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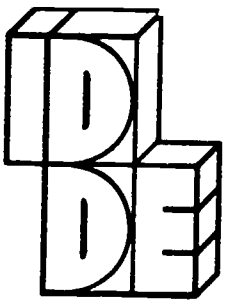
ABSTRACT

This study explores the use of the adjunct question paradigm in self-instruction and distance education materials. The subjects were 187 high school students who read text passages and answered one high level (implication or inference) or low level (verbatim or paraphrase) question. These questions were either inserted in the text or massed at the end of the passage. Subjects were either allowed to look back at the text while answering the questions (the freedom group, FREE) or were not allowed to look back (the read-read-question group, RRQ; the read-question-read group, RQR). One control group read the passages twice without questions and another neither read the passages nor answered the questions. All subjects were tested on recall of low level and performance on high level posttest items. On high level incidental items, the RQR group performed better than the RRQ group, but the FREE group recalled more low level incidental material than the RQR group. In the two no-lookback groups, those who were asked high level adjunct questions performed better when the questions were massed together, while those who were asked low level adjunct questions performed better when the questions were inserted. In general the lookback group recalled as much, and performed as well, as the two no-lookback groups. For all incidental dependent variables, most treatment groups did not score significantly higher than the READ-TWICE control group. Discussions of the limitations of the study that may have influenced the results and the implications of the findings conclude the report. A reference list of 101 items is appended. (Author/RP)



INSTRUCTIONAL DESIGN, DEVELOPMENT, AND EVALUATION

WORKING PAPERS

ADJUNCT QUESTIONS AND MEDIATED SELF INSTRUCTION: COMPARISONS OF LOOKBACK AND NO-LOOKBACK PROCEDURES, WITH HIGH OR LOW LEVEL QUESTIONS, MASSED OR INSERTED IN THE TEXT.

by

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ABSTRACT

Senior high school students read text passages and answered one high level (implication or inference) or low level (verbatim or paraphrase) question, either inserted in the text or massed at the end of the passage. Subjects either were allowed to look back at the test while answering the questions (the freedom group, FREE); or were not allowed to look back (the read-read-question group, RRQ; the read-question-read group, RQR). One control group read the passages without questions and another neither read the passages nor answered the questions. All subjects were tested on recall of low level and performance on high level posttest items related to intentional material (related to adjunct question) and incidental material (unrelated to adjunct question).

On high level intentional items, the RQR group performed better than the RRQ group. The FREE group recalled more low level incidental material than the RQR group. The group asked high level adjunct questions performed better when the questions were massed together while the group asked low level adjunct questions performed better when the questions were inserted. This interaction occurred for the two "no-lookback" groups (RRQ, RQR) but not for the lookback group (FREE). In general the lookback group recalled as much, and performed as well, as the two no-lookback groups.

THE PROBLEM

Students who study at institutions of higher education receive a large amount of their instruction from the texts they read after attending an organizing lecture. Some receive instruction from self-instructional materials. Students who study for degrees at a distance, typically receive, through the postal service, learning packages which contain printed textual material, printed study guides, audio-cassettes and assignments or exercises. Of these, it is the printed texts and self-instructional study guides that contain most of the material to be learned. In mixed-mode institutions, distance learners take the same examinations and have the same assignment deadlines as the fulltime students who study at the same university. If distance students are to compete adequately with fulltime students, they must receive instructional materials of high quality.

Many of the instructional prescriptions developed by Gagne (1985), Gagne and Briggs (1979), Gropper (1983), Landa (1983), Merrill (1983), Reigeluth (1983), Scandura (1983) and other instructional theorists may be adapted for use with self-instructional or distance learning materials. The instructional prescriptions that seem most easily adapted are those prescriptions related to the teaching of concepts, procedures and principles (see Merrill, 1983), Gagne's nine events of instruction (see Gagne, 1985) and those related to motivation (see Keller 1983).

However, most self-instructional packages, distance materials and textbooks are not well designed. Often, they do not attempt to teach the application of concepts, theories and procedures; rather they provide a lot of verbal information from which the learner must extract that which may be useful. Apart from Gagne's nine events of instruction (Gagne, 1985; Gagne and Briggs, 1979), which are very loose prescriptions, there are no theoretical prescriptions about how to help learners obtain a meaningful understanding of verbal information presented in print.

The research on distance education (Holmberg, 1981 and 1982) does not address the problem of how to make the learning of verbal information more meaningful for the self-learner - the researchers seem to be more concerned with high technology delivery systems. Two recent attempts to develop theories of distance education (Perraton, 1981; and Holmberg, 1985) do not address the problem.

Benjamin Bloom, in his model of school learning (1976), identifies "quality of instruction" as an important variable in learning. Quality of instruction, measured during instruction, is a good predictor of achievement measured after instruction - in his synthesis Bloom found that typically r = 0.50. The most important component of quality of instruction is "participation" - the degree to which the students are "actively involved in their learning" (p. 134).

The participation of the learner in the learning task relates to the active involvement of the learner in carrying out the directions stated as cues. An active rather than passive involvement in learning is required. Individual students differ in the amount of participation in the learning process they both desire and require and in the amount of practice they need before they gain proficiency (Atkinson, 1968; Glaser, 1968). However, as students move through the various tasks in a mastery learning situation, the difference in amount of participation and practice needed becomes less (Bloom, 1974; Anderson, 1984).

When achievement is related to group participation, the correlation is usually only r = +0.27 (Morsh, 1956; Lysakowski and Walberg, 1982; Walberg, 1984), but because students differ in the amount of participation they need, individual participation is more highly related to achievement than is group participation. Twenty percent of the variance (r = +0.45 approx.) in individual achievement is accounted for by individual variance in participation (Anderson, 1976; Sjogren, 1967; Siegel, 1963; Krauskopf, 1963; Olson, 1931; Edminston and Rhoades, 1959; Walberg, 1984).

Bloom shows (1976, P. 134) that the extent, type and quality of participation in the learning process is the best single indicator of quality of instruction. If students are participating fully, the cues, reinforcement and feedback must be adequate.

One of the most effective and easiest ways for developers to increase the quality of instruction is for them to increase the degree of student participation. Normally, in distance materials developed to teach concepts, principles and theories, faculty can increase participation by increasing the number of questions, activities, problems, case studies, and vocationally related projects. However, what should be done when the learners are attempting to learn from the continuous prose in less well designed self-instructional or distance materials, or from the prose in their required texts.

As distance and self-learners typically receive verbal information in prose form, they must, in Bloom's terms, "participate in the learning" by interacting with the prose, if they are to obtain a meaningful understanding of the verbal information. One way to increase participation, is to provide questions and activities within the prose materials. Perhaps it is from reading research that insights can be obtained into how to make verbal information more meaningful for self-learners. One likely source of inspiration is the research into the effectiveness of adjunct questions - questions inserted or embedded in the text.

One of the primary modes through which students acquire information and knowledge in an academic setting, and particularly in distance education or self-study, is by reading expository prose. There have been numerous studies aimed at evaluating the effectiveness of adjunct questions in a prose learning setting. (See Anderson and Biddle, 1975; Andre, 1979; Faw and Waller, 1976; Hamaker, 1986; Hamilton, 1985a; Rickards, 1979 for reviews of the research.) In general, adjunct questions have been found to be effective. Can the knowledge obtained by adjunct question researchers be used by instructional designers developing strategies for use in distance education or in mediated self-instruction?

In his analysis of distance education with respect to contemporary teaching models, Baath (1979) argues that Rothkopf's model for written instruction seems to be directly applicable to print based distance education. However, the differences between the experimental adjunct question studies (where subjects may not look at the text while answering the questions) and real life distance or self-study education (where students are free to look if they wish) are so great that to generalize findings from the studies to distance education and self-instruction may not be prudent. It may be concluded, however, from Baath's analysis, that the development of adjunct study guides to textual material may be a useful addition to the instructional repertoire of the distance educator and the developer of self-instructional materials.

Because adjunct question research is difficult to generalize to the real world, and because distance education students typically behave very differently from subjects in adjunct question research (see the following review of the studies), then prescriptions for the use of adjunct questions in distance education and self-instruction need to be developed and tested. The aim of this study is to determine the applicability of adjunct question research findings to the development of such prescriptions.

The Adjunct Question Research Paradigm

Early Research - A Behavioral Perspective.

During the last twenty years there has been considerable interest in the use of inserted or adjunct questions designed to help students learn from textual material. Rothkopf (1965) stimulated the current interest when he investigated the "mathemagenic" (birth of learning) effects of adjunct questions and developed a research paradigm similar to the one described below.

Typically, in adjunct question research, adjunct questions are placed either before or after the information in the text needed to answer them. They are intended to increase the likelihood that readers will correctly answer criterion test questions. Although variations exist, the text segments and questions are usually provided on separate sheets. The reader is neither allowed to turn back to a previous page once he has turned it, nor allowed to take notes while reading.

In most studies, a posttest assesses the effects of the adjunct questions and the results compared to those of a "read only, no questions" control group. The amount of the questioned material recalled, the intentional learning, and the amount recalled of material for which there was no question, the incidental learning, seem to be of interest. Rothkopf (1965) argues that the mathemagenic effect, the amount of incidental material recalled, is of greater educational significance.

The procedures described above are not very similar to the way in which typical distance students interact with their print-based instructional materials. Distance students and self-learners would typically look back over a passage while answering a question. Also, the faculty involved in providing distance education are more interested in the intentional learning than the incidental learning - although the learning of incidental material would be advantageous to students. For these reasons, the results of adjunct question research must be carefully analyzed before the implications of their use in distance education, and in the development of self-instructional materials, can be clarified.

More Recent Research - A More Cognitive Perspective

Since Rothkopf's original neo-behavioral perspective, that the questions act as reinforcing stimuli, there has been a shift towards a cognitive perspective, which emphasizes the active role of the learner. The questions are no longer thought of as merely assisting in the retrieval of information from memory but are considered as assisting in the storage of the information. (Many of the most influential instructional design theorists seem yet to make this transition.)

There has also been a shift of interest from the effects of factual or verbatim level questions to those of a higher or semantic level. Some of the recent reviews of adjunct question research (Andre, 1979; Carrier and Fautsch-Patridge, 1981; and Rickards, 1979) have really been attempts to examine the nature of the semantic processing activities generated in the reader by the adjunct questions.

In recent adjunct question research, one of the independent variables (the treatments) is typically the level of processing induced in the reader by the adjunct question, a second is the position (pre- or post-) of the question with respect to the passage, and another is the frequency of presentation of the questions or, as it is often presented, the amount of prose between the inserted questions. The reviews (Hamilton, 1985; Hamaker, 1986) imply that higher level processing typically leads to greater recall and greater use of the information presented, as does more frequent questioning and the use of post rather than prequestions.

The measured learning outcome (the dependent variable) is usually the level of processing required by the criterion posttest and, often, whether the posttest item is related to intentional or incidental material. Inference and implication posttest items are hypothesized to require a higher level of semantic processing than do verbatim and paraphrase questions. Incidental learning is considered more important than intentional learning (see previous comment).

Except for Andre's model (1979) which does not apply to all of the variables studied, the reviews (Hamilton, 1985; Hamaker, 1986; and Rickards, 1979) indicate that there does not appear to be a solid theoretical foundation for adjunct question research - that is, there is no sound explanation for the results; nor does the present paradigm approximate any real learning situation, and certainly not distance education or self-instruction. However, there has been a large number of studies and several tentative conclusions have been drawn. Perhaps these studies offer some insight for the developer of self-instruction and for the distance educator.

Review of Adjunct Question Research

There have been several recent, comprehensive reviews of the effects of adjunct questions on learning from text (Andre, 1979; Anderson and Biddle, 1975; Carrier and Fatsch-Patridge, 1981; Duchastel, 1983; Faw and Waller, 1976; Hamaker, 1986; Hamilton, 1985; Rickards and Denner, 1978, Rickards and Denner, 1979; Rickards, 1979; van Hout-Walters, 1980). The reviews show that disagreements exist about how adjunct questions affect the processing of textual information.

Rickards and Denner (1978), in their review of the development of adjunct question research, argue that the critical factors in such research are:

* the variables examined (position, type, frequency, level),
* the interactions among these variables,
* the processes induced in the reader by the various questions,
* and individual differences in cognitive processing associated with adjunct questions.

Type of Questions

A large number of experiments have found that verbatim postquestions produce better performance on verbatim criterion tests than do no questions at all (Anderson and Biddle, 1975; McGaw and Grotelueschen, 1972; Boker, 1972; Reynolds et al., 1979; Rickards et al., 1979; Rothkopf, 1966; Rothkopf and Bisbicos, 1967; Sagria and DiVesta, 1978; Shavelson et al., 1974).

However, Watts and Anderson (1971) and Friedman and Rickards (1981) found that the no-question control group performed as well as the experimental group on verbatim posttest items. Hamilton (1985) argues that the Watts and Anderson results can be explained by the ease with which the adjunct questions could be answered (99% correct), while the adjunct questions used by Friedman and Rickards were very difficult (38% correct) and provided no semantic cues to the learner (they were four versions of the same sentence with the position of one word altered - see Friedman and Rickards, 1981, p 429). Hamilton's analysis also demonstrates the need to report performance on the adjunct questions themselves in any study of the effectiveness of adjunct questions in prose.

Hamilton (1985) and Hamaker (1986) conclude that verbatim post and prequestions consistently increase the probability of recall of intentional material - material related to the adjunct question. In fact, for the retention of intentional verbatim material, the position of the adjunct question seems to be unimportant. However, only verbatim postquestions consistently increase the probability of recall of incidental material - material unrelated to the adjunct question.

It appears, from this synthesis, that educators should use verbatim postquestions in their self-instructional or distance materials if their objectives include the verbatim recall of intentional and incidental information.

Adjunct question researchers have slowly moved from a behavioristic to cognitive perspective and now study the level of processing required to answer the adjunct questions. Because rote learning of facts is considered by most present day adjunct question researchers to be of little educational value, the earlier studies which used verbatim questions are no longer considered significant (Carver, 1972; Watts and Anderson, 1971).

Both the level of processing of questions (verbatim vs. semantic) and the interaction of level and position of question have been investigated. Generally, higher-level (semantic) questions produce more and better organized recall, especially free recall, of both intentional and incidental material than lower-level questions (see the reviews of Hamilton, 1985; and Hamaker, 1986).

Four types of semantic questions have been used; inference, subsumption, implication, and paraphrase questions. Shavelson et al. (1974) and Andre and Womack (1978) found that a group given semantic postquestions performed significantly better on intentional posttest items presented immediately after the passage than a group given verbatim questions and a no-question control group. Shavelson et al. (1974), Anderson and Biddle (1975) and Friedman and Rickards (1981) found similar results with a delayed test.

