The interaction of cognitive style, text presentation style, and the effect on learning: a case for adaptive text presentation computer?

James McKee
University of Wollongong

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The interaction of cognitive style, text presentation style, and the effect on learning: A case for adaptive text presentation by computer?

A thesis submitted in fulfilment of the requirements for the award of the degree

HONOURS MASTER OF ARTS BY RESEARCH

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by

James McKee, BSc, BA(Hons)

Department of Psychology

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Abstract

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Abstract

This is an investigation into factors affecting retention of text material read for tertiary studies. There are a number of factors that researchers have used to increase depth of processing and thereby improve retention, but little has been reported as broadly useful to education. Can this be remedied by taking into account individual differences with particular emphasis given to cognitive style, and matching a student’s style with the mode of presentation?

A definition of cognitive style from Witkin Oltman Raskin and Karp (1971), is that “cognitive styles are the characteristic, self consistent modes of functioning which individuals show in their perceptual and intellectual activities”. Pizzamiglio and Zoccolotti (1986) say that a cognitive style describes the mode of information processing, rather than the level of performance.

Forty five first year psychology students were tested for cognitive style as measured by field dependence/independence. Vocabulary ability was also measured. They were then given two comprehension tests, using a personal computer to present the text and questions. The control text was presented one sentence at a time in
conventional format, while the sentences of the experimental text had each phrase on a new line.

Of the subjects that did the comprehension test, 12 were clearly field dependent, and 14 clearly field independent. The field independent group did better on the phrase rather than the control mode of presentation, this was not in the expected direction, but did support the primary proposition that mode of presentation does affect people according to their cognitive style.

The secondary line of investigation was to see if the field dependant group could be assisted in their comprehension, by adding structure to the sentence. The additional structure was attempted by separating each meaningful phrase onto a new line. With this assistance, the field dependent group were expected to perform better on the phrase, rather than the control mode of presentation. The results showed no difference in the comprehension score, so it was concluded that the phrase mode had not assisted in creating any additional structure.
Introduction

Memory retention of data can be improved by various techniques, many of these concentrate on rote memorisation. However if the increased retention of data is to be of any use in an educational setting, the data must be comprehended and integrated into existing material, and thereby made into useable information (Farr, 1987).

To improve comprehension, it is generally advisable for the presentation to be well structured (Mitchell, 1982). To improve integration the material must be presented in such a way that it easily builds on existing concepts available to the individual. The presentation rate of the material should be no faster than that which allows the individual to absorb it into existing schemas. This procedure is advocated by the mastery learning system (Lee & Pruitt, 1984). To ensure that a student does not attempt further material without understanding, the student stays with a segment of material until they can answer the requisite questions.

To avoid undue delay in the rate of presentation and to maximise the effect of structuring the material. It is advisable to take into account the learning (cognitive) style of the individual and match the presentation style accordingly. People with a field dependent cognitive style, may have difficulty with unstructured material (Witkin et al., 1977). There is discussion in the literature on
educational research, that the teaching style should be
matched with learning style to maximise the educational
setting (Riesman, 1972).

These aspects of tailoring the educational setting to
match the student, are of course very difficult to practise.
Any one aspect on its own would be difficult for a one on
one, teacher to student situation. To consider all the above
aspects in a teaching situation of one teacher to thirty or
more students would be extremely difficult. These same
difficulties must similarly hinder any educational or
psychological testing of techniques.

There is now some emphasis being placed on using
computers to monitor student progress by collating assignment
marks etc. i.e. computer managed instruction. There is also
the use of computer aided instruction which generally seems
to have no significant advantage over traditional teaching
when the educational results are examined, "the results of
studies investigating computer based learning also contribute
to the overall picture of small or trivial effects" (Spencer,
1988, p. 38).

A newer computer technique being developed is the
adoption of the attribute treatment interaction system (Bock
& Mislevy, 1982; and Bunderson, Inouye, & Olsen, 1987).
Attribute treatment interaction (ATI) is where the material
presentation rate and question difficulty is set according to
the results of progressive tests, given throughout the
presentation of the material (Rhetts, 1972). The ATI technique attempts to match presentation rate to the students prior knowledge but does not attempt to match presentation style to the student's preferred learning style, although the original hypothesis by Cronbach (1967), did incorporate modes of presentation.

Perhaps what is needed is an expert system that will control the presentation module of the computer aided lesson. The system would adapt the mode and rate of presentation according to the student's ability, and learning/cognitive style. However before we know how best to construct the expert system, we need to test the suggested presentation techniques in a controlled environment.

The foregoing ideas need to be considered as variables in a set of test procedures. The only way to control such a complex environment may be to enlist the aid of the computer. A computer program can be used to ensure a consistent and reproducible presentation mode which can be set to adapt according to the student's learning requirements.

This procedure will primarily address itself to the reading aspect of student learning. Students who need human dialogue, a teacher's flexibility of interaction, or the concrete learning environment of demonstrations and laboratory workshops, can not be easily investigated this
way. In case this was a problem in my procedure, two questions were inserted into the test sequence to ask if the subject had any difficulty with the procedure. Simulation and modelling techniques that are available, are now being explored by lesson authors using multi media computer systems to develop these other lesson types.

If it can be demonstrated that some students comprehend better and thereby retain more, because the presentation technique has been selected to match their cognitive style, it will lend emphasis to exploring other educational settings, for the effect of individual cognitive differences.

Learning

What is meant by learning? Schmeck has two definitions, firstly, "learning is an observable change in a person's reaction to an equally observable stimulus situation". Secondly, from a neurological perspective, "the process whereby the nervous system is transformed by its own activity. It is the 'tracks' left behind by thoughts" (1988, p. 4).

The learning process covers a wide range of factors including the acquisition of new motor skills e.g. riding a bike; new cognitive skills e.g. how to integrate; new data in the form of specific facts e.g. the capital of Australia is
Canberra; and new information, where items of data are related into a useable concept e.g. the realisation that lack of hygiene leads to a higher mortality rate.

Learning is a multi faceted subject with many variables interacting to effect the quality of learning process. It would be advantageous to perform a meta-analysis of all learning variables when researching a learning situation (Farr, 1987). A meta-analysis is often very complex, and a subset of variables is usually chosen. It is therefore important when choosing the subset that it be relatively self contained. For this purpose I will discuss a range of learning attributes, to obtain a perspective for this study of a chosen subset, within the overall learning framework.

For the learning process to occur, there must first be the perception of stimuli, and enough stimuli must be retained for useful processing. The processing will determine the relevance of the items of data, and if required to be kept, where to file the data in long term memory (Farr, 1987). Some of the alternative views of memory structure are discussed in the section on memory.

For the data to become meaningful information to the reader, it must be comprehended and integrated into existing knowledge, while being appropriately filed to enable later retrieval (Farr, 1987). Data must be held in short term memory for any processing to occur. The amount of processing and comprehension, will determine how well the data and
information is stored in long term memory for later retrieval. The degree of comprehension may be the way to determine how much relevant processing occurred. The question of what is meant by amount of processing, will be discussed further in the section on processing.

The particular learning process being investigated, is the acquisition of new information by the reading of text material and its comprehension. I am using the amount of comprehension as indicative of the amount of processing. The assumption is, that more relevant processing leads to better comprehension, and thereby retention of more material.

To complicate the measurement of human learning is the fact that all subjects are different. There are individual differences in the level of knowledge, in the way knowledge is applied, and the preference for a particular mode of learning. Bassett said "there is no body of research-based theory dealing with the pedagogy of individual differences. How differences among students are handled depends on the judgement of the teacher" (1978, p. 2).

Research by Pask (1988) into learning strategies and conceptual style, divided learners into serial learners and holistic learners. The serial learner works step by step, whereas the holistic learner likes to proceed by invention and discovery. Pask (1988) further divided the serial learners into two types. One will ask for guidance on which topics to follow, learning each local rule as they go, the
other only wants to follow a narrow prescribed path, learning or rather memorising in a rote fashion.

In this section on learning I will first cover perception and memory briefly and then comprehension and processing in rather more detail. This is to form a background to the area of main interest, which will be covered in the sections on improving retention, and the effect of individual differences on the learning process.

Witkin et al. refer to difficulties that people with a field dependent cognitive style have with material that is unstructured (1977). They also say that there appears to be no significant difference between people with field dependent and independent cognitive styles, in respect of general learning and memory abilities.

Authors when writing about learning differences may refer to conceptual style, learning style, or cognitive style. I have used the author's terminology when discussing their work, but I will use the term cognitive style for my discussions.

What are the cognitive processes of a field dependent person when they encounter unstructured material? There is no answer to this question advanced by Witkin et al. (1977). The origins of the field dependent/independent cognitive style, is in the field of perception, and deals with the difficulty a field dependent person has in visually isolating an element
from a complex whole (Witkin et al., 1971). Perhaps this process is for some people automatic, and for the field dependent person not so automatic, and therefore more difficult. This might mean the field dependent person has to divert cognitive resources to deal with this kind of situation.

My thesis is to explore the interaction of cognitive style, and the style of text presentation, and to highlight the effect of text structure on the retention capabilities of people with the cognitive style of field dependence. In the section on models of memory processing I will discuss the concept of levels of processing, which I suggest leads to the automatic/controlled processing model, and to the interactive compensatory model of Stanovich (1980). The interactive/compensatory model would appear to offer a plausible explanation on the way processing resources might be diverted, by the person with a field dependent cognitive style, when faced with unstructured material. This model will be covered in more detail in the section on models of memory processing.

Perception and attention

For something to be remembered and therefore learnt it must first be perceived. "Our perceptions focus upon those aspects of our environment to which we pay attention or that intrude themselves upon our attention" (Smith, 1975, p. 2)
Research has demonstrated that many people exercise selective attention in terms of what they perceive, as compared to what may have impinged on their visual or aural receptors. "Selective attention involves processing some stimuli but not others at a particular moment" (Wessells, 1982, p. 117).

But is 'attention' sufficient, for a subject to record the information for long term retention? It is certainly a prerequisite, but it is also necessary to process the data adequately, to extract any meaning. Spencer 1988 said that "the depth with which its information is processed may depend on the way in which it is perceived" (p. 120).

The work by Witkin, Moore, Goodenough and Cox (1977) shows that field dependent people will perceive social cues more readily than field independent people and thereby remember more of the related material. "field dependent persons are better at remembering social material and that this superiority is based on their selective attention to social material" (Witkin et al., 1977).

The perceptual modality of the information of interest, continues to act as a trigger to focus attention, and to establish the degree of processing that will occur.

Much of the work on increasing the level of comprehension and improving the recall of information, seems to be based around providing cues of one sort or another. The
suggestion is that the cue perhaps causes a predisposition for the readers attention to focus on the text following the cue. The effect of the focus is assumed to cause more relevant processing, and this will help to integrate any new data into existing knowledge.

Before I look at the processing aspect, it is necessary to look at how data is held for processing, that is to look at memory, and how it is organised.

Memory

Learning can not be investigated without considering the role of memory. A description of memory taken from work by Piaget and Inhelder is that "memory is seen as a store of information that has been encoded by a process of assimilation, and therefore its content and structure reflect the child's schemata through which knowledge is assimilated" (cited in Naus & Halasz, 1979, p. 279).

One aspect of improving learning ability, is to improve long term retention of information. To understand the various memory structures, and how memory works, we need to "relate the processes involved in learning to those of memory, taking into account the characteristic of the learner and the learning task" (Farr, 1987, p. s-1).

There has been much work done to define memory, and there are various ways of categorising memory. Some of these will be briefly explored in order to clarify the particular
perspective on memory taken by this study. A dominant model of memory, is based on the residency time of the memory trace i.e. the concept of sensory memory, short term memory (STM), and long term memory (LTM), (Wessells, 1983).

Sensory memory refers to the aural, visual or tactile memory store of the perceived image. This is then processed within the short term memory, evaluated, and relevant material stored in long term or permanent memory. Short term memory is often referred to as working memory, and is distinguished as being limited, some say to a maximum of 7 chunks of data, and of short duration, up to 15 seconds.

This model is however subject to alternative opinions. There was the suggestion by Craik and Lockhart (1972), that STM and LTM were just different levels of processing. Also from Spencer, "the distinction between STM and LTM has more recently given way to the view that memory should be viewed as an integral part of the whole information processing system" (1988, p. 119). Wessells (1982) describes levels of processing as stages of processing, and relates the term sensory memory to the process of sensory analysis. The term working store is replaced by the process of pattern recognition, and category labelling, followed by the formulation of meaning. The concept of increasing the depth of processing, relates to a greater degree of analysis that can occur if circumstances are right.
The earlier three system model, implied different memory compartments and structures. The levels of processing concept, as an explanation, then gained favour. The main idea from this discussion is that the memory aspects of STM and LTM are distinguished, not by different memory compartments, but by the kind of processing that is occurring. The model becomes a process model rather than a storage model.

As a description of memory, we can use a structural model based on a duration modality, that is sensory memory, working store and long term memory. The alternate view of this is to use a process model based on a depth modality, this is explored more fully in the section on levels of processing. Both of these models use different storage representations for the different phases. We also have a model based on a usage modality, that is memory of facts (data and information) and a memory of processes (the way to use the information).

Other views of the different ways to categorise memory, are given by Hirsh and Tulving. Farr (1987) cites Hirsh (1974) who stated that there are at least two categories of memory, fact memory and skill memory, and Tulving (1985) who said that memory has three interrelated major systems and calls them procedural, semantic and episodic.

Procedural memory refers to learned connections between stimulus and response patterns that have worked effectively. It is like a stored action plan that is compiled and ready to
function. It does, however, suffer from a degree of inflexibility (Tulving, 1985).

Semantic memory is not compiled and represents states of knowledge of the world internally, with no associated action plan and can be applied to a range of circumstances.

Episodic is a subset of semantic and refers to storage of personally experienced events. Farr (1987) dismissed this memory as of little importance in the concern for long term retention. However I feel that this form of memory can be important to an individual. Personally experienced events are elaborated by the involvement of several of the senses, compared with just reading a text description of an event. If elaboration of semantic data can be related to an episodic event, it may achieve more durability. This is surely what analogies are all about; and analogies can be seen as a form of mental modelling for purposes of problem solving (Holyoak, 1984).

Anderson uses the ACT* model to describe how a memory trace is activated from memory node to memory node. From original cue word, via associated words, to target memory. The spreading activation is defined as a "declarative network of factual knowledge" (Anderson, 1984, p. 78). This declarative memory could be said to be the same as Tulving's description of semantic/episodic memory. Anderson's production memory would seem to be the same as Tulving's procedural memory.
The long term retention of information is a prerequisite for any improvement in procedural memory, which has more to do with problem solving ability. Skill memory is also a form of procedural memory, and relates to cognitive or motor skills. Procedural memory is not within the scope of this thesis.

The concern of this study is with comprehension as an aid to long term memory of information; which has been defined alternatively as fact memory, declarative or semantic/episodic memory. This study is not concerned with the procedural or skill memory, which may have quite different attributes to fact memory. The investigation covered by this thesis is on the effect that the field dependent/independent cognitive style has on memory retention, and whether this can be manipulated by changing the text presentation style. I think that a useful explanation of the mechanism of the difficulty experienced by the field dependent group is given by the interactive/compensatory process model. This model will be discussed more fully in the section on models of memory processing.

Within the process model of memory it is still important to retain the concept of a working store (WS), to describe where perceptions are evaluated, prior to being stored in long term memory. Anderson (1980) also uses the concept to describe where the retrieval process, and the assembly of a
response takes place. "the fact is active in short term memory when it is being focused upon" (Anderson, 1980, p. 169).

Crowder also refers to the need for short term memory, not "as a dedicated subsystem with different properties" but as "some sort of transient activity trace" (1993, p. 145). A clearer view of this concept is perhaps put by Cowan "A more coherent conception of STM is hierarchical, with the focus of attention depicted as a subset of the activated portion of long term memory" (1993, p.162). Also " working memory is often defined as that part of permanent LTM that is temporarily active above some critical threshold" (Cantor & Engle, 1993, p. 1101)

The importance of the concept of working store can be seen by the research of Perfetti (1983), and Miller (1984), they investigated the impact of a less effective working store on the comprehension process.
Perfetti was concerned with the effect of the capacity of the working store memory on retention performance. "for low-ability readers, for whom coding is less facile functional working store memory differences would become significant" (1988, p. 88). This is saying, that if a person has difficulty interpreting input, fast enough for appropriate processing, then a small working store will aggravate the problem.

This is expressed in another way by Miller (1984) to describe the way WS memory is used by the comprehension process. Miller (1984) suggests that the WS is of limited capacity, and that this would mean that the comprehension process must use an overlapping procedure, to contain the current span of text comprehension.

The overlapping procedure is used when a piece of text cannot be held in WS in its entirety while being analysed for comprehension. Instead, analysis is done on a fragment at a time, and on the linkage between two fragments. Comprehension moves along the piece of text, accumulating as the text is processed, piece by piece. This would suggest that if the focus of meaning keeps shifting over a lengthy portion of text, then the number of separate comprehension segments may be too many for the WS. The limitation of the WS will reduce
the ability of a reader to link the meaning across different segments of text, and will impair overall comprehension.

**Comprehension**

"So reading comprehension entails cognitive processes of knowing, reasoning, and inferencing" (Carroll, 1977, p. 2).

Data may be remembered, but in order for material to be of any practical value, i.e. the ability to apply the data, the material must be comprehended. To be comprehended the material usually has to be related and fitted into the individuals existing knowledge, and during this process it is elaborated and encoded.

The amount of comprehension that is apparent following the reading of a passage of information, might be used as a measure of the depth of processing that occurred. However the amount of prior knowledge is a significant determinant of the amount of comprehension (Farr, 1987)

Graesser and Riha (1984) reported research that found that when they warned subjects that they would be tested using questions requiring recall rather than with multiple choice questions, the subjects spent more time reading. The analysis of sentence reading times indicated that the time had been spent on components associated with deeper levels of processing. "Readers in the recall condition allocated more resources to the deeper levels, presumably in order to
integrate and organise information in the passage as a whole” (Graeser and Riha, 1984, p211).

Studies investigating comprehension tend to indicate that good organisation, and prior cues to the content, (Summers, Horton, and Diehl, 1985) will improve the amount of comprehension. An alternative view resulted from a study by O'Brien and Myers (1985) that showed making comprehension difficult but not impossible, improved memory.

Work by Yuill and Jocelyne (1988) also showed that strategy training could assist poor readers overcome some of their limitations in comprehension. Young children aged 7-8 years old, with differing comprehension skills were asked to read abstract stories. The stories had titles and pictures, that in some cases helped integrate the story line and in some cases did not. There was no effect on verbatim recall in either case, but the poor comprehenders were assisted with comprehension.

A second experiment was without the titles and pictures, and one group was trained to look for integrative clues. The group of poor comprehenders that had been trained, did better than the untrained group. The good comprehenders did well anyway. Yuill and Jocelyn (1988) felt that the poor comprehenders when reading were focussing on different aspects of the information, to the good comprehenders.
Graesser and Riha (1984) say "Most researchers believe that comprehension is somehow related to the way readers allocate their cognitive resources to different text components during reading". The next section reviews some of the various ways that the memory processing resources are thought to be allocated.
The section on memory accepted the process model of memory structure, and the concept of levels of processing. The next section discusses this concept in more detail and clarifies my use of the term depth of processing. The sections following build on the levels of processing concept to define more precisely what happens at the different levels, and the allocation of the processing resource.

Levels of processing

The concept of levels of processing was put forward by Craik and Lockhart (1972) to replace the multi store model of memory storage. The proposition is that data is successively processed in stages, from analysing the sensory image, through pattern recognition, to semantic analysis.

The process stages correspond to the levels of processing from shallow processing of physical details to deep processing for conceptual analysis. The concept of working store is explained as a re-circulating process. The process keeps a small amount of data active at the forefront of attention, while it is processed for deeper analysis for long term retention.
The depth of processing is defined in terms of the meaningfulness extracted from the stimulus rather than the number of analysis performed upon it. Information which is processed at a greater depth, which will be more meaningful than shallow processed information, will also be more memorable (Spencer, 1988, p. 119).

There is a preference to put the levels of processing on a continuum from shallow processing to deep processing, rather than discrete stages (Wessells, 1982).

The discussions on processing models leads me to suggest, that at the very least, we have two levels of processing. The first being automatic, which is at a surface level and is generally shallow, this level can only handle routine events. The definition of a routine event will depend on the knowledge and experience of the person. A subject expert may deal with relatively complex material at an automatic level of processing, compared with a person naive in that subject. The second level of processing is controlled and is concerned with deep processing, which allows the analysis of new events, and the integration of new data with existing knowledge. The automated processing mode uses much less processing capacity than controlled processing.

