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The effects of variations in the uncertainty of prequestions and information feedback on the short and long term retention of prose materials.

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THE EFFECTS OF VARIATIONS IN THE UNCERTAINTY OF PREQUESTIONS AND INFORMATION FEEDBACK ON THE SHORT AND LONG TERM RETENTION OF PROSE MATERIALS

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ABSTRACT

THE EFFECTS OF VARIATIONS IN THE UNCERTAINTY
OF PREQUESTIONS AND INFORMATION FEEDBACK
ON THE SHORT AND LONG TERM RETENTION
OF PROSE MATERIALS

(December 1975)

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This study attempted to replicate the results of Frase (1967, 1968 a, d) and Morasky (1969) with regard to the findings that (a) postquestions lead to greater relevant and incidental factual prose learning than prequestions, and (b) postquestions lead to better long term retention than prequestions, respectively. The study also manipulated the uncertainty of prequestions and information feedback in an attempt to obtain support for an explanation of the factual question-position prose learning effect proposed by Patrick (1967).

It was hypothesized (Patrick, 1967) that the superior prose learning of postquestion groups was attributable to (1) a state of heightened uncertainty at the time of information input, (2) the occurrence of original (unbiased by prequestions) responding to text content, and (3) post acquisition retrieval of information recently stored in memory. It was also hypothesized that the reduced learning of prequestion groups was probably due to the fact that students interpret the prequestion situation as a task of relative ease and engage in perfunctory types of information processing responses. The above theorizing led to the

speculation that the factual prose learning of prequestion groups could be improved if the factors of uncertainty, original responding, and post acquisition review were incorporated into a prequestion situation.

Overall, 144 treatment and 72 replication control subjects (pre-, post-, and no question control groups), from three colleges in Massachusetts, participated in the study. All of the subjects were asked to read 18 paragraphs of factual text regarding the life of William James. The treatment group subjects saw a prequestion before each paragraph. The uncertainty of the prequestions was varied between-subjects by presenting questions either with (certain) or without (uncertain) question stems, and with varying numbers of multiple-choice response alternatives (one, two or four). After acquisition, subjects were given either a delayed test, or both an immediate and a delayed test. Several within-subjects factors were varied in order to manipulate post acquisition review, and to test an ancillary hypothesis regarding the effects of delayed knowledge of results (DKR) in an ongoing prose learning situation. Immediate, delayed or no KR was presented after each paragraph or each set of six paragraphs, respectively. KR was accompanied by the question stem (certain KR) or not accompanied by the question stem (uncertain KR). Several hypotheses, regarding expected main effects and interactions between the between- and within-subjects variables, were proposed in the study. These hypotheses were based on the presumed effects of pre- and postquestions outlined in the preceding section. In brief, it was generally expected that both relevant and incidental learning would increase as the degree of prequestion and

KR uncertainty increased.

The major expectations of the study were not realized. The results of Frase (1967, 1968a, d) and Morasky (1969) were not replicated. No support was found for the hypothesis that pre- and post-question groups would benefit to different degrees from an immediate posttest due to different degrees of original learning. The hypothesis that uncertain (incomplete) prequestions would lead to deeper text processing and better long term retention than certain (complete) prequestions, was also not supported. In fact, learning tended to decrease as prequestion uncertainty increased. Weak support was found for the hypotheses that delayed and incomplete KR would facilitate learning and retention. The discussion outlined a rationale to account for the generally debilitating effects of uncertain prequestions and also cited the need to control for the range of inter-study reactivity exhibited by subjects in prose learning studies. Two major conclusions were reached. Incomplete prequestions do not elicit the same type of relevant uncertainty as postquestions. And, the factual prose learning question-position effect appears to be of limited utility in applied educational situations.

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BACKGROUND AND PURPOSE

In overall perspective this study shares a frame of reference in common with a number of recent studies that have investigated the effects adjunct questions have on the responses students make to prose instructional materials (Rothkopf, 1966; Frase 1967, 1968a, d; Bruning 1968; Watts and Anderson, 1971; McGaw 1972; Boyd 1973; and LaPorte and Voss, 1975). In 1965, Rothkopf outlined a theoretical and an experimental approach to the problem of doing research in the area of written instruction. The area of research has since become known to some as the study of mathemagenic behaviors. Others who are less convinced of the need for the term mathemagenics, refer to this research as the study of learning from prose. Although interpreted by some as referring solely to inspection activities, the term mathemagenic behavior can perhaps be conceived of best as a label, in the generic sense, for an intervening variable referring to the sum effect of the cognitive processes that are brought to bear in a text learning task.

Rothkopf (1965) proposed that specific classes of mathemagenic behaviors, critical to the comprehension and retention of text, are subject to influence or control from external sources in the form of test-like events or questions. The central idea in the concept of mathemagenic behaviors is the notion that specific responses in a text learning situation are subject to systematic or predictable influence from external sources. From an instructional technology point of view the concept of what constitutes an external source, could be broadened. Adjunct questions, prose structure, hortative directions., knowledge of

results, underlining, repetition, and knowledge of objectives, are samples of some of the external sources that can be manipulated to influence mathemagenic behaviors. From an applied standpoint the study of classes of external stimuli is significant in that it is expected that various external stimuli might ultimately be programmed into text learning situations to maintain the learners arousal, attention, and perseverance, and to facilitate the cognitive structuring of information, hence, facilitating both learning and retention.

Over the past ten years evidence has been presented to suggest that the placement, repetition, pacing, density, and type of questions interspersed in text influence the acquisition of relevant factual content (questions about the text seen both during learning and on a criterion posttest) and incidental content (questions about the text seen only on a criterion posttest). There has been a persistent general trend for frequent factual postquestioning to result in enhanced incidental and relevant learning in comparison to both prequestion and no question text groups. Evidence for the superiority of postquestioning versus no questioning on incidental text learning however, is relatively tenuous. Attempts to replicate the original findings of Frase (1967, 1968a, d) have not been particularly consistent. A major purpose of the present study was to attempt to replicate Frase's basic findings regarding the positioning of factual questions using the same text material about William James as was used by Frase (1967, 1968d). Three groups, prequestion, postquestion, and no question were included in this replication attempt. These

three groups also served as controls for treatment groups exposed to uncertain questions. The three groups will therefore, be referred to as the replication control groups.