Shavelson et al. (1974) and Rickards (1976) found that inference and implication prequestions led readers to correctly answer more intentional implication and inference posttest items than did verbatim questions, no questions or questions unrelated to the intentional learning. Hamaker's (1986) review shows that higher order questions have a much greater "effect size" than verbatim questions on all levels of posttest items except repeated verbatim items.

Despite the lack of consistent results, there appears to be general agreement that higher-level questions are likely to be more effective than lower level as adjunct aids to text comprehension. This seems to agree with the "levels of processing" model (Craik and Lockhart, 1972; Craik and Tulving, 1975; Fisher and Craik, 1977; Jacoby and Craik, 1978; Craik, 1979) which argues that higher level adjunct questions lead to better processing of both higher and lower level material.

Position and Frequency of Question

Hamilton (1985) reviews the position of questions (pre or post) studies and concludes that postquestions and prequestions increase the probability of recall of intentional verbatim material equally. For the retention of intentional semantic material, however, semantic pre-questions lead to improved retention. Appropriately constructed semantic prequestions can produce a more complete processing of the passage as the reader focuses on the "topical interrelationships and organization" (Hamilton, 1985, p.77). Hamaker's review (1986) shows that semantic postquestions generally have minimal effects on the processing of intentional material.

Regarding incidental learning, the general conclusion from several reviews (Anderson and Biddle, 1975; Andre, 1979; Hamaker, 1986; Hamilton, 1985; Rickards, 1979) is that verbatim postquestions lead to better recall of incidental material than verbatim prequestions; and while verbatim postquestions lead to better recall than read-only controls, verbatim prequestions do not. Anderson and Biddle (1975) in their review suggest that adjunct postquestions facilitate incidental learning whereas prequestions inhibit such learning. Semantic pre-questions probably led readers to focus on the intentional material and a so induce a more superficial level of processing of incidental material.

There is no agreement about the best position for higher-level questions. Felker and Dapra (1975) found that semantic postquestions led to better performance on both intentional and incidental posttest items than semantic prequestions. However, Rickards (1976) arrived at the opposite conclusion. Hamaker in his review, and Hamilton in his meta analysis, both agree with Rickards and Mayer (1975) who found both positions to be equivalent.

There is also no agreement about the results of the various frequency of question studies. Some studies (see Rickards, 1979) found that as the questions become less frequent, the amount of intentional and incidental learning increases for the

prequestion group but decreases for the postquestion group. Rickards and DiVesta (1974) found that while higher level postquestions were more effective when occuring more frequently in text, there was no interaction between frequency and position for lower level questions. Andre and Womack (1978) found that postquestions placed at the end of each paragraph was preferable to the questions being massed at the end of the complete text.

Rickards and Denner (1978) argue that the reason for the lack of agreement is that researchers are unable to define the various levels of semantic processing in precise operational terms. In other words, the frequency studies have not used a consistent differentiation among levels of questions. Thus, any results about a certain level of question having a better effect with a certain frequency of presentation has little validity. Also, for the same reason, any interactions between frequency and level found also has little vaillidity.

For distance educators, primarily interested in intentional learning, the results of these studies indicate that, semantic postquestions will better prepare readers for intentional semantic posttest items than will verbatim postquestions or no questions at all. Further, verbatim prequestions are more useful than verbatim postquestions for facilitating the learning of verbatim information. However, if the goal is that incidental learning also occurs then, for both semantic and verbatim learning, postquestions are more effective.

Types of Processing

Both Andre (1979) and Rickards (1979) have recently attempted to develop models to explain the type and nature of the cognitive processes adjunct questions produce. Rickards (1979, p193) extended Frase's (1967, 1970) suggestion that adjunct questions produce both a backward processing and a forward processing by concluding that four processes are probably involved:

(1) a general backward process involving the mental review of material thematically related to that questioned;
(2) a specific backward process reviewing only the questioned material;
(3) a general forward process with increased attention to the following text; and
(4) a specific forward process whereby the learner adopts a learning set attuned solely to the particular type of information questioned.

Prequestions produce a specific forward processing which overfocus the reader's attention on a specific type of information and depresses incidental learning (see the reviews of Hamilton, 1985; and Hamaker, 1986). This effect is greater for verbatim than higher order prequestions. Rickards and DiVesta (1974) found that factual postquestions induced a specific backward process while higher level postquestions produced a general backward process.

Sefkow and Meyers (1980) studied the backward review effect of both low and high order postquestions. The results indicated that a specific backward process is used, since memory is enhanced for only the parts of the passages related to the postquestions. Sefkow and Myers also attempted to discover whether the backward processing enhanced storage or retrieval. The results indicated that the effect of the post question is to strengthen storage, rather than to merely trigger retrieval.

Both Reynolds, Stanford, and Anderson (1979) and Reynolds and Anderson (1982) found that adjunct postquestions caused a specific forward as well as a specific backward effect. Using a computer to present the text, Reynolds et al (1979) found that learners spent a disproportionate amount of time on questioned versus non-questioned segments of text. Reynolds and Anderson (1982) found an increase in the amount of time spent on text segments related to the content questioned in previous postquestions. Subjects spent more and more time considering each question and less and less time in reading the passages (further evidence for the notion that questions enhance storage of information as well as trigger retrieval).

A problem may occur in self-instruction and distance education if the adjunct questions are too specific. Because self and distance learners have the freedom to look back at the passage after reading a postquestion, they may focus too closely on the material about which a question was asked and neglect the other information. However, if intentional learning is mosre important then this should not matter. If the appropriateness of adjunct question procedures for self-instruction and distance education is to be established then this study needs to compare subjects in typical adjunct question groups with subjects using typical distance education materials. This study may find that learners in self-learner (or freedom) treatment groups recall as much intentional material as learners in the adjunct question groups but recall less of the incidental material. On the other hand, with higher level questions, the fact that the self-learner has the freedom to read the passage both before and after sighting the question may lead to both backward and forward general processing and improved learning.

Levels of Semantic Processing

Perhaps the most important questions that adjunct question research must answer are: "What level of processing is necessary if students are to recall and use information in expository prose?" and "What types of questions best facilitate that type of processing?" Andre (1979) concluded his lengthy review by arguing that while support exists for the notion that higher semantic processing is preferable to lower levels of processing, little or no research has compared the various levels of semantic processing. Andre goes on to suggest the following as classifications for high level semantic questions (p.282):

(1) application questions that require subjects to choose from among various alternatives a new example of a concept or principle encountered in text;
(2) meaningful learning or inference and implication questions requiring readers to identify relationships between elements of a passage which are implied but not explicitly stated; and
(3) higher-order questions, defined as being the analysis, synthesis and evaluation levels on Bloom's taxonomy.

Each of Andre's classes is applicable to degree-level self-instructional and distance education courses. It is likely, however, that David Merrill's (1983) Component Display Theory (CDT) is a better model for teaching the recall and application of concepts, principles and procedures than is the use of adjunct questions, and that CDT is more easily adapted for self-instruction and distance education. This reviewer has not read any studies where classification 3 was used. Therefore, since this study is intended to compare typical adjunct question procedures with the freedom of self-instruction, it must concentrate on classification 2.

Andre (1979) also classified studies on the basis of the level of posttest employed - whether it requires recall of passage material or higher-level functioning. Andre argues that, if recall questions are used, we cannot tell if readers are recalling the passage rotely or have learned from a passage - thus they may not be particularly useful. He also notes that higher-level questions often lead to improved recall of facts contained in a passage. If readers have to attend to more of the passage to answer the higher level question, then they are able to freely recall more facts than those who focus on specific items to answer factual-level questions. Andre calls this the directed attention model (DAM).

This model has sparked an interesting debate among adjunct question researchers. Andre (1979) argues that if a posttest is only going to ask for the free recall of factual material, then improved recall can be achieved in two ways - firstly, by using higher order questions to direct attention to more of the passage, and secondly, by simply asking more factual questions per passage. However, the use of higher level questions merely to cause better recall of factual material represents a "clear misunderstanding of the instructional use of prose" (p291). Higher level questions should help learners develop better and more organized recall not merely recall a lot of information.

Rickards (1979), however, argues that higher level questions not only cause better recall but also more organized recall. Higher-level questions affect not only the level at which prose is processed but the manner in which it is organized in memory. Rickards and DiVesta (1974) and Rickards (1976) show that higher-level questions result in more organized and structured recall and in better long-term retention than lower-level questions. Simply providing more frequent factual-level questions would not achieve similar results.

Even Andre (1979) argues that his DAM does not fully explain the facilitative effects of higher order questions. Different types of questions, by directing the reader's attention to particular types of information, ultimately result in inducing different processing strategies in the reader.

There is little agreement among adjunct question researchers about the facilitative effects of higher level adjunct questions on posttests containing higher level questions. A series of studies conducted by Andre's associates seem to suggest that students given factual-level questions actually perform better than those given application-level questions. However, Andre (1979, p299) points to the higher difficulty level of adjunct application questions and variations in the ability level of subjects to explain these results. His general conclusion seems to be that questions may well have different effects on different learners in different situations.

Rickards and his associates have also studied the level of question problem. Friedman and Rickards (1981) presented readers with three different types of questions:

(1) verbatim;

(2) paraphrase; and

(3) inferential.

They reasoned (p428) that "only inferential questions should (lead readers) to process text by relating it to (their) existing knowledge. Since (they require) deeper semantic processing than that produced by either verbatim or paraphrase questions, (inferential questions) should elicit superior learning of questioned and non-questioned material".

Andre and Sola (1976) suggested that when a reader reads a passage it is encoded initially at a shallow level. Thus, any high level postquestion would be too difficult to answer and the desired level of processing can not occur. Reading the passage twice, before attempting the question, may raise the level of the initial encoding and make answering a high level postquestion a little easier by improving the backward processing. Andre and Sola also suggested that re-reading the passage after an initial attempt to encode it is a better solution to the higher level postquestion problem. The high level postquestion inserted between readings of the same passage should guide the re-processing of the passage during the second reading and enhance forward processing.

Following the suggestion by Andre and Sola, Friedman and Rickards (1981) required subjects either to read a paragraph twice before answering an inserted question (RRQ), or to read the paragraph, answer the question, and then re-read the paragraph (RQR). They hypothesized that the RQR sequence, due to its potential facilitation of both forward and backward processing, was superior to the RRQ sequence.

The results of the experiment indicated that both paraphrase and inference questions proved superior to verbatim questions for both intentional and incidental semantic and verbatim learning. Paraphrase and inference questions also resulted in superior performance on intentional items at all levels, including verbatim, implying that a transfer of level effect was facilitated by these questions. In addition, subjects receiving inference questions outperformed those receiving paraphrase questions in both intentional and incidental learning. However, the profound effects of presentation sequence suggested by Andre and Sola were not found. Only the RQR group exhibited the transfer of level effect, possibly indicating that this sequence results in improved learning across cognitive levels.

Overall, the results of this experiment support the conclusion that "the level of semantic processing employed by readers can be manipulated by varying the cognitive level of postquestions interspersed in text" (p433). Because of the similarity between the procedure followed by RQR subjects and the suggestions about "how to proceed" provided students in many self-instructional and distance courses, it is proposed that, in this study, RRQ and RQR groups be compared with "freedom" groups.

The Limitations of the Adjunct Question Research Paradigm.

The greatest limitation of the adjunct question paradigm is its lack of generalizability. Real life students are not constrained as are the subjects in adjunct question research. Adjunct question subjects may not take notes nor underline relevant sections nor re-read the passage nor look back at the passage after reading the question. Students in real life can do all of those things. Often the texts they read as part of their courses include questions intended to help them learn. Studies need to be done to find out how students approach these questions, how they should approach these, whether or not the present questions enhance their learning, and what the questions should be like if the students learning is to be enhanced.

Very few studies have attempted to explore the use of adjunct question in more realistic settings (see Gagne et al, 1979; Ellis et al, 1980; and Anderson et al, 1974), and none have attempted to determine the effectiveness of adjunct questions in study guides to texts, in self-instructional packages and distance education materials. Further, few studies have compared typical adjunct question procedure with more realistic procedures. It is intended that this study help to fill that void.

Self-Instruction, Distance Education and the Adjunct Question Paradigm.

While reading a text, working through self-instructional packages, and studying distance education materials, students are presented with lengthy prose materials from which they are expected to learn that which the instructor intended. Sometimes the materials are designed to teach the application of a concept, procedure or principle, but more often than not the learner is expected to extract information from continuous prose. Some distance educators and faculty provide study guides that include questions to help the students focus on that which they want them to learn and also to help them to process the information at the required level. These questions are usually massed at the end of a unit or chapter, but, in self-instructional and distance materials are often inserted in the text.

However, it is important to remember that real-life students can not be forced into the artificial procedures of the adjunct question paradigm. They are free to proceed as they wish, looking back at the passage while answering the questions if they so desire.

Shavelson (in Shavelson et al, 1974b) argued that allowing readers such freedom results in a "mathemathantic" (death of learning) effect, rather than "mathemagenic" (birth of learning) effect because readers focus so much on the material related to the adjunct postquestion that they do not process the other information. His view is supported by Duchastel (1983) and Duchastel and Nungester (1984) who ascribe the lack of a facilitative effect on incidental posttest questions to the fact that students could "lookback". However, Hamaker (1986), in an extensive review and meta-analysis, provides evidence of the faulty logic of these researchers as he points out that they did not directly compare lookback and non-lookback groups. Hamaker ends up supporting Andre's (1981) view that there is no difference between lookback and non-lookback groups. Due to the scarcity of adjunct question research studies comparing typical adjunct procedures with those procedures used in generalizable real-life settings, and the above described debate, this study should compare "freedom" groups with typical adjunct question paradigm groups.

It can be inferred from their practice that some distance educators, and some faculty involved in providing self-instructional materials, disagree with Shavelson and believe that including questions in their materials is preferable to providing no questions at all and that higher level questions are preferable to lower level questions. However, they have no evidence to support their beliefs and no research-based prescriptions about what type of questions to ask their learners.

As mentioned above, there is also the possibility that good directions (suggesting RQR) and well designed higher level questions can lead distance learners to process the new material using both backward and forward processing and that this will lead to improved learning. With high level implication, inference, analysis, evaluation and synthesis questions, readers have to retrieve information they have previously stored semantically, to alter that material during semantic rehearsal of the new information, and to store the new combination semantically in long-term memory.

If this is the process that occurs, then allowing distance learners the freedom to re-read the study material while attempting to answer high level adjunct questions should not lead to the over-focusing some adjunct question researchers suggest. It should lead instead to improved cognitive processing and the development of a more appropriate cognitive structure. With a more appropriate cognitive structure, the learner should better be able to answer intentional and incidental posttest questions requiring high level processing, and to have improved retention.

