six year old son by playing his first game with him. _____

2. Employed as a practising school teacher. _____

3. Being a member of a debating team. _____

4. Learning the Russian alphabet. _____

5. Writing an instructional programme on "Changing to Metrication".

_____

CHECK YOUR ANSWERS

Answers to (5) 6.1C

1. Continuous

2. Intermittent

3. Intermittent

4. Continuous

5. Continuous   (developing new behaviour, or restructuring old

        behaviour in a new situation.)

(5) 7.1C   <u>MAINTAINING BEHAVIOUR</u>

Once a new behaviour is established, intermittent reinforcement should be the rule in maintaining that behaviour. The *pattern* of the *intermittent* reinforcement can either be FIXED or VARIABLE.

- FIXED   - The pattern is *fixed* and without variation. For instance, every 5th response is reinforced, or reinforcement is provided every 10 minutes.

- VARIABLE   - There is no particular pattern of reinforcement used. Reinforcement can be provided at any time, or after any number of responses made.

Just as the *pattern* can be either fixed or varied, so the *basis* for reinforcement can be made according to the RATE of responses made, or the INTERVAL of time taken. The basis can be either *fixed* or *variable*.

LOOK AT THE DIAGRAM

- FIXED

- VARIABLE

     RATIO

- Reinforcement is provided according to the *rate* of responses made. Eg being paid $2.00 for every 100 newspapers sold.

- Playing a birdie on the 6th and 13th holes.

- FIXED

- VARIABLE

     INTERVAL

- Reinforcement based on *intervals* of *time*. Working for $2.00 an hour.

- Saying "Here! here!" every now and then while listening to a politician speaking.
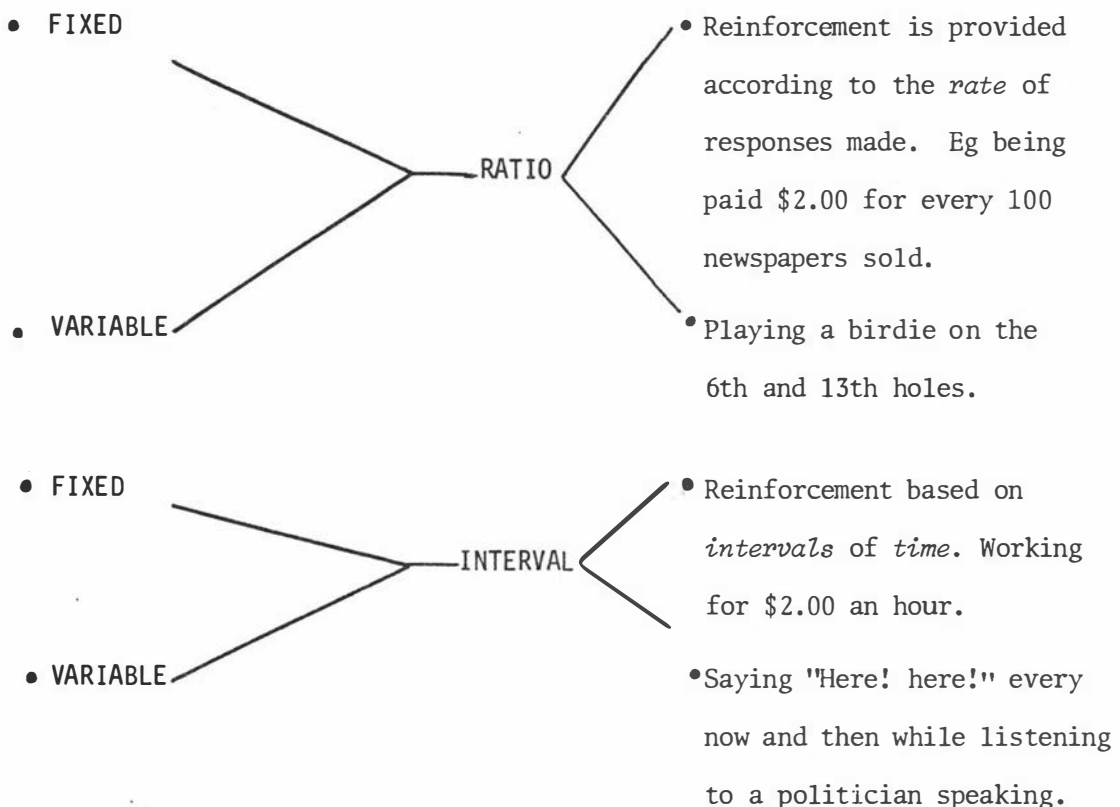
(5) 7.1Cb

Now answer the following questions.

1. To praise a student only after he has done some outstanding work, is an example of:

    _____ a. Fixed reinforcement
    _____ b. Variable reinforcement
    _____ c. Continuous reinforcement

2. Which behaviour is more likely to maintain horse-racing-following behaviour?

    _____ a. Winning every time
    _____ b. Winning every second race
    _____ c. Winning every now and then

3. Name the Schedule of Reinforcement that your answer to number 2 is characteristic of. _____

What Schedules of Reinforcement are these examples characteristic of?

4. Receiving a bonus for completing a contract ahead of schedule

    _____

5. Developing an immunisation serum for the common cold.

    _____

6. Payment of a 4% royalty on each book published.

    _____

7. Encouraging a student every so often during a driving lesson with comments like, "Good"; You're getting better"; "I'm breathing easier now!"

8. Competing as an international 1500 meter athlete.

CHECK YOUR ANSWERS

Answers to (5) 7.1Cb

1. b

2. c

3. It should have been Variable ratio

4. Fixed interval

5. Variable ratio

6. Fixed ratio

7. Who needs reinforcement! Variable interval

8. Variable ratio

(5) 8.1   ESTABLISHING AND MAINTAINING
                    BEHAVIOUR

Suppose you are a teacher in a city High School in charge of a group of Fifth Formers who have been renowned for their sloven-liness. They usually straggle into class up to 15 minutes after the bell, and invariably forget to bring their appropriate books for the lesson. You decide to make one of the objectives for your group, "promptness and preparedness in class attendance." You get on reasonably well with the class and they respond to your attention.

1.   What are the *precise* behaviours you want to establish?

   a _____

   b _____

2.   What are the precise behaviours you want to eliminate?

   a _____

   b _____

3.   Should establishing the desired behaviours eliminate the undesired behaviours? _____

4.   What sort of behaviour is necessary from the class before reinforcement can be provided? Justify your answer by giving an illustration. _____

   _____

5.   What is the technical name given to the *process* of establishing behaviour? _____

6.   If you periodically congratulated one of the group for his promptness, and bringing his correct testbooks, this would be an example of; (a) Establishing, or (b) Maintaining behaviour? _____

7.   What Schedule of Reinforcement is being used in Number 6?

   _____

(5) 8.1b

8. If you said to the class each Monday, "Thank you for coming to class on time". What Schedule of Reinforcement would you be using? _____.

9. On Monday morning they came to class 10 minutes late. On Tuesday they were 5 minutes late. You commended their improvement. On Wednesday they came 5 minutes late. What do you do?

_____ a. Say, "Good, I see you're only 5 minutes late".

_____ b. Say, "You're still late. You will all remain behind after school for 15 minutes".

_____ c. Say nothing.

10. Justify your answer for number 9.

_____

_____

TURN TO THE APPROPRIATE ANSWER
PAGE AT THE BACK OF THE
PROGRAMME, AND CHECK YOUR
RESPONSES.

(6) 6.1A   ATTITUDES

An individual's *attitude* toward a person, object, or situation will
often determine what sort of response he makes to it. His behaviour
may be characteristic of either APPROACH or AVOIDANCE to the situation.

• BEHAVIOUR which brings an individual in *contact* with a person,
        object, or situation is called APPROACH behaviour.

• BEHAVIOUR which moves a person *away* from contact is called
    AVOIDANCE behaviour.

Observation of a single act is often not enough to determine
whether the individual's overall attitude is characteristic of
approach or avoidance. Several observations over time are required.
Answer these:

1.   Rata is a Samoan. He tells you that George is prejudiced
      against Islanders.

      a. Which is more likely. George has exhibited avoidance
          or approach behaviour in Rata's presence? _____

      b. Is Rata's attitude toward George more likely to be
          positive or negative?   _____

2.   A child comes from the playground and tells you, "Cops
      are pigs".

      a. If you severely scold him, is his attitude
          toward the Police likely to be positive,
          negative, or unpredictable?   _____

      b. If you scolded him, is his behaviour about
          telling you-things-he-heard likely to be
          approach or avoidance?   _____

      c. If you ignore the remark, is the attitude
          likely to be reinforced, non-reinforced,
          or punished?   _____

                    CHECK YOUR ANSWERS

Answers to (6) 6.1A

1a. Avoidance   b. Negative (probably)

2a. Unpredictable   b. Avoidance   c. Non-reinforced

(6) 7.2A   <u>ATTITUDES</u>

An individual's attitude toward a person, or situation is likely
to determine what sort of response he makes to it. Attitudes are
developed, maintained and extinguished like any other behaviour
in terms of the reinforcement, negative reinforcement, non-
reinforcement and punishment they receive.

Here are two rules:

1. Teach APPROACH behaviours by simultaneously presenting
    to the child the situation to be approached (or some
    representation of it) with a rewarding condition.

2. Teach AVOIDANCE behaviours by simultaneously presenting
    to the child the situation to be avoided (for some
    representation of it) and a mildly aversive condition
    (or some representation of it).

THE CONSEQUENCES OF APPROACH AND AVOIDANCE BEHAVIOURS MAY BE
AT TIMES EITHER *POSITIVE* OR *NEGATIVE*, DEPENDING ON THE SITUATION.

- A *mildly* aversive situation to the positive avoidance
  behaviour, "Drive Slowly", could be, watching a colour
  TV film of people in a car accident caused by speeding.

- A *strongly* aversive situation to the *positive* avoidance
  behaviour, "Drive Slowly", could be, actually experiencing
  a car accident resulting from speeding. The punishing
  experience could in turn lead to the development of a
  negative attitude whereby the individual refused to
  travel in any car, regardless of the speed it was driven at.

(6) .7.2AB

State whether each of these is an example of Approach or Avoidance. Then say whether each is positive or negative.

1. Danny was taught, "A policeman is your friend". Danny got lost in the city a while back. He went to look for a policeman to help him.

    _____   _____

2. Whenever Judy was naughty, she was locked in a cupboard for punishment. Even now she is uncomfortable entering elevators and small rooms.

    _____   _____

3. Jake was a big, mean, tough man. Jake didn't care for anyone else. Dick was impressed. He wanted to be like Jake.

    _____   _____

4. Her mother taught her, "Roads are dangerous places. Cross them if you have to, but never play on them". One day her ball bounced on to the road. She waited for the traffic on the road to clear before she stepped out and picked it up.