The concept of depth of processing might alternatively be explained by the allocation of processing resources. If we accept the limited capacity processing model, an individual
has a specific amount of processing capacity available at a given instant. If there is one task to be processed, then all the processing capacity is available to be used on that one task. If however there is more than one task, the processing capacity must be shared by all the tasks. This does not deny the possibility, that by training, an individual might be able to increase the amount of processing capacity focussed on the problem in question. This could be explained by the training increasing the ability of the person to concentrate all available capacity on one process.

The way that the sharing occurs, might be by parallel processes (Glass, 1984), or serially with the concurrent processes switching rapidly between tasks. If switching is fast enough, it would appear as if processing multiple tasks were in parallel. However over a given time period, the effect of parallel or serial switching is the same. When there is more than one task in progress, the amount of processing (capacity x time) brought to bear on any one task is less. Sweller (1988) agrees that the architecture is irrelevant. What is important is the amount of controlled processing used on a task. This is because automatic processing uses very little processing capacity.

Sweller (1988) suggests that if the problem solving strategy (such as means end), uses too many cognitive resources, or the material is very complex, there are fewer resources left for learning. Mitchell concurred, and found
that there was "some evidence that short term visual memory (STVM) is impaired when people engage in a concurrent arithmetic task" (1982, p. 103).

Within the concept of levels of processing, there are a number of models used to describe the way a person processes incoming stimuli. I have chosen two models; the automatic/controlled model, to which is added the aspect of limited processing and the interactive-compensatory model. I feel these models are interrelated, and together they help explain why comprehension is reduced, when cognitive style and mode of presentation are not in congruence.

Automatic/controlled processing model

In the automatic/controlled model, well rehearsed activities are processed in automatic mode, but new activities require conscious or controlled processing. This is also referred to as the dual process theory (Shiffrin & Schnieder, 1977). Controlled processing also called attentional or conscious processing, is "slow, serial, effortful, and capacity limited (Fisk & Schneider, 1984, p. 181). The processing is under direct subject control and is activated to deal with novel or inconsistent information.

The automated activity does not require conscious processing and is in contrast to controlled responses that require attention. Lesgold suggests that, "this distinction
between automated and controlled processing as being similar to Anderson's distinction between declarative and procedural knowledge" (1984, p. 47).

This comparison is rather misleading. Anderson (1980) certainly indicates that the development of procedural knowledge requires controlled processing, but goes on to say that sufficient rehearsal of a procedure can enable it to become automatic. Anderson (1980) gives several examples of procedural knowledge; how to ride a bike, a golf swing, and the use of a person's native language, all of which are automated activities for the experienced person.

Fisk and Schneider (1984) investigated controlled and automatic processing with respect to their effect on LTM.

Their first experiment examined LTM storage as a function of controlled processing. They tested a subject's ability to recall the frequency occurrence of words presented under various distracting conditions. They found that diverting controlled processing by getting subjects to attend to a digit detection task while the words were presented, resulted in a poor frequency estimate. If the concurrent task was to attend to the word by determining if the word fitted a particular category, then the frequency estimation was good.

Their second experiment examined LTM storage as a function of automatic processing. Subjects were trained to perform category recognition of a word as an automatic
function. They were then given a distractor task to perform concurrently with the category recognition task. Subjects had a very poor ability to perform estimates of word frequency, even though they were categorising the words correctly.

The general conclusion was that automatic processing could occur with no appreciable effect on LTM storage. If controlled processing resources are distracted, it is possible for reading to continue, but then no LTM storage will occur. If the controlled processing is related to the LTM storage task, there is likely to be good retention.

The paradigms used in the Fisk and Schneider (1984) research were oriented to word and digit recognition, rather than the retention of information (that is data with content meaningful to the reader). The principle of the dual (automatic/controlled) process theory of information processing, does extend from simple word recognition to reading and comprehending text. However it would be difficult to construct a test procedure for comprehension of prose material with the inclusion of distractors. One would have to be careful that the addition of a distractor did not overwhelm the subjects processing resources to the exclusion of any comprehension.

Reading is an activity, that by the time a student reaches tertiary studies, is a very automated process. This is supported by the work of Britton, Glyn, and Myer (1982). Comprehension of academic material however, often requires
more use of conscious or controlled processing, as the student struggles with new words and concepts.

Graesser and Riha (1984) used multiple regression analysis of sentence reading times to identify the distinct components of the reading task. They looked for those that most affected sentence reading times and accounted for individual differences between readers. They were specifically interested in the way readers allocate their processing resources to the different components, and how this affected comprehension.

The test procedure required the subjects to read a passage, and then answer some comprehension questions. The passage was presented by computer one sentence at a time, and the subject pressed a button when they were ready for the next sentence. This enabled the reading time for each question to be obtained. They segregated their subjects into fast and slow readers and good and poor comprehenders, giving four groups.

The passages used were evaluated for the occurrence of predictor variables, which were variables that have been determined as contributing to reading time. They determined a set of word level, sentence level, and passage level predictors for each passage. For example, a sentence would be scaled on the number of new nouns in it. New argument nouns are those that introduce a new person or object in the passage for the first time. An example of a passage level
predictor is that the passage would be scaled on its perceived interestingness.

The results evaluated time spent on each sentence with the predictor variable estimation, and the comprehension of the passage. The indications were that fast readers with poor comprehension, did not adequately process uninteresting material, and slow readers with poor comprehension did not adequately process new nouns, propositions, and abstract sentences.

Automatic processing would be used on very familiar text units e.g. letters, syllables and words and syntax in common usage, and is accomplished very quickly. Non automatic processing would be used to interrelate words in sentences, and sentences in paragraphs, that is, according to Graesser and Riha "components associated with 'deeper' levels of analysis" (1984, p. 211), which is more time consuming.

Graesser and Riha (1984) described a specific study to investigate the differences between controlled (non automatic) and automatic processing done by them previously, (Graesser, 1981; Graesser, Hoffman & Clark, 1980). Readers were assigned to one of two goals. One group was told they would be asked to answer questions by recall, the other group was told they would be given multiple choice questions. The analysis of the results showed that according to the type of instruction given to the subject there was a difference in the way the subjects processed the material when reading.
We found differences between instructional conditions when we examined the slope coefficients of those components associated with deeper levels of processing, such as new argument nouns, passage familiarity, and passage narrativity. The slopes were steeper in the recall condition, than in the multiple choice condition. Readers in the recall condition allocated more resources to the deeper levels, presumably in order to integrate and organise information in the passage as a whole (Graesser & Riha, 1984, p. 211).

Graesser and Riha stated that "Most models of reading assume that readers have a limited supply of cognitive resources which are somehow allocated to the processing of different components of text" (1984, p. 210). A number of researchers subscribe to the limited capacity model (Stanovich, 1980; Glass, 1984; Britton et al., 1982; Sternberg, 1984; Sweller, 1988). Graesser and Riha (1984) also concluded that most models use the concept of automatic and non-automatic processing.

Glass (1984) further proposed, that the limited capacity model, should also be a parallel processing model. Glass (1984) showed that distractions in text that are similar to the comprehension target, will cause loss of attention from the primary comprehension task. The greater the similarity
the greater the loss of cognitive capacity on the primary task.

Interactive/compensatory processing model

Stanovich (1980) rejected both the top down and bottom up models of memory processing in favour of the interactive model proposed by Rumelhart (1977).

The bottom up model allowed for the series of transformations on input data from low level pattern matching to high level semantic analysis. The top down model has the flow of information controlled by the higher level process. The interactive model has the lower level processes able to constrain the higher level processes and vice versa.

Stanovich linked the interactive model with a compensatory concept to form the interactive-compensatory model. What the compensatory feature does, is to allow resources from one level to be used to supplement a weakness at another level. Stanovich (1980) said "the poor reader who has deficient word analysis skills might possibly show greater reliance on contextual factors" (1980, p. 63). This means that comprehension level resources are being spent on the low level word recognition task. Spencer (1988), and later research by Goldsmith-Phillips (1989) also found support for the interactive-compensatory hypothesis.

There is some evidence which indicates that when certain skills are deficient, switching instruction to a medium
which places reliance on more highly developed skills, or which compensates for the deficiency, will enable information to be more readily assimilated (Spencer, 1988, p. 184).

I think the idea of switching medium, could be equally applied to changing the style, or altering the structure of material presentation. Spencer was primarily considering medium in terms of text books versus films, whereas with a computer, the presentation can be changed dynamically, and cover some aspects of both book and film.

I have chosen the automatic/controlled model as a basic processing model, where the reader needs to conciously process when reading new or difficult text. I accept the amount of concious processing available in a given time period is limited. This means that if the basic reading activity requires some concious processing, there is less processing available for understanding the overall meaning, and therefore the amount of comprehension is reduced. Stanovich (1980) felt that the evidence was that the comprehension strategies of good readers are superior to those of poor readers.

I have adopted the premise that processing in depth relates to a larger amount of controlled processing capacity being spent on the primary task e.g. semantic analysis.
Shallow processing involves a lesser amount spent by processing at an automatic level e.g. word recognition in fluent readers with familiar words. The deep processing for semantic analysis needs to be achieved by concentrating on the primary task of comprehension, and excluding any distractions. This would provide the additional processing capacity required to do the extra elaborations, needed to improve the encoding of information and its retention.

Fluent readers read at the level of word recognition by automatic processing, and can concentrate their controlled processing resources for comprehension strategies and elaborations, leading to long term retention. However the interactive compensatory model allows that distinction between low and high level processes to be blurred. A reader having difficulty at the word recognition level, may use context strategies to help with word recognition, and this is done at the expense of comprehension strategies.

The aim of improving comprehension of prose material is to assist the long term retention of information. A number of factors have been advocated to aid comprehension, and amongst the most important are to provide structure to the material, ensure there is focus on the important concepts, and to elaborate the material as it is read.
The best in literature can broaden, deepen, and enrich life, provided the reader learns how to mine its rich ores. Literature does not come knocking at dark doorways, seeking the sleepers. It must be sought out, stalked, captured, mastered. It must be deeply read (Lefevre, 1964, p. 197).

A recent adjunct to depth of processing is the elaboration of processing, with deep encoding being more elaborate or extensive and, therefore, providing more stored information than shallow processes. Retrieval being affected by the amount of stored information will be better for deep, elaborated encoding (Spencer, 1988, p. 120).
Elaboration

The concept of elaborative processing is based on the premise that semantic memory is made up of a series of propositions that describe an event. For example the proposition SAT (DOG,CHAIR), represents the sentence or event, 'the dog sat on the chair'. It is thought that as a person encodes information for storage in memory, a certain number of additional propositions are also formed.

The additional propositions associate the new information with existing knowledge. The more additional encodings that are made when forming a memory, the better the chance during recall that one of the elaborations will lead to the target proposition (Anderson, 1979).

There are arguments, as to whether is memory comprised solely of semantic propositions, or analogue images, or a combination. However, as I am concerned with semantic analysis, I will concentrate on the aspect of memory dealing with semantic propositions.

Research by Reder (1976) measured the time to indicate the plausibility of a statement in relation to a short (20 sentence) story. The highly plausible statements were indicated faster than less plausible statements. This was
true if the question was asked immediately or after a 5 day delay. According to Anderson and Reder (1979), the subjects were making the plausibility judgements by reconstructive computation.

The questions that were asked were not concerned with direct recall of story content, but on how plausible a statement was, as an addition to the story. The subject therefore had to have been making elaborations to the story, in order to make the judgement.

Anderson & Reder (1979) argue that:
the variation in memory with DOP [depth of processing] is a result of the number of elaborations subjects produce while studying the material, that these elaborations establish more redundant encoding of the to-be-remembered information, and that elaboration is critical, especially for long-term retention. (p. 385)

The word redundant might imply that the encodings are not required. If the recall follows the direct path to the desired information, the extra encoding will not be required. However if the original link can not be recalled, the extra encodings increase the probability that the act of spreading activation will hit on these elaborations as additional cues, and bring attention to the necessary bit of data.
**Spreading activation**

The term spreading activation has been given to the retrieval aspect of the process of recalling a target proposition. This is because a cue event can cause a sequence of associated memory traces to be activated, as the search for the target memory progresses. The search, and the spreading activation of memory nodes, would stop when either the target was retrieved, or there were no more related associations to follow.

Anderson (1984) said he developed the ACT* model to explain the concept of spreading activation. The model was developed following the work of Quillian (1969), Anderson (1976), McClelland & Rumelhart (1981) and Anderson (1983). A brief summary of the limitations of each of these retrieval models is given below.

Anderson (1984) reported that Quillian (1969) had developed a theory of spreading activation to help understand how comprehension of linguistic material was formed. The theory had a problem accounting for the effect, whereby frequency of association improved the speed of recall.

Anderson in 1976, further developed his ACTE model by adding spreading activation to his existing production system model, which he had used to explain cognitive processes.
Anderson (1984) felt the ACTE model was limited, because activation was considered as an all or none facility.

McLelland and Rumelhart (1980) developed what was primarily a pattern matching model. This had a limitation, that activation levels tended to maximum or minimum. This was satisfactory to explain pattern matching activity but not to explain the activation of the memory for a fact. There was the need for a fact node to have a graded activation level. The model also did not allow the separation of factual knowledge, from the processes that act on it.

The ACT* model was designed to incorporate the main ideas of each of these, but with most of the limitations accounted for. The ACT* construct consists of the three premises:

1. Representations: Knowledge is a network of concept nodes and the links between them.
2. State: The level of activation of the nodes.
3. Process: The mechanism that activates the nodes.

Anderson (1984) also lists a number of properties that are needed for the ACT* model. I shall list just those that I feel have a particular bearing on this study:
1. Allows continuous levels of activation.

2. Explains how the level of activation matches performance.

3. Integrates the priming, and fact retrieval paradigms.

4. Explains how the factors, (decrease in association frequency, increase in competing associations, increase in distance of association) all go toward reducing the level of activation.

5. Explains why time to reject a proposition increases with its similarity to target.

6. Explains interaction between level of activation, and complexity of computation.

Structure of text presentation

The effect of spreading activation which aids recall, is said to be assisted by increasing the number of elaborations made while reading text. We now need to see what factors will increase the number of elaborations made while reading. One approach is to look at the general concept of providing structure to text.

We could look at the schema theory for memory structure and the way a schema provides a "sophisticated type of advanced organiser that an individual uses to make sense of and efficiently encode new facts" (Thorndike, 1984, p. 183). According to Thorndike (1984) a schema is the outline of
major points describing a concept, object or event. The schema a reader has of a subject area acts as a guide to the incorporation of new information by providing a structural syntax or framework against which the reader sets new facts and associations.

There is also the concept of meta-cognition where the reader provides some control over the way their cognitive resources are used in the task of understanding and remembering. Meta-cognition can obviously be used by the reader in conjunction with their schema view of the subject to decide where and how to use their cognitive resources.

Kintsch (1982) suggests that the reader constructs coherent information from elementary units based on the concept of what the comprehension goal is expected to be. Johnson-Laird (1988) uses the idea of the reader building a model, constructed and adjusted, according to the derived meanings and the reader's current knowledge, as part of the comprehension process.

The schema theory and the meta-cognitive approach, where the reader takes a conscious role in the comprehension process, are therefore more than just an advance organiser or a set of cues belonging to the text material; however the only research I can find, uses the advance organiser technique.
De Groot and van de Pal (1989) researched whether readers provided their own linking elaborations for items of material that have a causal relationship. Subjects were given a piece of text of 5 sentences describing an event, and then timed on their reading of a further sentence. If the timed sentence was causally related to the first part of the text, the sentence was read faster than if it were not related.

The study showed that the subjects took longer to read items that were not causally linked, indicating that the readers were using context to comprehend as they read. It would have been interesting to see if they were actually reading slower, or rereading to check context. This would seem to indicate that if material is not presented in a logically related sequence, reading would take longer, and use more processing capacity.

Britton et al. (1982) researched the effect of text structure on the amount of processing capacity needed to read material. In a series of experiments using college students studying psychology, they found that by simplifying the syntax but leaving the information content the same, the cognitive processing load was reduced. This was tested by measuring the response time to do a secondary task. The
response time for the secondary task increased with the more complex syntax.

They also showed that by cueing the main ideas, the reader used less processing capacity. This was tested in a similar manner, but this time they removed idea cues in the form of relation and significance words, titles and headings, and a summary in the form of a concluding sentence. This also increased the response time to perform the secondary task, indicating that increased processing capacity was needed to read the material without the structure cues provided.

Kiewra and Frank (1986) conducted a study of the interaction between cognitive style, and the text structure at data acquisition, and at recall. In the analysis they did of the students comments about the tasks undertaken in their research procedure, the comments showed that the learners with a field dependent cognitive style, preferred the structured approach to information acquisition, even though the structured approach did not always assist their recall.

Einstein and Hunt (1980) designed experiments to investigate two alternative lines of research into memory processing. One was for levels of processing, the other, for the organisational perspective of memory processing. The research method was to present a list of nouns to psychology students, and get them to perform a task based on the list.
The level of processing investigation was based on an individual item task approach. The non semantic task was to judge the noun on how easy it was to rhyme with it. The semantic task was to determine the pleasantness of the word.

The Organisational scheme was based on sorting the nouns. The non semantic task was to group according to the first letter. The semantic task was to group on taxonomic meaning.

They found that directing attention to relational aspects in the material, led to improved retrieval schemes being developed. Directing attention to the individual items, led to the reader being better able to perform discrimination tasks. Their findings gave support to the necessity of relating the nature of the memory task to be performed, to the type of prior instructions given to the reader.

Similarly the structure of the material presentation, needs to provide the links and organisation for retrieval. "The linked statements and cognitive units are organised and indexed for efficient memory retrieval by reference hierarchies and plot unit networks" (Black, 1984, p. 252). This would imply that if material was well organised and matched to the users existing knowledge structures then maximum elaboration could occur, and this would be consistent with long term retention (LTR).
Some individual styles however, seem to be better able to cope with material that is not so well ordered. It is not disputed that individuals are different in their learning abilities (Watts, 1978), and this difference can be due to motivation, intelligence, and culture. This leads to a further question of whether they are different in their learning/cognitive styles?

Attention focus

This section discusses the different mechanisms such as cues, questions, and multiple passes, used to focus the reader's attention on important aspects of the material. This discussion perhaps belongs in the previous section on structure, but as it covers specific techniques, it will be treated separately.

Miller (1984) states that "an important part of the comprehension process is to accurately identify the conceptual focus of a text" (p. 337). Miller goes on to elaborate on the difficulty caused to the reader if there are frequent shifts in focus of the text. In particular when the sentence structure causes temporary misdirection of the correct focus.

Tulving (1979) put the view, that successful recollection of an event, depends on the current knowledge
about the event, on the cue information available, and how well the two match.

Kiewra & Frank (1986), researched the interaction between cognitive style, and structure at data acquisition, and at recall. Structure was provided by an organisation chart of headings and sub headings. The chart was provided to assist note taking, or as a cue during recall testing.

They found that learners with a field dependent cognitive style did better when there was a match between the format at note taking and the format at recall. That is, field dependant learners did better for cued recall, when the acquisition was structured, and did better for free recall, when the acquisition was unstructured. It would seem that readers with a cognitive style of field dependence, can get locked into a particular memory retrieval sequence. Field independent subjects however, did better when the format at note taking and recall were different.

Frase (1975) discussed work on prose processing and the concept of questions and multiple passes known as PQ4R. The PQ4R methodology, is to preview the material quickly, raise some questions about the material, then read slowly, reflect on whether the questions have been covered, recite the material and finally review it again. The 4R's are
essentially rehearsals of the material, and presumably allow time for elaborations to occur.

Anderson and Biddle (1975) undertook a number of experiments to investigate how the use of adjunct questions provided memory enhancement. Adjunct questions are questions inserted in the text for the student to consider, having just read the related text. This research did not take into account the cognitive style of the subject.

They conducted a series of 4 experiments with the adjunct questions being either verbatim from the text, or paraphrased. They had anticipated that the paraphrase questions would require deeper processing and therefore lead to better retention. The results showed that the questions did enhance retrieval performance, but the verbatim questions produced better results than the paraphrase questions. Anderson & Biddle failed to isolate the reason for this, and were therefore unable to achieve their primary objective of trying to account for how the adjunct questions enhanced retrieval.

Frase (1977) reported on research by Surber, Anderson, and Stevens (1975) that showed that giving subjects guidance objectives before study, improved retention. Frase concluded that "items upon which attention is focused are often well
remembered" (1977, p. 61), and that a mismatch between goal and subject matter may interfere with learning.

One can conclude that 'purpose for reading' like 'intention in thinking' is crucial to comprehension (Stauffer, 1977, p. 242). The reading-thinking process must begin in the mind of the reader. He must raise the questions (Stauffer, 1977, p. 245).