If this study is to determine the effectiveness of typical distance education and self-instructional procedures with respect to adjunct questions, then the effectiveness of such procedures should be compared with the effectiveness of the more recent, more logical and more effective adjunct question procedures. Groups of learners using self-study (freedom) versions of the materials should be compared with groups of learners using read-question-read versions (RRQ) and read-read-question (RQR) versions of the materials after Friedman and Rickards (1981).

Some subjects should receive higher level adjunct postquestion and others lower level postquestions. After Andre and Womack (1978), some should receive the questions inserted between passages, while others should receive the questions massed together at the end of the complete text. The posttest should also include high and low level items about both intentional material and incidental material. To help with the generalizability of the results to the heterogeneous group of learners typically using self-instructional and distance materials, the group of subjects in this study should be as heterogeneous as the prose materials will allow.

Hamaker's (1986) review of the adjunct question research pointed out the "scarcity of lookback studies" (p229) and that no studies had yet compared the adjunct question paradigm procedures, where no lookbacks are permitted, with realistic procedures where lookbacks are permitted and even encouraged. This study will help provide information about the applicability of the results of adjunct question research to generalizable real-life settings such as self-instruction and distance education. It will also either confirm that adjunct question researchers have been correct in conducting their studies using non-realistic settings or it will show adjunct question researchers that they need not persist with such ecologically invalid procedures.

The Study

Independent Variables

There are three independent variables:

(a) The presentation sequence (with three levels)

* RQR, read the text, attempt the question, re-read the text,
* RRQ, read the text, read it again, answer the question,
* FREE, read the text and question as often as needed with complete freedom.

(b) The level of the adjunct question (with two levels)

* HI, higher level questions - implication or inference,
* LO, lower level questions - verbatim or paraphrase.

(c) The frequency of the adjunct questions asked (with two levels)

* INSERT, questions inserted between text passages,
* MASS, questions massed at the end of the text.

Dependent Variables

There are two dependent variables

(a) The level of the post-test item (with two levels)

* HI, high level questions - inference and implication
* LO, low level questions - verbatim and paraphrase

(b) The relationship of the post-test question to the material questioned in the adjunct question.

* INTENT, intentional material - related to material questioned by the adjunct question.
* INCID, incidental material - related to material not question by an adjunct question.

The Experimental Hypotheses

The Main Effects Hypotheses

These are the experimental hypotheses related to the main effects.

(a) Presentation sequence and intentional learning FREE = RQR > RRQ

The freedom groups (FREE - representing real life self-study and distance education situations) and the read-question-read groups (RQR) are expected to use both backward and forward processing and better encode the information than are the read-read-question groups (RRQ) which can only use backward processing. Thus the FREE and RQR groups are expected to recall more low level intentional material and to perform better on high level questions about intentional material than the RRQ groups.

(b) Presentation sequence and incidental learning RRQ > RQR > FREE

The RRQ groups read the passage twice and, because their attention during the second reading has not been focused by a question, are expected to recall more low order incidental material and perform better on high level questions about incidental material than are the RQR groups who are focused on the intentional material during the second reading by a question. The RQR groups are expected to do better on questions about incidental material than the FREE groups who may read the question first and, as indicated in the pre-question research, may merely forward process the intentional material ignoring the incidental material.

(c) Level of adjunct question and high level posttest items HI > LO

Inference and implication questions are expected to facilitate deeper semantic processing than verbatim and paraphrase questions. Thus the higher level adjunct question groups (HI) are expected to perform better on high level post test questions than the low level adjunct question groups (LO).

(d) Level of adjunct question and low level posttest items HI = LO

High level adjunct questions are expected to cause subjects to attend to more material, process it more deeply and have better organized memory than those asked low level adjunct questions. Thus the high level groups (HI) should recall as much low level material as the low groups (LO) even though not specifically asked low level adjunct questions.

(e) Frequency of adjunct question for all posttest items INSERT > MASS

Because there is less chance of a match between text and question as the total amount of text between a particular target sentence and the related adjunct question increases, adjunct questions inserted after every paragraph are expected to facilitate better recall and performance than all adjunct questions massed at the end.

The Interaction Hypotheses

There are no interaction hypotheses for two reasons.

* There are no consistent research results to establish a theory, and
* The more recent reviews (Hamilton, 1985; Hamaker, 1986) do not suggest strong or consistent interaction effects.

Thus the factorial design is used to explore the possibility of interaction effects.

Method

Subjects

The subjects were 187 students (attrition from 195) from a large high school in Central New York. The school was selected because the principal and faculty were willing to cooperate. The subjects ranged from good grade 12 students to lower middle grade 10 students, and all were taught English by the two cooperating teachers. The researcher would have preferred to increase the power of the study by using all of the grade 12 students within the school because the variance would be lower, grade 12 students would be more cooperative, and the variance in an entire grade twelve would be similar to the variance in first year distance learners in higher education. The school was unable to provide the requested sample.

All 195 students were required to participate and they were randomly assigned to 12 treatment groups and one control group - about 15 per group. The members of a second control group were those absent from the treatment but were present for the posttest. This control group of 17 students was not randomly assigned and the researcher has not determined how representative the members were.

The assignment procedure used to place the 195 in the thirteen treatment groups involved using a pack of cards. The pack was shuffled and the cards dealt face up on a table. Each time a spade showed, a booklet from the treatment group assigned the number on the card was placed in the "assigned" pile. As there were 13 treatments and 13 spades, each treatment was assigned once per shuffle. The first booklet from each treatment was mixed in this way, then the second, then the next, and so on until all the booklets were randomly mixed. The random mix was taken to the classrooms and handed out to each class row by row.

Design

The experimental design was a posttest only control group design. The two statistical designs of the experiment can be represented as a 3 x 2 x 2 between-subjects factorial design, and a one-way design with 12 groups and two separate control groups. For the factorial design, the between-subject factors were the presentation sequence (read-question-read, read-read-question, and complete freedom), the level of the adjunct question (high and low), and the frequency of the adjunct questions asked (inserted and massed).

The data from the experiment were analyzed using a 3 x 2 x 2 factorial analysis of variance and comparisons among the treatment groups were made using the Duncan post hoc test. A one-way analysis of variance with 14 levels was used to compare each treatment with the other treatments and with the two control groups and again the Duncan test was used. The Duncan test was chosen because the study was exploratory and the Duncan is not as conservative as the Scheffe or Tukey tests.

The dependent variables can also be represented as a 2 x 2 factorial design. The factors in the design were the level of the posttest item (high level and low level) and the relationship between the posttest items to the material covered by the adjunct questions (intentional and incidental material). [The ideal statistical treatment for this design would have been MANOVA. However, this researcher is unable to use MANOVA.]

The Instructional Task and Materials

The instructional material used in this study was an excerpt taken from a booklet entitled "The Energy Story" written by this researcher some years ago for use in high schools. The excerpt was broken into 17 passages of between 100 and 130 words.

The researcher/author identified the most structurally important sentence, phrase or idea in each passage and developed two completion or short answer questions for each of these sentences, phrases or ideas. One question, defined as low level, required the reader to recall or identify something and was expected to induce verbatim or paraphrase processing in subjects in the low level question groups. The other question, defined as high level, required the reader to make an inference or find an implication and was expected to induce high level semantic processing in subjects from the high level question groups.

To illustrate, passage 10 from the "Energy Story" is presented below with the target sentence underlined.

> We can see the light and feel the heat radiated from the sun. This energy is absorbed by the land, oceans and atmosphere and the earth heats up. The earth reflects 30% of this solar energy directly back into space and it radiates another 47% into space directly as heat. The remaining 23% is radiated into space as heat indirectly through evaporation, precipitation and the food chain cycle. Some of the sun's energy is used to evaporate the ocean to form clouds. Some is used to heat the atmosphere to cause winds. Only a very small percentage (0.023%) of the sun's energy goes into the process of sugar formation in plants.

The adjunct questions for this passage are:

1. Low level.

   How much of the sun's energy goes into the production of sugars in plants?

2. High level.

   What is so important about the fact that only a very small percentage of the sun's energy helps produce sugars in plants?

The Treatments

Subjects in the treatment groups were provided with an adjunct question about each passage they read. The members of the LO groups received a question, defined as low level, which required the readers to recall or identify something and was expected to induce verbatim or paraphrase processing. The members of the HI groups received a question, defined as high level, which required the reader to make an inference or find an implication and was expected to induce high level semantic processing. Subjects in the treatment groups received adjunct questions in differing frequencies. Subjects in the MASS groups received all of the adjunct questions massed together at the end of all the passages. The INSERT groups received adjunct questions inserted between passages.

Subjects in the treatment groups also received differing presentation sequences. The RQR groups read the passage (or passages), received the question (or questions), then received the passage(s) again. The RRQ groups were provided the passage, then the passage again, and finally the adjunct question. Although the FREE group were able to proceed in any fashion, they were advised to read the passage, answer the question, re-read the passage, and attempt the question again.

The no-question control group spent approximately the same time on each passage as the treatment groups but received no questions (the read twice control group). The no-passage control group received neither the questions nor the passages.

The booklets for the 13 treatment groups are described below.

Read-question-read, inserted-question groups (RQR-H-I and RQR-L-I).

Each passage was presented twice with the high or low level adjunct question placed between them. The instructions informed subjects that they could not take notes and that once they had turned a page they could znot turn back.

Read-question-read, massed-questions groups (RQR-H-M and RQR-L-M).

All 17 passages were presented once, then all the questions massed together, then the passages were presented again. The instructions were the same as the above.

Read-read-question, inserted-question groups (RRQ-H-I and RRQ-L-I).

Each passage was provided twice before the high or low level question was provided. The instructions informed subjects that they could not take notes and that once they had turned a page they could not turn back.

Read-read-question, massed-questions groups (RRQ-H-M and RRQ-L-M).

All 17 passages were presented once, they were presented again, then all the questions were presented massed together. The instructions were as above.

Freedom, inserted-question groups (FR-H-I and FR-L-I).

Each question was presented on the same page as the passage to which it refers. Subjects were allowed the freedom to proceed as they wished although the following procedure was recommended:

- Read the passage;
- Read the question;
- Re-read the passage; and
- Answer the question.

Freedom, massed question groups (FR-H-M and FR-L-M).

All the passages were provided once, then all the questions were provided at the end of the booklet massed together. Subjects were allowed the freedom to proceed as they wished although the following procedure was recommended:

- Read the passages all together or singly;
- Read the questions at the back of the booklet;
- Re-read the passage(s); and
- Answer the questions at the back of the booklet while looking back at the qestion.

Read twice control group (RTCG)

Each passage was provided twice. The instructions informed subjects that they could not take notes and that once they had turned a page they could not turn back.

No passage control group (NPCG)

The subjects in the no passage control group were those students who were absent from class on treatment day but present on the posttest day. They received no treatment.

Each adjunct question included a single line on which the answer could be written. This was included to help reinforce that long detailed answers were not required and to help persuade the students to answer the questions.

Tests and Measures

The dependent measure was made up of 34 multiple choice questions. 17 questions were based on the target sentence, phrase or idea in each passage - the intentional material. The other 17 questions were based on another sentence, phrase or idea in the passage - the incidental material. 17 of these questions, one for each of the 17 passages, were high level questions requiring the subject to choose among inferences or implications. The other 17 questions were low level questions requiring the subject to either choose the exact duplicate of the passage sentence or phrase or recognize a factual statement from the passage.

A coin was tossed, once for each passage, to randomly determine whether the intentional material question was high level or low level. Each subject answered 9 intentional high level questions, 8 intentional low level questions, 8 incidental high level questions and 9 incidental low level questions.

As an illustration, the posttest questions for paragraph 10 above were:

1. High level intentional question.

   Only 1/4000th (0.023%) of the sun's energy that reaches earth goes into the process of sugar formation in plants. According to the passage, what is most important about this fact?

   A. Plants do not need very much energy to make sugars and, thus, are very efficient organisms.
   B. Fossil fuels such as oil, coal and natural gas are formed from dead plants and animals (which eat the plants) and take thousands of years to form.
   C. We need to find an energy source that taps a higher percentage of the sun's energy and also makes that energy immediately available.
   D. Both B and C above.

2. Low level incidental question.

Which of the following is a sentence from a passage you read?

A. The sun reflects 47% of this solar energy directly back into space and it radiates another 30% into space directly as heat.
B. The sun reflects 30% of this solar energy directly back into space and it radiates another 47% into space directly as heat.
C. The sun reflects 30% of this solar energy directly back into space and it radiates another 23% indirectly through evaporation and precipitation.
D. The sun radiates 47% of this solar energy directly back into space and it radiates another 23% indirectly through evaporation and precipitation.

Procedures.

The experiment was conducted in the English classrooms of the two cooperating teachers on a Friday. The treatment booklets, already randomly mixed as described above, were already placed face down on the desks when the subjects arrived for class. The subjects were told to read their special instructions, to follow only those instructions and to ignore what other students were doing as everyone had different instructions. As the subjects worked through the materials the cooperating teacher copied the treatment codes onto a class list. Subjects worked at their own rate and read their English texts if they finished before time. The treatments were completed within the 41 minute class period.

The retention posttest was run 4 days later on the following Tuesday. It was a multiple-choice test as described above and the subjects marked a special answer sheet. As the subjects worked, the cooperating teacher transferred the treatment code from the class list to their answer sheets. If subjects finished the test before time, they were asked to check their answers and to write a comment about the experience on the back of the answer sheet. All subjects completed the test in the 41 minutes allowed.

Students who were absent for the treatment but present for the posttest still took the posttest. They were given the special code NPCG - the no passage, no question control group. As noted above, this control group was not randomly selected and its representativeness can not be assessed.

Results

The Power of the Study

As can be seen from Tables 1 through 4, the posttest variance in each group is large, probably because the subjects ranged from poor grade 10 students to good grade 12 students. The power of the study was greatly reduced by this large within-group variance, and few significant results were obtained. A complete range of grade 12 students would have provided the variability needed for good external validity and would have increased the power of the study by having less within-group variance than this sample from grades 10, 11 and 12.

To increase the possibility of significant results being detected, and to decrease the possibility of a Type II error, the Duncan post hoc test was used because it is less conservative than the Scheffe, Tukey or Newman-Keuls tests. To the same end, the F-test alpha value was set at 0.1 instead of 0.05 as is typically done. It should be noted, however, that when the F-test found significance between 0.10 and 0.05, both the Duncan test and pair-wise comparisons of LS means found significance at the 0.05 level.

The Analysis

A 3x2x2 analysis of variance was performed on all nine dependent variables which were the 4 subscales of the posttest and the various combinations of these subscales. The nine dependent variables, and the tables showing the results, are:

(a) Intentional learning - High level items (Tables 1 and 11).
(b) Intentional learning - Low level items (Tables 2 and 12).
(c) Incidental learning - High level items (Tables 3 and 13).
(d) Incidental learning - Low level items (Tables 4 and 14).
(e) Intentional Learning - Total score [a + b] (Tables 5 and 15).
(f) Incidental learning - Total score [c + d] (Tables 6 and 16).
(g) High level items - Total score [a + c] (Tables 7 and 17).
(h) Low level items - Total score [b + d] (Tables 8 and 18).
(i) Total score on all items [a + b + c + d] (Tables 9 and 19).