Theoretical explanations of the phenomena whereby, factual postquestioning has tended to result in greater relevant and incidental text learning than factual prequestioning or no questioning have varied. Data regarding the direction of effects of the cognitive processing induced by questioning, are inconclusive but the following hypotheses have been offered to explain the various aspects of the question position phenomena: (a) adjunct text questions operate in a forward manner to shape cumulatively, question relevant inspection behaviors; (b) prequestions focus attention on relevant content; (c) prequestions present a situation of relevant ease and lead subjects to engage in perfunctory responses; (d) postquestions in text consitute a situation of relevant uncertainty and induce heightened arousal and attention to all text content; (e) postquestions induce specific reaward (related to relevant content) review effects after the acquisition trial; (f) postquestions induce general reward (related to incidental content) review effects; and (g) postquestions increase the level of attention that subjects give to materials immediately following inserted questions (a cyclic, contiguity type effect).

Proponents of Berlyne's (1954a, b: 1957; 1962; 1966) theory of epistemic curiosity and conceptual uncertainty have also posited that different question forms elicit varying amounts of uncertainty, conflict or curiosity which should lead to differences, in relevant and

incidental learning, among question types. Finally, it has been posited that different question forms evoke qualitatively different responses to the same text content which in turn leads to differences in learning and retention.

All in all, it would seem that many of the findings noted in adjunct question text studies could be explained, at least in part, by a law of least effort explanation (Anderson, 1970). Adjunct question situations which permit a learner to emit a to be learned response without really attending to or processing the information (like the phenomena of remembering a phone number just long enough to dial the call) lead to poor acquisition and retention. Adjunct question situations which force the learner to attend to and process the text information in some in-depth manner (like forcing the student to recall from memory, recently seen information, or requiring a transformation of the information) lead to enhanced acquisition and retention.

The hypothetical explanations of the question position phenomena (especially c, d and e, above), as evidence in the early Frase studies (1967, 1968a, d), suggested the second major purpose of this study. The following premise was deemed to be highly plausible; namely, the superior relevant and incidental performance of the postquestion group is probably due to heightened relevant uncertainty which increases attention to text about to be stored, and post-acquisition review which requires cognitive processing of text just recently stored. This study investigated this exploratory question: Can relevant and incidental learning, similar to that elicited by factual postquestions,

be elicited by prequestions if the prequestion text situation is modified to increase the degree of uncertainty and to incorporate a form of postquestion review?

Accordingly, the prequestion situation was varied between treatment subjects. Subjects were exposed to prequestion forms with either complete or incomplete question stems. The number of question response alternatives presented (one, two or four) was also varied between-subjects in order to contribute to the degree of uncertainty. The six between-subjects prequestion uncertainty conditions that resulted from the crossing of these two factors were compared, on an a-priori basis, to the three replication control groups. These latter groups served as referents regarding differences in incidental and relevant factual learning evoked by pre- or postquestion placement.

Post-acquisition review was incorporated in the situation in a within-subjects manner by introducing delayed knowledge of results (DKR) and by varying the uncertainty of KR. For the purposes of baseline comparisons the type of KR factor consisted of three levels; no KR, immediate KR and delayed KR. The KR uncertainty factor consisted of complete or incomplete KR. In line with the law of least effort hypothesis it was expected that complete prequestions with immediate complete KR might evoke perfunctory responses from the learners, resulting in token acquisition and retention. Conversely, it was hypothesized that incomplete prequestions followed by delayed incomplete KR might confront the learners with the greatest challenge and lead to the deepest text processing.

The effects of repeated testing were a consideration in the study. It was hypothesized that immediate posttesting (testing for both relevant and incidental factual text items immediately after the learning trial with all of the text materials) might serve to heighten mathemagenic responses to content in short term or intermediate storage. The net effect of an immediate posttest therefore, would probably be to attenuate potential long term differences between the postquestion group and both prequestion and no question groups on relevant and incidental learning. Immediate testing might also attenuate differences between immediate and delayed KR for the same reasons. A question type (pre, post or no question) by times tested (subjects given immediate and delayed test or only the delayed test) interaction was expected in the analysis of the delayed test data. It was posited that the postquestion group would demonstrate the greatest long term retention, on both types of learning, in the absence of the immediate test. In a similar vein it was expected that the type of KR factor might also interact with the times tested factor. It was thought that the DKR effect would be stronger on the delayed test for those subjects who only received the delayed test.

KR was also of interest in an operant reinforcement sense. Several investigators proposed that adjunct questions act to cumulatively shape inspection behaviors on succeeding paragraphs of text. Implicit within this hypothesis is the process of reinforcement of discriminative operant respones. As a logical extension of this theorizing it was thought that it would be worthwhile to explore the effects of several simple reinforcement schedules, on subjects' text

processing behaviors, with KR being the reinforcing event in a classical sense. The three events of no KR, delayed KR and immediate KR were therefore, ordered in three different between-subject variations, across three sets of six paragraphs. It was hypothesized that the order, immediate KR (first 6 paragraphs), delayed KR (second set of paragraphs) and no KR (last set of six paragraphs) would lead to the greatest learning and retention on the last set of paragraphs. An oversight in counterbalancing procedures however, introduced a confounding which negated the testing of this hypothesis.

Given the basic interest of this study in investigating external stimuli which might evoke mathemagenic positive responses, it was decided to explore one last variable, for two reasons. Increases in curiosity and arousal, with concomitant increases in text learning have been attributed to the act of requiring subjects to guess at the answers to prequestions presented with text passages. In order to attempt to replicate this finding, and in order to insure a baseline level of responding to the unusual between subjects factors, subjects were asked to guess the correct responses to the modified prequestions, prior to reading the passages.

By way of summary then, this study proposed to replicate the early Frase studies (1967, 1968a, d) and explore several ways of maintaining the information processing responses of subjects who were asked to read 18 paragraphs of factual text, followed by an immediate and/or delayed test of their learning.