The use of the self generated question technique, as a precursor to reading, was used by McKee (1987), in a CAI text reading procedure. The effectiveness of the questions raised by the subjects was not controlled, and were unlikely to assist in processing the following material.

Module 5 of the lesson covered the topics; comparing two populations, the null hypothesis, and the t test. The topics were outlined in the lesson preview, and the students were asked to type in up to 8 lines of questions related to those topics. Of the eight students that did this module, four merely asked "what is a null hypothesis?", two asked questions not related to the topics, and only two asked additional questions related to the topics.

Most of the questions typed in by the subject were unlikely to help focus the subjects attention. I think that it would need sophisticated software to provide analysis of
the questions typed in, and guidance to the student to correct the quality of each question the student typed.

Improving comprehension and recall by the use of self generated questions, is affected by the quality of questions asked. MacDonald (1986) investigated whether training on how to ask good questions, would improve comprehension and recall. The result showed that the training only assisted those people with good pretest scores, although an improvement in question quality did relate to an improvement in comprehension and recall.

An interesting strategy was developed by Larson et al. (1986) for adapting the SQ3R (this was later developed to the PQ4R reading methodology) into a strategy called OINC. The OINC methodology was developed to assist the learning of technical material where drawings are an integral part of the instruction procedure.

The methodology requires the student to learn the overall function, then create an image of each sub section, and draw them as necessary. The student then names the parts and elaborates as needed, and finally summarises the information of each functional part, then reviews the overall function and purpose of each part.
The research carried out by Larson et al. (1986) showed the methodology to be successful. What I find interesting is that the methodology has aspects of mastery learning (which I cover later), multiple passes, and instructions for students to elaborate.

These methodologies are designed to ensure that all students regardless of ability are coached through to successful completion of a course. This is done by ensuring that they do not progress unless they are completely familiar with the material. However the presentation of the material makes no allowances for any individual differences of ability, knowledge or cognitive style.
Individual Differences

The educational literature has a great deal of discussion on individual differences ranging from motivation, values and attitudes, through to cognitive abilities.

One aspect of motivation is locus of control. Kelly and Thibout define an individual with internal locus of control as one who "adopts an information orientation, is highly responsive to task cues, and engages in information seeking behaviour". They also define an individual with an external locus of control as one who "has in contrast a hedonistic orientation-he reacts to the pleasure and pain of a situation", (cited in Bassett, 1978, p. 33).

Eysenck refers to the effect of neuroticism and extroversion, and their combinatorial effect on academic achievement. "stable introverts do best of all; unstable extraverts do worst of all" (Eysenck, 1976, Foreword). Mohan (1976) followed up on this work, and found it also held true in India.

What effect do these personality traits have on the mechanisms of learning and retention? Shade (1983) puts the view that high achievers tend to be introverted, field independent, self motivated, and prefer working alone. Whereas low achievers tend to be extroverted, field dependent, and work better in a people oriented environment, they need cues and reinforcement from a teacher.
Hadfield and Maddux (1988) found that field dependent students had a high level of anxiety when dealing with mathematics compared with field independent students.

Lyn and Gordon (1961) suggest that introverts differ from extroverts in a number of characteristics, in a way that could have an effect on academic progress. The characteristics are; learning speed, work decrement, preference for speed or accuracy, and intelligence. Mohan (1976) adds that the level of aspiration may also be related to academic success. Lyn and Gordon (1961) explained the characteristics in the following way:-

* Learning speed - introverts form conditioned responses more quickly, which is perhaps advantageous when acquiring new vocabulary.

* Work decrement - extroverts show more work decrement on tasks of sustained attention.

* Preference for speed or accuracy - Introverts show a preference for accuracy over speed.

* Intelligence - there is no conclusive evidence as relates to introversion / extroversion.

* Level of aspiration - introverts high on achievement motivation will show better performance on educational tasks.
Research by Walczyk and Hall (1989) showed evidence that reflective children were better at monitoring their own level of comprehension. It seemed that the impulsive child was likely to give up sooner, assume understanding, and overlook contradictions.

Various individual difference measures were investigated by Hall, Rocklin, Dansereau, Skaggs, O'Donnell, Lambiotte, and Young (1988) to see if there was any interaction with the study conditions. The results showed that the extrovert students did not work well on their own and did better in a group.

Sipps and Alexander (1987) in comparing the MBTI and EPI scales did find support for extroversion/introversion as a complex construct and a valid means of measuring the impulsive/non planning nature of a person.

It is possible that the emotional characteristics of a person create a predisposition for a particular cognitive style. Reisman (1972) complained that there had been too much attention given in education to the factors of emotion and motivation and not enough to cognition. This has been redressed in recent years, but we still have little research data on the interaction between these factors.

Maznah and Ng (1985) designed a test to measure the relative effects of locus of control, cognitive style, and anxiety on academic achievement. They differentiated between
locus of control, being whether there is internal or external control of reinforcement expectancy, and cognitive style, being differences in information processing behaviour.

They tested 375 children, and their results showed all factors to be significant predictors of academic achievement. Locus of control was the most significant, followed by state anxiety, cognitive style, and trait anxiety in that order. Cognitive style was tested using the children's embedded figures test for field dependence/independence.

I review a number of approaches to the subject of individual differences with particular attention to those that seem to provide an insight or effect on the learning process.

As my study is concerned with text presentation and cognitive style, I need to isolate those aspects of individual differences associated with cognitive ability, from those aspects associated with motivational and emotional characteristics. Although it does appear that there is some linkage between these aspects when one looks at the descriptions used to characterise their attributes.

The individual differences associated with cognitive abilities that includes the various measures of; cognitive style, verbal ability, and prior knowledge are of particular
relevance to this study, and I will need to measure or control these in my research procedure.

**Mastery Learning**

Before I look in more detail at individual differences in cognitive abilities, I would like to consider a teaching environment that ignores the educational separation of students according to IQ. Mastery learning only considers the student's level of knowledge.

This is an educational technique that starts with the assumption that all students have equal capacity to succeed with a learning task. The system merely requires that each student is given time to reach mastery of a topic before going on to the next topic. It certainly refutes the idea of separating students according to IQ, but does support the idea that each student be allowed to proceed at their own rate.

Lee and Pruitt (1984) refer to Carroll (1963) who took the view that aptitude is the amount of time a student needs to attain mastery of a subject. Lee and Pruitt (1984) also said that there should be an assumption that students may need different types of instruction to attain mastery.
According to Lee and Pruitt (1984) teachers need to individualise their approach to their students and need to be much more conscious of the management of the learning process. They also need to be aware of the demand on them to get students to persevere, particularly in trying the different instruction approaches.

A list of some characteristics of mastery learning drawn from Lee and Pruitt (1984) is as follows:-

. Individual, small or large groups.
. Student centred objectives.
. Active student role in achievement.
. Instruction is adaptable.
. Teachers expect most students to eventually pass.
. Instruction is multi-faceted.

There is an emphasis in the list on the involvement of the student in the learning process. Pope and Keen (1981) put forward a request that personal construct psychology be incorporated into educational research. They look forward to the day when "An educational system in which individual learning styles are important and educational research is predicated on the individual's perspective" (1981, p. 34).

The model Lee and Pruitt (1984) give for mastery learning is:-
. Set the learning objectives.
. Give a pre test to ascertain current knowledge level.
. Give instruction, variety of material and flexible time frame.
. Give the mastery tests.
. Provide remediation for those not attaining mastery.

This system would be exceedingly difficult to practice in a conventional classroom environment. Slavin (1987) reviewed mastery learning in schools and found no appreciable improvement in achievement. The mastery procedure however seems to be particularly suited to a computer aided instruction (CAI) system.

Lee and Pruitt (1984) suggest a revision of the mastery scheme that they term the "Essentials, Correctives and Enrichment model" (1984, p. 9) which is intended to enable teachers to use the mastery approach in existing school programs.

The model has 13 steps summarised as follows:-

. Select short units of instruction.
. Set all learning objectives.
Divide content into essential and enrichment goals.
Set evaluation for each essential objective.
Develop teaching strategy for essential objectives.
Write remediation for each essential objective.
Set two sets of questions for mastery test.
Write enrichment activities.
Develop grading policy that will determine mastery.
Present instruction.
Give mastery test one to students.
Provide remediation to those that did not achieve mastery and give enrichment activities to those that did.
Give mastery test two to those that took the corrective material.

One reason for providing so much detail for this model is the idea of tailoring presentation to individual needs. Although the approach only provides something different (if a student has a difficulty), rather than something that matches the needs of the student.

It might be useful to compare the above model of the approach to mastery instruction, with Gagne's 9 events for
instruction of a small group. From Gagne, Briggs, and Wager (1988), they are as follows:

. Gain attention.
. Inform learner of the objective.
. Stimulate recall of prerequisite learning.
. Present the material.
. Provide learning guidance.
. Elicit performance.
. Provide feedback.
. Assess performance.
. Enhance retention and transfer.

Although these events are nominated as instruction of a small group, a number of the events are interactions with an individual. All the events are much more an interaction activity than the procedure steps indicated in the mastery model. However the mastery model does have the formal requirement for a remedial, and enhancement instruction path, in addition to the standard level of instruction. This is not so obvious in Gagne’s 9 events, and is only implicit in the guidance, and feedback events.

The whole concept of the mastery model I think provides a good teaching system. It might however be more than teachers on their own can handle. It requires three levels of lesson preparation, as well as monitoring student
performance, and redirecting them to the appropriate lesson strand. The nature of the procedure lends itself to a self-paced mode of presentation, and with the three levels of presentation material, would be a reasonable model for producing good CAI.

Pope and Keen refer to the description of the future school put forward by Silberman "... where learning methods are varied, where children can work and are expected to work on their own, at their own pace and at work of their own choosing" (1981, p. 10). Spencer said that "the self pacing allows for individual differences in rate of study and is essential if the level of achievement is held constant" (1988, p. 89).

The mastery approach tends to make the assumption that everyone is of equal ability and can all reach the same goal but perhaps at a different speed. The next few sections explore some of the factors that describe differences between individuals, in relation to their cognitive abilities.

**Intelligence or Verbal Ability?**

There have been many investigations into the correlation of intelligence with academic achievement, particularly when using IQ tests.

There can be no doubt that intelligence plays a predominant part in making for success or failure in
academic life. However the relationship between intelligence and performance is complex; low and very low intelligence makes it certain that a person cannot succeed at high levels of education - success cannot be guaranteed. It obviously depends in part at least on personal qualities of persistence, application and hard work (Eysenck, 1976, Foreword).

There seems to be a relationship between Eysenck's factors of intelligence and some of the attributes of cognitive style. The statement that divergent thinkers lean to arts and convergent thinkers lean to sciences (Eysenck, 1979) is similar to the statement that the field dependent cognitive style person leans to arts and the field independent person to sciences (Raskin, 1986). However Kogan (1976) felt that IQ was linked to cognitive style, but the degree of linkage was marginal.

Sternberg (1984) reviewed the research and literature on the various methods of measuring and categorising intelligence. He discussed three approaches to the problem of defining intelligence. The first approach was in terms of factors thought to be involved, from Spearman with 2 factors, Thurstone with 7 primary factors, to Guilford with 120 factors.

The list of Thurstones 7 factors are; verbal comprehension, verbal fluency, number, spatial visualisation, memory, reasoning, and perceptual speed. Many of these also
appear in Eysenck's list of intelligence factors, he lists verbal, numeric, memory, perceptual, divergent, reasoning, and visual-spatial as the primary factors (Eysenck, 1979).

The most significant aspect of these alternate lists of factors is that "people who tend to be proficient in one ability tend to score high in the others as well" (Sternberg, 1984 p142). It is also interesting to note the appearance of so many factors related to verbal ability. These two points together imply that a test of verbal ability is a sufficient test of IQ.

The next approach was the cognitive view which looked at the mental processes in respect of information processing capability from speed of processing to the accuracy and strategy. This approach however is still looking at the same tasks used to measure intelligence in the factor approach.

Sternberg proposes a two-facet theory, which instead of being based on the tasks incorporated in the intelligence test, looks at the skills that underly the task ability. "The two-facet theory proposes that a task measures 'intelligence' to the extent that it requires either or both of two skills: (1) the ability to deal with novel kinds of task and situational demands and (2) the ability to automatize information processing" (Sternberg, 1984, p149).

Sternberg appears to be relating the measure of intelligence to the ability to automatize the information
processing of routine events, so that more processing resource is available to deal with novel events and situations.

MacLeod, Hunt, and Mathews (1978) investigated individual differences in relation to spatial and verbal abilities. They found that subjects demonstrated different comprehension strategies based on either a verbal strategy or a spatial strategy and that the strategy could be predicted according to psychometric tests of verbal and spatial ability. In later research (1980) they verified the results, but also showed that subjects could be trained relatively easily to transfer to the other strategy.

Perfetti 1983 thinks that it is likely that the same verbal abilities that are central to verbal intelligence, are important for the reading ability. "It is quite possible that verbal knowledge is the fundamental factor for reading and verbal intelligence" (Perfetti, 1983, p93). Verbal knowledge comprises the knowledge of word forms and rules, and also concept knowledge, Whereas knowledge of word forms and rules is critical to reading ability, so access to word meanings is also important, and vocabulary breadth is both part of reading ability and a general verbal ability. (Perfetti, 1983, p96).
The relative importance of existing knowledge to the comprehension process is put by Miller (1984) as "text and world knowledge are actively manipulated during comprehension, and successful comprehension depends, amongst other things, upon the readers ability to accurately process this information" (p. 342).

Graesser and Riha put a similar view in their review of predictors of reading time (1984). They discussed the need for a reader to make inferences to link a sentence with the previous context, but expressed difficulty in analysing what inferences were being generated by the reader. They said that analysing the text would not help, as most inferences were generated based on the word knowledge schemas suggested by the text to the reader.

Bloom et al. (1956) divided knowledge into a number of categories, the three major sub headings were:-

a) Knowledge of specifics.

b) Knowledge of ways and means to deal with specifics.

c) Knowledge of the universals and abstractions in a field.

Item a) is the concern of this study, as b) and c) relate to procedural memory or knowledge. In the learning of new information there has been discussion on the need to structure the presentation in order to make it more amenable
to comprehension and therefore long term retention. However the problem of the optimal way that knowledge can be structured to provide the most comprehensible organisation, is still to be resolved.

There is a significant difficulty in obtaining a formal definition of the "essential" knowledge structure hierarchy of any subject. This affects the foundation of any theories on learning. We know that prior knowledge is a significant factor in learning, because it acts as a schema on which new information can be built. We do not know a great deal about human knowledge representation. This was found to be a problem when the computing industry began to try and create expert systems. These systems are being designed to solve real world problems by first building a knowledge base from the respective experts in the particular field.

The development of these systems are being hindered by the difficulty of eliciting the knowledge in a structured manner from the experts (Cullen & Bryman, 1988). The expert system builders are looking to cognitive science for help but "no single knowledge representation scheme seems all encompassing or powerful enough to represent all forms of knowledge" (Garg-Janardan & Salvendy, 1988, p. 331).

If we have difficulty in formalising the structure of knowledge, then this difficulty must flow through teaching of the knowledge, and influence the student's ability to
understand the information. This must then hinder their learning. "memory processing can be seen as occurring within the context of a persons general knowledge of the world" (Naus & Halsz, 1979, p. 278). "more able students organise their knowledge differently than less able students" (Briars, 1983, p. 193).

Learning style

Nations cited in (Watts, 1978), proposed three components of learning style. These are; sensory orientation - a preference for either visual cues or aural cues, responsive mode - a preference for working in a group or to work independently, and thinking pattern - a preference for a deliberate methodical approach or to make large intuitive leaps. Kagan (1972) refers to the latter as the reflexive/impulsive mode of cognitive style.

A number of studies have attempted to arrive at an inventory of learning processes used by students to see if these can be used as better predictors of academic success than the Scholastic Apptitude Scores. An alternative called Approaches to Studying Inventory (ASI) was investigated by Watkins (1986). He took the ASI score together with the tertiary entry score (TES), and a number of the student's background characteristics as a combined score, and found it
to be a better predictor of academic achievement than the TES score alone.

The analysis of the detail items making up the total score, showed some interesting differences between academic faculties. The ASI factor of disorganised study methods was associated with low marks in Arts subjects, and the ASI factor of surface learning strategies was associated with low marks in economics.

Sims, Veres, Watson, and Buckner (1986) reported that the measurement aspects of the learning style inventory (LSI) had been criticised. They therefore investigated both LSI and the replacement inventory, LSI II. They found better internal consistency with LSI II, but were not convinced at the reliability over time for LSI II.

Marshall and Merritt (1986) developed a questionnaire to determine learning styles based on the cognitive theory of Kolb (1981) which was derived from the theories of Bruner and Piaget.

The four main segments of the model moved through the sequence; concrete experience, through reflective observation, and active experimentation, to abstract conceptualisation. The questionnaire was tested on 543 university students, and showed good reliability and also
supported the idea that most students have a predominant learning style.

This kind of instrument might be very useful when used as an adjunct to a CAI lesson to determine the learning style of the student. The control module would then take the most appropriate route through the lesson consistent with that style.

However I am disappointed that I have not found any references to research that attempts to relate learning style to cognitive style. Although Sperry (1972) feels the terms learning style and cognitive style are often used interchangeably, I feel that educational research is more likely to use the term learning style, and use it in a more general and broad fashion, than the way that psychology research would use the term cognitive style.

This can be seen in the description by Claxton and Murrell (1987) of 4 approaches to the question of learning style. These are personality, information processing, social interaction, and instructional methods. It is the second item, information processing, that is the primary interest to this study, and the one most used in relation to describing cognitive style.

Cognitive style
In discussing child development Stauffer suggests that "Thus early in life the rudiments of dealing with a number of options and part-whole relationships is being pieced together" (1977, p. 243). Stauffer goes on to discuss the child's language acquisition process, which "reflects the generalisation tendency of the human mind" (1977, p. 243). Then as the child matures it is able to "organise objects and events into categories" (1977, p. 244).

Stauffer (1977) says that over the same period the individual differences of being impulsive or reflective develop. The cognitive style of reflectiveness versus impulsivity, is the tendency to react slowly after thought, rather than quickly jumping to a conclusion (Kagan, 1972).

"The concept of cognitive style accentuates the 'how' rather than the 'how much' of behaviour; thus it describes modes of information processing rather than different levels of performance" (Pizzamiglio & Zoccolotti, 1986, p. 31).

Cognitive style is the way a person typically perceives, remembers and processes information, and is stable over time. Witkin et al., (1972) have shown with their longitudinal research into the field dependent/independent cognitive styles, that during the growth years there is relative stability, with a tendency to increasing differentiation with age, until with adulthood a person becomes extremely stable in relation to cognitive style.
Types of cognitive style

As well as the styles of reflective/impulsive and psychological differentiation there have been suggested other cognitive styles. There are the styles related to the way people think, such as broad and narrow categorising and analysing/synthesising. There is also a style related to behaviour, such as introversion/extraversion. There is the style of leveling/sharpening, which relates to the persons view of the world, whether they look for differences around them or prefer a consistent environment (Smith, 1975).

Other definitions of cognitive style are given by Messick (1972) who lists nine styles. I think the three most significant are reflective/impulsive (Kagan, 1972), levelling/sharpening (Holzman & Gardener, 1972) and field dependence/independence (Witkin, Goodenough, & Karp, 1972). The other styles described, all seem to be partly a redefinition of these three. Davis cited in (Sperry, 1972) suggested the characteristic of active analysis by the learner to be common to the styles of field independence, differentiation, and reflectivity. He also thought the characteristic of passive global acceptance to be common to the definition of field dependence, undifferentiation, and impulsivity.

There is also cognitive complexity versus simplicity (Bieri 1961). Simplicity is the tendency to label things into
a few broad categories and use these for most analysis rather than the complexity of the real world. This could be another view of differentiation. Two that seem to have had most research related to the process of learning are reflective/impulsive and differentiation.

The dimension reflective/impulsive is put forward by Claxton and Murrell, 1987, as an argument against the use of multiple choice questions. This is because of the tendency for the impulsive student to take the first choice that appears to match, without checking all choices closely.

Sperry introduces the chapter on learning styles with the comment, "individuals who are field dependent, impulsive, and rather close minded and intolerant of ambiguity will tend to be levellers" and "The sharpener, who tends to be field independent, reflective, and open minded and tolerant of ambiguity" (1972, p. 140).

The style of field dependence/independence is also known as psychological differentiation and describes an individual's ability to identify and use the component parts of a situation, rather than only dealing with the whole. We talk of people for whom everything is black or white and can not see the shades of grey in a situation, these perhaps would be people significantly field dependent.