A one-way analysis of variance with 14 levels was performed to compare the 12 treatments with each other and with the two control groups (see Table 10). Again the Duncan post hoc procedure was used (see Tables 11 through 19).

Presentation Sequence

For high level items on intentional material, as hypothesized, the RQR groups ($\bar{x}$ = 54.81) performed significantly better ($p = 0.029$) than the RRQ groups ($\bar{x}$ = 49.54) (see Tables 1 and 11). The prediction that the FREE groups ($\bar{x}$ = 52.15) would also score significantly higher than the RRQ group was not supported. It is important to note that the FREE group does not perform significantly worse than the RQR group.

For posttest items requiring recall of low level material, the RQR groups (68.33), the RRQ groups (71.35) and the FREE groups (71.68) did not differ significantly. Also, for posttest items requiring high level performance on incidental material, the RRQ groups (61.20), the RQR groups (60.83) and the FREE groups (58.67) did not differ significantly. Thus, for low level intentional items and high level incidental items all groups may be considered equal (see Tables 2, 3) and the null hypotheses accepted with little chance of a Type II error.

For low level items on incidental material the hypothesis that the RRQ groups would recall more incidental material than the RQR groups, which would recall more than the FREE groups, was not supported. Rather, the FREE groups (43.31) recalled significantly more low level incidental material ($p = 0.029$) than did the RQR groups (37.53), with the RRQ groups (41.90) not differing significantly from the others (see Tables 4 and 14). The data support the opposite conclusion that FREE groups will recall more low level incidental material than will RQR groups.

When the subscales were combined to form total scores on intentional and incidental material, there were no significant differences among groups for presentation sequence. Also, there were no significance differences when the subscales were combined to form a total score for high level items.

When the subscales were combined to obtain a total low level score, significant differences were obtained (see tables 8 and 18). The FREE groups ($\bar{x}$ = 56.66) recalled significantly more low level material ($p = 0.0273$) than the RQR groups ($\bar{x}$ = 52.03) with the RRQ groups ($\bar{x}$ = 55.76) not differing significantly from the other groups. The prediction that the FREE groups would not recall as much as the other groups was not supported. In fact, the hypothesis was significantly contradicted: The data support the alternative hypothesis that FREE groups recall more low level material than RQR groups.

No significant differences for presentation sequence were found when the subscales were combined to form a total posttest score.

Level of Adjunct Questions

The first hypothesis related to the level of adjunct question was that, on high level posttest items, the HI groups (which received high level adjunct questions) would perform better than the LO groups (which received low level adjunct questions). Although there were no significant differences, the means were ordered in the opposite direction. Hence, the experimental hypothesis is not supported (see Tables 1, 3, 7) and the null hypothesis, that there was no difference between the HI and LO groups, must be accepted with little chance of a Type II error.

The second hypothesis related to the level of adjunct question was that, on low level posttest items, the HI groups would score as well as the LO groups. As no significant differences between the HI and LO groups were found on low level items (see Tables 2, 4, 8), the experimental hypothesis is supported and the statistical null hypothesis, that there are no differences between the HI and LO groups, must be accepted with little chance of a Type II error.

Frequency of Adjunct Post-question

The experimental hypothesis related to frequency of question was that adjunct questions are expected to facilitate better recall and performance if they are inserted in the text than if they are massed together. This experimental hypothesis was not supported as no significant differences were found for any of the nine dependent variables - the difference between the INSERTed and MASSed groups was never greater than 2% (see Tables 1 through 9), and any small difference tended to favor the MASSed groups. Thus the null hypothesis, that there is no difference between groups answering inserted questions and groups answering massed questions, is accepted with little chance of a Type II error.

Interaction Effects

There were five significant interactions, for a significance level chosen at $p < 0.10$, all for high level posttest items. The first three were QxF interactions, that is, interactions between level of adjunct question and whether those questions were inserted in the text or massed together. One interaction effect was found for high level items about intentional material ($F = 2.69$, $p = 0.10$), another for high level incidental items ($F = 3.78$, $p = 0.054$) and a third for the total score on high level items ($F = 5.35$, $p = 0.022$). In all three cases, high level adjunct questions facilitated better performance on high level items when massed, while low level adjunct questions facilitated better performance on high level items when inserted. (See Tables 1, 3, 7, 11, 13, and 17.)

The other two significant interactions were found for the interaction between all main effects, PxQxF, that is, an interaction between presentation sequence, level of adjunct question and whether the adjunct questions are inserted in the text or massed together. One interaction was found for high level items about intentional material ($F = 1.95$, $p = 0.14$) and the other for the total score on high level posttest items ($F = 2.30$, $p = 0.10$). In both cases, high level adjunct questions facilitate better performance if massed and low level adjunct questions facilitate better performance if inserted, for RRQ and RQR groups but not for FREE groups. (See Tables 1, 7, 11 and 17.)

Comparison with the Controls

For high level posttest items about intentional material (Tables 10 and 11), although scoring between 53.17 and 48.48, three FREE groups, three RQR groups and two RRQ groups did NOT perform significantly better than the READ-TWICE control group (41.48) when the significance level of the Duncan post hoc test was left at 0.05. This researcher did not know how to alter the Duncan test to a 0.10 significance level and perhaps the 20% difference between the read-twice control and the lowest treatment group would have been significant at that level. All treatments performed better than the NO-PASSAGE control group (26.50).

For low level intentional items (Tables 10 and 12), only the FREE-LO-MASSED group (73.86) recalled significantly more intentional material than the READ-TWICE control group (59.17). Because of the large within cell variance, the FREE-HI-MASSED group (72.92), the RRQ-LO-INSERTED group (72.73) and the FREE-LO-INSERTED group (71.43) were not considered significantly different from the READ-TWICE control group by the Duncan post hoc test set at a significant level of 0.05. Again these groups may have been significant at the 0.10 exploratory level. However, all treatment groups recalled significantly more than the NO-PASSAGE control group (42.31).

For high level incidental material (Tables 10 and 13), no treatment performed significantly better than the READ-TWICE control group. The RQR-LO-MASSED group did not perform significantly better than the NO-PASSAGE control group.

For low level incidental material (Tables 10 and 14), only the FREE-LO-MASSED group (47.47) recalled significantly more than the READ-TWICE control group (34.07). Only two FREE groups and two RRQ groups recalled significantly more than the NO-PASSAGE control group (29.06).

For all intentional items (Tables 10 and 15), three FREE groups, three RQR groups and two RRQ groups (all groups above 59.5) recalled significantly more and performed significantly better than the READ-TWICE control group (49.80). All treatment groups recalled significantly more and performed significantly better than the NO-PASSAGE control group (33.94).

For all incidental items (Tables 10 and 16), while ALL treatment groups recalled significantly more and performed significantly better than the NO-PASSAGE control group (33.94), NO treatment groups (even RRQ-HI-MASSED at 53.78) recalled significantly more or performed significantly better than the READ-TWICE control group (43.14).

For all high level items (Tables 10 and 17), while all treatment groups performed significantly better than the NO-PASSAGE control group (32.58), only two RQR groups and one RRQ group (those above 58.00) performed significantly better than the READ-TWICE control group (47.06).

For all low level items (Tables 10 and 18), while all treatment groups recalled significantly more than the NO-PASSAGE control group (35.29), only three FREE groups and two RRQ groups (those above 56.00) recalled significantly more than the READ-TWICE control group (45.88).

For all items, the total score (Tables 10 and 19), while all treatment groups performed significantly better than the NO-PASSAGE control group (33.94), only three FREE groups, two RRQ groups and two RQR groups (those above 54.5) performed better than the READ-TWICE control group (46.47).

TABLE 1: DEPENDENT VARIABLE 1. HIGH LEVEL - INTENTIONAL LEARNING

P	R Q R mean = 54.81 SD = 13.48 n = 45			R R Q mean = 49.54 SD = 12.75 n = 48			FREE mean = 52.15 SD = 10.44 n = 49						df 2 F 2.44	p 0.091 see table 11
Q	HIGH mean = 51.05 SD = 12.86 n = 74						LOW mean = 53.27 SD = 11.76 n = 68						df 1 F 1.27	p 0.261 ns
F	INSERTED mean = 51.54 SD = 11.99 n = 72						MASSED mean = 52.70 SD = 12.79 n = 70						d 1 F 0.25	p 0.621 ns
PQ	RQR-Hi $\bar{x}$ = 52.78 s = 12.37 n = 24	RQR-Low $\bar{x}$ = 57.14 s = 14.61 n = 21	RRQ-Hi $\bar{x}$ = 50.43 s = 14.48 n = 26	RRQ-Low $\bar{x}$ = 48.48 s = 10.59 n = 22	FREE-Hi $\bar{x}$ = 50.00 s = 11.81 n = 24	FREE-Lo $\bar{x}$ = 54.22 s = 8.68 n = 25							df 1 F 0.91	p 0.404 ns
PF	RQR-Insert $\bar{x}$ = 55.56 s = 13.40 n = 23	RQR-Massed $\bar{x}$ = 54.04 s = 13.84 n = 22	RRQ-Insert $\bar{x}$ = 46.86 s = 10.03 n = 23	RRQ-Massed $\bar{x}$ = 52.00 s = 14.60 n = 25	FREE-Insert $\bar{x}$ = 52.14 s = 11.23 n = 26	FREE-Mass $\bar{x}$ = 52.17 s = 9.73 n = 23							df 1 F 0.90	p 0.410 ns
QF	High - Inserted $\bar{x}$ = 48.77 SD = 11.04 n = 36		High - massed $\bar{x}$ = 53.22 SD = 14.19 n = 38		Low - Inserted $\bar{x}$ = 54.32 SD = 12.39 n = 36		Low - massed $\bar{x}$ = 52.08 SD = 11.09 n = 32						df 1 F 2.69	p 0.103 ns
PQF	RQR-H-I 50.00 7.49 n = 12	RQR-H-M 55.56 15.71 n = 12	RQR-L-I 61.62 16.00 n = 11	RQR-L-M 52.22 11.77 n = 10	RRQ-H-I 45.37 11.07 n = 12	RRQ-H-M 54.76 15.99 n = 14	RRQ-L-I 48.48 8.99 n = 11	RRQ-L-M 48.48 12.45 n = 11	FR-H-I 50.93 13.73 n = 12	FR-H-M 49.07 10.00 n = 12	FR-L-I 53.17 8.91 n = 14	FR-L-M 55.56 8.61 n = 11	df 1 F 1.95	p 0146 see table 11

P = Presentation Sequence Q = Question Level F = Frequency of Question

TABLE 2: DEPENDENT VARIABLE 2. LOW LEVEL - INTENTIONAL LEARNING

P	R Q R mean = 68.33 SD = 14.50 n = 45		R R Q mean = 71.35 SD = 14.11 n = 48		FREE mean = 71.68 SD = 15.68 n = 49								df 2 F 0.69	p 0.502 ns
Q	HIGH mean = 69.76 SD = 14.63 n = 74				LOW mean = 71.32 SD = 14.97 n = 68								df 1 F 0.35	p 0.556 ns
F	INSERTED mean = 70.66 SD = 14.56 n = 72				MASSED mean = 70.36 SD = 15.07 n = 70								d 1 F 0.01	p 0.922 ns
PQ	RQR-Hi $\bar{x}$ = 67.71 s = 13.75 n = 24	RQR-Low $\bar{x}$ = 69.05 s = 15.62 n = 21	RRQ-Hi $\bar{x}$ = 70.67 s = 13.67 n = 26	RRQ-Low $\bar{x}$ = 72.16 s = 14.91 n = 22	FREE-Hi $\bar{x}$ = 70.83 s = 16.76 n = 24	FREE-Lo $\bar{x}$ = 72.50 s = 14.88 n = 25							df 1 F 0.61	p 0.996 ns
PF	RQR-Insert $\bar{x}$ = 69.57 s = 14.51 n = 23	RQR-Massed $\bar{x}$ = 67.05 s = 14.71 n = 22	RRQ-Insert $\bar{x}$ = 72.28 s = 14.08 n = 23	RRQ-Massed $\bar{x}$ = 70.50 s = 14.38 n = 25	FREE-Insert $\bar{x}$ = 70.19 s = 15.44 n = 26	FREE-Mass $\bar{x}$ = 73.37 s = 16.12 n = 23							df 1 F 0.61	p 0.612 ns
QF	High - inserted $\bar{x}$ = 70.14 SD = 15.61 n = 36		High - massed $\bar{x}$ = 69.41 SD = 13.85 n = 38		Low - inserted $\bar{x}$ = 71.18 SD = 13.63 n = 36		Low - massed $\bar{x}$ = 71.48 SD = 13.57 n = 32						df 1 F 0.04	p 0.847 ns
PQF	RQR-H-I 69.79 12.45 n = 12	RQR-H-M 65.63 15.19 n = 12	RQR-L-I 69.32 17.11 n = 11	RQR-L-M 68.75 14.73 n = 10	RRQ-H-I 71.88 16.10 n = 12	RRQ-H-M 69.64 11.72 n = 14	RRQ-L-I 72.73 12.27 n = 11	RRQ-L-M 71.59 17.76 n = 11	FR-H-I 68.75 18.84 n = 12	FR-H-M 72.92 14.92 n = 12	FR-L-I 71.43 12.43 n = 14	FR-L-M 73.86 18.07 n = 11	df 1 F 0.09	p 0.914 ns

P = Presentation Sequence Q = Question Level F = Frequency of Question

TABLE 3: DEPENDENT VARIABLE 3. HIGH LEVEL - INCIDENTAL LEARNING

P	R Q R mean = 60.83 SD = 17.80 n = 45	R R Q mean = 61.20 SD = 18.46 n = 48	FREE mean = 58.67 SD = 14.92 n = 49	df 2 F 0.31	p 0.732 ns	
Q	HIGH mean = 59.63 SD = 16.36 n = 74	LOW mean = 60.85 SD = 17.80 n = 68		df 1 F 0.18	p 0.674 ns	
F	INSERTED mean = 60.24 SD = 17.34 n = 72	MASSED mean = 60.18 SD = 16.80 n = 70		d 1 F 0.03	p 0.870 ns	
PQ	RQR-Hi $\bar{x}$ = 59.90 s = 15.63 n = 24	RQR-Low $\bar{x}$ = 61.90 s = 20.34 n = 21	RRQ-Hi $\bar{x}$ = 60.58 s = 16.84 n = 26	RRQ-Low $\bar{x}$ = 61.93 s = 20.59 n = 22	FREE-Hi $\bar{x}$ = 58.33 s = 17.16 n = 24	FREE-Lo $\bar{x}$ = 59.00 s = 12.77 n = 25	df 1 F 0.02	p 0.981 ns
PF	RQR-Insert $\bar{x}$ = 61.96 s = 18.65 n = 23	RQR-Massed $\bar{x}$ = 59.66 s = 17.22 n = 22	RRQ-Insert $\bar{x}$ = 59.24 s = 17.76 n = 23	RRQ-Massed $\bar{x}$ = 63.00 s = 19.26 n = 25	FREE-Insert $\bar{x}$ = 59.62 s = 16.32 n = 26	FREE-Mass $\bar{x}$ = 57.61 s = 13.45 n = 23	df 1 F 0.51	p 0.600 ns
QF	High - Inserted $\bar{x}$ = 56.94 SD = 15.65 n = 36	High - massed $\bar{x}$ = 62.17 SD = 16.82 n = 38	Low - Inserted $\bar{x}$ = 63.54 SD = 18.51 n = 36	Low - massed $\bar{x}$ = 57.81 SD = 16.73 n = 32	df 1 F 3.78	p 0.054 see table 13	