REVIEW OF PREVIOUS RESEARCH

Prose Learning: History and Present Status

Interest in directing or manipulating the learning that occurs when subjects interact with prose materials has a long history. Germane (1920) compared outlining and summarizing with re-reading, as methods of study. Distad (1927) compared the effects of four different conditions: (a) undirected reading, (b) reading to answer questions of teacher, (c) reading to answer pupil generated questions, and (d) reading to solve a general problem, over a single reading of four types of content. In another study (Holmes, 1931) the effects of questions versus reading and re-reading were compared for two types of content material. Short and long term retention were assessed on 20 questions that one-half of the subjects saw during reading (question-relevant items). Overall, the question group surpassed the read and re-read group. Paralleling current findings though, there was some evidence to indicate that the question group was inferior on the immediate retention of incidental content.

Jersild (1929) varied the format and mode (true-false, multiple-choice, essay, and written or oral, respectively) of massed prequestioning or pre-examination prior to study or lecture. He found the true-false format to have the least desirable effect on learning and concluded in accord with Bruning (1968) that a direct interrogation constitutes a more effective stimulus than does a narrative statement. In brief, he postulated that questioning prior to learning gives rise

to a more lively response during learning because questions constitute challenges and instigate doubt and uncertainty.

A study by Washburne (1929) was uncanny in that it anticipated, in part, the current methodology that has been used to study the effects of questioning on the retention of factual prose materials. Specifically, Washburne varied the position (questions placed before or after paragraphs) and spacing or pacing (the set of questions massed before the group of paragraphs or each question placed near its respective paragraph) of questions. He manipulated question type (specific factual versus generalization questions) and distinguished between relevant (content cued by questions during acquisition) and incidental (content not so cued) learning. The positioning of questions and the relevant versus incidental learning distinction were later to become important aspects of early prose learning methodology.

The Washburne (1929) study reported that the best placement consisted of grouping all of the questions at the beginning of the story. Placing the 27 questions at the end or after their respective paragraphs led to poorer learning than the condition in which all of the questions were placed at the beginning of the story. Placing questions after each paragraph also inhibited irrelevant learning. The former result deviates from current findings but appears to possibly be attributable to a methodological difference. Contrary to current methods, Washburne (1929) presented questions and their respective paragraphs together on the same page and also permitted subjects to review. Thus, subjects might easily have turned a nominally defined postquestion into a

functional prequestion, or vice-versa. In any event, the nominal distinction between pre- and postquestioning was compromised by presenting both questions and paragraphs on the same page.

These early studies have been cited to establish a historical frame of reference for a resurgence of interest in studying ways of influencing learning from prose materials or instructive documents. What they share in common with current studies is an interest in the study of the effects of questions on students' studying behaviors or reading strategies. Although commonalities do exist between the guided reading studies of the twenties and current prose learning studies, differences between the two are also quite in evidence. The earlier studies were more molar and pragmatic in their approach and purposes. Current studies can be conceptualized as more molecular and theoretical, being concerned with, (a) uncovering and describing the nature of the responses which facilitate learning from prose, (b) determining the contingencies which evoke specific (relevant) and generalized (incidental) text learning responses from subjects, and (c) assessing the effects that different types of questions and different text structures have, on learning from prose. It should also be noted that current interests have spun off from the plethora of studies on programmed instruction and in part are a reaction against the rigid formalism of linear programming (see Frase, 1968b).

In order to outline the present status of prose learning one needs to start with the theorizing of Rothkopf and Frase. Rothkopf (1965) noted that study in the realm of written instruction could be divided

into two areas: (1) the study of the organization and sequencing of content, and (2) the study of ways to insure that content is effectively used. In speculating about the nature of prose learning behaviors relevant to the second area he coined the term "mathemagenic" behavior as a label to be used to describe responses that produce learning in a text processing situation. Critical to the concept was Rothkopf's assumption that classes of mathemagenic responses could be altered by environmental events to the desired end of more efficient learning. Rothkopf suggested that test like questions constituted one type of environmental event that could facilitate learning.

In support of this conceptualization Rothkopf (1966) reported on a prose study in which postquestioning produced generally facilitative learning effects. The incidental learning of the postquestion group reportedly surpassed that of prequestion and control groups. Rothkopf and Bisbicos (1967) also implied that a learning to learn or a shaping phenomena was in operation in prose learning studies invqlving the placement of questions before or questions after paragraphs. They concluded that questions after paragraphs tend to elicit or shape increasingly more effective inspection behaviors as subjects are exposed to a cumulatively increasing number of experimental questions interspersed in the stimulus materials. They also presented evidence to show that specific or restricted classes of questions elicited an increase in responding to specific classes of information.

In an attempt to elaborate upon the Rothkopf (1965) model, Frase (1967) noted that the mathemagenic model failed to account for the fact

that questions before and questions after paragraphs were confounded in that a postquestion could serve as an irrelevant question preceding the paragraph that followed. Frase (1968b) subsequently proposed a model which, in agreement with Rothkopf's notions, emphasized the reinforcement of attentive responses as opposed to the reinforcement of specific stimulus response associations, but which also took into account the directionality of operation of questions.

In brief, Frase hypothesized that questions after paragraphs facilitate general attentive behaviors on the paragraphs that follow in that they serve as hints or as anticipatory goal mechanisms of what is to come. Questions before paragraphs were envisioned as differentially effecting attentive behaviors as a function of the number of question related associates contained within a paragraph. Thus, both questions before and questions after paragraphs were considered to operate in essentially a forward sequential direction, but in different ways.

According to Frase, a question before a paragraph becomes a discriminative stimulus for an attentive response that is limited in scope by the number of question related terms in the paragraph. Thus subjects would be expected to attend to the relevant materials and to skip over the incidental content.

With postquestions, however, it would be predicted that subjects attend to all of the stimulus materials in accordance with anticipations modified by previous questions in the series. This attentive behavior would result in the learning of the relevant items as well as the

learning of a greater number of incidental items, as compared to prequestioning. In both situations, prequestioning and postquestioning, the appropriate attentive behaviors are assumed to be reinforced by the act of finding the answer to the question and thus reducing uncertainty.

It is also noted that, in contrast to Rothkopf and Bisbicos' (1967) contention that inspection behaviors are subject to shaping with postquestions, Frase (1968a) reported that the superiority of postquestion groups was established or was in existence from the very first paragraph. This result was interpreted as indicating that postquestions immediately elicit or maintain pre-established reading strategies or problem solving skills rather than generating these behaviors as a function of length of exposure to experimental materials.