Before discussing the field dependent/independent cognitive style in more detail, I will just mention an
attempt to restructure all styles into one comprehensive procedure. This was done by Hill (1970), who created a battery of tests to be analysed by computer program. This would give an overall learning performance rating for a student, and covered the areas of symbolic orientation, cultural determinants, modality of inference, and memory. The rating was given the name educational cognitive style, and was used in a reading comprehension study by Crandell (1979).

Crandell (1979) devised a test of assembly procedure instructions, that used various picture and text combinations. These comprised pictures with text, just pictures, and just text, these combinations were used in conjunction with the ECS model.

The test showed no significant difference, but did indicate some areas that would be useful to follow up. I think the ECS model is complex, and the test with 5 style groups from 96 subjects was too ambitious a research investigation, for a model with a limited empirical research background.

Crandell (1979) reported that research by Cohen had suggested that "the information processing behaviours of field independent people might be helpful in problem-solving certain kinds of reading comprehension problems" (Crandell, 1979, p. 35).
A reflection on Crandell's use of pictures, is a warning from research by Reid and Beveridge (1990) which showed that adding pictures assisted the good reader but decreased learning for the less able reader. The less able reader spent longer looking at the pictures, possibly in preference for the difficult reading task. Reid and Beveridge supposed that the student did not do so well, because they were unable in this case to integrate the picture information with the text information.

Field dependence-independence

The style that has been most researched and described, is that of field dependence/independence. The original work on this style was done by Witkin and was concerned with a person's perceptual processes. He used investigative techniques that included the rod and frame test and the embedded figures test.

The tests were concerned with whether a subject could recognise a simple stimulus within and partially hidden by a more complex background. Those people unable to separate the simple stimulus are classed as relatively field dependent (Witkin, Goodenough & Karp, 1972).

The cognitive style of field dependence is not limited to perception but extends to any situation where an
individual needs to be able to analyse a structure and recognise the component parts.

Can the tests for field dependence/independence be used to assist people in their approach to learning?

"the instrumentation, such as the embedded-figures test, does not provide results that can be easily translated into teaching practices" (Claxton & Murrell, 1987, p. 13).

However if we look at Witkin et al. (1977) we find a number of keys to the way we can look at this problem. A summary of characteristics relevant to the learning process applicable to field dependent/independent students are as follows:-

a) field dependent.

. Better at memorising social information.

. Have more difficulty with unstructured material.

. Have a tendency to accept the organisation presented.

. May need more instructions on problem solving.

. May need a goal set for them.

b) field independent.

. May need more focussing on social material.

. Can reorganise material to suit themselves.
. May be more able to generate their own solution.
. Have internally set goals.

The above material was drawn from (Woolfolk and McCune-Nicolich, 1984; and Witkin et al., 1977)

Spencer (1988) describes a procedure based on film shots developed by Saloman (1979). Some film segments zoomed to a close up and others cut from distance to close up. The subjects were tested on their ability to perceive detail and relate to a whole and then shown the film segments. The results indicated a need for a particular skill in perceiving the elements, which the zoom version was able to replace.

The extension to a more general frame of reference caused the style of field dependence/independence to be re designated global-analytic which is thought to be part of the broader dimension of psychological differentiation. The important fact is that EFT (embedded frame test) performance is also indicative of an individuals level of psychological differentiation (Witkin, Oltman, Raskin & Karp, 1971).

The research of Pizzamiglio and Zoccolotti (1986) led them to conclude that the field dependence/independence concept provides a way to categorise the information processing style of an individual and that this categorisation is stable over time and a good indication of the degree of differentiation in general.
Bertini also states that "a cognitive style approach can give us information about the unique ways in which cognition is organised in different individuals" (1986, p. 94). Perhaps more significant is his quote cited from Witkin "they (cognitive styles) are truly broad personal styles. They are our typical ways of processing information" (1973 p. 5).

The research by Witkin, Moore, Goodenough & Cox (1977), showed that field-dependent persons picked up on social cues and thereby remembered associated material; this occurred even when the social material was peripheral to the main task. A question to be raised is whether linking non social material to social material would cause the associated material to also be learnt.

Raskin (1986) showed that measures of field dependence/independence did not predict choices of fields of study at college entry, but did affect choice of major at graduation. Field independent people specialised in mathematics and science and field dependent people became education majors. The research by Raskin (1986) showed that students changed their major to be more compatible with their cognitive style.

The factor most critical to learning is that field independent persons will do more analysis and impose their own structure on disorganised material.
Frequently in learning, the material to be learned lacks clear inherent structure, creating the requirement that the learner himself provide organisation as an aid to learning. Field-dependent persons are likely to have greater difficulty in learning such material compared with field-independent persons. (Witkin et al, 1977, p.21)

A study into teaching grammar with two alternate lesson formats showed that field independent subjects did better with a lesson that gave plenty of examples. The conclusion was that field independent students are more adept at learning rules and how to use them than field dependent students (Abraham, 1985).

Research by Adams and McLeod (1979) into using additional guidance for mathematics teaching did not show any improvement for the field dependent students. But they were using an eight week course and tried to find correlational significance over the whole of the field dependence/independence scale, rather than just using the ends of the scale. I think that there would have been too many other factors over that time period, and the test was too insensitive.

A study that showed some relationship to the cognitive development theories of Bruner, was research by Koran, Snow and McDonald cited in (Witkin et al 1977), which used a video
modelling procedure against a written procedure. This found that field dependent people gained more advantage from the video modelling procedure, indicating a preference for a more concrete presentation (cited in Witkin et al., 1977).

The importance of the field independent ability to isolate an element from a complex whole (i.e. the ability to disembed), was investigated by Hedberg and Perry (1983). They used a test procedure based on selecting teaching materials from a database of modules for a suggested curriculum. The materials could be selected by keyword or via an abstract.

The results indicated that the field dependent teachers needed the keywords, and when they could only use an abstract to identify appropriate modules, they were not able to do as well as the field independent teachers.

Other research by Benbasat and Dexter, and Barif and Lusk, into this ability, was cited in Hedberg and Perry (1983). Benbasat and Dexter (1979) used a simulation model that enabled decision makers to vary a single, or a few of the five decision variables, to provide assistance to field dependent people. The field dependent people that had previously done worse than the field independent people did as well as the field independent people when using the simulation model. Barif and Lusk, (1977), presented decision makers with several report formats of increasing complexity,
they found that field dependent people prefered the simpler formats.

The embedded figures test has been used by a number of researchers including (Maznah & Ng, 1985; Shade, 1983; Hadfield & Maddux, 1988; Adams & McLeod, 1979) to investigate the educational aspects of the field dependent/independent cognitive style.

One interesting advance on the use of the embedded figures test has been put forward by Melancon and Thompson (1989), who felt that the embedded figures test was too difficult to administer. They have proposed a replacement test called find the embedded figures test. The FEFT was tested against the group embedded figures test, and results showed the FEFT to be reliable. The FEFT uses a multiple choice question approach which would make it easier to incorporate into a computer test sequence, but there might need to be a check on the effect on impulsive subjects.

The aspects of cognitive style that I have set down are only those that I felt had some bearing on the way an individual may approach the learning process. I have omitted other aspects where cognitive style affects the more general psychological functioning.
The above aspects of the field dependent/independent cognitive style, have concentrated on the factors related to learning which therefore relates primarily to the student. In the learning situation there is in most cases the additional role of the teacher, and a question should be asked as to whether the cognitive style of the teacher has any affect.

Raskin (1986) found that in a test of college graduates the education majors tended to be field dependent, this could mean that there is a predisposition for teachers to be field dependent.

Matching teacher and student styles

There is the instructional style of the teacher the preferred learning style of the student and of course the interaction of the styles of the student and the teacher.

The majority of what I have written, has been concerned with the learning ability, and learning environment of the student. However in the classroom, the teacher is a significant component of the environment, and the teacher controls the presentation to the student.

Witkin, Moore, Goodenough and Cox, believe they have "established match or mismatch in cognitive style as a factor in teacher, student and other kinds of social interaction as well" (1977, p. 35). They further conclude, that it is necessary, "to provide teachers with information on how to
adapt their teaching strategies to match the learning needs of dissimilar students" (1977, p. 37).

The educational research and discussion on individual differences puts most of the onus for compensating for individual differences, on the teacher. "On the whole, the evidence gathered should convince us of the importance of taking a teachers cognitive style into account when considering teaching effectiveness" (Bertini, 1986, p. 103).

Schurr, Houlette and Ellen (1986) warn that they have seen evidence that there is interaction between instructors grading practices, and student personality types. This has lead to grade changes based on personality characteristics.

The position I take, is that to ask the teacher to measure and take into account, so many variables of individual differences, on top of the actual teaching curriculum, is asking too much. This might account for the fact that I see very little evidence of the results from individual difference research appearing in the classroom. I believe that assistance needs to be given using computer managed instruction, and computer assisted instruction.

Selecting the Research Model

Factors to consider
I have reviewed some of the issues relating to the process of learning, and I covered perception, attention, memory, comprehension, and processing. The process model of memory was adopted, and the concept of a working store was retained to describe the activity related to processing information for analysis and comprehension. There was particular attention paid to levels of processing as related to automatic and controlled processing, with a limit to the controlled processing resource. The concept of the interactive compensatory model provided for controlled processing resources to be switched to low level activities, if the reader was having difficulty with the text material.

The concept of automatic/controlled processing could be seen as a dichotomy, with no graduation from controlled to automatic. However any complex process is merely a set of sub processes some of which may be sufficiently familiar as to be an automatic process, while some need to be at the conscious level of controlled processing. The latter is the level where data is elaborated to fit with current knowledge and experience, which will improve comprehension and memory retention.

In a reading task, all the basic elements of the reading task may be automatic, but understanding the concepts, and the filing of the information, needs to be via controlled processing.
I think that there may be several scenarios for when full understanding and thereby comprehension, may not take place:

1. The words and local concepts may be familiar and the reader is lulled into reading quickly in just automatic mode. The reader does not think to invoke controlled processing which is required for full understanding. The person reading may find the subject boring, and may be unaware that merely reading will not necessarily lead to understanding and good retention.

The default condition for perception, is to filter incoming stimuli, and only present for processing what is considered important at the time. "some readers continue reading without assessing whether they have understood adequately what they have read" (Kirby, 1988, p. 238).

This would mean that when reading, a person may normally operate in automatic mode, until a cue word attracts attention, or there is a conscious effort to process in controlled mode. "So with reading, it is an easier matter to respond to the superficial, yet research shows that it is possible to encourage students to go beyond it" (Frase, 1977, p. 56).
2. The total amount of processing capacity available, may not be sufficient for all the controlled processing to occur. The information may be so unfamiliar that the capacity of the controlled processing is being taken up with trying to understand the words in their context and perhaps the local concepts, but can not also grasp the more global concepts.

Mitchell said that "It is easy to see that incomplete knowledge of word meanings could reduce reading speed and lower the reader's level of comprehension" (1982, p. 17).

3. Distractions while reading, may mean that conscious processing is redirected away from the primary comprehension task. Reading then proceeds at an automatic level but no conscious processing for understanding takes place. See the work by Fisk and Schneider (1984) referred to in the section on models of memory processing.

Graeser and Riha said that "If resources are not distributed effectively, or if the text is too demanding on processing resources, then comprehension will suffer" (1984, p. 210).

The section that reviewed factors associated with long term retention, covered elaboration and how it worked with the concept of spreading activation during retrieval. Text structure was reviewed as an aid to comprehension, and focus
of attention was discussed as a means of directing controlled processing resources to required text segments.

If the text meaning appears to be obvious and already known to the reader, then they may read only by automatic processing, that is they are only performing a word recognition task. They may not realise that they need to elaborate and encode the text for integration into existing knowledge. The person may believe they are comprehending the concepts, and suppose that they already have the data adequately stored.

If however new data is buried within familiar data, this may cause the new data to be overlooked. By making the text somewhat more difficult to read, then the person may be persuaded to process the data in a more controlled fashion, elaborating and encoding and thereby remembering any new content.

Spencer (1988) in reviewing the work of Salomon (1984) and Langer (1984) concluded that if the mode of presentation is too easy, then the student will not learn as well, as when the student has to work hard to understand. The problem is still, how to persuade the student, that making a conscious effort to understand is essential for comprehension and, therefore, for long term retention.
This may not necessarily be in opposition to the concept that better organised text is more easily remembered. I have been particularly concerned with the way that material should be organised, by the use of cues of one form or another.

In simple terms we might say that the presentation has to be pitched to be sufficiently novel/difficult and/or interesting, to obtain the attention of the reader. This is necessary so they consciously examine what they are reading. It is both the characteristics of the content, and the mode of presentation, that effect the way a reader processes the material. These factors however must not be so novel or difficult so as to absorb all the controlled processing resources, thereby preventing the reader adequately integrating any new data.

To test the interaction effect of presentation mode and cognitive style, the options are to either make the presentation more difficult or to attempt to make it easier. This research was to see if the field dependent group had difficulty with complex text, and to see if they could be assisted by changing the mode of presentation.

The section on individual differences concentrated on verbal ability as a measure of the level of intellectual ability. The affect of prior knowledge was discussed as an aid to comprehension and long term storage. Learning styles
were reviewed, but as their definition was very broad, the individual difference of cognitive style was selected as a description of information processing behaviour. The field dependent/independent cognitive style was selected as relevant to the learning process.

It has been suggested that there is in common to all theories on cognitive style, an emphasis on structure rather than content. The style of field dependence is particularly susceptible to lack of structure (Witkin et al., 1977).

Depending on the structure of material, the field dependent person may have difficulty disembedding items of information from the overall presentation. The field dependent person may have to redirect their controlled processing resource to help them restructure the material, and away from the comprehension function.

For FD people, correct priming cues may need to be given e.g. section titles and/or leading questions and/or preview summaries. Care is needed in the sequence of presentation. For example some presenters will give an incorrect example first, as if it were true, then proceed to disprove it; thereby demonstrating the correct situation. A FD person may well be irrevocably set on the wrong path by the misleading opening position. Glass (1984) warns of the loss of cognitive
capacity on the primary comprehension task caused by a distraction in the text.

On the other hand an FI person may prefer the latter intriguing approach. They may also prefer a presentation of the overall picture first, with all the component parts placed immediately but without explanation into their correct perspective. They may then prefer to explore for themselves, fitting the new data to their own knowledge as they go. The FD person may easily get lost, misdirect themselves, and get confused with this approach. In the section on learning I referred to research by Pask (1988), that found there were people that needed a learning strategy based on a top down, step by step, preset sequence.

The contradiction may be accounted for, by considering that FD people are particularly susceptible to priming cues, that set the scene for the ensuing text segment. Field dependent people may be misled by mistaking a cue, and set an incorrect context for the following text. The misconception would continue until the reader was forced to recognise a change in theme.

On the other hand a FI person is not so susceptible to misdirection because of their ability to see the more global context, and therefore see any minor misdirection in its rightful perspective.
These two perspectives on the way people comprehend best, means that it is imperative that a person is identified as FD or FI, and that material is presented accordingly.

These two opposites of approach may account for the difficulty experienced with CAI where there has been only inconclusive learning results. Perhaps it is because the CAI is written without regard to style, thereby only suiting one or other cognitive style. The lesson may not be adaptive enough to cater for the student having difficulty with the author's style of presenting a topic.

Test requirements

Farr reported that a review of the literature showed many relevant studies were methodologically flawed "lacking a common metric for measuring the degree of learning and the rate of forgetting", and refers to a review by Lane of the acquisition process, "there is disappointing little in the literature of practical use to the learning and retention of the broad range of complex real-world cognitive tasks" (Farr, 1987, p. 1).

The approach Farr (1987) wished to take in the investigation into learning research was to conduct a meta-analysis (coined by Glass, 1977), which is an integrated review approach. I also feel that in researching such a complex subject it is important to take all major dimensions
However Glass (1977) warns of overly complex variables, one in particular, "hours of instruction" which is not amenable to meta-analysis, because one hour per week for ten weeks can not equate to five two hour sessions in a week. The term "hours of instruction" contains several temporal scheduling factors that are important to learning and retention. This particular variable is very relevant to any trials for learning and retention and must be strictly controlled.

Farr therefore decided not to follow the meta-analysis approach as such, but instead the spirit. He felt there was no real controversy on what the crucial variables were that affected long term retention, e.g. overlearning is generally agreed to be more resistant to forgetting.

My first consideration for the test of retention of text material was whether to use word lists, or to use prose and a comprehension test.

A methodology often used in learning research is the use of word lists. Wagender (1987) warns that there may be some memory processes that only work with meaningful data. As I needed to test the effect of structure of presented material against the variable of field dependence/independence, it was
necessary to use narrative material, and test for comprehension rather than just individual facts.

Carrol (1977) complains that many tests of reading ability are language tests not comprehension tests. There is also a complaint that the tests do not indicate what a low score means, whether the deficit is in language, cognition or affect. "... similar remarks could be made about dozens of other tests that purport to measure reading comprehension" (Carrol, 1977, p. 2).

Frase (1975) also refers to the difficulty of research into prose processing with the comment "An inhibiting factor to research on prose learning thus has been the complexity of the stimulus environment that prose represents" (1975, p. 2).

In Farr's opinion, what is lacking, is an understanding of what occurs with overlearning. Does the increased retention result from "further opportunity for deeper level of processing and more elaborate encoding?" (Farr, 1987, p. 13). Elaboration is the process of increasing the range and depth of encoding and is according to Anderson & Reder (1979), clearly associated with improved amount of retention.

I will return to a description of the requirements for the comprehension test, after discussing the aspects of structure and individual differences that need to be taken into account. There are many ways of improving the structure of presented text by the use of cues or the provision of meta
cognitive organisers, but I wanted to avoid adding other effects. I thought that the procedure followed by Cromer had some interesting aspects.

Cromer (1970) described 4 models to account for reading difficulty, which were: defect, deficit, disruption and difference. The difference group is of particular interest in relation to this thesis. Though regarded generally as poor readers, they did comprehend as well as good readers, when material was presented with some preorganisation. As Cromer (1970) put it "the individual would read adequately if the material were consistent with his behaviour patterns" (p. 471).

The research by Cromer (1970) used freshmen from a US junior college as subjects, who were accomplished readers. The difference group had adequate intelligence, language skills and vocabulary skills but had difficulty comprehending. It was assumed that though they could read aloud correctly they did not organise the input adequately, they organised on a word by word basis rather than in meaningful units. Cromer (1970) hypothesized that by presenting the difference group with material in meaningful units they could be encouraged to perform more like good readers.

As this research procedure of Cromer (1970) has some similarity to the comprehension test used in this study, it
would be useful to outline the more significant points that relate to my requirements.

Cromer (1970) used a set of stories, each set presented in four modes: regular sentences, single words, meaningful phrases, and fragmented word groups. No subject read a story more than once. The meaningful phrases and fragmented phrases were structured according to Lefevre's (1964) criteria that "the significant elements are grammatical and syntactical structures; noun and verb groups and clusters, clauses, sentences" (Cromer, 1970, p. 474).

The difference poor readers answered significantly more questions correctly on the meaningful phrase mode than the other three modes which were not significantly different from each other.

The good readers answered correctly on the regular sentence and meaningful phrase mode and scored equally low on the single word and fragmented grouping. This indicated that I need only use the meaningful phrase, and the regular sentence modes, to select between the difference poor reader, and the good reader.

Cromer (1970) suggested the study showed that "the difference poor readers typically do not organise reading input in a way that facilitates good comprehension" (p. 480). He then goes on to suggest that the ability to organise input into meaningful units should occur when the individual has
become proficient at single word recognition. If the individual does not then go on to learn to read in terms of the linguistic structure, or overlearns the reading word by word style, then that person will not comprehend adequately.

The description of the way the input was presented to create structure that assisted the difference group is interesting. To avoid the diversion of controlled processing to structure analysis, rather than comprehension, the field dependent cognitive style reader has a requirement for a structure that will assist them in disembedding component ideas. Perhaps the procedure used by Cromer for difference poor readers would assist the field dependent reader.

The discussion on individual differences also referred to the fact that prior knowledge is a strong determinant of how well a subject learns. With educational text it is difficult to set up a test with all the subjects having the same knowledge. There is a similar problem if a part or abstract from a well known piece of literature is used.

For these reasons I discarded a number of reading tests including (Anderson, Dunstan & Pool, 1969) where they concentrated on scientific articles with questions on individual facts rather than concepts. Both Australian Council for Education Research (1980) and Pauk and Wilson, (1974) use famous literary works and only a few questions. The College Entrance exam Board (1983) uses a technique of filling in a missing word, which follows the Cloze procedure
for comprehension testing, but seems more dependent on language ability than comprehension.