    _____   _____

5. When she was a child Janice was taught that sex was bad. She has never adjusted to sexual relations in marriage.

    _____   _____

CHECK YOUR ANSWERS

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Answer to (6) 7.2Ab

1. Approach   positive
2. Avoidance   negative
3. Approach   negative
4. Avoidance   positive
5. Avoidance   negative

(6) 7.1A   ATTITUDES

- The MODELLING Effect -

As we have seen, attitudes are established in the same way
as any other behaviour. However, studies have shown that
the manner in which we reveal approach or avoidance, positive
or negative attitudes toward people or things, is influenced
very much by the observations we make of *other people's*
behaviour and attitudes. We tend to watch them, and MODEL
our own attitudes on those aspects of their behaviour which,
for various reasons, we admire.

THUS:

    1. People are more likely to develop the same attitudes
       as others who have prestige.

    2. People will perform reinforced activities in prefer-
       ence to punished activities.

    3. People will tend NOT to engage in activities they
       have seen punished in others.

    4. People will tend to engage in activities they have
       seen others reinforced for.

Parents are the most powerful models in early childhood.
Teachers can become models for their pupils. People in posit-
ions of power and authority tend to be models for people
subordinate to them. The reinforcement of our peers (fellow
students, co-workers, people of similar socio-economic status,
etc.) influence our attitudes and behaviour. We tend to take
our cues from the reinforced behaviour of our peers, even if
that behaviour is at variance with other groups in society.
For example, the confrontation between youth (change) and the
"establishment" (status-quo).

(6) 7.1Ab

Answer these:

1. Bob sees his father stealing oysters from a rocky point. If Bob knows before hand that taking oysters without a permit is prohibited by law, is his attitude toward obeying the law in this instance likely to be increased or decreased? _____

2. If Bob's father was caught every time he stole oysters and fined $100 on each occasion, what would be Bob's probable attitude toward obeying the law?

    a. Avoidance, positive   [ ]

    b. Avoidance, negative   [ ]

    c. Approach, positive   [ ]

    d. Approach, negative   [ ]

3. If Bob's father was caught only occasionally, what would be Bob's probable attitude toward obeying the Law?

    a. Unpredictable   [ ]

    b. Approach, positive   [ ]

    c. Avoidance, negative   [ ]

4. Name 3 influences on your "dress" behaviour.

    a. _____

    b. _____

    c. _____

5. What do we call the process implicit in question 4?

    _____

Answers to (6) 7.1Ab

1. Decreased

2. c. although possibly reinforced by a mildly aversive situation, the constant prosecution of his father.

3. a.

4. TV; models; magazines; peer group fashion, etc.

5. Modelling

(6) 5.1B   <u>CONTINGENCY MANAGEMENT</u>

(MOTIVATION)

The term "motivation" is one of the most loosely used words in the experience of the day to day teacher. Often the cry is heard, "These students lack any motivation at all". Used in this way, we suppose that motivation is the "cause" of someone's behaviour that "comes from within". You either have it, or you don't!

We should try to be a little more precise. Let's define motivation as the MANIPULATION OF REINFORCERS AND THE ENVIRONMENT TO INCREASE THE PROBABILITY THAT TASKS WILL BE PERFORMED IMMEDIATELY AND ON A LONG TERM BASIS. (The jargon should be readily getting through now!)

What we want to be able to do is to *manage behaviour* by using *existing* reinforcers and by arranging the conditions so that intrinsic and extrinsic reinforcers follow the behaviour we want to occur and recur.

Let's make sure we really understand the meaning of the word "reinforcer". You will remember that earlier in the programme we described a "reinforcer" as a stimulus situation (S^R) following some behaviour that *increased* and *probability* that that behaviour would *occur again*. We did NOT say that a reinforcer meant, "to add to", "agree with", or "make clear".

Now, just to see whether you have understood the particular meaning we have placed on the word "reinforcement", tick *only* those phrases which use the word "reinforce" or "reinforcement" in the way in which it has been defined.

1. Pictures reinforce learning.   [ ]
2. Let me reinforce this statement by telling you of an experience I had.   [ ]
3. I reinforce my arithmetic lesson by giving lots of examples.   [ ]
4. Bill likes to play with the sand tray. I can use that as a reinforcer for some other behaviour.   [ ]

PLEASE CHECK YOUR ANSWERS

Answer to (6) 5.1B

You should only have ticked number 4

1. Pictures MAY make learning clearer - they do not
    necessarily increase the occurrence of a particular
    behaviour.

2. The word is used incorrectly. It is clarification
    of the statement, not recurrence that is wanted.

3. Any reinforcement will depend on the stimulus
    situation *following* the use of the examples.

(6) 6.2B   <u>CONTINGENCY MANAGEMENT</u>

<u>(The Concept of CONTINGENCY)</u>

If you stop to look about you, you will soon realize that most things in the world are in some way naturally CONTINGENT (or dependent) upon something else. Watching TV is *contingent* upon turning the set on. Voting in the General Election is *contingent* upon being on the Electoral Roll. You can't be a "Women's Liber", advocate (or antagonist) without first being aware (at least in part) of some of the issues!

Schematically, contingency can be represented as:
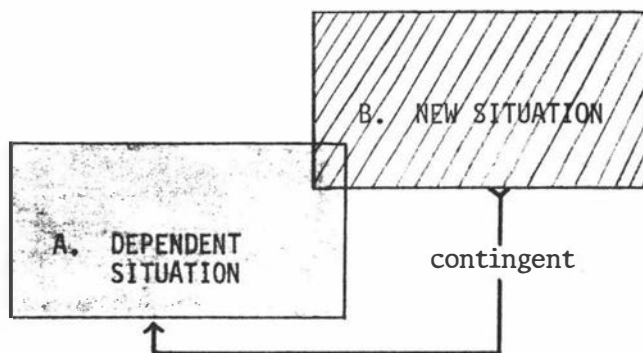
Check the item in each pair that is contingent upon the other.

1.   a.   Reading   [ ]
      b.   Opening the book   [ ]

2.   a.   Environmental awareness   [ ]
      b.   Conservationist   [ ]

3.   a.   A Member of Parliament   [ ]
      b.   Party candidate   [ ]

There are positive contingencies and negative contingencies. Check the *positive* contingency in each pair.

4.   a.   The best military cadet is awarded
            the Sword of Honour   [ ]
      b.   The worst cadet is asked to resign   [ ]

5.   a.   Little work brings little reward   [ ]
      b.   Successful people work hard   [ ]

Answers to (6) 6.2B

1a   2b   3a   4a   5b

(6) .6,1B   CONTINGENCY MANAGEMENT

               (The Concept of PREFERENCE)

When people are asked to make a choice between two or more
alternatives, they usually find that they *prefer* one over
the others. If they are given many alternatives, their task
is that much more difficult in selecting the most desired
one. The preference is individually biased. What I like,
you may not.

      Tick your preference from these pairs.

      1. a. Mowing lawns   [ ]
          b. Having a drink   [ ]

      2. a. Dinner at a quiet restaurant [ ]
          b. A noisy party   [ ]

      3. a. Early to bed, early to rise [ ]
          b. Late to bed, late to rise   [ ]

      4. a. Going out on a date   [ ]
          b. Reading this programme!   [ ]

      Don't bother to check your answers! I'm sure you get the
idea. However, the point is, if sufficient numbers of people
had answered these questions, and those people had represented
a wide range of differences in life styles and interests, each
alternative would have been preferred by someone.

      What are we getting at? Simply this:

      1. If people are given a choice, they usually have
          a preference for one over another.

      2. That preference will be determined by all sorts
          of personal factors.

(7) 7.4B   CONTINGENCY MANAGEMENT

Once a teacher has gathered children together in a classroom or prescribed location, he has intervened in their behaviour. Consequently, he might as well ensure that that intervention is as efficient and profitable to each child as possible.

The teachers job in the classroom is to so arrange the learning environment that for most of the day the child's responses successively approximate the criterion behaviours indicated by the teacher. This process of *behaviour modification* involves these three elements.

The *antecedent* conditions (the before situation)

The *behaviours* to be observed and modified

The *consequences* which will reinforce the behaviours (the after situation)

Using the S-R notation system that we learned in (4) 7.1, give the technical names for:

1. The antecedent conditions   _____

2. The behaviour observed   _____

3. The consequences which will reinforce the behaviours   _____

CHECK YOUR ANSWERS

Your answer to (7) 7.4B

    1. S^O

    2. R

    3. S^R

(7) 7.3B

A procedure by which a teacher manipulates the child's learning environment has been called *CONTINGENCY MANAGEMENT*. It involves the arrangement of the antecedent and consequent events that are *contingent* on the child's behaviours and which affect those behaviours.

The primary rationale behind Contingency Management is that procedures can be developed for systematically increasing the probability of desired behaviour by making the individual's high priority (preference) purposes contingent on satisfying the objectives *you* set up (often *his* low preference behaviour.

The basic principle is:

> Low Probability Behaviours can be reinforced by
> *B E H A V I O U R S* of a Higher Probability of occurrence

That is, the performance of High Probability Behaviours (HPB's - the most preferred behaviours), can be made *contingent* upon the performance of Low Probability Behaviours (LPB's - the least preferred behaviours).

Look at this example of Contingency-Management.

Dick wants his 17 year old son, Dan to mow the lawns this Saturday. Dan is not too eager, but he wants to take his girlfriend Karen out to a dine-and-dance on Saturday night. Dick knows how to achieve his lawn mowing objective by using Contingency-Management. He will arrange a performance environment in this way.

7.3Bb

1. Dick defines the Low Probability
    Behaviour (for Dan), but principal
    objective (for Dick).   = Mow lawns

2. States performance *criterion*.   = Entire lawns, trim
                                             edges, and sweep
                                             paths.

3. Dick identifies Dan's high   = Use of car to take
    probability behaviour.   Karen out.

4. Dick states *amount* of high   = From 7.0 pm
    probability behaviour.   Saturday to
                                             1.0 am Sunday.

Now let's look at the important elements of a Contingency-Management Contract (C-M).

1. The Low Probability Behaviour (LPB) must be clearly
    stated. This is the *performance objective*. It
    should be described in behavioural (ie measurable)
    terms.