It should be noted that the procedures employed in the early (1965-1968) prose learning studies of both Rothkopf and Frase had a number of features in common. These procedural commonalities involved the placement of a factual question or several factual questions before or after one or several (pacing condition factor) paragraphs respectively. Each factual question and paragraph was presented on a separate sheet of paper and subjects were not permitted to look back once they had read a particular sheet. Upon completion of the reading (unlimited time) of the experimental materials subjects were quizzed (completion type constructed response or multiple choice test items) on the factual questions that they were exposed to during reading (relevant learning)

and were also quizzed on factual content which was not focused on by questions during reading (irrelevant learning).

A consideration of the procedures employed in the early prose learning studies of Rothkopf and Frase led to the conclusion that parallels could be drawn between prose learning studies that focused on the acquisition of facts and incidental learning studies that employed paired-associates (McLaughlin, 1965). In a position not at odds with Frase's (1968b) model, it was suggested (Patrick, 1967) that factual questions placed either before or after paragraphs, constitute situations that can be considered as two highly different orienting tasks. In traditional incidental learning methodology the orienting task is the ruse or subterfuge that is devised by way of either verbal instructions or physical manipulation, or both, in order to get the subject to attend to the incidental content in the absence of specific instructions to learn that content. In terms of the terminology reviewed by McLaughlin (1965), the postquestion situation appears to have a lot in common with the classical incidental learning situation defined or classified as an intrinsic Type II design. The prequestion prose situation, on the other hand, overlaps to a great degree with the incidental situation classified as extrinsic Type II design. In Type II designs subjects serve as their own controls in that they are responsible for learning both the intentional and incidental content.

A post-hoc analysis of the functional relationships involved in prose learning was constructed. Patrick (1967) contended that questions operate in both a forward and a backward manner but differentially

so for both incidental and relevant learning, and for both the pre- and postquestion conditions. The four part analysis reads as follows:

(1) With prequestions, incidental learning is mainly a function of the position of the question. The prequestion situation reflects an orienting task that is highly unfavorable to incidental learning. The temporal sequence of the task almost insures that subjects will only cursorily attend to those materials that are not relevant to the question. However, as the number of paragraphs between questions is increased, incidental learning increases (Frase, 1967, 1968a, d). Increasing the length of the material possibly increases the overall difficulty of the task and thus seems to require that subjects discriminate more closely between relevant and irrelevant items. It is also noted that as the pacing condition is increased a subject is required to keep more than one question in mind at a time. This could also account for the greater discrimination that appears to occur.

(2) With postquestions, incidental learning appears to be entirely a function of the position of the question. A question after a paragraph is an orienting task that maximally facilitates incidental learning in that a subject not knowing what the question will be, has to attend to all of the materials. Increasing the number of paragraphs that appear before the questions does not seem to depress or increase incidental learning. In fact, there seems to be an indication that the graph of incidental learning over all postquestion pacing conditions (1, 2, 3, 4 and 5 paragraphs) is best fitted by a straight line of zero slope (Frase, 1968d).

Thus incidental learning seems to work in a forward direction for both pre- and postquestions but for different reasons and consequently at different strengths. With prequestions both question position and length seem to be critical but with postquestions, question position seems to be the single main functional determinant of incidental learning.

(3) With postquestions, relevant learning seems to work in both a forward and a rearward direction. With paragraph review not permitted, subjects seem to be forced to rely more upon short term memory in order to answer the questions that appear after the paragraphs. The fact that subjects attend closely to all of the material, due to the imposed orienting task, and rely upon memory to recall the answers to the questions probably accounts for the fact that stronger question-response relevant learning associations are formed under postquestioning than prequestioning (Frase, 1967, 1968a, d).

The fact that the positioning of questions interacts with the pacing of questions, resulting in greater postquestion group relevant learning under the more frequent pacing condition (Frase, 1968a, d) would seem to be able to be explained by hypothesizing that short term memory becomes overloaded as the amount of material interpolated between text content and postquestions increases. Consequently relevant learning with postquestions appears to be partly a function of forced recall (envisioned as a search through memory), and the efficiency of this recall is in part determined by the contiguity between the text item and its forced recall.

(4) With prequestions, relevant learning seems to work in a forward direction as a function of question position and length of material. It would seem that the superiority of postquestioning over prequestioning on relevant learning could be explained in terms of the strength of the associations elicited by the two.

With prequestions, the subject has the question in mind prior to seeing the paragraph. He then searches the paragraph for the answer and an "Aha! That's it!" response probably occurs when he finds it. The ease with which the subject is able to complete the task is perhaps deceptive and could result in a weaker stimulus response association than the postquestion condition in which the subject has to hook up the stimulus and response mainly through recall. A subjective task analysis of the situation seems to support the conclusion that the critical nominal differences between pre- and postquestions with relevant learning are: (a) the forced recall that occurs with postquestions, (b) the arousal and uncertainty that accompanies the acquisition or information input stage with postquestions and (c) the fact that subjects' initial responses to the paragraph content are unbiased by any advance knowledge of the relevant questions.

In contrast, the nominal constraints inherent in the factual prequestion prose situation appear to comprise an instructional task that: (a) is lacking in arousal and uncertainty, (b) shapes subjects' initial paragraph inspection activities and responses in accord with the semantic constraints implicit in the prequestion, and (c) doesn't force the subject to mentally rehearse the question-response association in the

absence of the surrogate storage afforded by the paragraph which remains in view during information processing.

The explanation of the interaction between length of material and prequestioning for relevant learning would seem to parallel that for incidental learning. It would seem that for the prequestion condition, an increase in the number of paragraphs would elicit a stronger or closer discrimination between incidental and relevant items. Hence, the "Aha! That's it!" response would seem to be less easily reached due to the greater uncertainty caused by the increased amount of content to be read and the greater number of questions that a subject has to keep in mind.

The above reconstruction would derive some support from a study (Faust and Anderson, 1967) in which it was revealed that subjects who were exposed to a program containing several irrelevant (incidental) items per each programmed item, did better than subjects who were exposed to 100 percent programmed materials with no added irrelevant content. It was concluded that the incidental content insured that subjects at least notice the relevant stimulus before making a response.

In any event, the fact that relevant associations become stronger with prequestioning as the material between prequestions is increased, is attested to by the fact that relevant learning increases as the number of passages is increased (Frase, 1968a, d).