All prior testing to establish the current level of knowledge has a tendency to change the amount of the subjects' knowledge. I therefore needed to use invented material comprising facts and concepts, as in short articles. It has been indicated that social material, cues field dependent subjects, and scientific material is of more interest to field independent subjects. This should therefore be taken into account.

IQ is often not accounted for as a variable in memory tests, excepting where it indicates a degree of prior learning. However if we consider the dual process model of Shiffrin and Schneider (1977), and the concept of processing capacity, it is easy to think in terms of some individuals having more capacity than others. If ability to decode and integrate material is at an automatic level for one person and not for another, then the former will be able to process information faster (Sternberg 1984).

It was therefore necessary to take verbal ability into account. As vocabulary is an important component of verbal ability, it should be sufficient to measure the vocabulary level of the subjects.

A comprehension test forms the main part of the procedure with sentences and phrases following a similar
pattern as the procedure used by Cromer (1970). The final aspect of the research model was to decide on the rate of presentation. The options I considered were:

1. To control the rate of presentation forcing the subject to read at a predetermined rate (Mitchell, 1984). Tobin (1987), after an extensive literature review, proposed that a wait time between verbal utterances, allows for additional think time, and presumed, that the extra time would improve cognitive achievement. There is indication that reading rate is associated with deeper processing, and I wanted to measure the reading rate selected by the subject, so this option was not suitable.

2. To allow the subject to browse back and forward until satisfied they had learnt the material. This procedure might have more emphasis from motivating factors, so this option was discarded.

3. To allow the subject to determine the rate of presentation but only able to go forward. This is the procedure I opted for, and it would allow the collection of reading times. An analysis of the reading times might confirm the research by Graesser and Riha (1984), which suggested that a longer reading time indicated greater depth of processing.

Summary of Research Model
Farr has suggested that overlearning is a process that improves long term memory retention (1987). This however presumes that learning is taking place, and by repetition we improve long term retention. This procedure works well in a situation where manual skills are being taught. It is not so clearly an advantage when we are concerned with academic learning.

For text material to be learnt, such that it leads to long term retention, comprehension of the material is an essential prerequisite.

The discussion on automatic/controlled processing leads me to suggest that deeper processing in the form of controlled or conscious processing is needed to elaborate and integrate the data into existing knowledge for good comprehension. The revision of this model into the interactive/compensatory model suggests that controlled processing resources can be diverted from the comprehension process to lower level activities if required. Whereas this is not directly tested in this research procedure, I do address this concept in more detail in the discussion of results.

What can cause a reader to read more consciously than just reading as an automatic process? I have discussed the
focussing of attention by content structure, cues, questions, and multiple passes on the data. Is there a more basic presentation factor affecting attention, and can structure be given without adding information? Do all readers process the same text in the same way. Or does the way text is presented, cause some readers to understand less well, than other readers at the same knowledge level.

The questions for consideration are:-

. Do readers at the same knowledge level differ in the amount of comprehension obtained from a given text passage?

. Is the cognitive style of the reader a factor in this difference?

. Does the presentation style of the text have a contributory effect on this difference?

If the answer is affirmative to these questions, we have determined that text presentation and cognitive style are underlying factors that effect the level of comprehension. Future research should then determine what approaches to presentation of the text, taking into account the cognitive style of the reader, can be used to increase the controlled processing needed to improve comprehension. An alternative
might be teach the field dependent person to recognise or create structure more automatically thus allowing processing resources to be released for the comprehension task.

From this starting point, researchers can investigate the structure and presentation of the topic. Then having improved the level of comprehension immediately following reading, further research can go on to measure the effect on long term retention.

In conclusion, to test for an answer to these questions, and establish which factors are basic to understanding the interaction of presentation mode and cognitive style:-

. I needed to test the vocabulary level of my subjects to ascertain some measure of their current knowledge and reading skill.

. I needed to test their cognitive style, whether field dependent or field independent. This was done with an embedded figures test which is available in a format suitable to give to a group.

. Finally I needed a comprehension test that I could adapt to include different presentation styles.

Research Procedure
Materials

The three tests selected are as follows:

1. To ensure an equivalent reading ability, the Mill Hill Vocabulary scale was used. Perfetti (1983) refers to the relationship between reading ability and vocabulary skill.

2. The test chosen for the cognitive style of field dependence/independence (psychological differentiation), was the group embedded figures test (Witkin, Oltman, Raskin and Karp, 1971). This is a perceptual test that has been proved with a range of research tests, to demonstrate that a person has a consistent approach to cognitive functioning. The subject looks at a simple figure, and then has to examine a complex figure and locate the simple figure. They are unable to see both the simple and complex figures together, and the complex figure has been designed to obscure the simple figure. The subject therefore has to disembed the simple figure from the complex figure.

The ability to disembed has been demonstrated to go beyond perceptual tasks, and can be seen in any cognitive activity that requires the separation of an item from a greater whole. Studies by Fenchel and Karp cited in Witkin Oltman Raskin and Karp (1971) demonstrated a relation between
the embedded figures test, and the cognitive ability to isolate an element from a complex context.

3. A comprehension test formed the final part. This was used to test the effect of text structure on retention. As I was unable to locate an appropriate test, I designed one myself. The material was taken from "Steps to Reading Proficiency" (Phillips & Sotiriou, 1987), which is a test of critical reading ability. The design of the presentation format was adapted from a procedure outlined in the paper by (Cromer, 1970).

In the control presentation, the sentence was presented in conventional format see figure 1. In the test presentation, the sentence was presented with one phrase per line, each phrase was intended to be a meaningful unit, see figure 2. The phrase was selected as a grammatical unit e.g. a noun or verb group or clause. There was a possibility that this procedure might make reading more difficult, by breaking the span of attention. However Cromer (1970) had used the technique successfully, and I used it to see if the effect he had found was related to cognitive style.
Figure 1.
Story 1. Sentence mode of presentation

C:START=CLK(0)
TX:
: My wife gingerly peeled the Scotch tape from Jill's two little Christmas packages as the security officer watched.
U:RESP
TX:
: "I should have known better'" I said.
U:RESP
TX:
: We were standing in the lobby of the Ventura School which is not really a school, but a big California Youth Authority reformatory in Ventura County.

Figure 2.
Story 2. Phrase mode of presentation

C:START=CLK(0)
TX:
: My wife gingerly peeled the Scotch tape from Jill's two little Christmas packages as the security officer watched.
U:RESP
TX:
: "I should have known better'" I said.
We were standing in the lobby of the Ventura School which is not really a school, but a big California Youth Authority reformatory in Ventura County.

To present the text I decided to use a personal computer and a program I wrote myself. I used an authoring language called PILOT to develop the program. I had looked at a system for presenting comprehension tests via Macintosh computer, described by Nason and Zabrucky (1988), but the authoring language was unfamiliar to me. The program I wrote, explained the procedure to the subject, presented the text according to the design, asked the comprehension questions, and collected the data into a file for later processing.

**Method**

The subjects were 45 volunteers, male and female in approximately equal numbers, enrolled in first year psychology. They were given the first two tests at the one time, one immediately following the other. I then asked them to attend the personal computer laboratory, the same time the following week for the comprehension test.
The subjects of particular interest were those clearly either field dependent or field independent. Those in the middle range were not included in the final analysis, but all the 36 subjects that came to the comprehension test were allowed to take the test.

The subjects in each of the above groups were sorted into their vocabulary score sequence, and I discarded the very low scores so as to avoid anyone with specific reading limitations. I then organised the subjects into pairs that had close to the same vocabulary score; one field dependent person and one field independent person.

For the comprehension test I wanted to avoid any learning effect caused by doing a particular mode first. Therefore the subjects were assigned to take the test so that one person would do story one in conventional sentence format and story two in phrase format, the next person would do story one in phrase format and story two in conventional format.

A personal computer was used to present the comprehension test. The stories were each presented a sentence at a time, and the student was allowed to control the reading rate by pressing the ENTER key when ready to proceed.
The program first explained the test procedure, and gave examples of the mode of presentation, and asked the subject to read carefully so as to be able to answer the comprehension questions. The program then presented the first story in one format, followed by questions, then the second story in the other format, and the second set of questions.

Before presenting the 16 multiple choice questions to test the subjects comprehension, the program creates a delay in the form of questions about the subjects reaction to the presentation. The questions were as follows:-

1. Did you have any problem using the system?
   a) none at all, b) some difficulty, c) a lot of difficulty.

2. Did you feel annoyed by the presentation style?
   a) not at all, b) a little, c) a great deal.

3. Please type in any other comment.

Some responses to question 3 were complaints about the use of the enter key. This was due to some students being unfamiliar with the use of a personal computer. They sometimes pressed the enter key too long, which caused the program to respond with several screens rapidly, one after the other.
Additional data gathered by the program were the subjects' name, the reading rate, the amount of time to answer the questions, and the number of correct answers.

Variables

The subject attribute is the measurement of field dependence/independence as shown by the group embedded figures test. The scores were grouped so that 0-11 was coded as 1, 12-15 was coded as 3, and 16-18 was coded as 2. As I was particularly interested in those at either end of the dichotomous scale, only codes 1 (field dependent) and 2 (field independent) were included in the final analysis. This is the independent variable, with the name GEFT, which gives the two attribute groups, GEFT (1,2).

The first subject had story one presented in control (conventional) format and story two in phrase format. The next subject did story one in phrase format, and story two in control format. The format type for story one is shown in variable PSN1, with phrase format equal to 1 and control format as 2. The format type for story two is taken as the reverse of PSN1. The dependent variable is the comprehension score, which was assigned the variable NR1 for story one, and NR2 for story two.
The vocabulary score is variable VOCAB, and was used as a covariate. The time to read each story was divided by the number of words to get the reading rate RR1 and RR2. The time to answer questions was named TQ1 and TQ2.

The responses to the questions that were interposed between the story, and the comprehension questions, are shown in the data table as FDM1 and FDM2. The subject's response to question 2, was coded as 1 in the column headed C/P if they preferred control mode over phrase mode, without regard to which story. If phrase mode was preferred over control mode, I coded a 1 in the column headed P/C.

The response to the last request I coded so that it appeared in the same format as the responses to the two questions. Most responses related to question 2, so this was used as confirmation to the question 2 answer. The counts for the various responses to the questions are shown following the raw data in Appendix C. The counts for those experiencing difficulty showed no difference between the FD and FI groups.
Comprehension Test Design

The research procedure for the comprehension test is represented in the following diagram:-

<table>
<thead>
<tr>
<th>Comprehension Score</th>
<th>Vocabulary</th>
</tr>
</thead>
<tbody>
<tr>
<td>Story1</td>
<td>Story2</td>
</tr>
</tbody>
</table>

Presentation mode

Phrase Control | Phrase Control

GEFT(1) field dependent

subject 1  NR1  NR2  V1
subject 2  NR1  NR2  V3
   "       "       V5
   "       "       

GEFT(2) field independent

subject n  NR1  NR2  V2
subject n+1 NR1  NR2  V4
   "       "       V6
   "       "       

•
For each story, there are the two main categories of field dependence and field independence, and the sub categories of control and test presentation style, giving four sub groups:

field dependent control, field independent control,
field dependent phrase, field independent phrase.

NR indicates the number of correct answers to the comprehension test, the suffix 1 and 2 indicate story one and two respectively. V1 indicates the highest vocabulary score, V2 the next highest etc. The other measures taken e.g. reading rate and time to answer are not shown on the diagram.

The procedure appears to indicate a repeated measures design for story one and story two, but this was discarded on two counts. Firstly, the results from a combined test would have made the explanation difficult to follow. Secondly, the content of the two stories used to test comprehension, were not symmetrical, and are quite different in style. This will be covered in more detail in the discussion section. Consequently the data for each story was analysed separately using an analysis of variance and covariance with the SPSS(tm) Manova test.
Hypotheses

The general null hypothesis is that there is no difference in the comprehension scores between the field dependent group and the field independent group.

\[ H_0 \quad \text{FD} = \text{FI} \]

Additionally, that the mode of text presentation will make no difference, giving the further null hypotheses:

\[ H_{0a} \quad \text{FD phrase} = \text{FD control} \]
\[ H_{0b} \quad \text{FI phrase} = \text{FI control} \]

My thesis hypothesises that field dependent subjects may have some difficulty determining the concepts in a poorly structured or difficult text. The first alternate hypothesis, is that the comprehension score of the field dependent group, would be different to the field independent group.

\[ H_1 \quad \text{FD} \neq \text{FI} \]

Further that the mode of presentation would have an effect such that:

\[ H_{1a} \quad \text{FD phrase} \neq \text{FD control} \]
\[ H_{1b} \quad \text{FI phrase} \neq \text{FI control} \]
These hypotheses can be made more specific, i.e. for the control mode of presentation, the comprehension score of the field dependent group would be less than the field independent group.

\[ H2 \; \text{FD control} < \text{FI control} \]

Further, that the attempted additional structure for the phrase mode, would improve the comprehension scores of the field dependent group for the phrase mode over the control mode of presentation.

\[ H3 \; \text{FD phrase} > \text{FD control} \]

**Results**

The raw data is shown in Appendix C.

**Results of vocabulary and GEFT tests**

The results of the vocabulary test and the group embedded figures test were analysed and compared with the normalised data from the test suppliers. This was to provide a reliability check, that the tests had been applied appropriately.
The vocabulary test normalised data was from first year students at Melbourne University in 1947. The maximum possible score is 66, the normalised mean was 41.1 with an SD of 7.8.

The results of my test showed a top score of 50 and a lower score of 16, subjects with scores less than this were rejected. The mean was 32.3 and the SD was 8.1, the mean is substantially down on the normalised mean, which might be due to a change in the nature of the general vocabulary since 1947.

A Pearsons (r) correlation was done with the vocabulary score against the variables from the other tests, the only variable that had a significant correlation was the comprehension score for story 1, with a coefficient of .347, p < .05.
The Group embedded figures test normalised data is from a USA Liberal Arts college. The maximum possible score for the test is 18, and the quartile ranges are shown in Table 2.
Table 2.

Witkin et al (1977) GEFT test scores

<table>
<thead>
<tr>
<th>Quartile</th>
<th>Men</th>
<th>Women</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0-9</td>
<td>0-8</td>
</tr>
<tr>
<td>2</td>
<td>10-12</td>
<td>9-11</td>
</tr>
<tr>
<td>3</td>
<td>13-15</td>
<td>12-14</td>
</tr>
<tr>
<td>4</td>
<td>16-18</td>
<td>15-18</td>
</tr>
</tbody>
</table>

Mean 12 10.8
SD 4.1 4.2

I did not separate my results by sex, as I was only interested in degree of field dependence/independence, and the sex of the subject was irrelevant to this study. The test results I obtained are shown in Table 3.

Table 3.

GEFT scores

<table>
<thead>
<tr>
<th>Score</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-9</td>
<td>11</td>
</tr>
<tr>
<td>10-12</td>
<td>6</td>
</tr>
<tr>
<td>13-15</td>
<td>4</td>
</tr>
<tr>
<td>16-18</td>
<td>12</td>
</tr>
</tbody>
</table>
The lowest score was 0 and the highest 18, with a mean of 12.89 and an SD of 4.56, these figures compare very well with the normalised scores.

However the quartile scores I obtained, are quite different from the normalised scores. My results are much more clearly differentiated into FD and FI. The 0-9 group was taken as the field dependent (FD) group, and the 16-18 as the field independent (FI) group.

The Pearson’s (r) correlation for the GEFT scores showed no significance against any of the variables from the other tests at \( r = .05 \).

Table 4.
Correlation coefficients for GEFT

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
</tr>
</thead>
<tbody>
<tr>
<td>VOCAB</td>
<td>-.2785</td>
</tr>
<tr>
<td>NR1</td>
<td>-.0827</td>
</tr>
<tr>
<td>NR2</td>
<td>.1605</td>
</tr>
<tr>
<td>RR1</td>
<td>.0463</td>
</tr>
<tr>
<td>TQ1</td>
<td>-.2010</td>
</tr>
<tr>
<td>RR2</td>
<td>-.2344</td>
</tr>
<tr>
<td>TQ2</td>
<td>-.0964</td>
</tr>
</tbody>
</table>
Analysis of comprehension test data

Figures 3 and 4 show examples of the two stories used in the comprehension test.

Figure 3.
Story 1. The Juvenile system

My wife gingerly peeled the Scotch tape from Jill's two little Christmas packages as the security officer watched.

"I should have known better'" I said.

We were standing in the lobby of the Ventura School which is not really a school, but a big California Youth Authority reformatory in Ventura County.

Figure 4.
Story 2. A Theatre critic

I'm a movie critic - how can I hate the theater? It's almost unnatural. But everytime I go, proud of my attention to duty, I feel awful. Something is wrong."

So writes David Denby in the January Atlantic Monthly.
His article, Stranger in a Strange Land: A Moviegoer at the Theater, will make theater people groan, but they should read it anyway.

The two stories were passed through the readability analyser of the Microsoft word processor (WORD 5) which gave the results shown in Table 8. The Flesch reading ease index of 60-70 is rated as standard for a person of 7 years education in the USA, a score of 0-30 would be rated very difficult. For the other indices a higher score indicates greater difficulty.

Table 8.
Readability scores for Story 1 and 2.

<table>
<thead>
<tr>
<th></th>
<th>Story 1.</th>
<th>Story 2.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Passive sentences</td>
<td>18%</td>
<td>5%</td>
</tr>
<tr>
<td>Flesch reading ease</td>
<td>65.7</td>
<td>69.5</td>
</tr>
<tr>
<td>Flesch grade level</td>
<td>8.4</td>
<td>8.0</td>
</tr>
<tr>
<td>Flesch-Kincaid</td>
<td>8.5</td>
<td>7.2</td>
</tr>
<tr>
<td>Gunning Fog</td>
<td>10.3</td>
<td>9.2</td>
</tr>
<tr>
<td>Averages</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Words per sentence</td>
<td>17</td>
<td>15</td>
</tr>
<tr>
<td>Characters per word</td>
<td>4</td>
<td>4</td>
</tr>
</tbody>
</table>

These statistics are very interesting, the scores all favour story 2 as being more readable, whereas the mean
scores from both groups of subjects in Table 7, indicated that story 2 was more difficult to comprehend.

Results of the comprehension test

The mean and standard deviation for the 26 subjects that did the comprehension test are shown in Table 5 for story 1 and 2.

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>NR1</td>
<td>11.7</td>
<td>1.7</td>
</tr>
<tr>
<td>NR2</td>
<td>8.5</td>
<td>1.9</td>
</tr>
<tr>
<td>RR1</td>
<td>184</td>
<td>61</td>
</tr>
<tr>
<td>RR2</td>
<td>196</td>
<td>51</td>
</tr>
<tr>
<td>TQ1</td>
<td>263</td>
<td>69</td>
</tr>
<tr>
<td>TQ2</td>
<td>262</td>
<td>57</td>
</tr>
</tbody>
</table>

It is strange that the difficulty of story 2, as reflected in the lower mean number of questions answered correctly, is not reflected in the mean reading rate, nor mean time to answer for story 2, see Table 5.
The Pearsons correlation for the variables of reading rate and time to answer, and the scores from the comprehension tests are shown in Table 6.

Table 6.
Correlation Coefficients

<table>
<thead>
<tr>
<th></th>
<th>NR1</th>
<th>NR2</th>
<th>RR1</th>
<th>TQ1</th>
<th>RR2</th>
<th>TQ2</th>
</tr>
</thead>
<tbody>
<tr>
<td>GEFT</td>
<td>-.0827</td>
<td>.1605</td>
<td>.0463</td>
<td>-.2010</td>
<td>-.2344</td>
<td>-.0964</td>
</tr>
<tr>
<td>VOCAB</td>
<td>.3471*</td>
<td>.2980</td>
<td>.2674</td>
<td>-.2653</td>
<td>.3338</td>
<td>.0902</td>
</tr>
<tr>
<td>NR1</td>
<td>1.0000</td>
<td>.2732</td>
<td>.0006</td>
<td>-.1363</td>
<td>-.0817</td>
<td>.2541</td>
</tr>
<tr>
<td>NR2</td>
<td>.2732</td>
<td>1.0000</td>
<td>.2330</td>
<td>-.3239</td>
<td>.0812</td>
<td>.0895</td>
</tr>
<tr>
<td>RR1</td>
<td>.0006</td>
<td>.2330</td>
<td>1.0000</td>
<td>-.6750#</td>
<td>.7144#</td>
<td>-.4076*</td>
</tr>
<tr>
<td>TQ1</td>
<td>-.1363</td>
<td>-.3239</td>
<td>-.6750#</td>
<td>1.0000</td>
<td>-.4996#</td>
<td>.5172#</td>
</tr>
<tr>
<td>RR2</td>
<td>-.0817</td>
<td>.0812</td>
<td>.7144#</td>
<td>-.4996#</td>
<td>1.0000</td>
<td>-.4401#</td>
</tr>
<tr>
<td>TQ2</td>
<td>.2541</td>
<td>.0895</td>
<td>-.4076*</td>
<td>.5172#</td>
<td>-.4401#</td>
<td>1.0000</td>
</tr>
</tbody>
</table>

* - Signif. LE .05  # - Signif. LE .01 (2-tailed)

Table 6 shows a strong correlation between the reading rates for both stories. There is no correlation indicated between the reading rate and the comprehension score, nor between the time to answer, and the comprehension score. The difficulty subjects had with getting the right answer did not seem to affect their speed of answering questions. There is a strong inverse correlation between the reading rate and the
time to answer for both stories. This would indicate that the faster they read the story, the slower they took to answer the questions.