    2. The criterion of minimal acceptable
        performance must also be stated.

3. The High Probability Behaviour (HPB) must be
    identified for the performer, and *mutually* agreed
    upon.

    4. The *amount* of HPB to be given must be
        stated.

7.3Bc

1. Pick which is an example of C-M contract.

    a. Learn really well the geography of the Appalachian
        Mountains. Use any of the resource material in the
        classroom for your study. You may then go to the
        cafeteria for a 20 minute coffee break.   [ ]

    b. Correctly list the four stages of tropical cyclone
        development in order of their occurrence, and select
        from a given list the descriptions that pertain to
        each. You may then go to the cafeteria for a 20
        minute coffee break.   [ ]

2. Justify your answer for number 1. _____

    _____

    _____

3. Pick which is an example of a C-M contract.

    a. Study the programme, "Programming", and correctly
        list the 5 principles of instructional programming.
        Then, take a 20 minute coffee break.   [ ]

    b. Study the programme, "Programming", then, given
        sample frames, correctly state in the space provided
        the method of programming used in writing the frame.
        When you've successfully completed that, take a break.   [ ]

4. Justify your answer. _____

    _____

CHECK YOUR ANSWERS

(6) 7.3Bb Answers

1. b

2. Performance is stated in behavioural terms, with a standard of acceptable performance-correctly listing the 4 stages; i.e. a minimal standard of 100% correct.

3. a

4. The amount of HPB in (b) is not stated. This statement is provided in (a).

(6) 7.2B   CONTINGENCY MANAGEMENT

Characteristics

Every good C-M contract should have these characteristics:

- *CLEAR* Performance Statement
- *FAIR* Pay-off of HPB
- *POSITIVE* requirements

A CLEAR contract is when the peformer knows exactly what the performance objectives of the LPB are, and the specific HPB's he will be permitted to engage in (or the choice from which he may select from), and the amount of HPB he will be permitted.

A FAIR contract is when the *performer* agrees that the HPB is equal, or greater than the LPB in terms of pay-off to him; in short, when he freely accepts the contract.

A POSITIVE contract is when it does not employ avoidance of punishment or some aversive situation as an imposed HPB.

EXAMPLES:

CLEAR	Research eight controversial issues in New Zealand primary education to be discussed with the Minister of Education. Then travel to Wellington for a morning interview with him.
UNCLEAR	Understand the importance of canals in the transportation system of early industrial England. Then view a colour videotape on Inland Waterways in England.

(6) 7.2Bb

FAIR	Work the review problems on page 51. When you get 13 out of 15 correct you are free until the next session.
UNFAIR	Work on the review problems on page 51. When you get them all correct, go on to the next assignment until 5 minutes before the end of the session. Then read, "The Far Eastern Review".

POSITIVE	Work through the programme and then take a terminal test. If you score 80% or better you are free until the start of the next session.
NEGATIVE	Work through the programme and get 80% of it correct. If you don't you will have to do this session again.

(6) 7.2Bc

State whether each of these is/is not either CLEAR, FAIR, or POSITIVE. Give reasons for your answers.

1. "Carefully review your corrected composition. For each error that I have noted, use your grammar text to find the rule of correct usage that applies. Write the composition sentence containing that error, and the rule on a separate sheet of paper. If you finish before the end of the period you need not come to the remedial class after school today". _____.

    Why? _____

    _____

2. "Work in pairs and memorize the first 25 elements of the valence chart. When you have done so, come to me for a quiz on them. If both you and your partner score at least 23 out of 25 correct, you may both get a cup of coffee". _____.

    Why? _____

    _____

3. "Review the chapters we've discussed over the last ten periods. When you think you're ready for the test, come to my desk. If you do well on the test, you can have the first two periods off tomorrow". _____.

    Why? _____

    _____

CHECK YOUR ANSWERS

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Your answers to (6) 7.2Bc should look something like these.

1.   Negative, and possibly unfair. The HPB here is avoiding
      an aversive situation - the remedial class.

2.   Not fair. The HPB is not worth the work required by the
      LPB. Also, access to the HPB depends on the performance
      of the partner.

3.   Not clear. "Review", "think you are ready", and "do well",
      are not measurable terms and are subject to the probability
      of wide interpretation.

(6) 7.1 <u>CONTINGENCY MANAGEMENT</u>

The primary considerations of a contingency management situation are that the teacher:

1. Measures the behaviour prior to the C-M intervention so as to obtain baseline (pre-test) data for decision-making and as a point of comparison with subsequent behaviour.

2. Attends to the *types of reinforcers*, that is, the HPB's, so that children who initially respond only to extrinsic and "token" reinforcers, later respond to social reinforcement.

3. Changes the *Schedules of Reinforcement*, first making them appropriate to response acquisition (establishing behaviour) and later to response maintenance (maintaining behaviour).

4. Arranges a learning environment in the light of the baseline behaviour and available reinforcers so that data can be gathered on the new behaviours resulting from this intervention.

Here is a fictious case study:

(6) 7.1b

A class in a metropolitan school containing 28 standard one pupils. The class has a reputation for being "difficult". Most of the children are unruly and disruptive in their behaviour. From base line data that you have gathered, you note that on average 32% of the time children are engaged in "off task" behaviour, that is, doing other than what they've been asked to do. You decide to set up a C-M situation.

1. Describe a specific criterion behaviour for the class (LPB).

    _____

    _____

2. Describe possible reinforcers that might be appropriate to your intervention (LPB).

    _____

    _____

3. Describe how you might arrange the learning environment to achieve your objective, by stating what you would say or do to set up the situation.

    _____

    _____

    _____

    _____

    _____

    _____

    _____

ONLY AFTER YOU'VE MADE YOUR RESPONSES
SHOULD YOU CHECK YOUR ANSWER
WITH OURS.

Your answer to (6) 7.1b should be patterned along these lines.

1.   Sitting in chairs with both feet on the floor working at an activity for 20 minutes.

2.   Play activities for 5 minute period such as checkers, junior scrabble, etc.

3.   "This afternoon and every afternoon from now on, we are going to play a game. This means that you will have more playtimes in the afternoon, but only if you play the game correctly.

Here are the rules: There will be two kinds of times; work times, and 5 minute play times. I will press this buzzer at the beginning and the end of the playtimes. When the buzzer rings you will be allowed to do these sorts of things (describe the activities) providing you have followed the rules properly. To follow the rules you must stay in your seats, without moving your chairs and desks around the floor during your worktime; unless I ask you to do something else. For those who leave their seats during the worktime, that is, those who don't play the game properly, there will be no playtime for them to do what they like. They will have to remain in their seats with their heads down on crossed arms, on their desks like this (demonstrate).

Since these people have lost the game, no one else should speak to them or play with them during playtime. You will know if you haven't earned your playtime because before I sound the buzzer, I will read a list of the names of those people who were out of their chairs during the worktime. Remember that all pencil sharpening, chair moving and going to the toilet can be done during the playtime, but must not be done during the worktime.

Any questions?"

Some Further Comments on Contingency Management

To make effective use of C-M procedures you must devise a plan. In that plan you must explicitly determine these things:

1.   The specific criterion objectives (skills, tasks, attitudes, etc.) you wish each child to achieve in the class.

2.   The specific cues that you will use to evoke those responses that will lead most directly to the criterion behaviour.

3.   The responses to be measured.

4.   The reinforcers to be used.

5.   The reinforcement contingencies to be tried.

We have tried to describe some of the more important aspects of implementing a C-M system. Hopefully, enough to get you interested. However, the ultimate pay-offs of C-M are essentially intrinsically related. They include:

1.   The "reward orientated" aspects of C-M featured in HP Behaviours are progressively reduced until the LPB's become their own HPB. That is, the task itself becomes intrinsically rewarding for the individual. Rewards, and token rewards are used essentially to get behaviour started (they are not bribes; there is never any intention to "pervert' the behaviour of the recipient). The ultimate goal should be the development of independent, self-respecting, creative and productive citizens.

2.   People soon become their own contingency managers (especially when LPB's have become HPB's - when the task has become intrinsically rewarding).

3.   The unwanted side effects of a threat and coercion "system of motivation" are missing or diminished in C-M operated environments.

If you're still sceptical, try it yourself!

(6) 8.1   ATTITUDES AND CONTINGENCY-MANAGEMENT

1.   Jack is thinking of becoming a school teacher. His friend Howard
     works for an insurance company and is trying to recuit Jack. "Look",
     he says, "How many school teachers do you know who drive around town
     in $11,000+ cars, and play golf twice a week?"

     a.   Howard's implicit attitude towards teaching as a career is?

          _____   _____

     b.   Howard is attempting to change Jack's attitude on teaching
          as a career from

          _____   _____

          to,
          _____   _____

2.   Name the *process* by which Howard is attempting to affect the change
     in attitude.   _____

3.   Describe in Contingency-Management terms Howard's proposition.
     (Use both C-M abbreviations, and the specific behaviours they
     represent.)

4.   You are a Fifth Form teacher in Social Studies. Your students
     have been studying New Zealand's role in the Pacific, and especially
     our relations with Fiji. A specific event of interest has been
     New Zealand's assistance to Fiji after a recent hurricane in the
     Islands. You decide to spend two periods examining the major cause
     and effects of tropical cyclones in the South West Pacific region.

     a.   State a specific criterion behaviour for this course.

          _____

          _____

          _____

(6) 8,2b

        b.   Describe possible *extrinsic* reinforcers that might
                  be appropriate in this situation.

_____

_____

_____

        c.   Describe at least one intrinsically derived HPB that
                  you would wish to see arise from this study.

_____

_____

_____

5.   One of your students, Robert, decides to do an extensive project

on the topic. He has arranged to visit the Meterological Office

to gather data for his project.

        a.   Give the two technical names for Robert's probable
                  attitude toward geography?

                _____   _____

        b.   If Robert became so enthusiastic about Geography, that
                  he refused to study anything else, what would be his
                  attitude to Geography in relation to the rest of the
                  curriculum?

                _____   _____

ANSWERS

(Level 8 Exercises)

Answers to (1) 8.1

1. The stamps. Show and discuss stamps each time he
    correctly completes an exercise.

2. We don't really know. Unpredictable.

3. Non-reinforcement

4. Negative reinforcement

5. b.

Answers to (2) 8.1

1. a. Sight of rat; shrill noise

    b. Lever of machine

2. a. Crying

    b. Pulling lever

3. a. Respondent

    b. Operant

4. a. The response of crying at the sight of the rat
        had been automatically conditioned through the
        pairing of the shrill noise with the rat.

    b. Pulling the lever was a random response whose
        probability of recurrence had been increased
        because of the consequence of a reinforcing
        stimulus - the candy.