PQF	RQR-H-I	RQR-H-M	RQR-L-I	RQR-L-M	RRQ-H-I	RRQ-H-M	RRQ-L-I	RRQ-L-M	FR-H-I	FR-H-M	FR-L-I	FR-L-M	df	p
	55.21	64.58	69.32	53.75	57.29	63.39	61.43	62.50	58.33	58.33	53.17	60.71	1	0.259
	14.56	15.84	20.44	17.73	12.45	19.36	22.68	19.36	20.18	14.43	8.91	12.84	F	ns
	n = 12	n = 12	n = 11	n = 10	n = 12	n = 14	n = 11	n = 11	n = 12	n = 12	n = 14	n = 11	1.36	

P = Presentation Sequence Q = Question Level F = Frequency of Question

TABLE 4: DEPENDENT VARIABLE 4. LOW LEVEL - INCIDENTAL LEARNING

P	R Q R mean = 37.53 SD = 14.27 n = 45			R R Q mean = 41.90 SD = 12.81 n = 48			FREE mean = 43.31 SD = 11.62 n = 49						df 2 F 2.52	p 0.084 see table 14
Q	HIGH mean = 41.14 SD = 13.68 n = 74						LOW mean = 40.85 SD = 12.65 n = 68						df 1 F 0.00	p 0.963 ns
F	INSERTED mean = 39.51 SD = 12.49 n = 72						MASSED mean = 42.54 SD = 13.51 n = 70						d 1 F 1.92	p 0.168 ns
PQ	RQR-Hi $\bar{x}$ = 36.11 s = 15.10 n = 24	RQR-Low $\bar{x}$ = 39.15 s = 13.43 n = 21		RRQ-Hi $\bar{x}$ = 43.16 s = 13.45 n = 26	RRQ-Low $\bar{x}$ = 40.40 s = 12.15 n = 22		FREE-Hi $\bar{x}$ = 43.98 s = 10.61 n = 24	FREE-Lo $\bar{x}$ = 42.67 s = 12.70 n = 25					df 1 F 0.57	p 0.565 ns
PF	RQR-Insert $\bar{x}$ = 37.20 s = 15.57 n = 23	RQR-Massed $\bar{x}$ = 37.88 s = 13.13 n = 22		RRQ-Insert $\bar{x}$ = 38.65 s = 12.02 n = 23	RRQ-Massed $\bar{x}$ = 44.89 s = 13.02 n = 25		FREE-Insert $\bar{x}$ = 42.31 s = 9.44 n = 26	FREE-Mass $\bar{x}$ = 44.44 s = 13.81 n = 23					df 1 F 0.58	p 0.561 ns
QF	High - inserted $\bar{x}$ = 41.05 SD = 13.23 n = 36			High - massed $\bar{x}$ = 41.23 SD = 13.89 n = 38			Low - inserted $\bar{x}$ = 37.96 SD = 11.69 n = 36			Low - massed $\bar{x}$ = 44.10 SD = 13.08 n = 32			df 1 F 1.97	p 0.162 ns
PQF	RQR-H-I 36.11 15.80 n = 12	RQR-H-M 36.11 15.08 n = 12	RQR-L-I 38.38 16.00 n = 11	RQR-L-M 40.00 10.73 n = 10	RRQ-H-I 40.74 11.92 n = 12	RRQ-H-M 45.24 14.6 n = 14	RRQ-L-I 36.36 12.26 n = 11	RRQ-L-M 44.44 11.11 n = 11	FR-H-I 46.30 10.42 n = 12	FR-H-M 41.67 10.73 n = 12	FR-L-I 38.89 7.23 n = 14	FR-L-M 47.47 16.55 n = 11	df 1 F 0.68	p 0.508 ns

P = Presentation Sequence Q = Question Level F = Frequency of Question

TABLE 5: DEPENDENT VARIABLE 5. TOTAL SCORE - INTENTIONAL LEARNING

P	R Q R mean = 61.18 SD = 11.03 n = 45			R R Q mean = 59.80 SD = 10.18 n = 48			FREE mean = 61.34 SD = 10.47 n = 49				df 2 F 0.35	p 0.707 ns
Q	HIGH mean = 59.86 SD = 10.89 n = 74						LOW mean = 61.76 SD = 10.04 n = 68				df 1 F 1.14	p 0.287 ns
F	INSERTED mean = 60.54 SD = 10.61 n = 72						MASSED mean = 61.01 SD = 10.46 n = 70				d 1 F 0.05	p 0.817 ns
PQ	RQR-Hi $\bar{x}$ = 59.80 s = 9.91 n = 24	RQR-Low $\bar{x}$ = 62.75 s = 12.25 n = 21	RRQ-Hi $\bar{x}$ = 59.95 s = 11.29 n = 26	RRQ-Low $\bar{x}$ = 59.63 s = 8.95 n = 22	FREE-Hi $\bar{x}$ = 59.80 s = 11.85 n = 24	FREE-Lo $\bar{x}$ = 62.82 s = 8.94 n = 25					df 1 F 0.35	p 0.707 ns
PF	RQR-Insert $\bar{x}$ = 62.15 s = 11.61 n = 23	RQR-Massed $\bar{x}$ = 60.16 s = 10.57 n = 22	RQ-Insert $\bar{x}$ = 58.82 s = 9.71 n = 23	RRQ-Massed $\bar{x}$ = 60.71 s = 10.70 n = 25	FREE-Insert $\bar{x}$ = 60.63 s = 10.62 n = 26	FREE-Mass $\bar{x}$ = 62.15 s = 10.47 n = 23					df 1 F 0.48	p 0.617 ns
QF	High - inserted $\bar{x}$ = 58.82 SD = 10.98 n = 36		High - massed $\bar{x}$ = 60.84 SD = 10.88 n = 38	Low - inserted $\bar{x}$ = 62.25 SD = 10.08 n = 36		Low - massed $\bar{x}$ = 61.21 SD = 10.12 n = 32					df 1 F 0.73	p 0.395 ns
PQF	RQR-H-I 59.31 9.20 n = 12	RQR-H-M 60.29 10.97 n = 12	RQR-L-I 65.24 13.53 n = 11	RQR-L-M 60.00 10.67 n = 10	RRQ-H-I 57.84 11.72 n = 12	RRQ-H-M 61.76 11.00 n = 14	RRQ-L-I 59.89 7.36 n = 11	RRQ-L-M 59.36 10.67 n = 11	FR-H-I 59.31 12.66 n = 12	FR-H-M 60.29 11.53 n = 12	FR-L-I 61.76 8.86 n = 14	FR-L-M 64.17 9.28 n = 11	df 1 F 0.41 p 0.663 ns

P = Presentation Sequence Q = Question Level F = Frequency of Question

TABLE 6: DEPENDENT VARIABLE 6. TOTAL SCORE - INCIDENTAL LEARNING

P	R Q R mean = 48.50 SD = 11.64 n = 45			R R Q mean = 50.98 SD = 12.63 n = 48			FREE mean = 50.54 SD = 9.45 n = 49						df 2 F 0.59	p 0.557 ns
Q	HIGH mean = 49.84 SD = 10.98 n = 74						LOW mean = 50.26 SD = 11.65 n = 68						df 1 F 0.07	p 0.787 ns
F	INSERTED mean = 49.26 SD = 12.03 n = 72						MASSED mean = 50.84 SD = 10.46 n = 70						d 1 F 0.51	p 0.475 ns
PQ	RQR-Hi $\bar{x}$ = 47.30 s = 10.90 n = 24	RQR-Low $\bar{x}$ = 49.86 s = 12.56 n = 21	RRQ-Hi $\bar{x}$ = 51.36 s = 11.35 n = 26	RRQ-Low $\bar{x}$ = 50.53 s = 14.25 n = 22	FREE-Hi $\bar{x}$ = 50.74 s = 10.67 n = 24	FREE-Lo $\bar{x}$ = 50.35 s = 8.33 n = 25							df 1 F 0.24	p 0.789 ns
PF	RQR-Insert $\bar{x}$ = 48.85 s = 13.56 n = 23	RQR-Massed $\bar{x}$ = 48.13 s = 9.54 n = 22	RRQ-Insert $\bar{x}$ = 48.34 s = 12.91 n = 23	RRQ-Massed $\bar{x}$ = 53.41 s = 12.12 n = 25	FREE-Insert $\bar{x}$ = 50.45 s = 10.01 n = 26	FREE-Mass $\bar{x}$ = 50.64 s = 9.00 n = 23							df 1 F 0.93	p 0.397 ns
QF	High - inserted $\bar{x}$ = 48.53 SD = 11.80 n = 36		High - massed $\bar{x}$ = 51.08 SD = 10.15 n = 38		Low - inserted x = 50.00 SD = 12.38 n = 36		Low - massed $\bar{x}$ = 50.55 SD = 10.97 n = 32						df 1 F 0.28	p 0.594 ns
PQF	RQR-H-I 45.10 12.12 n = 12	RQR-H-M 49.51 9.54 n = 12	RQR-L-I 52.94 14.41 n = 11	RQR-L-M 46.47 9.78 n = 10	RRQ-H-I 48.53 10.97 n = 12	RRQ-H-M 53.78 11.50 n = 14	RRQ-L-I 54.55 13.94 n = 11	RRQ-L-M 52.94 13.41 n = 11	FR-H-I 51.96 12.25 n = 12	FR-H-M 49.51 9.20 n = 12	FR-L-I 49.16 7.86 n = 14	FR-L-M 51.87 9.04 n = 11	df 1 F 1.47	p 0.233 ns

P = Presentation Sequence Q = Question Level F = Frequency of Question

TABLE 7: DEPENDENT VARIABLE 7. HIGH LEVEL ITEMS - TOTAL SCORE

P	R Q R mean = 57.65 SD = 13.07 n = 45			R R Q mean = 55.02 SD = 11.92 n = 48			FREE mean = 55.22 SD = 9.44 n = 49						df 2 F 0.80	p 0.449 ns
Q	HIGH mean = 55.09 SD = 10.33 n = 74						LOW mean = 56.83 SD = 12.68 n = 68						df 1 F 0.88	p 0.349 ns
F	INSERTED mean = 55.64 SD = 11.84 n = 72						MASSED mean = 56.22 SD = 11.23 n = 70						d 1 F 0.03	p 0.870 ns
PQ	RQR-Hi $\bar{x}$ = 56.13 s = 9.96 n = 24	RQR-Low $\bar{x}$ = 59.38 s = 15.99 n = 21	RRQ-Hi $\bar{x}$ = 55.20 s = 10.53 n = 26	RRQ-Low $\bar{x}$ = 54.81 s = 13.63 n = 22	FREE-Hi $\bar{x}$ = 53.92 s = 10.79 n = 24	FREE-Lo $\bar{x}$ = 56.47 s = 7.96 n = 25							df 1 F 0.25	p 0.781 ns
PF	RQR-Insert $\bar{x}$ = 58.57 s = 14.46 n = 23	RQR-Massed $\bar{x}$ = 56.68 s = 11.70 n = 22	RRQ-Insert $\bar{x}$ = 52.69 s = 10.41 n = 23	RRQ-Massed $\bar{x}$ = 57.18 s = 12.99 n = 25	FREE-Insert $\bar{x}$ = 55.66 s = 10.15 n = 26	FREE-Mass $\bar{x}$ = 54.73 s = 8.77 n = 23							df 1 F 1.09	p 0.340 ns
QF	High - inserted $\bar{x}$ = 52.61 SD = 8.78 n = 36		High - massed $\bar{x}$ = 57.43 SD = 11.23 n = 38		Low - inserted $\bar{x}$ = 58.66 SD = 13.74 n = 36		Low - massed $\bar{x}$ = 54.78 SD = 11.22 n = 32						df 1 F 5.35	p 0.022 see Table 17
PQF	RQR-H-I	RQR-H-M	RQR-L-I	RQR-L-M	RRQ-H-I	RRQ-H-M	RRQ-L-I	RRQ-L-M	FR-H-I	FR-H-M	FR-L-I	FR-L-M	df	p
	52.45	59.80	65.24	52.94	50.98	58.82	54.55	55.08	54.41	53.43	56.72	56.15	1	0.104
	7.79	10.89	17.34	12.09	5.79	12.42	13.94	13.99	12.06	9.86	8.51	7.61	F	see Table 17
	n = 12	n = 12	n = 11	n = 10	n = 12	n = 14	n = 11	n = 11	n = 12	n = 12	n = 14	n = 11	2.30	