Basic statistics for cognitive style

A T-test was used to obtain the initial field dependent/independent group statistics, and Tables 7 and 9 show the basic statistics for the comprehension test results. The tests were redone as a Manova test to include the vocabulary score as a covariate to take into account the effect of vocabulary ability. The summary results are in Table 10. Appendix D has the full table of results.

Table 7.
Mean and SD of each story by Cognitive style

<table>
<thead>
<tr>
<th>Story</th>
<th>Cog style</th>
<th>No. cases</th>
<th>Mean</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>FD</td>
<td>12</td>
<td>11.8</td>
<td>1.2</td>
</tr>
<tr>
<td>1</td>
<td>FI</td>
<td>14</td>
<td>11.6</td>
<td>2.0</td>
</tr>
<tr>
<td>2</td>
<td>FD</td>
<td>12</td>
<td>7.7</td>
<td>1.5</td>
</tr>
<tr>
<td>2</td>
<td>FI</td>
<td>14</td>
<td>8.8</td>
<td>2.2</td>
</tr>
</tbody>
</table>

The most obvious result shown here in the means is that story one was much easier than story two for both cognitive style groups. The difference is significant with $F(1,67) =$
63.57, p < .01. It is also interesting that for both stories there is a larger SD for the field independent group (FI), than for the field dependent group (FD).

I then separated groups by the mode of presentation, C represents control mode, and P phrase mode:-

Table 9.
Mean and SD by mode of presentation

<table>
<thead>
<tr>
<th>Story</th>
<th>Mode</th>
<th>Cog style</th>
<th>No. of cases</th>
<th>mean</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>C</td>
<td>FD</td>
<td>6</td>
<td>11.3</td>
<td>1.4</td>
</tr>
<tr>
<td>1</td>
<td>C</td>
<td>FI</td>
<td>7</td>
<td>11.6</td>
<td>1.5</td>
</tr>
<tr>
<td>1</td>
<td>P</td>
<td>FD</td>
<td>6</td>
<td>12.3</td>
<td>.8</td>
</tr>
<tr>
<td>1</td>
<td>P</td>
<td>FI</td>
<td>7</td>
<td>11.7</td>
<td>2.5</td>
</tr>
<tr>
<td>2</td>
<td>C</td>
<td>FD</td>
<td>6</td>
<td>7.8</td>
<td>1.0</td>
</tr>
<tr>
<td>2</td>
<td>C</td>
<td>FI</td>
<td>7</td>
<td>8.3</td>
<td>2.7</td>
</tr>
<tr>
<td>2</td>
<td>P</td>
<td>FD</td>
<td>6</td>
<td>7.7</td>
<td>2.1</td>
</tr>
<tr>
<td>2</td>
<td>P</td>
<td>FI</td>
<td>7</td>
<td>9.3</td>
<td>1.6</td>
</tr>
</tbody>
</table>

For story one, the FD group appears to show a small improvement for the phrase mode. For story two the FI group appears to show an improvement for the phrase mode. The
interactions between the cognitive style and presentation mode can be seen in figure 5.

![Figure 5](image-url)

The above figure was suggested by examiner Dr R Baker to show the interaction effects from FD to FI between control mode and phrase mode of presentation for both stories.

Comparing cognitive styles for both stories

An analysis of variance was used to compare the FD to FI groups for each story separately; firstly using just the comprehension score, and then with the vocabulary score as a covariate. A more complete table of results is shown in Appendix D.

Table 10.
The effect of Vocabulary as a covariate
<table>
<thead>
<tr>
<th>Story</th>
<th>Groups Compared</th>
<th>Vocab</th>
<th>DF</th>
<th>Probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>FD to FI</td>
<td>N</td>
<td>24</td>
<td>.774</td>
</tr>
<tr>
<td>2</td>
<td>FD to FI</td>
<td>N</td>
<td>24</td>
<td>.183</td>
</tr>
<tr>
<td>1</td>
<td>FD to FI</td>
<td>Y</td>
<td>23</td>
<td>.993</td>
</tr>
<tr>
<td>2</td>
<td>FD to FI</td>
<td>Y</td>
<td>23</td>
<td>.032</td>
</tr>
</tbody>
</table>

The results for story one clearly shows no significant difference between the groups. However, when the vocabulary score is used as a covariate for story two, there is a significant difference in the comprehension scores, between the field dependent and the field independent groups, \( p < .05 \). This level of probability is sufficient to support the alternate hypothesis H1.

The comprehension results shown in Tables 7 and 9 indicate that story one was easier to comprehend. A closer examination indicated that it also had a social comment theme. Research has indicated that field dependent subjects find social themes interesting, and they therefore tend to remember them better (Witkin et al., 1977).

Research by Witkin et al also indicates that well organised text, or text simple in structure, will not be any more difficult for a field dependent person to understand.
than for a field independent person (1977). Story one therefore turned out to be unsuitable to test my premise. As can be seen in Table 9 the FD and FI scores are similar for story one. However for story 2 phrase mode, the FD group has a lower score, $M = 7.7$, to the FI group, $M = 9.3$.

Comparing cognitive styles for story two

Because of the unsuitability of story one, the alternate hypotheses H2 and H3 were analysed only for story two, with the results as shown in Table 11.
Table 11.
Alternate hypotheses 2 and 3 applied to Story 2.

<table>
<thead>
<tr>
<th>Hyp</th>
<th>Story</th>
<th>Groups compared</th>
<th>Vocab</th>
<th>DF</th>
<th>Prob 1tail</th>
</tr>
</thead>
<tbody>
<tr>
<td>H2</td>
<td>2</td>
<td>FD control to FI control</td>
<td>Y</td>
<td>10</td>
<td>.327 .163</td>
</tr>
<tr>
<td>H3</td>
<td>2</td>
<td>FD phrase to FD control</td>
<td>Y</td>
<td>10</td>
<td>.927 .463</td>
</tr>
</tbody>
</table>

These results show no significance for any difference between means, and confirm the null hypothesis for the mode of text presentation. However I will show in table 6, that when the data is adjusted for an FI outlier, then H2 is supported.

As hypothesis H1 has already been shown to be acceptable, I looked to see what the H1 result could be attributed to, and compared style within each mode of presentation.
Table 12.
Style within mode of presentation for Story 2.

<table>
<thead>
<tr>
<th>Story</th>
<th>Groups compared</th>
<th>Vocab</th>
<th>DF</th>
<th>Prob</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>FD control to FI control</td>
<td>Y</td>
<td>10</td>
<td>.327</td>
</tr>
<tr>
<td>2</td>
<td>FD phrase to FI phrase</td>
<td>Y</td>
<td>10</td>
<td>.056</td>
</tr>
</tbody>
</table>

Most of the significance for the story two results, was contributed by the phrase mode of presentation. There is a significant difference between the comprehension scores for FD and FI groups, when the phrase mode of presentation is used, $p < .05$.

I then looked for any effect from cognitive style on the other variables. The variables of reading rate, and time to answer questions, were tested as dependent variables, the results were generally inconclusive, except for two instances.

For Story two with phrase presentation, the reading rate was significantly dependent on the cognitive style, $p < .05$. Story one with phrase presentation, the time to answer questions did not have a statistically significant dependence on cognitive style, but enough dependence to be considered in further testing. There was no effect when these variables were tested as covariates.
Removal of an outlier

A closer look at the raw data showed one anomalous datum for the FI group, the results may indicate the student had given up trying to get answers correct. The student had a score of 9 for story one which is just less than the FI mean of 11.6, but had a score of only 3 for story two, which is greater than two standard deviations from the FI mean of 8.8. When this outlier is removed, there is a substantial improvement in the probability that there is a difference between the FD and FI groups for story 2, see Table 13.

Table 13.
Removal of FI outlier and comparing Style

<table>
<thead>
<tr>
<th>Hyp</th>
<th>Story</th>
<th>Groups compared</th>
<th>Vocab</th>
<th>DF</th>
<th>Prob</th>
<th>itail</th>
</tr>
</thead>
<tbody>
<tr>
<td>H0</td>
<td>2</td>
<td>FD to FI</td>
<td>Y</td>
<td>22</td>
<td>.004</td>
<td></td>
</tr>
<tr>
<td>H2</td>
<td>2</td>
<td>FD control to FI control</td>
<td>Y</td>
<td>10</td>
<td>.043</td>
<td>.021</td>
</tr>
</tbody>
</table>

This result tends to support the H2 hypothesis that field dependent subjects score less than field independent subjects when the text structure is difficult, \( p < .05 \). The only alternate hypothesis to fail after correcting for the
Discussion of Results

In the following discussion I have not included the effect of removing the outlier. However the facts learnt from my research are; one, there is a learning difference between FD and FI subjects, and two, this difference can be effected by the style of presentation of the learning material.

Witkin et al said that there should be no difference in general learning ability between field dependent and field independent subjects (1977). This should also mean there is no difference in reading and comprehension ability.

Given two pieces of text of roughly equivalent readability, using the Flesch readability index, we should expect no difference in comprehension score between the two cognitive styles. For one piece of text the two groups have a similar score, but for the second piece of text, both groups score less than for the first piece of text. A difference is indicated in the text, outside the scope of the readability analysis. This difference is likely to be in the organisation or structure of the text.
Research has indicated that field dependent people may need assistance with unstructured material. The assistance is needed to help dissembed the component themes that make up an overall concept (Witkin et al. 1977, Hedberg & Perry, 1983).

It is possible the structure of the second piece of text has caused the lower comprehension score for both groups. If this is more pronounced for the field dependent subjects, it suggests a case for the field dependent person having difficulty with the structure of the text. The field dependent person may divert processing resources normally assigned to functions such as elaboration that assist comprehension and recall, to the task of dealing with the text structure.

I proposed that assistance with the text structure could be given by changing the style of text presentation. I wanted to avoid creating extra effects caused by adding textual information in the form of subject headings etc., so I attempted to provide the extra structure by putting one phrase per new line.

I had assumed that all text would cause difficulty to field dependent subjects, and had overlooked at least two factors. One, that field dependent people are sensitive to certain cues that will improve their awareness, and therefore their comprehension (Witkin et al. 1977). Two, that field
dependent people will only have difficulty, when the narrative has a difficult structure (Witkin et al. 1977).

The readability scores shown in Table 3 indicated that story 2 was more readable than story 1, which is in disagreement with the comprehension scores shown in Tables 7 and 9. A closer look at the readability formulae used to obtain the scores, indicate that there is a large weighting in favour of the word length and number of words per sentence (Nycum, 1986). This explains the better readability score for story 2, and we need to look instead, at the organisation of the two stories.

The change in structure I had imposed i.e. separating phrases, was somewhat negated by the fact that story 2 already had a simple sentence structure, with shorter words and sentences. The difficulty that subjects had in comprehension of story 2, must therefore be looked for elsewhere. The difficulty could be in the organisation, or in the unfamiliar nature of the topic.

Changing the style of presentation, did affect the amount of learning, according to the relative field dependence/independence of the subjects. However the technique that I used (phrase mode) to provide more structure to the sentence, did not work as expected. The technique instead of assisting the field dependent subjects, appeared
to have the effect of disturbing the field independent subjects, which may have led their improved comprehension scores.

A count of the preferred mode of presentation, (variables P/C & C/P), indicated that the GEFT(2) field independent group, did not like the phrase mode of presentation by 7 to 3. There was no significant comment on this from the field dependent group.

Although the field independent group reported that they did not like the phrase mode of presentation, they did better in that mode. This was most evident for story two, with a mean of 8.3 for control mode and a mean of 9.3 for phrase mode, although this is not significant, $p < .05$.

There is an indication that this improvement might also apply to story one for the FD group. The FD group mean for the control presentation of story one at 11.3, is similar to the FI group mean of 11.6, and the FD group did better for the phrase mode, with a mean of 12.3, than for the control mode, with a mean of 11.3.

The differences phrase and control mode for either of the groups is not statistically significant. However for story two, the FD group with the phrase mode of presentation scored less than with the control mode, and the FI group with
phrase mode scored higher than with the control mode. Changing the mode of presentation caused a statistically significant difference between the means for the FD group compared with the FI group, p < .05.

This effect might be attributable to the fact that under some conditions, making reading less straightforward, does cause some individuals to process deeper (O'Brien & Myers, 1985). The phrase mode may have made reading the text more difficult, causing the FD group to score less, but making the FI group do more controlled processing, and therefore leading to their higher score.

A secondary result of the research was to indicate that as tests become closer to the normal learning environment, that is away from the learning of word lists, the harder it is to exclude or control all the associated variables. It therefore becomes necessary to at least measure as many variables as possible, and include them in the analysis. There was enough significance attached on occasion to the variables of 'reading rate' and 'time to answer' to measure and account for these variable in future research.

An important lesson to be learnt from the procedure used in this study, apart from the results from testing the hypotheses, is the care that needs to be taken in the selection of the material for the comprehension test.
Suggestions for further research

To follow this study with more testing, it would be necessary to select portions of text that have some complexity of interwoven themes, and to choose alternative ways of changing the text presentation that may assist comprehension for the FD subject.

The portions of text should each be rated for comprehension difficulty by testing with another group of subjects to get a standard score. Text pieces of medium to severe difficulty should be selected to test with field dependent and field independent subjects, to see which pieces cause difficulty for the field dependent subjects. These would then be used with a range of changes to the text presentation, to see if any of the alternatives improved comprehension.

It is possible that the only changes to work, will be those that add cues or meta cognitive organisers in some form. The best method may be to not to add anything, but to change the actual sequence and structure of the material.

My impression is that any testing for changes in the learning environment, should be done in the form of a battery of tests done over a period of time. The time period should
not be too long, else we could expect a change in the learning attributions of the subject. The time period should also not be so condensed as to make the testing process unduly tedious.

To provide more information on the way different subjects, approach reading for comprehension, there could be included various additional presentation aspects such as:-

1. Remove the warning that this was a test for comprehension for one sequence, and add the warning for another.
2. Add a distractor for one reading sequence.
3. Remove the ability for the subject to pace themselves.
4. Allow the subject to study the whole story by allowing them to reread as required, count the screens reread, and check for any correspondence with correct answers.
5. Include a test for working store memory.
6. Test for recall as well as for comprehension.

These extra test segments would need to be organised to be dealt with in a sequence that would gradually move toward an environment that had "all" effects omitted or controlled for.
The subject also needs some trial exposures to the testing procedure to eliminate any nervousness caused by the procedure particularly when using a computer.

The subject should be also tested for the reflective/impulsive cognitive style, because this cognitive style has been reported as having an effect on the learning attribution of a student, (Claxton & Murrell, 1987). This is particularly so when using multiple choice questions, which is unfortunately, the easiest way of asking and checking answers by computer.

In conclusion I have discussed the reading model that allows for automatic shallow processing that may have no effect on LTM, and controlled deep processing which allows for elaboration and therefore significant improvement of LTM.

There is evidence that text should be just hard enough to focus attention, but not too hard to obscure understanding (O’Brien & Myers, 1985). It has been assumed that this improves comprehension, by causing a reader to shift from automatic to controlled processing, i.e. paying attention to what is being read, and actively integrating it with existing knowledge.

I have shown evidence of individual differences in learning abilities that can be attributed to cognitive style.
In particular my tests have shown that the mode of material presentation, depending on cognitive style, can make a difference in the level of comprehension of a subject.

These various facets of the learning process in conjunction with individual differences, make it difficult for a teacher to be able to cater for students that are significantly different from the average. The teacher of a remedial class, may not know what a particular student's learning difference is. It is usual to merely try 'something different', which is proposed in the alternate teaching sequence of mastery learning (Lee & Pruitt, 1984).

Cronbach (1967) was one of the first to describe a situation of adapting instruction to individual differences and his hypothesis "implies that the person's learning rate will vary, depending on the nature of the instruction; I therefore expect that adapting instructional technique will in the long run be more important than merely altering the duration of exposure" (p. 26).

Carroll (1967) responded to Cronbach's (1967) hypothesis, saying that he was in general agreement, but suggested that the study of instructional techniques and individual differences would be very difficult. He also thought that "the cost of differentiating instruction may be too high" (Carroll, 1967, p. 41). This was certainly true in
1967, but with the multi media computer techniques of 1992, there is an opportunity to create computer aided instruction lessons that will allow for student differentiation.

One could argue that the present educational system must be satisfactory, as it serves a great many people fairly well. However there seems to always be a lot of trauma in the system, as educators argue backward and forward on the best teaching practices. Perhaps the difficulty is, sometimes the system suits one learning style, and sometimes the other. Claxton & Murrell (1988), argue for research to find how much difference is made, by the teaching methods being in conflict with the student's learning style.

The ideal educational environment might be one that actively joins the conventional system with an adaptive computer aided teaching system.

The conventional system would cater for the majority of students that it serves well, but would change emphasis more toward education management. It would teach the kernel essential topics, and teachers would lead discussions on application and understanding.

These classes could often be quite large, as the teacher would not have to cater for a wide range of student differences. The teacher would be able to direct the students
with difficulties, to alternate teaching programs. These programs may be handled by computer, which would be able to adjust to individual requirements for material presentation.

The teacher would be able to enter the results of previous tests, which would establish the current knowledge levels of the student. The computer system would start by acquiring information in a friendly fashion about the individual student's learning, and cognitive styles. It would then begin remedial or enhanced teaching, and take appropriate paths through the material according to the student's profile. It would test frequently, and continue to build a better profile as it acquired more knowledge about the student's performance.

This system would be just as suitable for the gifted student, who wants to move faster in a subject, as it would be as for a disadvantaged student, that needs assistance.

This combined teaching concept would surely allow many more students achieve a much greater potential.


Role of individual differences in cooperative learning of technical material. *Journal of Educational Psychology, 80*(2), 172-178.


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Appendix A.

Story 1 - Juvenile, and comprehension questions

My wife gingerly peeled the Scotch tape from Jill's two little Christmas packages as the security officer watched.
"I should have known better" I said.

We were standing in the lobby of the Ventura School which is not really a school, but a big California Youth Authority reformatory in Ventura County.

We had come to visit Jill, a teenage girl I had written about last summer.

We had brought her a couple of rolls of Lifesavers, some gum, a can of nuts and - wrapped in Christmas paper - a little radio and some film for her camera.

I should have known better than to bring in wrapped gifts because, as a reporter, I've visited dozens of reformatories, juvenile halls and prisons throughout the state and have become well aware of security concerns.

So I was more irritated with myself than with the security officer when he said the gifts would have to be unwrapped for inspection.

But then, after the inspection, my wife began to rewrap the packages and the officer asked her not to tape them because they would have to be reinspected later by the night staff.

I was bewildered.

After all, the man had just inspected the things.

"You mean we can't hand these to Jill?"

"You can't hand her anything," he responded in a flat tone, without malice, without any emotion at all.

The security officer then surveyed the other articles we had brought.

He picked up the little can of nuts, peeled back the lid and dumped the contents into a big brown paper bag.

With those two quick, bored motions, he had reduced a neat, almost attractive, bit of commercial packaging into what looked like sweepings from a cocktail party.

Then he handed my wife the two rolls of Lifesavers.
No candy allowed.
The gum, though, was ok.
But, no, we couldn't give it to Jill ourselves.
It would be given to her after we left.

We were asked to put the contents of our pockets on the table for a quick inspection.
We passed through a metal detection process, put our belongings back in our pockets and, then, were permitted to enter the visiting room to wait with empty hands for Jill.

In the visiting room and at patio tables outdoors, inmates sat with their families and ate meals brought in from outside.

As we waited for Jill, I puzzled over the rules and the security system.

Meals, apparently, could be brought right in, but Lifesavers were excluded and gum had to wait.

When Jill arrived, we brought her a can of Dr. Pepper out of a vending machine in the waiting room.

She is not allowed to handle money, she said, so I put the change in the machine for her.

Jill asked the staff member on duty in the visiting room if she could show her living quarters to my wife and me.