NOW GO ON TO THE NEXT EXERCISE FOR OBJECTIVE 3

Answer to (3) 8.1b

1.

```
           -------------------------------------
          /                                      \
        CS ----------------→  UCS   JOANNE   UCR ←------------- CR
```

```
                    -------------------------
                   /               J         \
                  /                O          \
2.        sight of ------→ chocolate A   sucks ←--------- plays with
             dog                     N chocolate;            dog
                                     N   stops
                                     E   crying
```
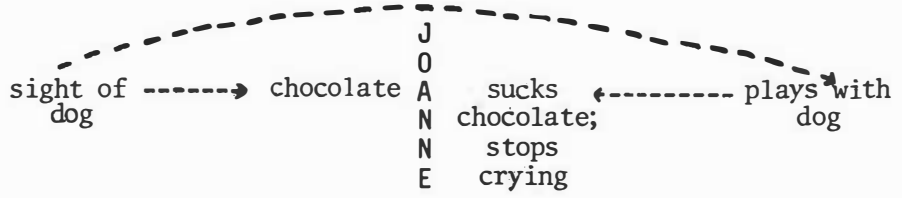
ON TO Objective (4)

Answers to (4) 8.1b

We suggest something like this:

S^O ——————————→ R   • S^{RO} ——————————→ R   •

| Cheque book open | Write date | Date written | Write name of payee |

S^{RO} ——————————→ R   • S^{RO} ——————————→ R   •

| Payee named | Write in words sum to be paid | Sum entered in words | Write in figures in left hand panel, sum to be paid |

S^{RO} ——————————→ R   • S^{RO} ——————————→

| Figures entered in panel | Check that amounts in words and figures are the same | | Entries correct |

R • S^{RO} ——————→ R   • S^{RO} ——————→ R

| Sign cheque | Cheque signed | Write words **"NOT NEGOTIABLE"** across left end of cheque | Words written cheque complete | Enter amount of cheque issued in cheque-book butt |

Remember: 1.   Every "R" MUST be an ACTION.

2.   An "S", is either a completed action, or the "cause"

of a NEW action.

Compare your answers to (5) 8.1 with ours.

1. a. Arrive on time.

    b. Come with the correct textbooks, etc.

2. Lateness to class.

    Bringing the wrong books.

3. Yes.

4. An approximation toward the criterion behaviour. Eg. Arriving to
    class a little earlier; bringing *some* of the correct books.
    Note: It is not necessary to wait for the criterion performance
    before reinforcement can be given. Your answer must include either
    the *idea* of *approximation* to criterion, or a specific example of
    this behaviour, for you to be correct.

5. Shaping.

6. (b) Maintaining behaviour.

7. Variable ratio.

8. Fixed interval

9. c.   a. Is wrong. It violates the shaping
                                        principle.

                                    b. Is wrong. It's punishment.

10. The behaviour on Wednesday shows no evidence of a further approximation
    toward the criterion - an improvement on getting to class on time. The
    behaviour is NON-REINFORCED.

    If subsequently, progress towards criterion behaviour remained
    static, you would need to re-examine your reinforcer and decide
    whether it was still appropriate.

<div align="center">MAKE SURE YOU CROSS ANY WRONG
RESPONSES, WRONG.</div>

Your answer to (6) 8.2

1. a. Avoidance   Negative
   b. Approach   Positive
       Avoidance   Negative

2. Modelling

3.   LPB ——————————————————— HPB
      Work for   Have expensive
   Insurance Company   car, play golf, etc

4. We suggest something like these:

   a. On completing this course, the student will be able to:
      (i) Define a tropical cyclone
      (ii) Identify as TRUE or FALSE, statements concerning
           the general weather conditions and phenomena that
           occur within the passage of a typical cyclone.
      (iii) Describe the Human material resources that are
           likely to be needed in the wake of a cyclone
           devastation in populated Pacific Island regions. etc.

   b. If students achieve specified performance targets (length
      of time on task; quality of work, etc).
      - Go to the library and read material of their
        own choice for one period.
      - Go home one period earlier in the afternoon, etc.

   c. A desire to become informed and show a concern for environmental
      and economic conditions in the Pacific Islands. This may be
      manifested in a variety of ways, from reading news items, pur-
      chasing books and periodicals to offering hospitality and actually
      planning to visit the Island nations, etc.

5. a. Approach   Positive
   b. Approach   Negative

NOW COMPLETE THE FINAL QUESTION.

SELF RATING SCALE

Instructions
<u>Instructions</u>

This test is concerned with measuring how much YOU think you know
about two tasks; Standard Deviations and Behavioural Learning
Theory. You are asked to give yourself a rating similar to that
which you would expect to get if you were given a test on the
subject matter. For each question you are asked to rate yourself
from 0 to 100 by putting a tick on the scale at the point about
which you would expect to score on the test. This is the 'Tens
Scale'. When you've done that, there is a second scale, the 'Units
Scale'. The numbers in it represent the units from the 'tens box'
in which you will have put your tick. Put another tick in this scale.
It will show whether your estimate falls nearer the *top* or *bottom*
end of the 'tens box'.

1.   If you were given a set of figures and asked to find the
      MEAN, MEDIAN and MODE, what do you think your score would
      be for the task?

      If you think it would be *easy* to do, and you would have
      little difficulty in getting the correct answers, your
      tick should go to the top half of the scale (51-100).
      If you think it would be *difficult* to do and you would
      have trouble in getting the correct answers, your tick
      should go to the bottom half of the scale (0-49).
      Please do this now.

                              TENS SCALE

                              [   ]   91-100
                              [   ]   81-90
              EASY   [   ]   71-80
                              [   ]   61-70
                              [   ]   51-60

                              [   ]   50

                              [   ]   40-49
                              [   ]   30-39
              DIFFICULT   [   ]   20-29
                              [   ]   10-19
                              [   ]   0-9

      Now show whether your 'ease' or 'difficulty' falls nearer
      the lower or higher ends of the 'units box'. Do this on
      the 'Units Scale'.

                              UNITS SCALE

        [0 | 1]   [2 | 3]   [4 | 5]   [6 | 7]   [8 | 9]

2.   A class of 25 children has been given a reading test. You
      are asked to calculate the STANDARD DEVIATION using
      ungrouped data. The statistical formula is given. How
      well do you think you could do the task.

TENS SCALE

	[ ]	91-100
	[ ]	81-90
WELL	[ ]	71-80
	[ ]	61-70
	[ ]	51=60
	[ ]	50
	[ ]	40-49
	[ ]	30-39
NOT SO WELL	[ ]	20-29
	[ ]	10-19
	[ ]	0-9

UNITS SCALE

| 0 | 1 | | 2 | 3 | | 4 | 5 | | 6 | 7 | | 8 | 9 |

3.   Using reinforcement theory, show how you would increase the
      probability of a desired response being made when you want
      it. Could you do this successfully, or unsuccessfully?

TENS SCALE

	[ ]	91-100
	[ ]	81-90
SUCCESSFUL	[ ]	71-80
	[ ]	61-70
	[ ]	51-60
	[ ]	50
	[ ]	40-49
	[ ]	30-39
UNSUCCESSFUL	[ ]	20-29
	[ ]	10-19
	[ ]	0-9

UNITS SCALE

| 0 | 1 | | 2 | 3 | | 4 | 5 | | 6 | 7 | | 8 | 9 |

4. From two examples of behaviour, identify which is
'operant' and which is 'respondent'.

If you know a lot about the subject your tick should be somewhere
in the top half of the scale, if you know little, it should be in
the bottom half.

TENS SCALE

A LOT
[ ] 91-100
[ ] 81-90
[ ] 71-80
[ ] 61-70
[ ] 51-60

[ ] 50

LITTLE
[ ] 40-49
[ ] 30-39
[ ] 20-29
[ ] 10-19
[ ] 0-9

UNITS SCALE

[0 | 1]   [2 | 3]   [4 | 5]   [6 | 7]   [8 | 9]

5. From an example of behavioural conditioning, identify the 4
important conditioning properties.

Rate yourself in terms of how much or how little you know.

TENS SCALE

A LOT
[ ] 91-100
[ ] 81-90
[ ] 71-80
[ ] 61-70
[ ] 51-60

[ ] 50

LITTLE
[ ] 40-49
[ ] 30-39
[ ] 20-29
[ ] 10-19
[ ] 0-9

UNITS SCALE

[0 | 1]   [2 | 3]   [4 | 5]   [6 | 7]   [8 | 9]

6. Write the behavioural sequence of a simple task by
    identifying its Stimulus-Response properties.

    Rate yourself in terms of how well, or how poorly
    you think you could do the task.

TENS SCALE

	[ ]	91-100
	[ ]	81-90
WELL	[ ]	71-80
	[ ]	61-70
	[ ]	51-60
	[ ]	50
	[ ]	40-49
	[ ]	30-39
POORLY	[ ]	20-29
	[ ]	10-19
	[ ]	0-9

UNITS SCALE

[0 | 1]   [2 | 3]   [4 | 5]   [6 | 7]   [8 | 9]

7. To a number of given situations, show how you would use
    reinforcement to establish, and then maintain behaviour.

    How well could you do this task?

TENS SCALE

	[ ]	91-100
	[ ]	81-90
WELL	[ ]	71-80
	[ ]	61-70
	[ ]	51-60
	[ ]	50
	[ ]	40-49
	[ ]	30-39
POORLY	[ ]	20-29
	[ ]	10-19
	[ ]	0-9

UNITS SCALE

[0 | 1]   [2 | 3]   [4 | 5]   [6 | 7]   [8 | 9]

8. Given a learning task: (1) State the Contingency-Management properties, and (2) Attitude factors that could be used in that task.

    Rate yourself in terms of how well or how poorly you think you would do the task.

<u>TENS SCALE</u>

	[　]	91-100
	[　]	81-90
WELL	[　]	71-80
	[　]	61-70
	[　]	51-60
	[　]	50
	[　]	40-49
	[　]	30-39
POORLY	[　]	20-29
	[　]	10-19
	[　]	0-9

<u>UNITS SCALE</u>

[0 | 1]   [2 | 3]   [4 | 5]   [6 | 7]   [8 | 9]

Name: _____

Sex: _____

APPENDIX D

STATISTICS TESTS

STANDARD DEVIATIONS

TEST A

Name: _____   Score: _____

Level: _____

1.5 In statistics, what do these symbols stand for?

a. Σ _____

b. X _____

c. N _____

2.6 Column A contains a number of statements describing various statistical terms. On the line to the left of each statement put the letter of the term that you think most closely fits the description. Column B may be used once, more than once, or not at all.

COLUMN A   COLUMN B

_____ 1. In a collection of measures, it
            is that measure which occurs most
            often.
                                                  A. Standard
                                                      deviation
_____ 2. The point of a score below which
            one half of the scores fall.

_____ 3. The score that would be assigned   B. Mean
            to each individual if the total
            for the collection were to be evenly
            divided among all individuals.   C. Median

_____ 4. The mean of the squared deviations
            from the mean.   D. Mode

_____ 5. The point in a distribution about
            which the sum of the deviations is   E. None
            zero.

_____ 6. The square root of the mean of the
            squared deviations from the mean.

_____ 7. Refers to the degree of correspondence
            or relationship between two variables.

3.6 From this distribution of scores find these measures:

    a. The mean   _____

    b. The median _____

    c. The mode   _____

        33 24 22 22 22 19 17 16 16
        15 15 14 10 10 10   9   8   6

4.7 A small class was given a test. From the raw scores below,
     calculate the mean and standard deviation. Use the formula
     given, and show your working. (Square root tables attached.)