P = Presentation Sequence Q = Question Level F = Frequency of Question

TABLE 8: DEPENDENT VARIABLE 8. LOW LEVEL ITEMS - TOTAL SCORE

P	R Q R mean = 52.03 SD = 9.04 n = 45			R R Q mean = 55.76 SD = 10.30 n = 48			FREE mean = 56.66 SD = 10.58 n = 49						df 2 F 2.68	p 0.072 see Table 18
Q	HIGH mean = 54.61 SD = 10.42 n = 74						LOW mean = 55.19 SD = 9.91 n = 68						df 1 F 0.15	p 0.703 ns
F	INSERTED mean = 54.17 SD = 10.07 n = 72						MASSEI mean = 55.63 SD = 10.25 n = 70						d 1 F 0.74	p 0.390 ns
PQ	RQR-Hi $\bar{x}$ = 50.98 s = 10.36 n = 24	RQR-Low $\bar{x}$ = 53.22 s = 7.32 n = 21	RRQ-Hi $\bar{x}$ = 56.11 s = 9.59 n = 26	RRQ-Low $\bar{x}$ = 55.35 s = 11.29 n = 22	FREE-Hi $\bar{x}$ = 56.62 s = 10.81 n = 24	FREE-Lo $\bar{x}$ = 56.71 s = 10.59 n = 25							df 1 F 0.25	p 0.782 ns
PF	RQR-Insert $\bar{x}$ = 52.43 s = 10.33 n = 23	RQR-Massed $\bar{x}$ = 51.60 s = 7.69 n = 22	RRQ-Insert $\bar{x}$ = 54.48 s = 10.22 n = 23	RRQ-Massed $\bar{x}$ = 56.94 s = 10.43 n = 25	FREE-Insert $\bar{x}$ = 55.43 s = 9.87 n = 26	FREE-Mass $\bar{x}$ = 58.06 s = 11.40 n = 23							df 1 F 0.39	p 0.679 ns
QF	High - inserted $\bar{x}$ = 54.74 SD = 11.49 n = 36		High - massed $\bar{x}$ = 54.49 SD = 9.44 n = 38	Low - inserted $\bar{x}$ = 53.59 SD = 8.53 n = 36		Low - massed $\bar{x}$ = 56.99 SD = 11.12 n = 32							df 1 F 1.16	p 0.283 ns
PQF	RQR-H-I 51.[illegible] 1[illegible].50 n = 12	RQR-H-M 50.00 8.13 n = 12	RQR-L-I 52.94 7.89 n = 11	RQR-L-M 53.53 7.04 n = 10	RRQ-H-I 55.39 10.18 n = 12	RRQ-H-M 56.72 9.40 n = 14	RRQ-L-I 53.48 10.07 n = 11	RRQ-L-M 57.22 12.08 n = 11	FR-H-I 56.86 12.12 n = 12	FR-H-M 56.37 9.86 n = 12	FR-L-I 54.20 7.71 n = 14	FR-L-M 59.89 13.11 n = 11	df 1 F 0.13	p 0.8775 ns

P = Presentation Sequence Q = Question Level F = Frequency of Question

TABLE 9: DEPENDENT VARIABLE 9. ALL ITEMS - TOTAL SCORE

P	R Q R mean = 54.84 SD = 9.07 n = 45			R R Q mean = 55.39 SD = 9.31 n = 48			FREE mean = 55.94 SD = 7.68 n = 49						df 2 F 0.21	p 0.814 ns
Q	HIGH mean = 54.84 SD = 8.14 n = 74						LOW mean = 56.01 SD = 9.20 n = 68						df 1 F 0.69	p 0.407 ns
F	INSERTED mean = 54.90 SD = 9.18 n = 72						MASSED mean = 55.92 SD = 8.10 n = 70						d 1 F 0.37	p 0.544 ns
PQ	RQR-Hi $\bar{x}$ = 53.55 s = 7.80 n = 24	RQR-Low $\bar{x}$ = 56.30 s = 10.33 n = 21		RRQ-Hi $\bar{x}$ = 55.66 s = 8.19 n = 26	RRQ-Low $\bar{x}$ = 55.08 s = 10.67 n = 22		FREE-Hi $\bar{x}$ = 55.27 s = 8.58 n = 24	FREE-Lo $\bar{x}$ = 56.59 s = 6.81 n = 25					df 1 F 0.35	p 0.706 ns
PF	RQR-Insert $\bar{x}$ = 55.50 s = 10.87 n = 23	RQR-Massed $\bar{x}$ = 54.14 s = 6.89 n = 22		RRQ-Insert $\bar{x}$ = 53.58 s = 8.87 n = 23	RRQ-Massed $\bar{x}$ = 57.06 s = 9.57 n = 25		FREE-Insert $\bar{x}$ = 55.54 s = 7.99 n = 26	FREE-Mass $\bar{x}$ = 56.39 s = 7.45 n = 23					df 1 F 0.92	p 0.402 ns
QF	High - Inserted $\bar{x}$ = 53.68 SD = 8.24 n = 36		High - massed $\bar{x}$ = 55.96 SD = 7.99 n = 38		Low - Inserted $\bar{x}$ = 56.13 SD = 10.00 n = 36			Low - massed $\bar{x}$ = 55.88 SD = 8.35 n = 32					df 1 F 0.76	p 0.386 ns
PQF	RQR-H-I 52.21 8.88 n = 12	RQR-H-M 54.90 6.68 n = 12	RQR-L-I 59.09 12.09 n = 11	RQR-L-M 53.24 7.40 n = 10	RRQ-H-I 53.19 6.57 n = 12	RRQ-H-M 57.77 9.05 n = 1[illegible]	RRQ-L-I 54.01 11.18 [illegible] = 11	RRQ-L-M 56.15 10.56 n = 11	FR-H-I 55.64 9.34 n = 12	FR-H-M 54.90 8.16 n = 12	FR-L-I 55.46 7.00 n = 14	FR-L-M 58.02 6.59 n = 11	df 1 F 1.33	p 0.267 ns

P = Presentation Sequence Q = Question Level F = Frequency of Question

TABLE 10: Means for ALL Groups on ALL Dependent Variables - F value for one way ANOVA with 14 levels.

Dependent Variable	Group													
	QRHI	QRHM	QRLI	QRLM	RQHI	RQHM	RQLI	RQLM	FRHI	FRHM	FRLI	FRLM	RTCG	NPCG
Intent. High	50.00	55.56	61.62	52.22	45.37	54.76	48.48	48.48	50.93	49.07	53.17	55.56	41.48	26.50
	df = 13, 169				F = 5.70			p < 0.0001						
Intent. Low	69.79	65.63	69.32	68.75	71.88	69.64	72.73	71.59	68.75	72.92	71.43	73.86	59.17	42.31
	df = 13, 169				F = 4.00			p < 0.0001						
Incid. High	55.21	64.58	69.32	53.75	57.29	63.69	61.36	62.50	58.33	58.33	60.71	56.82	53.33	39.42
	df = 13, 169				F = 2.10			p = 0.0168 < 0.05						
Incid. Low	36.11	36.11	38.38	40.00	40.74	45.24	36.36	44.44	46.30	41.67	38.89	47.47	34.07	29.06
	df = 13, 169				F = 1.92			p = 0.0317 < 0.05						
Intent. Total	59.31	60.29	65.24	60.00	57.84	61.76	59.89	59.36	59.31	60.29	61.76	64.17	49.80	33.94
	df = 13, 169				F = 6.81			p < 0.0001						
Incid. Total	45.10	49.51	52.94	46.47	48.53	53.78	48.13	52.94	51.96	49.51	49.16	51.87	43.14	33.94
	df = 13, 169				F = 2.62			p = 0.0026 <0.01						
Total High	52.45	59.80	65.24	52.94	50.98	58.82	54.55	55.08	54.41	53.43	56.72	56.15	47.06	32.58
	df = 13, 169				F = 5.26			p < 0.0001						
Total Low	51.96	50.00	52.94	53.53	55.39	56.72	53.48	57.22	56.86	56.37	54.20	59.89	45.88	35.29
	df = 13, 169				F = 4.53			p < 0.0001						
Total Recall	52.21	54.90	59.09	53.24	53.19	57.77	54.01	56.15	55.64	54.90	55.46	58.02	46.47	33.94
	df = 13, 169				F = 6.59			p < 0.0001						

TABLE 11: SUMMARY of SIGNIFICANT RESULTS: VAR. 1 INTENTIONAL MATERIAL - HIGH LEVEL QUESTIONS

	F - test p	Duncan post hoc p < 0.05	LS Means - Probability X1 = X2 p < 0.05
P	0.091	RQR > RRQ	RQR (54.81) > RRQ (49.54) p = 0.029
QxF	0.103	High is better massed - Low is better inserted	
PQF	0.146	High is better massed - Low is better inserted - for RRQ and RQR but not FREE	
ALL	0.0001 1 way	All treatments > NPCG (control) Only RQR-L-I, FREE-L-M, RQR-H-M, and RRQ-H-M > RTCG (control) RQR-L-I > RRQ-H-I, RRQ-L-I, RRQ-L-M, FR-H-M, and RQR-H-I	

TABLE 12: SUMMARY of SIGNIFICANT RESULTS: VAR. 2 INTENTIONAL MATERIAL - LOW LEVEL QUESTIONS

	F - test p	Duncan post hoc p < 0.05	LS Means - Probability X1 = X2 p < 0.05
ALL	0.0001 1 way	Only FR-L-M > RTCG All treatments > NPCG	

TABLE 13: SUMMARY OF SIGNIFICANT RESULTS: VAR. 3 INCIDENTAL MATERIAL - HIGH LEVEL QUESTIONS

	F - test p	Duncan post hoc p < 0.05	LS Means - Probability X1 = X2 p < 0.05
QxF	0.054	High is better massed - Low is better inserted	
ALL	0.0168 1 way	No treatments > RTCG All treatments > NPCG except RQR-L-M	

TABLE 14: SUMMARY of SIGNIFICANT RESULTS: VAR. 4 INCIDENTAL MATERIAL - LOW LEVEL QUESTIONS

	F - test p	Duncan post hoc p < 0.05	LS Means - Probability X1 = X2 p < 0.05
P	0.084	FREE > RQR	FREE (43.31) > RQR (37.53) p = 0.0290
ALL	0.0317 1 way	Only FR-L-M > RTCG Only FR-L-M, FR-H-I, RRQ-H-M, and RRQ-L-M > NPCG	

TABLE 15: SUMMARY of SIGNIFICANT RESULTS: VAR. 5 INTENTIONAL MATERIAL - TOTAL SCORE

	F - test p	Duncan post hoc p < 0.05	LS Means - Probability X1 = X2 p < 0.05
ALL	0.0001 1 way	All treatments > RTCG except RRQ-L-M, RQR-H-I, FR-H-I and RRQ-H-I All treatments > NPCG	

TABLE 16: SUMMARY of SIGNIFICANT RESULTS: VAR. 6 INCIDENTAL MATERIAL - TOTAL SCORE

	F - test p	Duncan post hoc p < 0.05	LS Means - Probability X1 = X2 p < 0.05
ALL	0.0026 1 way	No treatments > RTCG All treatments > NPCG	

TABLE 17: SUMMARY of SIGNIFICANT RESULTS: VAR. 7 HIGH LEVEL ITEMS TOTAL SCORE

	F - test p	Duncan post hoc p < 0.05	LS Means - Probability X1 = X2 p < 0.05
QxF	0.022	High is better massed - low is better inserted	
PQF	0.104 3x2x2	High is better massed - Low is better inserted - for RRQ and RQR but not FREE	
ALL	0.0001 1 way	All treatments > NPCG Only RQR-L-I, RQR-L-M, RRQ-H-M, > RTCG RQR-L-I > RRQ-H-I, RQR-H-I, RQR-L-M AND FR-H-M	

TABLE 18: SUMMARY of SIGNIFICANT RESULTS: VAR. 8 LOW LEVEL ITEMS TOTAL SCORE

	F - test p	Duncan post hoc p < 0.05	LS Means - Probability X1 = X2 p < 0.05
P	0.072	FREE > RQR	FREE (56.66) > RQR (52.03) p = 0.0273
ALL	0.0001 1 way	Only FR-L-M, RRQ-L-M, FR-H-I, RRQ-H-M, and FR-H-M > RTCG All treatments > NPCG	

TABLE 19: SUMMARY of SIGNIFICANT RESULTS: VAR. 9 TOTAL SCORE ALL ITEMS

	F - test p	Duncan post hoc p < 0.05	LS Means - Probability X1 = X2 p < 0.05
ALL	0.0001 1 way	Only RQR-L-I, FR-L-M, RRQ-H-M, RRQ-L-M, FR-H-I, FR-L-I, RQR-H-M > RTCG	
		All treatments > NPCG	

Discussion

Weaknesses in the Study

The main weakness in the study is that it lacks power due to too great a within-group variance. The cooperating principal, due to a misunderstanding, provided a very diverse sample which included the full range of poor grade 10 through very good grade 12. The complete grade 12 would have provided a sample with enough variance to establish generallzability, there was no need to sample across the three grade levels. To identify possible differences, and to lower the chance of making a Type II error, the alpha level was set at ten percent - $p = 0.10$.

Contributing to this weakness is the fact that the Duncan significance level was not altered from $p = 0.05$ (due to ignorance of this researcher) and thus differences at the $p < 0.10$ level were identified when the Duncan was used. This may explain why very few significant differences between the treatment groups and the READ-TWICE control group were found even when the differences between the means was over ten percentage points.

The second weakness lay with the statistical analysis which was a 3x2x2 analysis of variance for each of nine dependent variables. The four main dependent variables, the four subscales of the post-test, were treated as if they were completely independent when they could be considered as being related factorially, as a 2x2 relationship, with level of post-test item and whether the item was related to intentional or incidental material being the two main dependent variables. For this reason, and because nine dependent variables were derived from the four subscales, multivariate analysis of variance (MANOVA), and the Wilkes Lambda test, should have been employed. Again, the reason for this oversight was ignorance on the part of this researcher. Borg and Gall (1983, p.557) indicate that the significance of differences may be increased when interrelationships are taken into account with MANOVA.

Further, in an attempt to study three independent variables using a factorial design, this researcher caused increased divergence in the main effects groups. In any replication this researcher will concentrate on only two of the independent variables - presentation sequence and level of adjunct question.

Because the weaknesses in the study lowered its power, any differences that are found may be considered more credible.

Presentation Sequence and High Level Intentional Material

It was hypothesized that, for high level intentional learning, the FREE groups and the RQR groups would perform better than the RRQ groups. The rationale, after Andre and Sola (1976) and Friedman and Rickards (1981), was that when a reader first reads the passage it is encoded at a shallow level. Thus, the high level inserted post question is too difficult for the reader to answer and the desired higher level semantic processing does not occur.

Reading the passage twice, as in the RRQ case, should raise the level of the initial encoding and make answering the higher level post question a little easier by improving the backward processing. However, Andre and Sola (1976) argue that re-reading the passage, after an initial attempt to encode it while attempting the question, is a better solution to the higher level encoding problem. The post question should enhance the forward processing of the passage during the second reading. Thus the RQR procedure should lead to better semantic encoding than RRQ, and is preferable to a prequestion because the learning of incidental material should still occur.

The FREE group was advised to read the passage, read the question, re-read the passage and answer the question. It was expected that this procedure, if followed, should be as effective as the RQR sequence because both backward and forward processing should be facilitated.

As expected, the RQR groups did perform significantly better than the RRQ groups on high level intentional material. Because of the weaknesses in the study, the profound differences found by Andre and Sola were not replicated but the difference was significant. The Andre and Sola study was done with unconnected sentences while this study was done with connected discourse which generalizes better to real life and distance education.

The expected difference between the FREE groups and the RRQ groups was not found. However, the FREE groups did not perform significantly worse than the RQR groups so the assumption that the FREE procedure is as effective as the RQR procedure is supported for high level intentional material. The present procedures used by those distance educators and developers of self-instructional materials, who employ questions to help their learners process difficult prose material, can be continued with confidence. In fact, it is recommended that all distance educators, developers of self-study courses and lecturers who suggest readings add these procedures to their repertoires when their students are required to learn from connected discourse in texts and other prose materials.