"Are they your legal guardians?" asked the staff member.

Jill paused almost imperceptibly as she considered lying and then said "No."

In that case she could not.

Outside on the patio, we looked across the pleasant lawns of Ventura School to the "cottages" where the youngsters live in little 7-foot by 10-foot rooms.

We stood in the Sunday morning sunshine and watched inmates, boys and girls, walk to and from chapel services.

Most of these youngsters have adjusted to the rules and programs of the California Youth Authority.

It is uncertain what that means, because at least 70% of the inmates who pass through the state youth reformatories return to crime.

Jill has not adjusted. She is a bright, likable and attractive girl with blond hair and big, clear, blue eyes.

She would like to be an airline stewardess, but she is afraid she'll never have enough education.

Jill will be 18 this winter. She was born in England and has been in the United States since she was 12 years old.

At first she hated California, but now she loves it and doesn't want to live anywhere else.

I met Jill through attorneys who told me that she had been hogtied—her wrists chained to her ankles behind her back—on the floor of a cell in the Sacramento Juvenile Hall.

I was at first dubious that such a practice existed in California in the 1980s, but I subsequently learned that it is common to chain or tie kids up when they become extremely disruptive in some county juvenile halls and state reformatories throughout California.
Jill was not locked up in juvenile hall for being a latter day Bonnie Parker.

She got in trouble for things like being drunk in public, and for shoplifting a set of socket wrenches from a K Mart so a boy she knew could fix his car to go cruising.

She once brandished a knife in front of a police station, according to a probation report, and she wrote an obscenity on a Porsche belonging to a deputy district attorney.

She doesn't like authority.

And Jill can't handle being locked up.

She pounded on the door of her juvenile hall room in Sacramento, cursed the staff, hit them, kicked them.

In response, they locked her in isolation cells and chained her up.

When these methods didn't work with her, they did more of the same.

Finally, Jill was charged with assaulting a Sacramento County Juvenile Hall staff member- who she says she punched in the chest- and was sentenced to the California Youth Authority.

So the teenage girl who, outside of custody, had committed only minor violations, was transported 400 miles from her home and locked up with inmates, some of whom have committed murder.

Since she arrived at the reformatory last summer, Jill has been shackled or tied spreadeagled to beds at least 10 times because of disruptive behavior.

Near her throat is a long welt-like scratchmark that she got in a fight with another girl at Thanksgiving time.

She has tried to escape and she has attempted suicide at least twice.

On the inside of her left wrist is a patch of red scabs from self-inflicted cuts.

A suicidal youngster at Venture School is ordered to strip naked, given a gown and blankets and locked in a room monitored by a television camera.

"When I am in the camera room," Jill wrote to Youth Law Center attorney Elizabeth Jameson in San Francisco, "I feel more depressed because I feel so lonely and upset and I want somebody to talk to me.

Because they have cameras in the room, they feel they don't have to bother with you.

But it makes me feel more like killing myself."

Two weeks before Christmas, 16-year-old Melissa Pence, a close friend of Jill's committed suicide at the reformatory.

Jill saw her friend hanging by a sheet in a closet.
Melissa, who had been on nobody's Most Wanted List—neither the FBI's nor her parents'—was the sixth juvenile to commit suicide in various lockups throughout the state in 1984.

During our visit, Jill spoke of the Ventura School without rancor and described her misbehavior with candor and without excuses. Jill says she tries to go along with the reformatory program, but she keeps "going off", as she puts it, losing her temper and self control.

"Some mornings," she said, I wake up and I can't believe I'm really here."

Jill has a year to go on her sentence, but the methods of Ventura School, like those of Sacramento County Juvenile Hall, have not worked with her.

So, she is being transferred to Napa State Hospital, the big, violence-ridden mental institution in Northern California, where Jill will be kept in a locked unit.

Jill does not consider herself mentally ill, but she is accepting the transfer because it will take her closer to her home and family in Sacramento.

Indeed, Jill does not appear to be mentally ill. She probably has some serious emotional problems and needs professional guidance.

But should she be locked up? Is a big institution the answer for Jill?

I wonder about places that tie kids up, places that put suicidal youngsters in rooms alone and watch them on television sets, places that pour little cans of nuts into great big bags, places that won't let Lifesavers in.

I wonder if places like that have any real answers for anybody.

End Of This Story, Please answer the following questions.

REM: JUVQ
REM: Questions to story 1
*Q1
TX:
:Jill appears to be in:
:a. an insane asylum.
:b. a reformatory for juveniles.
:c. a private school.
:d. the county jail.
C:ANS$="B"
U:QUEST
*Q2
TX:
:Jill seems:
:a. happy.
:b. very happy.
:c. unhappy.
:d. none of these.
In this facility, the authorities consider Jill:
   a. uncooperative.
   b. cooperative.
   c. one of their best inmates.
   d. both b and c.
C:ANS$="A"

Jill has:
   a. attempted suicide.
   b. been involved in a fight with another girl.
   c. been a counselor for the other inmates.
   d. both a and b.
C:ANS$="A"

The author concludes that institutions such as the one Jill is in:
   a. have a positive effect on juveniles.
   b. do not help juveniles.
   c. are overcrowded.
   d. are underutilized.
C:ANS$="B"

From the details presented, it seems that Jill:
   a. has several freedoms.
   b. has a nice working relationship with the officers.
   c. has had her freedoms severely curtailed.
   d. both a and b.
C:ANS$="C"

A television camera is used to watch:
   a. all juveniles in the facility.
   b. suicidal youngsters.
   c. all visitors.
   d. the juveniles at night.
C:ANS$="B"

Because juvenile hall has not helped Jill, she is going to be sent to:
   a. a foster home.
   b. a halfway house.
   c. a boarding school.
   d. a mental institution.
C:ANS$="D"
Q9
TX:
The survey officer is described as responding "in a flat tone without malice." This description suggests the officer is:

a. angry.
b. cruel.
c. apathetic.
d. confused.
C:ANS$="C"
U:QUEST

Q10
TX:
A fact mentioned about juveniles who are released suggests that:
a. they almost all return to crime.
b. they almost all become law-abiding.
c. the majority become law-abiding.
d. the majority return to crime.
C:ANS$="D"
U:QUEST

Q11
TX:
In the following statement from the article, which word has a strongly negative connotation? "I met Jill through attorneys who told me that she had been hogtied ... on the floor of a cell in the Sacramento Juvenile Hall."
a. floor.
b. cell.
c. hogtied.
d. attorney.
C:ANS$="C"
U:QUEST

Q12
TX:
It seems that crimes that Jill committed before being sent to the Ventura School were:
a. minor.
b. major.
c. unnoticed.
d. infrequent.
C:ANS$="A"
U:QUEST

Q13
TX:
Choose an effective paraphrase for the following sentence.
"During our visit, Jill spoke without rancor and described her misbehaviour with candor and without excuses."
a. During our visit, Jill showed anger.
b. Jill wasn't angry but dishonest during our visit.
c. During our visit, Jill showed no anger about her treatment and was honest and forthright about what she had done.
d. During our visit, Jill talked of the Ventura School without anger and defined her crimes with honesty and without rationalizing.
A hidden assumption in the title, "When the Juvenile System Becomes a Cure that Kills," is that:

- juveniles are not sick.
- juvenile delinquents are sick, and juvenile systems should cure their illnesses.
- only doctors can cure juvenile delinquents.
- only psychologists can cure juvenile delinquents.

It seems that the author presents various details in the narrative regarding Jill to suggest that juvenile facilities in California:

- are highly organised.
- are highly efficient.
- do not attempt to rehabilitate juvenile delinquents.
- are run by too many administrators.

That is the end of the questions, thank you for participating.
'I'm a movie critic - how can I hate the theater?

It's almost unnatural.

But everytime I go, proud of my attention to duty,
I feel awful.

Something is wrong.'

So writes David Denby in the January Atlantic Monthly.

His article, Stranger in a Strange Land: A Moviegoer at the Theater,' will make theater people groan, but they should read it anyway.

It will show them where some of their customers are coming from these days - or, rather, not coming from.

Denby, a film critic for New York magazine, has no trouble seeing four or five movies a week.

He also attends concerts, dance events, the opera.

But he has to drag himself to the legitimate theater.

And he doesn't believe most of what he sees there - literally does not believe it.

It's not a question of the quality of the play.

There is something about the theater process that turns him off.

What, though?

Last year, Denby submitted himself to a flock of New York shows in order to find out.

A few of them he liked; 'Heartbreak House,' 'Noises Off,' 'My One and Only' and, especially, David Mamet's 'Glengarry Glen Ross,' which passed his toughest test.

It had "the hard, cool, non-symbolic quality of a great American film."

The rest of the shows left him homesick for the movies - that "dreamlike experience in the dark."

His article spells out his complaints against the embarrassingly out-front art of the theater, some of them fairly loopy.

Clearly, we are dealing with a real aversion here, not just an aesthetic preference.

And Denby isn't the only member of the film - TV generation to suffer from it.

To clear away some of the brush first: Denby's complaints against "the theatre" sometimes turn out to be merely his disagreements with certain shows.
For example, he finds Jessica Tandy too strong as the mother in "The Glass Menagerie."
He wants a more fragile, distracted Amanda - someone like Laurette Taylor.
That's a fair criticism, but it has nothing to do with the stage-vs.-screen question.
Would Denby like Tandy's approach any better if this were a movie?
When he does generalize, he goes too wide.
It's fair to criticize Bruce Davison for listening to his own voice as Tom in Menagerie."
That doesn't prove that the sound of the projected stage voice is in itself phony, as opposed to voices in the movies, where people sound like people.
In fact, the raised voice of the theater actor is no more unnatural a device than the enlarged face of the movie actor.
Like the close-up, it's a way of giving the audience access to what the character is feeling - the size of it.
To condemn the projected voice because some stage actors project self-consciously is like condemning the close-up because some film actors mug.
Again, Denby is within his rights to reject the sudsy optimism and "phony Broadway energy" of the musical "Baby."
This falls short of proving that it's the nature of theater to push middle-class affirmations at us, while movies share with us the cozy open secret that it's a crappy world.
Where does that leave Samuel Beckett and Frank Capra?
I'm not talking old movies, Denby might reply, I'm talking now.
Similarly, he gives British actors like Rex Harrison the right to project all over the place (although British playwrights like Tom Stoppard strike him as too clever by half).
So far, his argument has too many loopholes and not-provens to be taken as generic indictment of the stage.
It does, however amount to a lively gripe-list against the Broadway theater.
And here we notice something surprisingly personal in Denby's tone.
It's interesting that he begins his article with a memory of having been taken to Broadway shows by his parents as a kid.
Because a trip back to Shubert Alley seems to return him to the condition of a child - a precocious 15-year-old determined not to be impressed.
Watching Dustin Hoffman in "Death of a salesman," for example, Denby is positive that their teachers must have put them up to it.
How could any kid of today respond to such an old-fashioned, platitudinous piece?
Denby also can't stand the awful ordeal of squeezing past people in order to get to one's seat in a Broadway house.
Old people, with minks and camel's-hair coats folded on their laps.
Who talk about their diseases until the curtain goes up.
Yech!
Somehow this doesn't sound like a 41-year-old film critic who knows what Brahms thought about "Carmen."
It sounds like Holden Caufield deciding that all those people talking about the Lunts out in the lobby are phonies.
What is there about the theater, you wonder, that can make a grown man feel as surly as an adolescent?
Here, I think, we do get to a central difference between the theater and the movies.
At the movies, you don't have to do anything.
In the theater, you have to help.
And something in Denby resents it.
Almost every objection that he has to the stage experience relates to this.
As a film person, he yearns to be alone in the Platonic cave of the movie house, caught up in stream of ever-changing images that are both bigger than life and true to life.
He doesn't want to squint to see, or strain to hear.
Above all, he doesn't want to have to pretend.
"Think, when we speak of horses, that you see them."
That's not for Denby.
He wants to see real horses- that is, pictures of them.
He wants to see real waves and real smokestacks, and not be asked to see them as symbols.
He wants to see real people, too, behaving pretty much as real people do-no fancy language or strange posturings.
Next to this, theater offers too little to the eye and asks too much of the imagination.
Denby: "We (theaterphobes) cannot suspend disbelief; everything that happens in the theater reminds us that the only thing real in that place is the actors, standing on the stage.
How can anything be represented on a stage? The place for representation is the cinema...
A theaterphile would answer: "Ah, but that's the point. The stage is the place for representation, the place where one thing stands for something else. The cinema is the place for duplication. It fills the eye.

The stage fills the mind's eye-if the show is good enough."

Example: One of the shows that Denby passed up last winter, because he figured he wouldn't like it is "Cats." I have yet to see a still picture or film clip of this show that didn't make it look silly.

But in the theater, if the dancers are right (I can't yet speak for the Los Angeles company), we do see ... or feel ... the mystery of a rag-tag coven of cats celebrating in a midnight garbage dump.

Similarly, the silver masks worn by the chorus in "Equus" (stage version) evoked the otherness of horses much more than did any image in the film version, without insisting that the horses were "really" there.

It's the double image that we theaterphiles like—the signifier and the thing signified.

Thus for us, it's not a problem that Dustin Hoffman in "Death of a Salesman" gives us, as Denby puts it, "not an old man trying to act young, but a metaphor for an old man trying to act young."

For us, it's not a problem that the clock on the wall in "Night, Mother" is another metaphor.

We like it that the stage plays the game of as-if in such an open fashion.

But one has to join in the game.

Until reading Denby's piece, I hadn't realized what a problem this is for at least some people who have grown up with television.

"We suffer" writes Denby on behalf of his fellow theaterphobes, "from a kind of physical embarrassment at the spectacle of actors pretending that they are not being watched."

I wonder.

Isn't the embarrassment rather that the stage actor in some fashion acknowledges that he is being watched, and summons the viewer to come along on the journey?

Meaning that the viewer can't just sit back in the dark without feeling guilty?

Give me your hands, if we be friends."

That line also has a special magic for theaterphiles.

It signifies the moment when the tale has been told and both the actors and the audience can acknowledge thier
collaboration.
In contrast, when the lights go up there is nothing but a blank wall.
The dream is over.
Plenty of nonsense has been written about the theater, and Denby is right to be sceptical about phrases like "the electricity of the living actor."
(Which actor?
Olivier on film carries more excitement than Sam Glutz on stage.)
Denby is also right when he says that a bad play is a deadlier experience than a bad movie.
(The movie at least gives you some interesting pictures along the way.)
He's right to find language -as in "Heatbreak House" and Glengarry Glen Ross"- the glory of the theater.
(Which is why stage language has to be special, both in the writing and the playing.)
And when he praises a musical as entranced with theater styles as life as "My One and Only," one suspects that his theaterphobia is milder than it looks.
One wishes him a total recovery, for he's missing a lot of pleasure.
End Of This Story, Please answer the following questions.

REM: THEQ
REM: Questions to story 2
*Q1
TX:
:According to the article, the theaterphobe is:
:b. Dan Sullivan.
:c. neither one.
:d. both a and b.
C:ANS$="A"
U:QUEST
*Q2
TX:
:The theaterphile is:
:b. Dan Sullivan.
:c. neither one.
:d. both a and b.
C:ANS$="B"
U:QUEST
*Q3
TX:
:Denby seems to watch:
:a. only a few movies a week.
:b. several movies a week.
In regard to Broadway plays, Denby seems to:

a. have much praise.
b. have much criticism.
c. not understand them at all.
d. none of these.

Sullivan concludes with the thought that Denby:

a. will always dislike the theater.
b. is an incompetent film critic.
c. is an incompetent theater critic.
d. may only have a mild case of theaterphobia.

Sullivan states that Denby is from a generation of:

a. non readers.
b. revolutionaries.
c. film and television viewers.
d. all of these.

Sullivan claims that the raised voice is used by the theater actors to:

a. frighten the audience.
b. wake up the audience.
c. express the feelings of the character.
d. signal the end of the act.

When Denby talks about the kinds of people who go to the theater, Sullivan suggests that Denby's criticism is:

a. mature.
b. childlike.
c. much like his (Sullivan's).
d. both a and c.

When Sullivan says of Denby that, "When he does generalise, he goes to wide," Sullivan suggests that Denby:

a. makes sweeping generalisations.
Sullivan suggests that Denby does not appreciate the theater because it is:
a. too intellectual.
b. suggestive rather than direct.
c. not entirely visual.
d. all of these.
C:ANS$="D"

Sullivan states that the cinema "fills the eye {but} the stage fills the mind's eye." This metaphor implies that the theater:
a. speaks to the viewer's intellect.
b. is a visual expression.
c. is an emotional experience.
d. is often sad.
C:ANS$="A"

Sullivan says that theaterphiles like "the double image ... the signifier and the thing signified." He suggests that theaterphiles:
a. watch twice as much theater as filmgoers watch film.
b. want to see objects only for what they are.
c. want to see objects for what they are and for what they represent.
d. both a and b.
C:ANS$="C"

Choose an effective paraphrase for the following statement taken from the review: "Thus, for us, it's not a problem that Dustin Hoffman in 'Death of a Salesman' gives us, as Denby puts it, 'not an old man trying to act young, but a metaphor for an old man trying to act young.'"
a. Theatergoers are looking at the metaphor of Dustin Hoffman as an old man acting young rather than simply Dustin Hoffman as an old man acting young.
b. Dustin Hoffman creates problems when he tries to act young.
c. Dustin Hoffman is not really an old man acting young, but something else.
d. Therefore for us theatergoers, it's not an issue that Dustin Hoffman in the play "Death of a Salesman" portrays for us, paraphrasing Denby, not someone acting young but a metaphorical expression of an old man acting young.

C:ANS$="D"
U:QUEST
*Q14
TX:
Sullivan suggests that the actor in the theater:
a. is threatened if the audience gets too involved in the performance.
b. encourages the viewer to mentally take part in the performance.
c. sees the viewer as an important partner in the theater experience.
d. both b and c.
C:ANS$="D"
U:QUEST
*Q15
TX:
An analysis for the difference between theater and film, this review:
a. presents only the positive characteristics of the theater.
b. presents only the negative characteristics of the theater.
c. presents the positive and negative characteristics of theater and film but shows a preference for the theater.
d. presents the positive and negative characteristics of theater and film but shows a preference for film.
C:ANS$="C"
U:QUEST
*SYSX
C:END=CLK(0)
C:TIMER=END-START
C:TIMEQ=INT(TIMER)
K:S$!!"**!!NAME$!!"*RR*"!!READR!!"*TQ*"!!TIMEQ!!"*RT*"!!RI
GHT!!Q$
X:"L:!!F$!!",TQ"
REM: END OF MAIN :: SUBR BELOW
*QUEST
TS:V0,60,20,24
C:QN=QN+1
TH:Type a,b,c or d as your choice of the correct response.
--
*ACPT
AS:
X:"M:!!ANS$ TY:Correct, press ENTER for next question.
Type your choice in the form a or b or c or d. Try again.

Your choice was not correct, press ENTER for next question.