        15 13 13 12 11 11 10   9   8   8

     Formula for standard deviation:

$$s = \sqrt{\frac{\Sigma X^2}{N} - \left(\frac{\Sigma X}{N}\right)^2}$$

    a. Put in the values for the formula $s = \sqrt{\rule{2cm}{0.4pt} - \left(\rule{1cm}{0.4pt}\right)}$

    b. Mean = _____

    c. s   = _____

SQUARE ROOTS OF NUMBERS 1—10

	0	1	2	3	4	5	6	7	8	9	Differences 1 2 3	4 5 6	7 8 9
1·0	1·000	1·005	1·010	1·015	1·020	1·025	1·030	1·034	1·039	1·044	0 1 1	2 2 3	3 4 4
1·1	1·049	1·054	1·058	1·063	1·068	1·072	1·077	1·082	1·086	1·091	0 1 1	2 2 3	3 4 4
1·2	1·095	1·100	1·105	1·109	1·114	1·118	1·122	1·127	1·131	1·136	0 1 1	2 2 3	3 4 5
1·3	1·140	1·145	1·149	1·153	1·158	1·162	1·166	1·170	1·175	1·179	0 1 1	2 2 3	3 3 4
1·4	1·183	1·187	1·192	1·196	1·200	1·204	1·208	1·212	1·217	1·221	0 1 1	2 2 2	3 3 4
1·5	1·225	1·229	1·233	1·237	1·241	1·245	1·249	1·253	1·257	1·261	0 1 1	2 2 2	3 3 4
1·6	1·265	1·269	1·273	1·277	1·281	1·285	1·288	1·292	1·296	1·300	0 1 1	2 2 2	3 3 4
1·7	1·304	1·308	1·311	1·315	1·319	1·323	1·327	1·330	1·334	1·338	0 1 1	2 2 2	3 3 3
1·8	1·342	1·345	1·349	1·353	1·356	1·360	1·364	1·367	1·371	1·375	0 1 1	1 2 2	3 3 3
1·9	1·378	1·382	1·386	1·389	1·393	1·396	1·400	1·404	1·407	1·411	0 1 1	1 2 2	3 3 3
2·0	1·414	1·418	1·421	1·425	1·428	1·432	1·435	1·439	1·442	1·446	0 1 1	1 2 2	2 3 3
2·1	1·449	1·453	1·456	1·459	1·463	1·466	1·470	1·473	1·476	1·480	0 1 1	1 2 2	2 3 3
2·2	1·483	1·487	1·490	1·493	1·497	1·500	1·503	1·507	1·510	1·513	0 1 1	1 2 2	2 3 3
2·3	1·517	1·520	1·523	1·526	1·530	1·533	1·536	1·539	1·543	1·546	0 1 1	1 2 2	2 3 3
2·4	1·549	1·552	1·556	1·559	1·562	1·565	1·568	1·572	1·575	1·578	0 1 1	1 2 2	2 3 3
2·5	1·581	1·584	1·587	1·591	1·594	1·597	1·600	1·603	1·606	1·609	0 1 1	1 2 2	2 3 3
2·6	1·612	1·616	1·619	1·622	1·625	1·628	1·631	1·634	1·637	1·640	0 1 1	1 2 2	2 3 3
2·7	1·643	1·646	1·649	1·652	1·655	1·658	1·661	1·664	1·667	1·670	0 1 1	1 2 2	2 2 3
2·8	1·673	1·676	1·679	1·682	1·685	1·688	1·691	1·694	1·697	1·700	0 1 1	1 1 2	2 2 3
2·9	1·703	1·706	1·709	1·712	1·715	1·718	1·720	1·723	1·726	1·729	0 1 1	1 1 2	2 2 3
3·0	1·732	1·735	1·738	1·741	1·744	1·746	1·749	1·752	1·755	1·758	0 1 1	1 1 2	2 2 3
3·1	1·761	1·764	1·766	1·769	1·772	1·775	1·778	1·780	1·783	1·786	0 1 1	1 1 2	2 2 3
3·2	1·789	1·792	1·794	1·797	1·800	1·803	1·806	1·808	1·811	1·814	0 1 1	1 1 2	2 2 2
3·3	1·817	1·819	1·822	1·825	1·828	1·830	1·833	1·836	1·838	1·841	0 1 1	1 1 2	2 2 2
3·4	1·844	1·847	1·849	1·852	1·855	1·857	1·860	1·863	1·865	1·868	0 1 1	1 1 2	2 2 2
3·5	1·871	1·873	1·876	1·879	1·881	1·884	1·887	1·889	1·892	1·895	0 1 1	1 1 2	2 2 2
3·6	1·897	1·900	1·903	1·905	1·908	1·910	1·913	1·916	1·918	1·921	0 1 1	1 1 2	2 2 2
3·7	1·924	1·926	1·929	1·931	1·934	1·936	1·939	1·942	1·944	1·947	0 1 1	1 1 2	2 2 2
3·8	1·949	1·952	1·954	1·957	1·960	1·962	1·965	1·967	1·970	1·972	0 1 1	1 1 2	2 2 2
3·9	1·975	1·977	1·980	1·982	1·985	1·987	1·990	1·992	1·995	1·997	0 1 1	1 1 2	2 2 2
4·0	2·000	2·002	2·005	2·007	2·010	2·012	2·015	2·017	2·020	2·022	0 0 1	1 1 1	2 2 2
4·1	2·025	2·027	2·030	2·032	2·035	2·037	2·040	2·042	2·045	2·047	0 0 1	1 1 1	2 2 2
4·2	2·049	2·052	2·054	2·057	2·059	2·062	2·064	2·066	2·069	2·071	0 0 1	1 1 1	2 2 2
4·3	2·074	2·076	2·078	2·081	2·083	2·086	2·088	2·090	2·093	2·095	0 0 1	1 1 1	2 2 2
4·4	2·098	2·100	2·102	2·105	2·107	2·110	2·112	2·114	2·117	2·119	0 0 1	1 1 1	2 2 2
4·5	2·121	2·124	2·126	2·128	2·131	2·133	2·135	2·138	2·140	2·142	0 0 1	1 1 1	2 2 2
4·6	2·145	2·147	2·149	2·152	2·154	2·156	2·159	2·161	2·163	2·166	0 0 1	1 1 1	2 2 2
4·7	2·168	2·170	2·173	2·175	2·177	2·179	2·182	2·184	2·186	2·189	0 0 1	1 1 1	2 2 2
4·8	2·191	2·193	2·195	2·198	2·200	2·202	2·205	2·207	2·209	2·211	0 0 1	1 1 1	2 2 2
4·9	2·214	2·216	2·218	2·220	2·223	2·225	2·227	2·229	2·232	2·234	0 0 1	1 1 1	2 2 2
5·0	2·236	2·238	2·241	2·243	2·245	2·247	2·249	2·252	2·254	2·256	0 0 1	1 1 1	2 2 2
5·1	2·258	2·261	2·263	2·265	2·267	2·269	2·272	2·274	2·276	2·278	0 0 1	1 1 1	2 2 2
5·2	2·280	2·283	2·285	2·287	2·289	2·291	2·293	2·296	2·298	2·300	0 0 1	1 1 1	2 2 2
5·3	2·302	2·304	2·307	2·309	2·311	2·313	2·315	2·317	2·319	2·322	0 0 1	1 1 1	2 2 2
5·4	2·324	2·326	2·328	2·330	2·332	2·335	2·337	2·339	2·341	2·343	0 0 1	1 1 1	1 2 2

TEST C

Name: _____   Raw Score: _____

(code number)   Level: _____

A. If a term in the left hand column accurately describes a statement
    in the right hand column, enter the *number* of that term in the
    brackets after the relevant statement. If there is no such term
    in the left hand list that fits, write NONE in the backets.

                                    The sum of the measures divided
                                    by the number of the measures.

                                              [   ]

                                    Indicates a particular measurement's
                                    position in a group in terms of the
1. Standard deviation   percentage of measurements falling
                                    below it.

                                              [   ]

2. Mode

                                    The measures which occur most often
                                    in a collection of measures.
3. Median
                                              [   ]

4. Mean   Is an expression of a score's
                                    distance above or below the mean
                                    for the group of which it is a part.

                                              [   ]

                                    A point on the score scale below
                                    which one-half of the scores fall.

                                              [   ]

                                    A measure of average distance of
                                    individual scores in a distribution
                                    from the mean; technically, the
                                    square root of variance.

                                              [   ]

B.   From the following collection of scores

$$9 \quad 8 \quad 8 \quad 7 \quad 6 \quad 5 \quad 5 \quad 5 \quad 4 \quad 3$$

1.   Calculate the mean.   _____

2.   Calculate the median.   _____

3.   Determine the mode.   _____

4.   Complete this formula.   _____

$$S = \sqrt{\frac{\Sigma X^2}{N} - \left(\frac{\Sigma X}{N}\right)^2} \qquad\qquad S = \sqrt{\underline{\quad\quad} - \left(\frac{\quad}{\quad}\right)}$$

5.   Calculate the standard deviation.   _____

(Use the Table of Square Roots at the back
of this test. Make all your calculations
on this page.)

C.   The following figures were obtained from an end-of-term test.

$$
\begin{array}{cccccccc}
9 & 10 & 10 & 10 & 11 & 13 & 15 & 17 \\
17 & 19 & 21 & 24 & 25 & 25 & 24 & 25 \\
25 & 25 & 25 & 28 & 28 & 28 & 28 & 28 \\
30 & 30 & 30 & 31 & 33 & 33 & 33 & 37 \\
37 & 37 & 38 & 38 & 39 & 40 & 48 & 50
\end{array}
$$

1.   Construct a frequency distribution table.

2.   Complete this formula.

$$\bar{X} = M' + \frac{\Sigma f x'}{N} \quad (i) \qquad\qquad \bar{X} = \underline{\quad} + \frac{\quad}{\quad} (\quad)$$

3.   Complete this formula.

$$s = i\sqrt{\frac{\Sigma f x'^2}{N} - \left(\frac{\Sigma f x}{N}\right)^2} \qquad s = \sqrt{\frac{\quad}{\quad} - \frac{\quad}{\quad} - \left(\frac{\quad}{\quad}\right)}$$

4.   Calculate the mean from the grouped data.

_____

5.   Calculate the standard deviation from the grouped data.

_____

   (Use the Table of Square Roots on the next
   page. Question 1 should be worked on this
   page. Other calculations may be worked
   on the back of this page.)