Presentation Sequence and Low Level Intentional Material

Although the RQR sequence was developed to help readers semantically encode higher level intentional material, it was expected that the RQR and FREE groups would recall more lower level material than the RRQ groups due to the specific forward processing induced by the inserted question. This was expected because those asked low order questions would focus on the intentional learning during the second reading while those asked higher level questions would encode low order material while functioning at a higher level.

The prediction that RQR and FREE groups would recall more low level intentional material than RRQ groups was not supported. Friedman and Rickards (1981) found that their read-twice control groups were much superior to their read-once control groups, and this leads one to the conclusion that the RRQ groups may have done as well as the RQR and FREE groups because they read the material twice and encoded it at a level higher than the read-once groups. The RRQ sequence leads to specific backward processing of reasonably well encoded low level material and recall is facilitated.

Presentation Sequence and High Level Incidental Material

It was hypothesized that the RRQ groups would perform better on high level incidental items than the FREE and RQR groups. This was because the question caused specific backward processing of intentional material only after the reader had read the passage twice and had processed incidental material. This double reading should lead to better performance on high level incidental material whether the adjunct question was high or low level. Also the question causes the RRQ reader to approach the next double reading with general forward processing. They do not know what the question will be so they process all of the material carefully looking for patterns and information which may help them answer the unknown question.

The RQR groups may not bother to attempt backward processing when they see the question after reading the passage once because they know that they are going to read the passage a second time. They are, therefore, less likely to recall incidental material or perform well on higher level items related to incidental material. Also, having read the question, they approach the second reading with specific rather than general forward processing and may again ignore incidental material.

The FREE groups, although they are given directions to read the passage, read the question, re-read the passage and answer the question, may actually merely read the question and hunt for the answer. Thus the FREE groups were expected to recall less incidental material and to perform worse on high level items related to incidental material than both the RRQ and RQR groups.

For high level incidental material, the expected RRQ > RQR > FREE order was achieved. However, the differences were not significant (only 4% difference between RRQ and FREE with RQR in between) and the expected order probably occurred by chance. That the expected difference between the RRQ and RQR groups did not arise, is difficult to explain. Perhaps the material was not difficult enough, or perhaps the connectedness of the discourse provided semantic cues which enabled the RQR (and FREE) groups to respond appropriately to the higher level incidental items.

In terms of the theoretical position stated above, that the expected difference between the RRQ and FREE groups did not arise is even more difficult to explain. Perhaps the connectedness of the discourse helped as suggested above. Perhaps the FREE groups followed their instructions exactly, read the passage carefully once, used backward processing to answer the question, and used forward processing during the second reading. It is also possible that, in their attempts to answer the difficult inference and implication adjunct questions, the FREE groups had to read and re-read the material (possibly more than twice) in an attempt to encode the complete passage of connected discourse rather than concentrate on only the questioned material.

Whatever the reason for the FREE group performing as well on high order incidental questions as the RRQ and RQR groups, distance educators, developers of self-instructional materials, and faculty who provide study guides for their required texts can breath a little easier. They have evidence that, as long as they ask high level questions, allowing their students the freedom to lookback at the passages while answering the questions will not lead to the "death of learning effects" suggested by Shavelson (1974b), Duchastel (1983) and Duchastel and Nungester (1984).

Presentation Sequence and Low Level Incidental Material

For low level incidental material the expected RRQ > RQR > FREE order was not found. The order found was FREE > RRQ > RQR with only the FREE > RQR being significant. That the FREE group recalled the most low level incidental material was completely unexpected and is all the more surprising due to low power of this study.

Rothkopf (1965), in developing the adjunct question paradigm, argued that it is the incidental learning that is more educationally significant and, on the assumption that allowing readers the freedom to read as they wish would lead to only intentional material being learned, did not allow such free reading. More recently, Shavelson (1974b) argued that allowing the reader to look back at material while answering adjunct questions may lead to a mathemathantic (death of learning) effect.

This study does not support this well entrenched view. Giving the reader the freedom to look back at the passage while answering the low level and high level adjunct questions appears to lead to better recall of low level incidental material not poorer recall. Perhaps this is because, in their attempts to answer the questions, the readers in the FREE group, given the freedom to proceed as they wish, may actually read and re-read the passage many times to ensure they are answering correctly.

It is also possible that the fact that a single line was drawn under each question, and that the readers may have felt they were expected to write a concise answer on that line, caused improved processing of the passage. A further possibility is that the adjunct question paradigm was developed during the period when the research involved verbatim questions about unconnected sentences, and that it is no longer appropriate during the present emphasis on higher, or semantic, processing of connected discourse.

The most obvious conclusion from this finding is that adjunct question researchers need no longer worry about functioning within such an artificial setting. If the results of this finding about presentation sequence are generalizable, distance educators, developers of self-study courses, and those instructors who provide their learners with texts and readings containing continuous prose,can use questions to help their learners to process the prose more appropriately and to facilitate better learning of both intentional and incidental material. It is also possible that instructors, who have been using questions to help their students learn, need no longer worry that their practice causes a mathemathantic effect.

In summary, the FREE groups, or distance education and self-instruction model groups, learn as much high level intentional and incidental material as the RQR and RRQ adjunct question paradigm groups. Also, the FREE groups learn as much low level intentional and incidental material as the RRG groups and more than the RQR groups. This leads this researcher to suggest that the adjunct question researchers need no longer restrict their procedures to the traditional adjunct question paradigm. They can adopt the self-instruction or distance education model and allow the subjects the freedom to proceed as they wish, which includes being able to lookback at the passage while answering an adjunct question.

It is also possible that the findings of adjunct question research to date are generalizable to at least distance education, and probably to any real life setting where learning from prose is expected. This possibility can only be tested if adjunct question research is conducted in more ecologically valid settings, and the paradigm altered so that more ecologically sound procedures are followed.

Level of the Adjunct Questions

On high level posttest items, readers provided with high level adjunct questions were expected to perform better than those readers provided with low level adjunct questions. This prediction was based on the results of studies by Watts and Anderson (1971) and Friedman and Rickards (1981) which indicate that there is a continuum of processing of prose from shallow to deep and that the depth of processing of the reader can be manipulated by a parallel continuum from verbatim questions through paraphrase and inferential questions to higher level questions such as inference and implication questions. However, this hypothesis was not supported by this study. Readers given low level adjunct questions performed as well on high level posttest items as readers provided high level adjunct questions.

One possible reason for the lack of difference in this study is the different definition of low-level questions. Because a high level question was defined as an implication or inference question in this study, any question requiring recall, whether verbatim or paraphrase or combination of paraphrase and verbatim, was defined as low level. This definition is different from that used in typical adjunct question research in that only verbatim questions are defined as low level and paraphrase questions are defined as high level.

Perhaps many of the low level adjunct questions in this study required more than verbatim processing and this was enough to cause the deeper semantic processing required to find the implications and make the inferences. Friedman and Rickards (1981), for example, found that, while both paraphrase and inference adjunct questions facilitated deeper processing than verbatim questions, paraphrase and inference questions led to approximately equivalent depth of processing.

Because distance learners studying for degrees, and those using self-study courses, are typically required to process prose materials at a level higher than verbatim recall, the definition of high level questions as inference and implication (rather than merely paraphrase), and low level adjunct questions as both paraphrase and verbatim (rather than merely verbatim) is most appropriate. Depending on the educational level of the subjects in an adjunct question study, the subjects typical level of functioning will differ. Thus, the definitions of high and low level questions should differ with the educational level of the subjects to be appropriate. A follow up study of subjects in higher educational institutions should also include analysis, synthesis and evaluation adjunct questions.

Another possible reason for the lack of significant difference in performance on high level posttest items between the high and low level adjunct question groups is the connectedness of the discourse. The Watts and Anderson (1971) study, for example, investigated the effect of verbatim and paraphrase questions with passages made up of independent sentences. The Friedman and Rickards (1981) study investigated the effect of verbatim, paraphrase and inference questions on connected discourse about an imaginary country. This investigator, in an attempt to approximate real life instructional content, chose connected discourse about a real life problem, the likelihood of a future energy crisis. Even though the content was unfamiliar to the subjects (most were surprised because they had assumed the opposite was true because of the present energy glut) the realness of the content may have caused deeper processing in those asked low level adjunct questions.

A further possibility is that the high level adjunct questions were too difficult, especially for the grade 10 students scattered among the groups, and thus the processing was no deeper than that undertaken by those provided with low level questions. However, means of between 50% and 60% on the high level posttest questions may belie this point.

For low level posttest items it was predicted that the high level adjunct question groups would recall as much low level material as those provided with low level questions. It was hypothesized that those asked high level adjunct questions would actively process the complete passage, including the low level material, in their attempt to adequately answer the high level adjunct questions. This prediction was supported by this study. The high level groups recalled as much of the low level material as did the low level groups. It is difficult to determine, however, whether the lack of difference was due to the above proposition or to the connectedness of the discourse.

The Frequency of Question - Inserted versus Massed

Andre and Sola (1976) and Andre and Womack (1978) suggest that the amount of material between the target text and the related adjunct question determines whether or not the adjunct question can be answered effectively so that the appropriate processing occurs. Thus it was predicted that adjunct questions inserted in the text would facilitate better recall and performance than adjunct questions massed in one place. The answer to this question has been sought for some time by distance educators, faculty developing self-instructional courses and textbook writers. While the majority of distance educators and developers of self-study courses mass questions at the end of text, as do textbook authors, some have been arguing that inserted questions are more effective.

The results of this study are interesting. The main effect analysis indicates that the experimental hypothesis is not supported. There were no significant differences between the massed questions groups and the inserted questions groups for any of the nine dependent variables. This result is supported by the reviews of research to date, in that some studies indicated that inserted questions are preferred while others indicate that massed questions are more effective.

There was an interaction effect that was interesting in that it seemed contrary to logic and previous research. Some of the previous studies found that as the amount of text between questions increases, the degree of both intentional and incidental learning increases for pre-question groups but decreases for post-question groups. Others found no interaction. Rickards and DiVesta (1974) found no interaction for verbatim level adjunct questions but that higher level adjunct questions were more effecti when inserted.

This investigation found significant interactions for the three high level dependent variables and no interactions for the three low level dependent variables. Contrary to Rickards and DiVesta, high level adjunct questions were found to facilitate better high level performance when massed while low level adjunct questions facilitated better high level performance when inserted.

This unexpected outcome may in part be explained by the fact that the passages were part of connected discourse with several themes running through the complete text of seventeen passages. Those who waited until they had read all 17 passages before attempting to answer high level implication and inference adjunct questions may have been advantaged by this connectedness of the discourse.

Another interesting aspect of this interaction is that it occurs only in the IRQ and RQR groups. The FREE groups do not show an interaction. When one remembers that the FREE groups were advised to follow the same procedures (read the passage, read the question, re-read the passage, answer the question) whether their questions are inserted or massed, then the lack of interaction is explained.

Comparisons with the Control Groups

The most important result here is that for all incidental dependent variables, most treatment groups did not score significantly higher (at the 0.05 significance level) than the READ-TWICE control group. If this result reflects reality then there is one possible conclusion. Adjunct questions do not facilitate the learning of incidental material any better than does reading the passage twice, and distance educators and instructional designers can cause better recall of incidental material simply by persuading the reader to read the passage twice.

However, because of the problems with the power of the study, significant differences were not found even when treatment group means were over ten percentage points higher than the control group. If the within group variance had been reduced by the choice of a less heterogeneous sample, or if the Duncan test's level of significance had been changed from 0.05 to 0.10 to conform to the rest of the analysis, then the lack of difference between the READ-TWICE control group and treatment groups for incidental material may not have occurred.

Summary and Conclusions

The most important result of this study is that the FREE groups (which represented real-life, ecologically sound procedures) did not perform significantly worse than the RRQ and RQR groups (which represented the adjunct question paradigm) on any of the dependent variables. While this was expected for intentional material, it was unexpected for the incidental material because the forward processing induced after reading the question was supposed to be too specific for incidental material to be recalled. In fact, the only significant result featuring the FREE group was in its favor - the FREE group recalled significantly more incidental low order material than did the RQR group, and the group mean was greater, although not significantly so, than the RRQ group.

Thus, this study does not support the well entrenched view that lookbacks cause mathemathantic (death of learning) effects. It is interesting to note that, while this view was well known and well adhered to, there were no previous studies which compared adjunct question paradigm groups with realistic setting groups. This study has shown that adjunct question researchers may not need to persist with their ecologically invalid methodology. Further, educators who provide their learners with questions in the hope that they will facilitate learning can continue the practice without undue concern for the views of Shavelson (1974b), Duchastel (1983) and Duchastel and Nungester (1984) that they are doing something terribly wrong.

REFERENCES

Anderson, L.W. (1976) "An Empirical Investigation of Individual Differences in Time to Learn". Journal of Educational Psychology, 68, 226-23.

Anderson, L.W. (1984) Time and School Learning: Theory, Research, and Practice: New York: Saint Martins Press.

Anderson, T.H., Anderson, R.C.. Dalgaard, B., Paden, D., Biddle, W.. Surber, J., and Alessi, S. (1975) "An Experimental Evaluation of a Computer-Based Study Management System." Educational Psychologist, 11, 184-190.

Anderson, R.C. and Biddle, W.B. (1975) "On Asking People Questions About What They Are Reading." In G. Bower (Ed.), Psychology of Learning and Motivation (Vol. 9). New York: Academic Press.

Andre, T. (1979) "Does Answering Higher-level Questions while Reading Facilitate Productive Learning?" Review of Educational Research, 49, 280-318.

Andre, T., and Sola, J. (1976) "Imagery, Verbatim and Paraphrased Questions and Retention of Meaningful Sentences." Journal of Educational Psychology, 68, 661-669.

Andre, T., Mueller, C., Womack, S., Smid, K., and Tuttle, M. (1980) "Adjunct Application Questions Facilitate Later Application, or Do They?" Journal of Educational Psychology, 72, 533-543.

Andre, T., and Womack, S. (1978) "Verbatim and Paraphrased Adjunct Questions and Learning from Prose." Journal of Educational Psychology, 70, 796-802.

Atkinson, R.C. (1968) "Computer-based Instruction in Initial Reading". In Proceedings of the 1967 Invitational Conference on Testing Problems, Princeton: Educational Testing Service.

Baath, J.A. (1979) Correspondence Education in the Light of a Number of Contemporary Teaching Models. Malmo: Liber Hermods.

Benton, S.L. et al (1983) "Decision Difficulty and Recall of Prose". Journal of Educational Psychology, 75(5), 727-742.

Bloom, B.S. (1974) "Time and Learning" American Psychology, 29, 682-688.

Bloom, B.S. (1976) Human Characteristics and School Learning New York: McGraw Hill.