*EXIT
Appendix C

Raw Data from vocabulary, GEFT, and comprehension tests.

```
DATA LIST / GEFT 1-2 VOCAB 4-5 PS1 6 FDM1 9-11 RR1 13-15
 TQ1 17-19 NR1 21-22 PS2 24 FDM2 26-28 RR2 30-32 TQ2 34-36
 NR2 38-39
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Counts of responses to the questions asked about test procedure

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Appendix D.

17:25:57 SPSS Version 4.0 SunOs Sun-4 SunOS 4.0

**ANALYSIS OF VARIANCE -- DESIGN 1**

SPSS results for Table 10.
The effect of vocabulary as a covariate when comparing cognitive style.

47 0 manova nrl by geft(1,2)
Tests of Significance for NR1 using UNIQUE sums of squares

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48 0 manova nr2 by geft(1,2)
Tests of Significance for NR2 using UNIQUE sums of squares

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49 0 manova nrl by geft(1,2) with vocab
Tests of Significance for NR1 using UNIQUE sums of squares

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Correlations between Covariates and Predicted Dependent Variable

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Averaged Squared Correlations between Covariates and Predicted Dependent Variable

VARIABLE AVER. R-SQ

VOCAB 1.00000
Regression analysis for WITHIN CELLS error term
--- Individual Univariate .9500 confidence intervals
Dependent variable .. NR1

COVARIATE B Beta Std. Err. t-Value Sig. of t Lower -95% CL- Upper
VOCAB .0479394696 .2359822185 .04116 1.16462 .256 -.03721 .13309

50 0 manova nr2 by geft(1,2) with vocab

Tests of Significance for NR2 using UNIQUE sums of squares
Source of Variation SS DF MS F Sig of F
WITHIN CELLS 63.50 23 2.76
REGRESSION 25.11 1 25.11 9.09 .006
GEFT 14.47 1 14.47 5.24 .032

Correlations between Covariates and Predicted Dependent Variable

COVARIATE

VARIABLE VOCAB
NR2 1.00000

Averaged Squared Correlations between Covariates and Predicted Dependent Variable

VARIABLE AVER. R-SQ

VOCAB 1.00000
Regression analysis for WITHIN CELLS error term
--- Individual Univariate .9500 confidence intervals
Dependent variable .. NR2

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SPSS results for Table 11.
Alternate hypotheses 2 and 3 applied to story 2.

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46 0 RECODE GEFT (0 THRU 11 = 1) (12 THRU 15 = 3) (16 THRU 18 =2)
47 0 comment nr2 = story 2
48 0 select if PSN1 = 1
49 0 comment = control mode for story 2 - compare styles
50 0 MANOVA NR2 by GEFT(1,2) with VOCAB

Tests of Significance for NR2 using UNIQUE sums of squares

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Correlations between Covariates and Predicted Dependent Variable

VARIABLE VOCAB
NR2 1.00000

Averaged Squared Correlations between Covariates and Predicted Dependent Variable

VARIABLE AVER. R-SQ

VOCAB 1.00000

Regression analysis for WITHIN CELLS error term
--- Individual Univariate .9500 confidence intervals
Dependent variable .. NR2

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50 0 MANOVA NR2 by PSN1(1,2) with VOCAB

Tests of Significance for NR2 using UNIQUE sums of squares

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Regression analysis for WITHIN CELLS error term
--- Individual Univariate .9500 confidence intervals
Dependent variable .. NR2

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SPSS results for Table 12.
Style within mode of presentation for Story 2.

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48 0 select if PSN1 = 1
49 0 comment = control mode for story 2 - compare styles
50 0 MANOVA NR2 by GEFT(1,2) with VOCAB
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Tests of Significance for NR2 using UNIQUE sums of squares

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<td></td>
<td>.026</td>
</tr>
<tr>
<td>REGRESSION</td>
<td>19.66</td>
<td>1</td>
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<td>6.88</td>
<td>.026</td>
</tr>
<tr>
<td>GEFT</td>
<td>3.03</td>
<td>1</td>
<td>3.03</td>
<td>1.06</td>
<td>.327</td>
</tr>
</tbody>
</table>

Correlations between Covariates and Predicted Dependent Variable

<table>
<thead>
<tr>
<th>VARIABLE</th>
<th>VOCAB</th>
</tr>
</thead>
<tbody>
<tr>
<td>NR2</td>
<td>1.00000</td>
</tr>
</tbody>
</table>

Averaged Squared Correlations between Covariates and Predicted Dependent Variable

<table>
<thead>
<tr>
<th>VARIABLE</th>
<th>AVER. R-SQ</th>
</tr>
</thead>
<tbody>
<tr>
<td>VOCAB</td>
<td>1.00000</td>
</tr>
</tbody>
</table>

Regression analysis for WITHIN CELLS error term
--- Individual Univariate .9500 confidence intervals
Dependent variable .. NR2

<table>
<thead>
<tr>
<th>COVARIATE</th>
<th>B</th>
<th>Beta</th>
<th>Std. Err.</th>
<th>t-Value</th>
<th>Sig. of t</th>
<th>Lower -95%</th>
<th>CL- Upper</th>
</tr>
</thead>
<tbody>
<tr>
<td>VOCAB</td>
<td>.1531644131</td>
<td>.6383031726</td>
<td>.05841</td>
<td>2.62215</td>
<td>.026</td>
<td>.02301</td>
<td>.28331</td>
</tr>
</tbody>
</table>
45 0  Recode PS1 ('p'=1) ('s'=2) into PSN1
46 0  RECODE GEFT (0 THRU 11 = 1) (12 THRU 15 = 3) (16 THRU 18 =2)
47 0  comment nr2 = story 2
48 0  select if PSN1 = 2
49 0  comment = phrase mode for story 2 - compare styles
50 0  MANOVA NR2 by GEFT(1,2) with VOCAB

Tests of Significance for NR2 using UNIQUE sums of squares

<table>
<thead>
<tr>
<th>Source of Variation</th>
<th>SS</th>
<th>DF</th>
<th>MS</th>
<th>F</th>
<th>Sig of F</th>
</tr>
</thead>
<tbody>
<tr>
<td>WITHIN CELLS</td>
<td>28.31</td>
<td>10</td>
<td>2.83</td>
<td></td>
<td></td>
</tr>
<tr>
<td>REGRESSION</td>
<td>8.45</td>
<td>1</td>
<td>8.45</td>
<td>2.99</td>
<td>.115</td>
</tr>
<tr>
<td>GEFT</td>
<td>13.17</td>
<td>1</td>
<td>13.17</td>
<td>4.65</td>
<td>.056</td>
</tr>
</tbody>
</table>

Correlations between Covariates and Predicted Dependent Variable

<table>
<thead>
<tr>
<th>VARIABLE</th>
<th>COVARIATE</th>
<th>VOCAB</th>
<th>1.00000</th>
</tr>
</thead>
</table>

Averaged Squared Correlations between Covariates and Predicted Dependent Variable

<table>
<thead>
<tr>
<th>VARIABLE</th>
<th>AVER. R-SQ</th>
</tr>
</thead>
<tbody>
<tr>
<td>VOCAB</td>
<td>1.00000</td>
</tr>
</tbody>
</table>

Regression analysis for WITHIN CELLS error term

--- Individual Univariate .9500 confidence intervals
Dependent variable .. NR2

<table>
<thead>
<tr>
<th>COVARIATE</th>
<th>B</th>
<th>Beta</th>
<th>Std. Err.</th>
<th>t-Value</th>
<th>Sig. of t</th>
<th>Lower -95%</th>
<th>CL- Upper</th>
</tr>
</thead>
<tbody>
<tr>
<td>VOCAB</td>
<td>.1052401747</td>
<td>.4795563778</td>
<td>.06090</td>
<td>1.72817</td>
<td>.115</td>
<td>-.03045</td>
<td>.24093</td>
</tr>
</tbody>
</table>
SPSS results for Reading rate and Time to answer in addition to Comprehension score
Story 1.

51 0 manova nrl rrl tql by geft(1,2) with vocab

EFFECT .. WITHIN CELLS Regression
Multivariate Tests of Significance (S = 1, M = 1/2, N = 9 1/2)

<table>
<thead>
<tr>
<th>Test Name</th>
<th>Value</th>
<th>Exact</th>
<th>Hypoth. DF</th>
<th>Error DF</th>
<th>Sig. of F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pillais</td>
<td>.09822</td>
<td>.76244</td>
<td>3.00</td>
<td>21.00</td>
<td>.528</td>
</tr>
<tr>
<td>Hotellings</td>
<td>.10892</td>
<td>.76244</td>
<td>3.00</td>
<td>21.00</td>
<td>.528</td>
</tr>
<tr>
<td>Wilks</td>
<td>.90178</td>
<td>.76244</td>
<td>3.00</td>
<td>21.00</td>
<td>.528</td>
</tr>
<tr>
<td>Roys</td>
<td>.09822</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note.. F statistics are exact.

---

EFFECT .. WITHIN CELLS Regression (CONT.)
Univariate F-tests with (1,23) D. F.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Sq. Mul. R</th>
<th>Mul. R</th>
<th>Adj. R-sq.</th>
<th>Hypoth. MS</th>
<th>Error MS</th>
<th>F</th>
<th>Sig. of F</th>
</tr>
</thead>
<tbody>
<tr>
<td>NR1</td>
<td>.05569</td>
<td>.23598</td>
<td>.01463</td>
<td>3.72444</td>
<td>2.74594</td>
<td>1.35635</td>
<td>.256</td>
</tr>
<tr>
<td>RR1</td>
<td>.04348</td>
<td>.20853</td>
<td>.00190</td>
<td>4154.05886</td>
<td>3972.92239</td>
<td>1.04559</td>
<td>.317</td>
</tr>
<tr>
<td>TQ1</td>
<td>.03646</td>
<td>.19096</td>
<td>.00000</td>
<td>3590.09359</td>
<td>4124.59065</td>
<td>.87041</td>
<td>.361</td>
</tr>
</tbody>
</table>

Regression analysis for WITHIN CELLS error term
--- Individual Univariate .9500 confidence intervals

Dependent variable .. NR1

<table>
<thead>
<tr>
<th>COVARIATE</th>
<th>B</th>
<th>Beta</th>
<th>Std. Err.</th>
<th>t-Value</th>
<th>Sig. of t</th>
<th>Lower -95%</th>
<th>CL- Upper</th>
</tr>
</thead>
<tbody>
<tr>
<td>VOCAB</td>
<td>.0479394696</td>
<td>.2359822185</td>
<td>.04116</td>
<td>1.16462</td>
<td>.256</td>
<td>-.03721</td>
<td>.13309</td>
</tr>
</tbody>
</table>

Dependent variable .. RR1

<table>
<thead>
<tr>
<th>COVARIATE</th>
<th>B</th>
<th>Beta</th>
<th>Std. Err.</th>
<th>t-Value</th>
<th>Sig. of t</th>
<th>Lower -95%</th>
<th>CL- Upper</th>
</tr>
</thead>
<tbody>
<tr>
<td>VOCAB</td>
<td>1.6010284287</td>
<td>.2085275969</td>
<td>1.56573</td>
<td>1.02254</td>
<td>.317</td>
<td>-1.63794</td>
<td>4.83999</td>
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</tbody>
</table>

Dependent variable .. TQ1

<table>
<thead>
<tr>
<th>COVARIATE</th>
<th>B</th>
<th>Beta</th>
<th>Std. Err.</th>
<th>t-Value</th>
<th>Sig. of t</th>
<th>Lower -95%</th>
<th>CL- Upper</th>
</tr>
</thead>
</table>
VOCAB  -1.4883861015  -.1909556445  1.59534  -.93296  .361  -4.78860  1.81183

**EFFECT .. GEFT**

Multivariate Tests of Significance (S = 1, M = 1/2, N = 9 1/2)

<table>
<thead>
<tr>
<th>Test Name</th>
<th>Value</th>
<th>Exact F</th>
<th>Hypoth. DF</th>
<th>Error DF</th>
<th>Sig. of F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pillais</td>
<td>.15080</td>
<td>1.24304</td>
<td>3.00</td>
<td>21.00</td>
<td>.319</td>
</tr>
<tr>
<td>Hotellings</td>
<td>.17758</td>
<td>1.24304</td>
<td>3.00</td>
<td>21.00</td>
<td>.319</td>
</tr>
<tr>
<td>Wilks</td>
<td>.84920</td>
<td>1.24304</td>
<td>3.00</td>
<td>21.00</td>
<td>.319</td>
</tr>
<tr>
<td>Roys</td>
<td>.15080</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: F statistics are exact.

**EFFECT .. GEFT (CONT.)**

Univariate F-tests with (1,23) D. F.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Hypoth. SS</th>
<th>Error SS</th>
<th>Hypoth. MS</th>
<th>Error MS</th>
<th>F</th>
<th>Sig. of F</th>
</tr>
</thead>
<tbody>
<tr>
<td>NRl</td>
<td>.00021</td>
<td>63.15651</td>
<td>.00021</td>
<td>2.74594</td>
<td>.00008</td>
<td>.993</td>
</tr>
<tr>
<td>RRl</td>
<td>1306.54262</td>
<td>91377.21495</td>
<td>1306.54262</td>
<td>3972.92239</td>
<td>.32886</td>
<td>.572</td>
</tr>
<tr>
<td>TQl</td>
<td>14407.86191</td>
<td>94865.58498</td>
<td>14407.86191</td>
<td>4124.59065</td>
<td>3.49316</td>
<td>.074</td>
</tr>
</tbody>
</table>
SPSS results for Reading rate and Time to answer in addition to Comprehension score Story 2.

```
52 0  manova nr2 rr2 tq2 by geft(1,2) with vocab
EFFECT .. WITHIN CELLS Regression
Multivariate Tests of Significance (S = 1, M = 1/2, N = 9 1/2)

<table>
<thead>
<tr>
<th>Test Name</th>
<th>Value</th>
<th>Exact F</th>
<th>Hypoth. DF</th>
<th>Error DF</th>
<th>Sig. of F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pillais</td>
<td>.34459</td>
<td>3.68030</td>
<td>3.00</td>
<td>21.00</td>
<td>.028</td>
</tr>
<tr>
<td>Hotellings</td>
<td>.52576</td>
<td>3.68030</td>
<td>3.00</td>
<td>21.00</td>
<td>.028</td>
</tr>
<tr>
<td>Wilks</td>
<td>.65541</td>
<td>3.68030</td>
<td>3.00</td>
<td>21.00</td>
<td>.028</td>
</tr>
<tr>
<td>Roys</td>
<td>.34459</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: F statistics are exact.
```

---

```
EFFECT .. WITHIN CELLS Regression (CONT.)
Univariate F-tests with (1,23) D. F.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Sq. Mul. R</th>
<th>Mul. R</th>
<th>Adj. R-sq.</th>
<th>Hypoth. MS</th>
<th>Error MS</th>
<th>F</th>
<th>Sig. of F</th>
</tr>
</thead>
<tbody>
<tr>
<td>NR2</td>
<td>.28335</td>
<td>.53231</td>
<td>.25220</td>
<td>25.10723</td>
<td>2.76087</td>
<td>9.09397</td>
<td>.006</td>
</tr>
<tr>
<td>RR2</td>
<td>.09521</td>
<td>.30856</td>
<td>.05587</td>
<td>6175.43644</td>
<td>2551.50846</td>
<td>2.42031</td>
<td>.133</td>
</tr>
<tr>
<td>TQ2</td>
<td>.00555</td>
<td>.07453</td>
<td>.00000</td>
<td>472.20307</td>
<td>3675.65887</td>
<td>.12847</td>
<td>.723</td>
</tr>
</tbody>
</table>
```

Regression analysis for WITHIN CELLS error term
--- Individual Univariate .9500 confidence intervals

**Dependent variable .. NR2**

```
COVARIATE  B  Beta  Std. Err.  t-Value  Sig. of t  Lower -95%  CL- Upper
VOCAB    .1244692573  .5323104732  .04127  3.01562  .006  .03909  .20985
```

**Dependent variable .. RR2**

```
COVARIATE  B  Beta  Std. Err.  t-Value  Sig. of t  Lower -95%  CL- Upper
VOCAB    1.9520752222  .3085637597  1.25476  1.55573  .133  -.64360  4.54775
```

**Dependent variable .. TQ2**

```
COVARIATE  B  Beta  Std. Err.  t-Value  Sig. of t  Lower -95%  CL- Upper
VOCAB
```
### EFFECT .. GEFT

#### Multivariate Tests of Significance (S = 1, M = 1/2, N = 9 1/2)

<table>
<thead>
<tr>
<th>Test Name</th>
<th>Value</th>
<th>Exact F</th>
<th>Hypoth. DF</th>
<th>Error DF</th>
<th>Sig. of F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pillais</td>
<td>.27745</td>
<td>2.68787</td>
<td>3.00</td>
<td>21.00</td>
<td>.073</td>
</tr>
<tr>
<td>Hotellings</td>
<td>.38398</td>
<td>2.68787</td>
<td>3.00</td>
<td>21.00</td>
<td>.073</td>
</tr>
<tr>
<td>Wilks</td>
<td>.72255</td>
<td>2.68787</td>
<td>3.00</td>
<td>21.00</td>
<td>.073</td>
</tr>
<tr>
<td>Roys</td>
<td>.27745</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: F statistics are exact.

---

#### EFFECT .. GEFT (CONT.)

#### Univariate F-tests with (1,23) D. F.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Hypoth. SS</th>
<th>Error SS</th>
<th>Hypoth. MS</th>
<th>Error MS</th>
<th>F</th>
<th>Sig. of F</th>
</tr>
</thead>
<tbody>
<tr>
<td>NR2</td>
<td>14.46547</td>
<td>63.49992</td>
<td>14.46547</td>
<td>2.76087</td>
<td>5.23947</td>
<td>.032</td>
</tr>
<tr>
<td>RR2</td>
<td>3570.32785</td>
<td>58684.69451</td>
<td>3570.32785</td>
<td>2551.50846</td>
<td>1.39930</td>
<td>.249</td>
</tr>
<tr>
<td>TQ2</td>
<td>261.83903</td>
<td>84540.15407</td>
<td>261.83903</td>
<td>3675.65887</td>
<td>.07124</td>
<td>.792</td>
</tr>
</tbody>
</table>
SPSS results for Table 13.
Removal of outlier and compare styles.

46 0 comment outlier from FI removed
47 0 Recode PS1 ('p'=1) ('s'=2) into PSN1
48 0 RECODE GEFT (0 THRU 11 = 1) (12 THRU 15 = 3) (16 THRU 18 =2)
51 0 comment phrase and control
52 comment FD to FI for story 2
53 0 manova nr2 by geft(1,2) with vocab

Tests of Significance for NR2 using UNIQUE sums of squares

<table>
<thead>
<tr>
<th>Source of Variation</th>
<th>SS</th>
<th>DF</th>
<th>MS</th>
<th>F</th>
<th>Sig of F</th>
</tr>
</thead>
<tbody>
<tr>
<td>WITHIN CELLS</td>
<td>39.78</td>
<td>22</td>
<td>1.81</td>
<td></td>
<td></td>
</tr>
<tr>
<td>REGRESSION</td>
<td>12.78</td>
<td>1</td>
<td>12.78</td>
<td>7.07</td>
<td>.014</td>
</tr>
<tr>
<td>GEFT</td>
<td>19.04</td>
<td>1</td>
<td>19.04</td>
<td>10.53</td>
<td>.004</td>
</tr>
</tbody>
</table>

Correlations between Covariates and Predicted Dependent Variable

<table>
<thead>
<tr>
<th>COVARIATE</th>
<th>VARIABLE</th>
<th>VOCAB</th>
</tr>
</thead>
<tbody>
<tr>
<td>NR2</td>
<td>1.00000</td>
<td></td>
</tr>
</tbody>
</table>

Averaged Squared Correlations between Covariates and Predicted Dependent Variable

<table>
<thead>
<tr>
<th>VARIABLE</th>
<th>AVER. R-SQ</th>
</tr>
</thead>
<tbody>
<tr>
<td>VOCAB</td>
<td>1.00000</td>
</tr>
</tbody>
</table>

Regression analysis for WITHIN CELLS error term
--- Individual Univariate .9500 confidence intervals
Dependent variable .. NR2

<table>
<thead>
<tr>
<th>COVARIATE</th>
<th>B</th>
<th>Beta</th>
<th>Std. Err.</th>
<th>t-Value</th>
<th>Sig. of t</th>
<th>Lower -95%</th>
<th>CL- Upper</th>
</tr>
</thead>
<tbody>
<tr>
<td>VOCAB</td>
<td>.0919447602</td>
<td>.4930519207</td>
<td>.03459</td>
<td>2.65818</td>
<td>.014</td>
<td>.02021</td>
<td>.16368</td>
</tr>
</tbody>
</table>
RECODE PSL ('p'=1) ('s'=2) into PSNL

RECODE GEFT (0 THRU 11 = 1) (12 THRU 15 = 3) (16 THRU 18 = 2)

select if psnl = 1

comment control only - compare styles

manova nr2 by geft(1,2) with vocab

Tests of Significance for NR2 using UNIQUE sums of squares

<table>
<thead>
<tr>
<th>Source of Variation</th>
<th>SS</th>
<th>DF</th>
<th>MS</th>
<th>F</th>
<th>Sig of F</th>
</tr>
</thead>
<tbody>
<tr>
<td>WITHIN CELLS</td>
<td>10.53</td>
<td>9</td>
<td>1.17</td>
<td></td>
<td></td>
</tr>
<tr>
<td>REGRESSION</td>
<td>5.13</td>
<td>1</td>
<td>5.13</td>
<td>4.39</td>
<td>.066</td>
</tr>
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<td>6.46</td>
<td>1</td>
<td>6.46</td>
<td>5.52</td>
<td>.043</td>
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</tbody>
</table>

Correlations between Covariates and Predicted Dependent Variable

VARIABLE VOCAB

NR2 1.00000

Averaged Squared Correlations between Covariates and Predicted Dependent Variable

VARIABLE AVER. R-SQ

VOCAB 1.00000

Regression analysis for WITHIN CELLS error term
--- Individual Univariate .9500 confidence intervals

Dependent variable .. NR2

<table>
<thead>
<tr>
<th>COVARIATE</th>
<th>B</th>
<th>Beta</th>
<th>Std. Err.</th>
<th>t-Value</th>
<th>Sig. of t</th>
<th>Lower -95%</th>
<th>Upper CL- Upper</th>
</tr>
</thead>
</table>