SQUARE ROOTS OF NUMBERS 1—10

	0	1	2	3	4	5	6	7	8	9	Differences								
											1	2	3	4	5	6	7	8	9
1.0	1.000	1.005	1.010	1.015	1.020	1.025	1.030	1.034	1.039	1.044	0	1	1	2	2	3	3	4	4
1.1	1.049	1.054	1.058	1.063	1.068	1.072	1.077	1.082	1.086	1.091	0	1	1	2	2	3	3	4	4
1.2	1.095	1.100	1.105	1.109	1.114	1.118	1.122	1.127	1.131	1.136	0	1	1	2	2	3	3	4	4
1.3	1.140	1.145	1.149	1.153	1.158	1.162	1.166	1.170	1.175	1.179	0	1	1	2	2	3	3	3	4
1.4	1.183	1.187	1.192	1.196	1.200	1.204	1.208	1.212	1.217	1.221	0	1	1	2	2	2	3	3	4
1.5	1.225	1.229	1.233	1.237	1.241	1.245	1.249	1.253	1.257	1.261	0	1	1	2	2	2	3	3	4
1.6	1.265	1.269	1.273	1.277	1.281	1.285	1.288	1.292	1.296	1.300	0	1	1	2	2	2	3	3	4
1.7	1.304	1.308	1.311	1.315	1.319	1.323	1.327	1.330	1.334	1.338	0	1	1	2	2	2	3	3	3
1.8	1.342	1.345	1.349	1.353	1.356	1.360	1.364	1.367	1.371	1.375	0	1	1	1	2	2	3	3	3
1.9	1.378	1.382	1.386	1.389	1.393	1.396	1.400	1.404	1.407	1.411	0	1	1	1	2	2	3	3	3
2.0	1.414	1.418	1.421	1.425	1.428	1.432	1.435	1.439	1.442	1.446	0	1	1	1	2	2	2	3	3
2.1	1.449	1.453	1.456	1.459	1.463	1.466	1.470	1.473	1.476	1.480	0	1	1	1	2	2	2	3	3
2.2	1.483	1.487	1.490	1.493	1.497	1.500	1.503	1.507	1.510	1.513	0	1	1	1	2	2	2	3	3
2.3	1.517	1.520	1.523	1.526	1.530	1.533	1.536	1.539	1.543	1.546	0	1	1	1	2	2	2	3	3
2.4	1.549	1.552	1.556	1.559	1.562	1.565	1.568	1.572	1.575	1.578	0	1	1	1	2	2	2	3	3
2.5	1.581	1.584	1.587	1.591	1.594	1.597	1.600	1.603	1.606	1.609	0	1	1	1	2	2	2	3	3
2.6	1.612	1.616	1.619	1.622	1.625	1.628	1.631	1.634	1.637	1.640	0	1	1	1	2	2	2	3	3
2.7	1.643	1.646	1.649	1.652	1.655	1.658	1.661	1.664	1.667	1.670	0	1	1	1	2	2	2	3	3
2.8	1.673	1.676	1.679	1.682	1.685	1.688	1.691	1.694	1.697	1.700	0	1	1	1	1	2	2	2	3
2.9	1.703	1.706	1.709	1.712	1.715	1.718	1.720	1.723	1.726	1.729	0	1	1	1	1	2	2	2	3
3.0	1.732	1.735	1.738	1.741	1.744	1.746	1.749	1.752	1.755	1.758	0	1	1	1	1	2	2	2	3
3.1	1.761	1.764	1.766	1.769	1.772	1.775	1.778	1.780	1.783	1.786	0	1	1	1	1	2	2	2	3
3.2	1.789	1.792	1.794	1.797	1.800	1.803	1.806	1.808	1.811	1.814	0	1	1	1	1	2	2	2	2
3.3	1.817	1.819	1.822	1.825	1.828	1.830	1.833	1.836	1.838	1.841	0	1	1	1	1	2	2	2	2
3.4	1.844	1.847	1.849	1.852	1.855	1.857	1.860	1.863	1.865	1.868	0	1	1	1	1	2	2	2	2
3.5	1.871	1.873	1.876	1.879	1.881	1.884	1.887	1.889	1.892	1.895	0	1	1	1	1	2	2	2	2
3.6	1.897	1.900	1.903	1.905	1.908	1.910	1.913	1.916	1.918	1.921	0	1	1	1	1	2	2	2	2
3.7	1.924	1.926	1.929	1.931	1.934	1.936	1.939	1.942	1.944	1.947	0	1	1	1	1	2	2	2	2
3.8	1.949	1.952	1.954	1.957	1.960	1.962	1.965	1.967	1.970	1.972	0	1	1	1	1	2	2	2	2
3.9	1.975	1.977	1.980	1.982	1.985	1.987	1.990	1.992	1.995	1.997	0	1	1	1	1	2	2	2	2
4.0	2.000	2.002	2.005	2.007	2.010	2.012	2.015	2.017	2.020	2.022	0	0	1	1	1	1	2	2	2
4.1	2.025	2.027	2.030	2.032	2.035	2.037	2.040	2.042	2.045	2.047	0	0	1	1	1	1	2	2	2
4.2	2.049	2.052	2.054	2.057	2.059	2.062	2.064	2.066	2.069	2.071	0	0	1	1	1	1	2	2	2
4.3	2.074	2.076	2.078	2.081	2.083	2.085	2.088	2.090	2.093	2.095	0	0	1	1	1	1	2	2	2
4.4	2.098	2.100	2.102	2.105	2.107	2.110	2.112	2.114	2.117	2.119	0	0	1	1	1	1	2	2	2
4.5	2.121	2.124	2.126	2.128	2.131	2.133	2.135	2.138	2.140	2.142	0	0	1	1	1	1	2	2	2
4.6	2.145	2.147	2.149	2.152	2.154	2.156	2.159	2.161	2.163	2.166	0	0	1	1	1	1	2	2	2
4.7	2.168	2.170	2.173	2.175	2.177	2.179	2.182	2.184	2.186	2.189	0	0	1	1	1	1	2	2	2
4.8	2.191	2.193	2.195	2.198	2.200	2.202	2.205	2.207	2.209	2.211	0	0	1	1	1	1	2	2	2
4.9	2.214	2.216	2.218	2.220	2.223	2.225	2.227	2.229	2.232	2.234	0	0	1	1	1	1	2	2	2
5.0	2.236	2.238	2.241	2.243	2.245	2.247	2.249	2.252	2.254	2.256	0	0	1	1	1	1	2	2	2
5.1	2.258	2.261	2.263	2.265	2.267	2.269	2.272	2.274	2.276	2.278	0	0	1	1	1	1	2	2	2
5.2	2.280	2.283	2.285	2.287	2.289	2.291	2.293	2.296	2.298	2.300	0	0	1	1	1	1	2	2	2
5.3	2.302	2.304	2.307	2.309	2.311	2.313	2.315	2.317	2.319	2.322	0	0	1	1	1	1	2	2	2
5.4	2.324	2.326	2.328	2.330	2.332	2.335	2.337	2.339	2.341	2.343	0	0	1	1	1	1	1	2	2

WEIGHTING GUIDE

STANDARD DEVIATION TESTS B AND C

ITEM	SUB-ITEM	VALUE	TOTAL
A	1 - 6	1	6
B	1 - 3	1	3
	4 - 5	2	4
C	1	5	5
	2 - 5	2	8

Maximum Total 26

NOTE:

1.   Value of 2: Score 2 for completely correct answer:
     score 1 for partial correct.

2.   Value of 5: Score 1 mark each for correct completion
     of columns A, C, D, E and F.

QEA

Name: _____
(Code)

STUDENT ATTITUDE TOWARD STUDYING A PROGRAMMED

COURSE IN STATISTICS

G.J.F. Hunt

STUDENT ATTITUDE TOWARD STUDYING A PROGRAMMED

COURSE IN STATISTICS

This is not a test of information; therefore, there is no one "right" answer to a question. I am interested in your opinion of each of the statements below. Your opinion will be strictly confidential. Do not hesitate to put down exactly how you feel about each item.

Place a cross (X) on the Questionnaire Sheet beside the number that corresponds to the response that MOST NEARLY REPRESENTS YOUR REACTION TO EACH OF THE STATEMENTS BELOW. Your co-operation is very much appreciated.

1. There seemed to be too much material to be learned in each of the standard deviation exercises.

1	2	3	4	5
All the time	Most of the time	Some of the time	Only occasionally	Never

2. I felt challenged to do well by the standard deviation programme.

5	4	3	2	1
All the time	Most of the time	Some of the time	Only occasionally	Never

3. I would have preferred studying only the exercises in each objective that I felt I needed to.

5	4	3	2	1
Strongly agree	Agree	Uncertain	Disagree	Strongly disagree

4. I found it difficult to understand just what the standard deviation programme was all about.

1	2	3	4	5
Strongly agree	Agree	Uncertain	Disagree	Strongly disagree

5. For me, an important feature of instructional programmes is that you know how well you are doing all the time.

5	4	3	2	1
Strongly agree	Agree	Uncertain	Disagree	Strongly disagree

6. The exercise in the standard deviation programme covered a lot of subject matter I already knew.

1	2	3	4	5
All the time	Most of the time	Some of the time	Only occasionally	Never

7. I just wanted to get through the programme as quickly as possible, even if I made a lot of mistakes.

1	2	3	4	5
Strongly agree	Agree	Uncertain	Disagree	Strongly disagree

8. I found the exercises in the standard deviation programme easy to learn.

5	4	3	2	1
All the time	Most of the time	Some of the time	Only occasionally	Never

9. The amount of material to be learned in each of the standard deviation exercises was about right.

5	4	3	2	1
In every exercise	In most exercises	In some exercises	In the occasional exercise	In no exercise

10. I would have preferred to engage in some recreational activity, rather than study this programme.

1	2	3	4	5
Strongly agree	Agree	Uncertain	Disagree	Strongly disagree

11. I really wanted to understand the computational procedures in standard deviation.

5	4	3	2	1
Very much	Quite a bit	Indifferent	A little bit	Not at all

12. It's better to work through a programme carefully, and understand it completely, than to dash through and only know parts of it.

5	4	3	2	1
Strongly agree	Agree	Uncertain	Disagree	Strongly disagree

13. I work better when I know that each assignment will be assessed and credited towards my total year's performance.

1	2	3	4	5
Strongly agree	Agree	Uncertain	Disagree	Strongly disagree

14. If I couldn't get the correct answer to a question, I "peeked" ahead to the Right Answer page.

1	2	3	4	5
All the time	Most of the time	Some of the time	Only occasionally	Never

15. I couldn't work out a standard deviation because the programme just didn't give me sufficient information on how to do it.