Bloom, B.S. (1978) "New Views of the Learner: Implications for Instruction and Curriculum" Educational Leadership, 35 April.

Bloom, B.S. (1984) "The Search for Methods of Whole Group Instruction as Effective as One-to-One Tutoring" Ec :ational Leadership, 8, 4-18.

Boker, J.R. (1972) "Immediate and Delayed Retention Effects of Interspersing Questions in Written Instructional Passages." Journal of Educational Psychology, 64, 31-38.

Bransford, J.D., Franks, J.J., Morris, C.D. and Stein, B.S. (1979) "Some General Constraints on Learning and Memory Research." In L.S. Cermak and F.I.M. Craik (Eds) Levels of Processing in Human Memory. Hillsdale: Erlbaum.

Bull, S.G. (1973) "The Role of Questions in Maintaining Attention to Textual Material". Review of Educational Research, 43(1), 83-87.

Carrier, C.A., and Fautsch-Patridge, T. (1981) "Levels of Questions: A Framework for the Explanation of Processing Activities." Contemporary Educational Psychology, 6, 365-382.

Carver, R.A. (1972) "Critical Review of Mathemagenic Behaviors and the Effect of Questions Upon the Retention of Prose Material." Journal of Reading Behavior, 4, 93-119.

Craik, F.I.M. (1979) "Levels of Processing: Overview and Closing Comments." In L.S. Cermak and F.I.M. Craik (Eds) Levels of Processing in Human Memory. Hillsdale: Erlbaum.

Craik, F.I. M., and Lockhart, R.S. (1972) "Levels of Processing: A Framework for Memory Research." Journal of Verbal Learning and Verbal Behavior, 11, 671-684.

Craik, F.I.M., and Tulving, E. (1975) "Depth of Processing and the Retention of Words in Episodic Memory." Journal of Experimental Psychology: General, 104(3), 268-294.

Duchastel, P. (1983) "Interpreting Adjunct Question Research: Processes and Ecological Validity." Human Learning, 2, 1-5.

Duchastel, P.C. and Nungester, R.J. (1984) "Adjunct Questions Effects with Review." Contemporary Educational Psychology, 9(2), 97-103.

Duchastel, P. (1983b) "Toward the Ideal Study Guide: An Exploration of the Functions and Components of Study Guides". British Journal of Educational Technology, Oct, 14(3), 216-231.

Edminston, R.W. and Rhoades, B.J. (1959) "Predicting Achievement". Journal of Educational Research, 52, 177-180.

Ellis, J., Wulfeck, W., and Montague, W. (1980) "The Effects of Adjunct and Test Question's Similarity on Study Behavior and Learning in a Training Course." American Educational Research Journal, 17, 449-458.

Faw, H.W., and Waller, T.G. (1976) "Mathemagenic Behaviors and Efficiency in Learning from Prose Materials: Review, Critique and Recommendations." Review of Educational Research, 46, 691-720.

Felker, D.B., and Dapra, R.A. (1975) "Effects of Question Type and Question Placement on Problem-Solving Ability from Prose Material." Journal of Educational Psychology, 67, 380-384.

Fisher, R.P., and Craik, F.I.M. (1977) "Interaction Between Encoding and Retrieval Operations in Cued Recall." Journal of Experimental Psychology: Human Learning and Memory, 3 (6), 701-711.

Frase, L.T. (1967) "Learning from Prose Material: Length of Passage, Knowledge of Results, and Position of Questions." Journal of Educational Psychology, 58, 266-272.

Frase, L.T. (1969) "Structural Analysis of the Knowledge that Results from Thinking About Text." Journal of Educational Psychology, 60 (Monogr, Suppl. 6, Pt. 2).

Friedman, F., and Rickards, J.P. (1981) "Effect of Level, Review, and Sequence of Inserted Questions on Text Processing." Journal of Educational Psychology, 73, 427-436.

Gagne, E.D., Brounghton, S., Eggleston, P., Holmes, S., Hawkins, P., and Sheldon, K. (1979) "Type of Postquestion and Accuracy of Concept Classification in Learning from Text." Journal of Experimental Education, 46, 302-306.

Gagne, R.M. (1985) The Conditions of Learning" 4th Ed. N.Y.: Holt. Rinehart & Winston.

Gagne, R.M. & Briggs, L.J. (1979) Principles of Instructional Design. N.Y.: Holt, Rinehart and Winston.

Glaser, R. (1968) "Adapting the Elementary School Curriculum to Individual Performance". In Proceedings of the 1967 Invitational Conference on Testing Problems. Princeton: Educational Testing Service.

Gropper, G.L. (1983) "A Behavioral Approach to Instructional Prescription." In C.M. Reigeluth (Ed.) Instructional Design Theories and Models: An Overview of their Current Status. Hillsdale: Erlbaum, 1983.

Gustason, H.W. and Dock, D.L. (1970) "Effects of Adjunct Questions, Pre-testing, and Degree of Student Supervision on Learning from an Instructional Text". Journal of Experimental Education, 39(1), 53-58.

Hamaker, C. (1986) "The Effects of Adjunct Questions on Prose Learning." Review of Educational Research, 56(2), 212-242.

Hamilton, R.J. (1985) "A Framework for the Evaluation of the Effectiveness of Adjunct Questions and Objectives". Review of Educational Research, 55(1), 47-85.

Hamilton, R.J. (1985) "Role of Adjunct Questions and Subject Ability Levels On the Learning of Concepts from Prose." American Educational Research Journal, 23(1), 87-94.

Hiller, J.H. (1974) "Learning from Prose Text: Effects of Readability Level, Inserted Questions Difficulty and Individual Differences." Journal of Educational Psychology, 66, 202-211.

Holmberg, B. (1979) Distance Education Research: An Overview. ERIC Clearinghouse for Information Resources.

Holmberg, B. (1981) Status and Trends of Distance Education. London: Kogan Page.

Holmberg, B. (1982) Distance Education: A Short Handbook. Stockholm: LiberHermonds.

Holmberg, B. (1985) "Theoretical Underpinnings of Mediated Teaching as Self-contained Instruction: A Suggested Theory." Programmed Learning and Educational Technology. 22(1), 16-25.

Hudgins, B.B., Dorman, J., and Harris, M. (1979) "Some Effects of Adjunct Questions on Intermediate Grade Children with Differing Reading Comprehension Abilities." Journal of Educational Research, 72, 259-265.

Jenkins, J.J. (1978) "Four Points to Remember: A Tetrahedral Model of Memory Experiments." In L.S. Cermak and F.I.M. Craik (Eds.) Levels of Processing and Human Memory. Hillsdale, N.J.: Lawrence Erlbaum Associates.

Keller, J.M. (1979) "Motivation and Instructional Design: A Theoretical Perspective". Journal of Instructional Development, 2(4), 26-34.

Keller, J.M. (1983) "Motivational Design of Instruction." In C.M. Reigeluth (ed) Instructional-Design Theories and Models: An Overview of their Current Status. Hillsdale: Erlbaum.

Krauskopf, C.J. (1963) "Use of Written Responses in the Stimulated Recall Method". Journal of Educational Psychology, 54, 172-176.

Landa, L.N. (1983) "The Algo-Heuristic Theory of Instruction." In C.M. Reigeluth (Ed.) Instructional Design Theories and Models: An Overview of their Current Status. Hillsdale: Erlbaum, 1983.

Lee, H. (1980) "The Effects of Review Questions and Review Passages on Transfer Skills." Journal of Educational Research, 73, 330-336.

Lysadowski, R.S. and Walberg, H.J. (1982) "Instructional Effects of Cues, Participation and Corrective Feedback: A Quantitative Synthesis". AERJ, 19, 559-578.

Mayer, R.E. (1975) "Forward Transfer of Different Reading Strategies Evoked by Test-like Events in Mathematics Text." Journal of Educational Psychology, 67, 165-169.

McGraw, B., and Grotelueschen, A. "(1972) Direction of the Effect of Questions in Prose Material." Journal of Educational Psychology, 63, 580-588.

Merrill, M.D. (1983) "Component Display Theory." In C.M. Reigeluth (Ed.) Instructional Design Theories and Models: An Overview of their Current Status. Hillsdale: Erlbaum.

Moeser, S.D. (1983) "Levels of Processing: Qualitative Differences or Task-demand Differences?" Memory and Cognition, 11(3), 316-323.

Morris, C.D., Bransford, J.D. and Franks, J.J. (1977) "Levels of Processing Versus Transfer Appropriate Processing. "Journal of Verbal Learning and Verbal Behavior, 16, 519-533.

Morsh, J.E., (1956) Systematice Observations of Instructor Behaviour. San Antonio: USAF.

Olson, W.C. (1931) "A Study of Classroom Behaviour". Journal of Educational Psychology, 22, 449-454.

Peeck, J. (1970). "Effects of Prequestions on Delayed Retention of Prose Material." Journal of Educational Psychology, 61, 241-246.

Perraton, H. (1981) "A Theory of Distance Education ." Prospects. IX, 1, 13-24.

Raphael, T.E., and Person, P.D. (1985) "Incresing Students' Awareness of Sources of Information For Answering Questions," American Educational Research Journal, 22(2), 217-235.

Reigeluth, C.M. (1979) "In Search of a Better Way to Organise Instruction: The Elaboration Theory". Journal of Instructional Development, 2(3). 8-15.

Reigeluth, C.M. (1983) Instructional-Design Theories and Models: An Overview of their Current Status. Hillsdale: Erlbaum.

Reigeluth, C.M. (1983) "The Elaboration Theory of Instruction." In C.M. Reigeluth (Ed.) Instructional Design Theories and Models: An Overview of their Current Status. Hillsdale: Erlbaum, 1983.

Reynolds, R.C., Standiford, S.N., and Anderson, R.C. (1979) "Distribution of Reading Time when Questions are Asked About a Restricted Category of Text Information." Journal of Educational Psychology, 71, 183-190.

Reynolds, R.E., and Anderson, R.C. (1982) "Influence of Questions on the Allocation of Attention During Reading." Journal of Educational Psychology, 74, 623-633.

Rickards, J.P. (1976) "Interaction of Position and Conceptual Level of Adjunct Questions on Immediate and Delayed Retention of Text." Journal of Educational Psychology, 68, 210-217.

Rickards, J. P. (1976b). "Type of Verbatim Question Interspersed in Text: A New Look at the Position Effect." Journal of Reading Behaviour, 8, 37-45.

Rickards, J.P. (1979) "Adjunct Postquestions in Text: A critical Review of Methods and Processes." Review of Educational Research, 49, 181-196.

Rickards, J.P., Anderson, M.C., and McCormick, C.G. (1976) "Processing Effects of Common-word and Number Questions Inserted in Reading Material." Journal of Educational Research, 69, 274-277.

Rickards, J.P. and Denner, P.R. (1978). Inserted Questions as Aids to Reading Text." Instructional Science, 7, 313-346.

Rickards, J.P. and Denner, P.R. (1979) "Depressive Effects of Underlining and Adjunct Questions on Children's Recall of Text." Instructional Science, 8, 81-90.

Rickards, J.P., and DiVesta, F.J. (1974) "Type and Frequency of Questions in Processing Textual Material." Journal of Educational Psychology, 66, 354-362.

Rickards, J.P., and Hatcher, C.W. (1978) "Interspersed Meaningful Learning Questions as Semantic Cues for Poor Comprehenders." Reading Research Quarterly, 538-553.

Rothkopf, E.Z. (1965) "Some Theoretical and Experimental Approaches to Problems in Written Instruction." In J.D. Krumboltz (Ed.), Journal and the Educational Process, Chicago: Rand McNally.

Rothkopf, E.Z. (1974) "Barbarism and Mathemagenic Activities: Comments on Criticism by Carver." Journal of Reading Behavior, 6, 3-8.

Rothkopf, E.Z. (1972) "Variable Adjunct Question Schedules, Interpersonal Interaction and Incidental learning from Written Materials." Journal of Educational Psychology, 63, 87-92.

Rothkopf, E.Z. (1976) "Writing to Teach and Reading to Learn: A Perspective on the Psychology of Written Instruction." In N.L. Gage (Ed) The Psychology of Teaching Methods Chicago: The University of Chicago Press, 91-129.

Rothkopf, E.Z., and Billington, M.J. (1974). "Indirect Priming and Review through Questions." Journal of Educational Psychology, 66, 669-680.

Rothkopf, E.Z., and Bisbicos, E.E. (1967) "Selective Facilitative Effects of Interspersed Questions on Learning from Written Material." Journal of Educational Psychology, 58, 56-61.

Rothkopf, E. and Kaplan, R. (1972) "Exploration of the Effect of Density and Specificity of Instructional Objectives on Learning from Text". Journal of Educational Psychology, 63(4), 295-302.

Sagaria, S.D., and DiVesta, F.J. (1978) "Learner Expectations Induced by Adjunct Questions and the Retrieval of Intentional and Incidental Information." Journal of Educational Psychology, 70, 280-288.

Scandura, J.M. (1983) "Instructional Strategies Based on the Structural Learning Theory." In C.M. Reigeluth (Ed.) Instructional Design Theories and Models: An Overview of their Current Status. Hillsdale: Erlbaum.

Sefkow, S.B., and Myers, J.L. (1980) "Review Effects of Inserted Questions on Learning from Prose." American Educational Research Journal, 17, 435-447.

Shavelson, R.J., Berliner, D.C., Ravitch, M., and Loeding, D. (1974) "Effects of Position and Type of Question and Learning from Prose Material: Interaction of Treatments with Individual Differences." Journal of Educational Psychology, 66, 40-48.

Shavelson, R.J., Berliner, D.C., Loeding, D., Porteous, A., and Stanton, G. (1974b) "Adjunct questions, mathemagenics and mathemathantics." A paper presented at the APA conference.

Siegel, L. (1963) "Students' Thoughts During Class: A Criterion of Educational Research". Journal of Educational Psychology, 54, 45-61.

Sjogren, D.D. (1967) "Achievement as a Function of Study Time". American Education Research Journal, 1967, 4, 337-343.

Stein, B.S., Morris, C.D., and Bransford, J.D. (1978) "Constraints on Effective Elaboration." Journal of Verbal Learning and Verbal Behavior, 17, 707-714.

van Hout-Walters, B. (1980) Improving Learning from Texts: An Analysis of Research Articles. Unpublished manuscript, University of Nijmegen, The Netherlands.

Walberg, H.J. (1984) "Synthesis of Research on Teaching", in M.C. Wittrock (Ed.), Handbook of Research on Teaching: Washington, D.C. AERA.

Watts, G., and Anderson, R.C. (1971) "Effects of Three Types of Inserted Questions on Learning from Prose." Journal of Educational Psychology, 62, 387-394.

Wilson, M.A. (1979) "The Processing Strategies of Average and Below Average Readers Answering Factual and Inferential Questions on Three Equivalent Passages." Journal of Reading Behaviors, 11, 235-247.