In summary, it can be noted that the early factual prose learning studies of Rothkopf and Frase reported findings which seemed to support

the following assertions: (1) relevant learning has consistently been greater than incidental learning (Rothkopf, 1965; Rothkopf and Bisbicos, 1967; Frase, 1967, 1968a, d), (2) questions after paragraphs have resulted in significantly greater incidental learning than questions before paragraphs (Rothkopf, 1965; Rothkopf and Bisbicos, 1967; Frase, 1967, 1968a, d), (3) postquestioning has resulted in significantly greater relevant learning than prequestioning (Frase, 1967, 1968a, d), (4) the relevant and incidental learning of the postquestion group has been greater than that of the control group whereas the prequestion group has surpassed the control only on relevant learning and has been comparable to or below the control on incidental learning (Rothkopf, 1965; Frase, 1968d), (5) there has been an interaction between question position and question pacing. When averaged over both types of learning, the most frequent pacing condition (one question before or after each paragraph) facilitated the performance of the postquestion group and severely depressed the performance of the prequestion group. As the pacing condition was lengthened, the two groups became progressively more alike in performance (Frase, 1968a, d), (6) there was also an interaction between question pacing and type of learning. When averaged over question position, the most frequent pacing condition depressed incidental learning and facilitated relevant learning. As the pacing condition was increased, incidental learning was progressively facilitated and relevant learning remained about the same (Frase, 1968a, d).

Some of the initial findings of Rothkopf (1966), Rothkopf and Bisbicos (1967), Frase (1967, 1968) and Bruning (1968) were questioned

by Ladas (1973). Specifically, Ladas claimed that only the Bruning study offered partial evidence that factual postquestioning resulted in incidental learning superior to that of the no question control group. Ladas cited a number of deficiencies in the above studies which supported his conclusion. In large part these deficiencies involved inappropriate multiple comparison procedures, the use of estimated control group performance, and inadequate control for estimation of the possible transfer between factual relevant and incidental questions. Ladas emphasized that these oversights did not invalidate the other findings regarding question positioning and question pacing.

More recent studies by Watts and Anderson (1971), and McGaw and Grotelueschen (1972) have investigated differences among questions and whether questions are generally facilitating, respectively. Obtained differences were discussed in terms of the direction of the effects of the questions. McGaw and Grotelueschen (1972) reported that postquestioning resulted in increased facilitative (incidental learning) effects in comparison to no question controls. The results were attributed to increased attentive behaviors immediately after factual postquestions (forward effects) and a facilitative review effect on text materials just prior to questions (rearward effect). The relevant and incidental questions were constructed to be independent of one another but an empirical transfer test was not conducted. McGaw and Grotelueschen (1972) also expressed some reservation that the inserted questions might have evoked, inadvertently, a direct

review of their matched incidental content.

The Watts and Anderson (1971) study reported that application questions led to significantly greater general (relevant plus incidental) text learning performance than questions which either, called for correct responses which simply were repeats of examples from the text or which called for responses involving names. This study offered support for the assertion that application questions are more generally facilitating than repeat-example questions and name questions. The study did not support the assertion that application type postquestions lead to greater incidental learning than a control which reads the text content without benefit of adjunct questions.

The point to be made in the above review is that there is relatively little strong support for the purported generally facilitative effect (i.e., effect on incidental learning) of postquestioning. In most studies, differences between adjunct question and control groups have been in the predicted directions but, even where they were significant, the differences were relatively small or weak. In addition, the reported superiority of factual postquestioning over factual prequestioning has not always been supported.

Boyd (1973) and Sanders (1973) failed to find significant differences between pre- and postquestions on either relevant or incidental content. These same studies also failed to show that postquestions lead to greater incidental learning than a no question control. Boyd (1973) suggested that the failure to replicate might have been due to the greater amount of textual material spaced between questions. The

Sanders (1973) study reportedly used the same materials and spacing as Frase (1967) but Sanders apparently modified the content of the Frase questions and incorporated both specific and general comprehension type questions.

In consideration of the possible idiosyncracies associated with Frase's original questions and content, the present study attempted to replicate Frase's (1967, 1968d) basic findings regarding question position, by using the same text content and questions used by Frase. Thus, it was expected, at the least, that a specific factual post-question group would achieve greater relevant and incidental learning than a prequestion control, and, at the best, would also achieve greater incidental learning than a no question control.

In order to complete the summary of the literature in the area of prose learning it should be noted that the scope of research in prose learning has widened to encompass the broad classes of variables that Rothkopf (1965) cited as being related to mathemagenic activities. A number of studies (Frase 1969a, b, c; 1973a, b; Myers, Pezdek and Coulson, 1973; Friedman and Grietzer, 1972) have investigated the relationship between a stated goal for subjects and subjects' responses to text materials whose organization has been structured according to various logical class relations or various syntactical variations. The scope of prose research has thus been broadened, as noted by Frase (1970a, b) to investigate both the goal (question, directive, etc.) set for the learner and the organization of the material. Both of these sets of variables interact to determine what will be entered into memory and

consequently influence the sum character of the effective stimulation a learner generates from a text passage.

Uncertainty, Arousal and Curiosity

Theorizing regarding the effects of uncertainty, conceptual conflict, arousal, and curiosity, on learning and subsequent retention, can be traced to Berlyne (1954a, 1957). Berlyne (1954a) proposed a theory of human curiosity in which he drew a distinction between perceptual curiosity and epistemic curiosity; the former being related to increased perception of stimuli in an orienting response sense, and the latter being related to the acquisition of knowledge. In answer to the question, "Why do humans seek knowledge?", he presented a generalized fear-reduction hypothesis based on the drive-reduction properties of knowledge attainment and rehearsal. His main concern, however, was with the selectivity exhibited in the pursuit of knowledge.

Cultural conditioning could partially account for this selectivity, but Berlyne stated that it failed to account for the fact that the new and the strange arouse the most curiosity. Berlyne contended that an examination of the role of conflict was necessary in order to understand this phenomena. Berlyne (1954a) went on to propose that the drive aroused by questions is a form of epistemic curiosity and that the strength of epistemic curiosity can be measured through its effect on remembering. When a question is put to a subject either by himself or some external agent, epistemic curiosity is aroused and the greater the curiosity the greater the drive which is reduced when the question is

answered. Thus, he hypothesized that the habit strength between question and answer is linearly related to the amount of drive reduction.