1	2	3	4	5
Strongly agree	Agree	Uncertain	Disagree	Strongly disagree

16. I knew whether my answers were correct or not before I was told.

5	4	3	2	1
Always	Often	Occasionally	Seldom	Never

17. I would have preferred the programme to have been less well structured, even if it meant I made more mistakes.

5	4	3	2	1
Strongly agree	Agree	Uncertain	Disagree	Strongly disagree

18. The harder the exercise, the more I enjoyed it.

5	4	3	2	1
Strongly agree	Agree	Uncertain	Disagree	Strongly disagree

19. I could have achieved the standard deviation programme's objectives with only a fraction of the exercises given.

5	4	3	2	1
Strongly agree	Agree	Uncertain	Disagree	Strongly disagree

20. Being told I was correct was monotonous.

1	2	3	4	5
All the time	Most of the time	Some of the time	Only occasionally	Never

21. If I didn't get the right answer fairly quickly, I began to feel uneasy.

1	2	3	4	5
Always	Often	Occasionally	Seldom	Never

22. I found myself trying to get through the material rather than trying to learn.

1	2	3	4	5
All the time	Most of the time	Some of the time	Only occasionally	Never

23. Programmed Learning is just not for me.

1	2	3	4	5
Strongly agree	Agree	Uncertain	Disagree	Strongly disagree

24. I don't worry if learning becomes boring, just so long as I know I'm succeeding.

5	4	3	2	1
Strongly agree	Agree	Uncertain	Disagree	Strongly disagree

25. The programme aroused my interest in statistics enough to make me want to study it some more.

5	4	3	2	1
Strongly agree	Agree	Uncertain	Disagree	Strongly disagree

APPENDIX E

LEARNING THEORY TESTS

A BEHAVIOURAL APPROACH TO LEARNING

TEST A

Name: _____   Raw Score: _____

(Code Number)   Level: _____

1. (1.6) Tick the alternative MOST correct.

    The consequences from behaviour:

    a. Usually act as an aversive stimuli to the individual.

    b. Affect the probability that the response will recur.

    c. Must be of an overt nature to be important in learning.

    d. Although of initial importance, are of little value in predicting long term behaviour.

2. (1.7) Place the letter in colum B alongside the statement that most closely fits it in column A. Column B may be used once, or more than once.

    COLUMN A   COLUMN B

    _____ 1. Results in unpredictable behaviour.

    _____ 2. Increases the likelihood   a. Reinforcement
               that previous behaviour
               will recur.   b. Non-reinforcement

    _____ 3. Ensures that undesired   c. Punishment
               behaviour will not recur.
                                                d. None of the alternatives
    _____ 4. Decreases the likelihood
               that previous behaviour
               will recur.

    _____ 5. Is the opposite to rein-
               forcement.

3. (2.5) Write either 'O' for overt, or 'C' for covert behaviour.

    _____ 1. Watching the numbers 2 7 6 appear on a calculator screen.
    _____ 2. Exhaling into a breathalyser tube.
    _____ 3. Listening to the NZBC orchestra.
    _____ 4. Feeling 'good'.

4. (2.6) State each as either Respondent or Operant behaviour.

_____ 1. The most typical of human behaviour.
_____ 2. Sneezing.
_____ 3. Saying 'ninety-nine'.

5. (3.6) The smallest meaningful unit of behaviour is:

a. A stimulus
b. A response   *(Tick the appropriate one)*
c. A behavioural step
d. An S-R chain

6. (3.7) In a conditioning experiment, when a new stimulus, which has been paired to an old stimulus, but now acts as a stimulus in its own right, it is called the?

a. R
b. NS
c. UCS
d. CS

7. (4.6) From the following list, write in their *correct descending order*, the three levels at which behaviour can be QUANTIFIED.

                                    objective
a. _____   stimulus
b. _____   task
c. _____   response
                                    step

8. (4.7) Use the appropriate symbols to complete this behavioural sequence. R, S^O, UCR, S^R, CS, C^R.

Telephone rings ⟶ Pick up receiver ⟶ Hear voice
   (_____)   (_____)   (_____)

9. (5.7) Tick as either TRUE or FALSE the following statements on reinforcing behaviour.

    1. Continuous reinforcement should be used in maintaining behaviour.   T   F

    2. Punishment is the opposite or non-reinforcement.   T   F

    3. Reinforcement is more effective the sooner it follows the desired response in new behaviour.   T   F

    4. Every response should be reinforced.   T   F

    5. Intermittent reinforcement should only be used on established behaviour.   T   F

10. (5.7) Which one of the following best describes the principle of "shaping".

    a. Continuously reinforcing any approximation toward criterion behaviour.

    b. Reinforcing criterion behaviour.

    c. Reinforcing successively higher approximations of criterion behaviour.

    d. Intermittently reinforcing approximations toward criterion behaviour.

11. (5.6) Column A contains a list of characteristics of schedules of reinforcement. On the line to the left of each statement, put the letter of the schedule of reinforcement in column B that best fits the statement. Items in column B may be used once, more than once, or not at all.

               COLUMN A   COLUMN B

    _____ 1. Paying a factory worker
               $5.00 for every 10 shirts   A. Fixed ratio
               sewn.
                                                 B. Fixed interval
    _____ 2. Every essay is graded "A"
                                                 C. Continuous
    _____ 3. A slot machine player.
                                                 D. Variable ratio
    _____ 4. A salary of $5,250 a year.
                                                 E. Variable interval
    _____ 5. Providing encouraging
               comments during the course
               of a driving lesson.

315

12. (6.7) Tick as either TRUE or FALSE the following statements about attitudes.

    1. Reinforcing behaviour is approach behaviour. T F

    2. The consequences of avoidance behaviour are always negative. T F

    3. Approach behaviour can either be positive or negative. T F

    4. One should only teach a child approach behaviours. T F

    5. Questions of morality are essentially questions dealing with avoidance behaviour. T F

13. (6.7) The abbreviated letters represent various types of behaviour. Read the following instructions that were given to a class, and state which one of the sets would be the most appropriate in describing this behaviour.

    "Complete your review of literature on Early Maori Settlements, then make your own way to a location of your choice and study for 3 days the remnants of a Maori settlement."

    a. RCB-UCB

    b. LPB-HPB

    c. NegB-PosB

    d. AppB-Av.B

14. (6.7) C-M is a very useful technique:

    a. It makes all desired behaviour contingent upon intrinsic motivation.

    b. It helps you in classroom management to eliminate undesired or inappropriate behaviour.

    c. It makes a person's preferential behaviour contingent upon satisfying the objectives set for him.

    d. For clearly motivating any behaviour that can be seen as an approximation toward the criterion behaviour.

A BEHAVIOURAL APPROACH TO LEARNING

TEST C

Name: _____   Raw Score: _____

                                            Level: _____

1. John loves sport, but is less enthusiastic about other class
    activities. Right now the class is engaged in a social studies
    project. John is noisy and disruptive.

    A. Describe the behavioural *consequences* resulting from your
        efforts in each of the following examples.

        a. You have been shouting at him at least 15 times in
            the last 15 minutes. You now tell him to leave the
            room and not to return until the end of class. He
            leaves.

        b. You pay no attention to his (inappropriate) behaviour.
            You encourage whatever positive behaviour he demonstrates
            towards the project activity.

        c. You tell John that you want him to stop disturbing the
            class. If he doesn't stop you will ask him to leave
            the room until he is ready to participate positively
            with the rest of the group. He continues his
            (inappropriate) behaviour, so you ask him to leave until
            he is ready to participate positively.

    B. Name, in the above order, the three sorts of behaviour you
        have used.

        a. _____

        b. _____

        c. _____

2. There are two types of behaviour, voluntary and involuntary. Look at these examples and give the *correct technical name* to the type of behaviour that each is illustrating.

    a. A doctor taps your knee with a hammer, your leg jerks forward.
        _____

    b. A new born baby has a hungry feeling and cries. He feels food flowing into him, and stops crying.

        _____

    c. While Bronwyn's toddler was on a voyage of discovery, he found out that when he lifted the lid of his mother's jewellery box, a tune played. Now he regularly goes and lifts the lid.
        _____

3. The hassle of every day life, forces us, whether we like it or not, to respond in a "conditioned" way to all sorts of stimuli. For instance, if we are driving a car and we see a green traffic light turn red, a highly probable response is that we will take our foot off the accelerator and start applying the brakes.

    a. To the experienced driver, what is the technical term that can be given to the red traffic light? (Use abbreviations)
        _____

    b. To the same driver, what is the technical term that describes his action of depressing the brake pedal?

        _____

    c. What would be the technical term for the red light to "a man from mars" (i.e., someone who had never seen a red traffic light before)?
        _____

4.   For the *task*, "make buttered toast":

     a.   List the *steps*   _____

                                     _____

                                     _____

                                     _____

     b.   Write a behavioural sequence using the technical abbreviations
          for the stimulus and response properties of the sequence.

5.   You are teaching "Introductory Oral Spanish" in a language
     laboratory. You want your student to give the correct answer
     with proper pronunciation to 10 questions that you will ask
     him. You decide that saying "bueno" (good) will be adequate
     reinforcement.

     A.   At his first attempt to question 1, he makes the correct
          response, but with poor pronunciation. What do you do?

          [ ]   a. You say "bueno"
          [ ]   b. You say "do better next time"
          [ ]   c. You say nothing

     B.   You repeat the response and ask him a similar question. He
          makes the correct response, but with poor communication. What
          do you do?

          [ ]   a. You say "bueno"
          [ ]   b. You say "do better next time"
          [ ]   c. You say nothing

C.   You repeat the response and ask him a similar question. He makes the correct response with proper pronunciation. What do you do?

        [   ]   a. You say "bueno"
        [   ]   b. You say "do better next time"
        [   ]   c. You say nothing

D.   What is the technical name given to this process of establishing behaviour?

                        _____

E.   How does maintaining behaviour differ from establishing behaviour in respect to the application of reinforcement?

        _____

6.   You are asked to apply some of your knowledge on Contingency-Management with a Form 1 class. The teacher is very experienced and has taken over the class because of its reputation for being "difficult". The "off task" behaviour demonstrated by the class includes getting up and wandering about the room, stopping to chat with, and consequently disrupting, friends. The "on task" behaviour you wish to effect is children staying in their seats without moving their chairs and desks about the room, and working at the task they have been given. This behaviour must be demonstrated for at least 20 minutes at a time.

You have been given each afternoon (when the behaviour problem is at its worst) for one week to initiate a C-M procedure and effect a significant behavioural change in the class.

a.   State the LPB you wish to see demonstrated.

b.   State the HPB(s) you could use.

c.   What are the long term behaviours you wish to see demonstrated by the children?

d.   From your answer to (c), what will have happened to the initial LPB - HPB's?

QEB

Name: _____

(Code)

STUDENT ATTITUDE TOWARD STUDYING A PROGRAMMED

COURSE IN LEARNING THEORY

G.J.F. Hunt

STUDENT ATTITUDE TOWARD STUDYING A PROGRAMMED

COURSE IN LEARNING THEORY

This is not a test of information; therefore, there is no one "right" answer to a question. I am interested in your opinion on each of the statements below. Your opinion will be strictly confidential. Do not hesitate to put down exactly how you feel about each item.