Insofar as conflict is concerned, he hypothesized that conflict is drive producing and that the reduction of conflict is reinforcing. If we recognize that curiosity and conflict are frequently correlated, this could explain the rewarding value of investigating new things and the learning resulting from these investigations in that the novel or the new frequently elicit responses that are incompatible on the basis of past learning. Berlyne (1954a) therefore viewed epistemic curiosity as a drive reducible through knowledge acquisition and rehearsal and he envisioned questions as serving as thematic probes which evoke drive-producing meaning-responses. Curiosity about the new and the strange, and questions was attributed to learned conflict.

Supsequent investigations were undertaken to verify hypotheses generated from the theory of epistemic curiosity. Exposure of subjects to prequestions regarding relevant content led, among other results, to greater retention and reported curiosity than nonquestioning (Berlyne, 1954b). In an expository paper (1957) and study (1962) Berlyne attempted to demonstrate the close relationship between the information theory concept of uncertainty and epistemic curiosity. He postulated that epistemic curiosity varied directly as a function of conceptual conflict. He proposed that conceptual conflict arose as a function of competition or disagreement among response tendancies relating to beliefs, attitudes or thoughts. He further proposed that uncertainty increased as a function of (a) the number of competing response alternatives available, and (b)

the degree to which the alternatives appeared equiprobable.

Berlyne (1962) tested the relationship between uncertainty and epistemic curiosity by exposing subjects to 30 quotations accompanied by either two or three alleged authors and a distribution of fictitious experts' guesses as to the true author. Variations in the number of alleged authors and the distributions of guesses constituted the uncertainty manipulations. In accordance with predictions, measures of reported curiosity increased with the two operational determinants of conceptual conflict or uncertainty; namely, the number of alternative authors presented, and the equiprobability of the distribution of experts' guesses regarding the true author.

In a subsequent study Berlyne (1966) used his 1962 stimulus materials (quotations accompanied by varying numbers of alleged authors and varying distributions of fictitious teachers' guesses about the identity of the true author of each quotation) to test the effects of his uncertainty manipulations on his subjects' reported curiosity about and learning of, the identities of the true authors. No main effects regarding the uncertainty manipulations were found when learning was the dependent measure. Berlyne (1966) did find that guessing the identities of the true authors prior to the learning trial led to greater learning than not guessing. Delayed massed knowledge of results also led to greater learning than immediate knowledge of results.

The work of Berlyne (1957, 1962, 1966) was in part responsible for the prequestion uncertainty manipulations introduced in the present

study. Berlyne's (1957, 1962) theorizing would appear to support the hypothesis that prequestions without stems would lead to greater uncertainty than prequestions with stems. The idea of varying the number of multiple choice alternatives for each question seemed to directly relate to Berlyne's (1962) hypothesis that uncertainty would increase as the number of competing responses increased. Berlyne's (1957, 1962) work also suggested that response alternatives of equiprobable strength would lead to the greatest uncertainty and epistemic curiosity. In the absence of a question stem, it would seem that all presented response choices would be equiprobable, as answers to some unknown question or questions.

Berlyne's (1966) failure to find differences in learning and retention due to differences in the number of available response choices, may have been due to the fact that the range of choices was only two and three. The present study proposed to provide one, two and four response choices, thus sampling a wider range of available response choices. It was expected that this would lead to a wider range of uncertainty. Furthermore, it was expected that the uncertainty that was generated would be relevant to the task of learning factual bits of information from short paragraphs of text. The relevancy of the uncertainty is a consideration in that Salomon and Sieber (1970) have noted that uncertainty may be either relevant or irrelevant to a task and hence either be facilitative or debilitative of one's efforts in a particular intellectual endeavor.

The exploratory hypotheses to be tested therefore related directly

to the assumption that adjunct postquestions in text lead to enhanced relevant and incidental factual learning due to the uncertainty of the postquestion situation which nominally constrains subjects to read all materials carefully because the subjects do not know which information will turn out to be relevant to the postquestion. This line of reasoning led to the intuitive conjecture that the uncertainty of the prequestion situation could be varied by presenting prequestions with and without question stems and by varying the number of question response alternatives (potential answers) to each question. This intuitive reasoning would appear to be supported if one can generalize from the work of Berlyne (1957, 1962, 1966). It was hypothesized therefore that prequestions without stems would lead to greater relevant and incidental learning than prequestions with stems, due to the greater arousal or uncertainty accompanying the former condition.

The present study also proposed to require all subjects to guess at the correct response alternative to each prequestion, in order to insure that the subjects attended to the experimental manipulations. This presented the opportunity, in the perspective of a hypothesis of second order or secondary intent, to assess the effects of guessing on learning and retention. Berlyne (1966) found that requiring subjects to guess the correct response alternative to prequestions led to greater learning and retention than not guessing. Berlyne concluded that guessing enhanced epistemic curiosity. Peeck (1970) failed to replicate Berlyne's (1966) finding in regard to the effect of guessing.

The arousal properties of adjunct questions in text have been

discussed in relation to Berlyne's (1962) hypothesis, by Bull (1973). He proposed that arousal precedes and maintains attention and that different types of questions have varying arousal properties. Bull (1973) stated there was an interaction between degree of arousal and time of testing, with heightened arousal leading to greater long term or delayed retention. Bull also noted that the factual questions used by Frase (1967, 1968d) and Rothkopf (1966) would appear to represent the lower end of the arousal continuum.

In concluding this section it is noted that the prequestion uncertainty manipulations of the present study were viewed from two perspectives. First, it was felt that prequestions without stems would change the prequestion situation from extrinsic Type II to intrinsic Type II (McLaughlin 1965). Second, it was thought that prequestions without stems would elicit reactions of arousal and uncertainty a lá Berlyne. In either event it was hypothesized that the net effect would be an increase in incidental and relevant learning. Ultimately, it was expected that it would be difficult to specify which perspective accounted for the greatest part of the cause-effect learning contingency in the situation inasmuch as both perspectives predict functionally equivalent behaviors at the level of actual performance.

Knowledge of Results

Annet (1964) pointed out that knowledge of results (KR) is a specific type or subclass of a larger class of events referred to as information feedback. Information feedback generally subsumes a wide

range of motor and verbal input, contingent upon preceding output. KR refers more specifically to knowledge regarding a standard of performance (i.e., information whether a response is correct or incorrect). The specific influence of KR on learning is a moot point (Annet, 1964, 1969). The concepts of incentive, reinforcement and information have all been invoked to explain KR's effects on behavior. The present study proposed to examine KR from both a reinforcement and an information point of view. In both instances the emphasis of the interpretation was on the hypothesized effects of KR on subjects' mathemagenic behaviors.

In introducing the concept of mathemagenic behaviors, Rothkopf (1965) inferred that mathemagenic behaviors were adaptive in nature and as such should be amenable to response contingent reinforcement. A study by Rothkopf and Bisbicos (1967) found that postquestion group subjects tended to modify their mathemagenic behaviors over time so as to learn specific subsets of factual material. Frase (1968b) proposed that questions could be considered to be discriminative stimuli which set the occasion for selective classes of operant information processing responses. If such is the case, perhaps KR can serve as a reinforcing event to confirm or enhance the use of particular mathemagenic behaviors.

Three different reinforcement histories were built into the instructional materials. An operant theory interpretation of the concepts of shaping and reinforcement would seem to lead to the prediction that an instructional sequence involving immediate, delayed and then, no reinforcement or KR, would lead to more effective acquisition of the relevant

and incidental content, on the nonreinforcement trials, than a sequence or schedule of KR involving the exact reverse of the above sequence.

KR was also examined from the perspective of its capacity to serve as information. It was suspected that the effective information that is derived from KR varies as a function of the specific types of mathemagenic responses that subjects make to KR. It was further proposed that subjects' responses to KR may be enhanced by elementary environmental manipulations.

In general, KR has played a rather prominent role in the theory of programmed instruction and many educators accept as dogma the necessity and desirability of providing immediate KR, whether in programmed materials (Skinner, 1958, 1961; Krumboltz, 1961) or in regard to just about any other learning situation (Ammons, 1956). The principle of immediate knowledge of results (KR) has been generalized to human learning situations on the basis of animal learning data which has consistently shown that if KR is delayed, learning is increasingly debilitated (Renner, 1964). The literature on human motor skills studies can't be so strongly interpreted as supporting the necessity of immediate KR. Brackbill, Wagner and Wilson (1964) for instance, reported that in eleven out of fourteen studies delayed knowledge of results (DKR) resulted in learning equivalent to immediate knowledge of results (IKR). These results though, are consistent with a traditional negative expectation regarding the effects of DKR. This expectation holds that DKR, even if it doesn't severely depress learning, certainly can't be expected to enhance learning.

Only a few prose learning studies have included KR as a variable. Rothkopf (1966) found that experimental questions accompanied by KR resulted in greater relevant learning than questions not accompanied by KR. Frase (1967) replicated Rothkopf's (1966) study but included design provisions to check the possibility of an interaction between KR and question position. Without KR, postquestions surpassed pre-questions on relevant learning, but the two groups failed to differ when KR was made available. Berlyne (1966) also included KR as a variable in his quotations study. He varied the timing of KR, presenting either IKR or DKR. He found on an immediate recognition test, that the delayed condition resulted in better retention of the names of the 28 authors.

The superiority of Berlyne's (1966) DKR condition contradicts traditional learning theory notions regarding the timing of KR. His finding though was not inconsistent with the results of several more recent verbal learning studies (Sturges, 1969, 1972a, b; Sassenrath and Yonge, 1969; More, 1969; Kulhavy and Anderson, 1972; and Surber and Anderson, 1975) that have reported data regarding the delay of information feedback which openly challenges the generalizability of the principle of immediate information feedback or IKR to school situations involving verbal learning.

Several of the DKR studies relevant to present interests, exposed subjects to a test composed of a number of multiple choice questions relevant to the general factual content of a psychology course that the subjects had taken at an earlier date. Subjects were then exposed to

either complete or incomplete IKR or DKR and subsequently tested and retested in order to check on the differential effects of variations in KR on retention over time. Sturges (1969) exposed subjects to the above acquisition procedure and then provided either IKR per item or 24 hour DKR massed over all items. All subjects were tested immediately after KR and then 7 days later on the same 38 item multiple choice test that constituted the content of the acquisition phase. KR consisted of the original question stem accompanied by either one or four response alternatives.

Posttesting revealed that the DKR group which received all four response alternatives as information feedback performed significantly better than the equivalent IKR group on the seven day retention test. It was concluded that: (a) the DKR interval, per se, isn't the crucial factor effecting the DKR effect; what happens at the time of DKR is supposedly the crucial element, (b) the superior retention of the DKR group was probably due to increased attention and response to a greater number of retention relevant cues, namely, the four response alternatives, and (c) the manipulation of the stimulus situation at the time of KR influences the DKR effect. The impression created by the first conclusion appears to be a bit misleading. What happens during the DKR interval (time between acquisition and KR) is crucial. The fact of the interval itself and the concomitant cognitive processes that occur during this time constitute the stimulus situation that elicit the hypothesized heightened mathemagenic responding at the onset of DKR. That this responding doesn't occur upon IKR appears to be a direct

function of the lack of this interval and its concomitants. In any event Sturges' first conclusion is probably being slightly abused in that she may have been referring to the apparent absence of overt evidence of intra-DKR interval mediation which Brackbill and Kappy (1962) postulated as a potential raison d'etre for the enhanced long term retention that occurs with delayed KR (the DKR effect).

In two subsequent similar studies Sassenrath and Yonge (1968, 1969) varied the time of presentation of KR and the completeness of KR (question stems present or not present, and right versus right plus wrong response choices). They reported that delayed KR led to greater long term retention than immediate KR. They also found that KR without stems led to better long term retention than KR with stems when KR was given in contiguity with subjects' acquisition response. When considerable material was interpolated between acquisition responses and KR (i.e., when KR was massed at the end of the acquisition of 60 multiple-choice questions), complete KR led to better retention than incomplete KR on tests of immediate and delayed retention.