Place a cross (X) on the Questionnaire Sheet beside the number that corresponds to the response that MOST CLOSELY REPRESENTS YOUR REACTION TO EACH OF THE STATEMENTS BELOW. Your co-operation is very much appreciated.

1. There seemed to be too much information to be learned in each of the learning theory exercises.

1	2	3	4	5
All the time	Most of the time	Some of the time	Only occasionally	Never

2. I felt challenged to do well by the learning theory programme.

5	4	3	2	1
All the time	Most of the time	Some of the time	Only occasionally	Never

3. I would have preferred studying only the exercises in each objective that I felt I needed to.

5	4	3	2	1
Strongly agree	Agree	Uncertain	Disagree	Strongly disagree

4. I found it difficult to understand just what the learning theory programme was all about.

1	2	3	4	5
Strongly agree	Agree	Uncertain	Disagree	Strongly disagree

5. For me, an important feature of instructional programmes is that you know how well you are doing all the time.

5	4	3	2	5
Strongly agree	Agree	Uncertain	Disagree	Strongly disagree

6.   The exercises in the learning theory programme covered a lot of subject matter I already knew.

1	2	3	4	5
All the time	Most of the time	Some of the time	Only occasionally	Never

7.   I just wanted to get through the programme as quickly as possible, even if I made a lot of mistakes.

1	2	3	4	5
Strongly agree	Agree	Uncertain	Disagree	Strongly disagree

8.   I found the exercises in the learning theory programme easy to learn.

5	4	3	2	1
All the time	Most of the time	Some of the time	Only occasionally	Never

9.   The amount of material to be learned in each of the learning theory exercises was about right.

5	4	3	2	1
In every exercise	In most exercises	In some exercises	In the occasional exercise	In no exercise

10.   I would have preferred to engage in some recreational activity, rather than study this programme.

1	2	3	4	5
Strongly agree	Agree	Uncertain	Disagree	Strongly disagree

11.   I really wanted to understand the principles of behavioural learning.

1	2	3	4	5
Strongly agree	Agree	Uncertain	Disagree	Strongly disagree

12. It's better to work through a programme carefully, and understand it completely than to dash through and only know parts of it.

5	4	3	2	1
Strongly agree	Agree	Uncertain	Disagree	Strongly disagree

13. I work better when I know that each assignment will be assessed and credited towards my total year's performance.

1	2	3	4	5
Strongly agree	Agree	Uncertain	Disagree	Strongly disagree

14. If I couldn't get the correct answer to a question, I "peeked" ahead to the Right Answer page.

1	2	3	4	5
All the time	Most of the time	Some of the time	Only occasionally	Never

15. I couldn't understand the learning theory problems because the programme just didn't give me sufficient information on them.

1	2	3	4	5
Strongly agree	Agree	Uncertain	Disagree	Strongly disagree

16. I knew whether my answers were correct or not before I was told.

5	4	3	2	1
Always	Often	Occasionally	Seldom	Never

17. I would have preferred the programme to have been less well structured, even if it meant I made more mistakes.

5	4	3	2	1
Strongly agree	Agree	Uncertain	Disagree	Strongly disagree

18. The harder the exercise, the more I enjoyed it.

5	4	3	2	1
Strongly agree	Agree	Uncertain	Disagree	Strongly disagree

19. I could have achieved the learning theory programme's objectives with only a fraction of the exercises given.

5	4	3	2	1
Strongly agree	Agree	Uncertain	Disagree	Strongly disagree

20. Being told I was correct was monotonous.

1	2	3	4	5
All the time	Most of the time	Some of the time	Only occasionally	Never

21. If I couldn't get the right answer fairly quickly, I began to feel uneasy.

1	2	3	4	5
Always	Often	Occasionally	Seldom	Never

22. I found myself trying to get through the material rather than trying to learn.

1	2	3	4	5
All the time	Most of the time	Some of the time	Only occasionally	Never

23. Programmed learning is just not for me.

1	2	3	4	5
Strongly agree	Agree	Uncertain	Disagree	Strongly disagree

24. I don't worry if learning becomes boring, just so long as I know I'm succeeding.

5	4	3	2	1
Strongly agree	Agree	Uncertain	Disagree	Strongly disagree

25. The programme aroused my interest in behavioural learning enough to make me want to study it some more.

5	4	3	2	1
Strongly agree	Agree	Uncertain	Disagree	Strongly disagree

APPENDIX F

SUMMARY OF STEPWISE ANALYSIS FOR STATISTICS AND

LEARNING THEORY TESTS

SUMMARY OF STEPWISE REGRESSION ANALYSIS FOR STATISTICS TASK

Test C

Treatment	Step	Variable Entered	% of Variance	df	F
PVA	1	SRS	53	1/60	23.68**
	2	Ac	55	2/59	12.49**
	3	Test A	55	3/58	8.30**
	4	Ai	55	4/57	6.14**
PVB	1	SRS	49	1/51	16.23**
	2	Ai	53	2/50	9.88**
	3	Test A	55	3/49	7.17**
	4	Ac	56	4/48	5.46**
PVC	1	Test A	67	1/56	45.05**
	2	Ac	68	2/55	23.61**
	3	SRS	68	3/54	15.65**
PVD	1	Test A	40	1/43	8.25**
	2	Ai	46	2/42	5.58**
	3	SRS	49	3/41	4.23*
	4	Ac	51	4/40	3.43*

Note:

1. The F is the F ratio for the overall R at each step.
2. *   p<.05
3. **   p<.01
4. F in PVC step 4 was insufficient to enter.

SUMMARY OF STEPWISE REGRESSION ANALYSIS FOR STATISTICS TASK

Sa QEA

Treatment	Step	Variable Entered	% of Variance	df	F
PVA	1	SRS	47	1/60	16.80**
	2	Ac	54	2/59	12.08**
	3	Test A	54	3/58	8.00**
	4	Ai	54	4/57	5.92**
PVB	1	SRS	39	1/51	9.19*
	2	Test A	40	2/50	4.81*
	3	Ac	40	3/49	3.18*
	4	Ai	41	4/48	2.42*
PVC	1	Test A	46	1/56	15.37**
	2	SRS	49	2/55	8.82**
	3	Ac	50	3/54	6.21**
	4	Ai	51	4/53	4.63**
PVD	1	SRS	31	1/43	4.56*
	2	Ac	35	2/42	2.93
	3	Test A	35	3/41	1.95
	4	Ai	36	4/40	1.44

Note:

1. The F is the F ratio for the overall R at each step.
2. * p<.05
3. ** p<.01

SUMMARY OF STEPWISE REGRESSION ANALYSIS FOR STATISTICS TASK

Tam QEA

Treatment	Step	Variable Entered	% of Variance	df	F
PVA	1	AC	32	1/60	7.01*
	2	Ai	34	2/59	3.83*
	3	SRS	34	3/58	2.52
	4	Test A	34	4/57	1.87
PVB	1	SRS	22	1/51	2.62
	2	Ai	25	2/50	1.71
	3	Ac	40	3/49	3.16*
	4	Test A	41	4/48	2.41
PVC	1	SRS	45	1/56	14.25**
	2	Ai	49	2/55	8.78**
	3	Test A	50	3/54	5.97**
	4	Ac	50	4/53	4.49**
PVD	1	Ac	40	1/43	8.47**
	2	Ai	46	2/42	5.55**
	3	Test A	47	3/41	3.84*
	4	SRS	48	4/40	2.99*

Note:

1. The F is the F ratio for the overall R at each step.
2. * p<.05
3. ** p<.01

SUMMARY OF STEPWISE REGRESSION ANALYSIS FOR

LEARNING THEORY TASK

Test C

Treatment	Step	Variable Entered	% of Variance	df	F
PVA	1	Ac	.28	1/64	5.31**
	2	SRS	.31	2/63	3.39*
	3	Test A	.32	3/62	2.32
	4	Ai	.32	4/61	1.72
PVB	1	Ac	.35	1/64	9.15**
	2	Test A	.37	2/63	4.90*
	3	Ai	.37	3/62	3.31*
	4	SRS	.38	4/61	2.51*
PVC	1	Test A	.46	1/72	19.49**
	2	Ai	.59	2/71	18.69**
	3	SRS	.59	3/70	12.30**
PVD	1	Test A	.42	1/64	13.65**
	2	Ai	.50	2/63	10.28**
	3	SRS	.52	3/62	7.82**
	4	Ac	.53	4/61	5.84**

Note:

1. The F is the F ratio for the overall R at each step.
2. * $p<.05$
3. ** $p<.01$
4. F in PVC step 4 was insufficient to enter.

SUMMARY OF STEPWISE REGRESSION ANALYSIS FOR

LEARNING THEORY TASK

Sa QEB

Treatment	Step	Variable Entered	% of Variance	df	F
PVA	1	Ac	.21	1/64	2.88
	2	SRS	.23	1/63	1.80
	3	Ai	.24	1/62	1.21
	4	Test A	.24	1/61	.91
PVB	1	Test A	.22	1/64	3.32*
	2	SRS	.36	2/63	4.62*
	3	Ai	.40	3/62	3.88*
	4	Ac	.40	4/61	2.92*
PVC	1	Ai	.23	1/72	3.96
	2	Test A	.27	2/71	2.90
	3	SRS	.28	3/70	2.06
	4	Ac	.29	4/69	1.61
PVD	1	Test A	.40	1/64	12.39**
	2	Ai	.42	2/63	6.92**
	3	Ac	.43	3/62	4.75**
	4	SRS	.43	4/61	3.51*

Note:

1. The F is the F ratio for the overall R at each step.
2. * p<.05
3. ** p<.01

SUMMARY OF STEPWISE REGRESSION ANALYSIS FOR

LEARNING THEORY TASK

Tam QEB

Treatment	Step	Variable Entered	% of Variance	df	F
PVA	1	Ac	.28	1/64	5.54*
	2	Test A	.30	2/63	3.06
PVB	1	Ac	.38	1/64	11.11**
	2	Ai	.47	2/63	8.85**
	3	SRS	.48	3/62	6.17**
	4	Test A	.49	4/61	4.87**
PVC	1	Ai	.40	1/72	13.42**
	2	Ac	.47	2/71	9.86**
	3	SRS	.48	3/70	7.14**
PVD	1	Ai	.23	1/64	3.70
	2	Test A	.24	2/63	1.89

Note:

1. The F is the F ratio for the overall R at each step.
2. * $p < .05$
3. ** $p < .01$
4. F in PVA Step 3 and 4 was insufficient to enter.
5. F in PVC Step 4 was insufficient to enter.
6. F in PVC Step 3 and 4 was insufficient to enter.

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