Sassenrath and Yonge (1968) concluded that the DKR interval, mediation or rehearsal hypothesis (Brackbill and Kappy, 1962) wasn't supported because the DKR effect didn't show up on the retention test immediately after DKR. They stated that the cause of the DKR effect must be something other than whatever occurs before, during or immediately after KR. They inferred that the critical rehearsal probably occurs between DKR and the delayed retention test. A ceiling effect, however, appeared to be present in the above study. The

apparent ease of the questions, as evidenced by the high scores of both the IKR and DKR groups, could have washed out the effects of DKR on the immediate retention test. A similar ceiling effect occurred, with similar results on the DKR effect, in a study by Sturges (1969).

It is likely that even though the information contained in the KR presented to the IKR and the DKR groups was nominally the same, the differences in immediate entering behaviors, either attenuated or enhanced the functional value of the information that was derived from the KR experience. Thus the IKR subjects probably engaged in perfunctory types of responses which led to less permanent or less organized input and recollection of the content. The data would seem to indicate that the DKR subjects, for whatever reason, engaged in relevant mathemagenic responses. In short, it was postulated that the causal source of the DKR effect was shared by both the DKR group and the comparison IKR group.

In like manner it can also be hypothesized that incomplete KR (without stems) can be expected to educe greater learner uncertainty and subsequent responding than complete KR and hence result in enhanced retention. Incomplete KR of this nature is analogous to a form of test item in reverse and testing interpolated between acquisition and recall has been shown to facilitate subsequent retention (Spitzer, 1939; Sones and Stroud, 1940; and Tiedeman, 1948).

A study by More (1969) added further to the belief in the robustness of the DKR effect. Unlike the Sturges (1969), and Sassenrath and Yonge (1968, 1969) studies which, as the main experimental manipulation,

exposed subjects to multiple choice questions relevant to content which they had studied at an earlier date, More had his subjects read an unfamiliar 1200 word article and then tested them on its contents. Specifically, DKR groups of zero, 2½ hours, 1 day and 4 days, delay were used. All subjects read an article, were tested on it, and then received DKR at the appropriate times. Immediately after KR one-half of the subjects in each of the four DKR groups was tested, the other half of each group was tested three days later. This study thus controlled for the confounding of immediate post-DKR testing with delayed retention testing that occurred in the Sassenrath and Yonge (1968, 1969) and the Sturges (1969) studies. The DKR effects found in these latter studies could have been due to the practice effects (Spitzer, 1939) afforded by the test after DKR and not solely to the DKR. In any event, the immediate 20 item four-alternative multiple choice retention test revealed that the retention of all of More's (1969) DKR groups was superior to the zero or no-delay KR group. The delayed retention test revealed a curvilinear retention effect with the 2½ hour and 1 day delay groups, exhibiting superior delayed retention.

Subsequent studies by Sturges (1972a, b) varied the form of KR (complete or redundant), the form of immediate and delayed retention tests (recognition or recall), and the presence or absence of an immediate retention test. Several interactions were found among the levels of the above factors. Sturges (1972a, b) concluded that the 24 hour DKR effect was due primarily to factors operating at the time of DKR and not primarily to events intervening between acquisition and DKR.

She argued that the studies supported the conclusion that DKR subjects respond to more aspects of the KR situation than IKR subjects. Sturges noted that in situations where the form of KR closely resembled the delayed retention test, an immediate retention test was required to afford subjects practice with minimal cues, which subsequently facilitated retention. She also found that when KR was presented along with a cue, an immediate retention test after KR was not required to produce enhanced results on a delayed retention test. In summary, Sturges' explanations of the DKR phenomena observed in her 1972 studies reduced to the contention that DKR subjects respond to more aspects of the KR stimulus situation. In addition, DKR forms which induced subjects to attend to the semantic relationships between the question stem and question alternatives, as well as the relationship among question alternatives, facilitated long term retention.

Kulhavy and Anderson (1972) and Surber and Anderson (1975) also verified the existence of the DKR effect on delayed retention. Their explanation of the effect however differed from that of Sturges (1972a, b). Kulhavy and Anderson (1972) proposed an interference-perseveration hypothesis to account for the effect of DKR. They provided evidence to support the conclusion that proactive interference, due to subjects' commitment to incorrect responses or associations, interfered with subjects' ability to utilize immediate KR. They stated that delayed KR was more effective primarily because incorrect associations had the opportunity to decay during the DKR interval and thus interfered less with the correct responses presented at the time of DKR. They also

reported evidence which supported what was from their perspective a secondary hypothesis, namely, that the DKR effect occurs because subjects attend more to DKR than IKR. Surber and Anderson (1975) studied the DKR effect in a natural class setting. Their findings were consistent with the interference-perseveration hypothesis which predicted that the DKR effect would show up most strongly over those items which were responded to incorrectly on the initial test.

The cumulative evidence of the preceding review challenges the utility of the concept of IKR after a test of acquisition, insofar as the learning and retention of factual verbal materials are concerned. The explanation of the cause of the DKR effect seems to be best accounted for by a combination of increased attention to DKR and reduced competition, at the time of DKR, from incorrect question-response associations. These explanations are of interest in that they fall, either directly or indirectly, into the realm of mathemagenic activities.

The experimental materials for the majority of the DKR studies cited above consisted of multiple-choice questions on content unfamiliar to the subjects. In actuality, subjects were required to learn the answers to a list of questions. Only the More (1969) and Surber and Anderson (1975) studies exposed subjects to instructional passages prior to introducing the questions and DKR relevant to the instructional passages. In addition, the majority of the studies presented IKR or DKR which was massed over the entire series of items. The More (1969) and Sassenrath and Yonge (1969) studies presented IKR and both IKR and DKR, respectively, on an item by item basis. None of the studies however, presented IKR

or DKR in immediate continguity with the acquisition trials, such as occurs with programmed instruction.

Given the presumed effect of both DKR and incomplete KR on the mathemagenic behaviors of subjects, it appears that it would be worth while to consider incorporating the DKR and incomplete KR phenomena into the taxonomy of stimulus events that may be hypothesized to influence or shape the mathemagenic responses in which subjects engage. The present study therefore was designed to assess the effects of DKR and IKR, when presented in an adjunct manner along with prequestions, during the course of an ongoing prose learning acquisition session. However, unlike the above studies, KR was not given following subjects' responses to test items. KR was given after subjects saw a prequestion (with or without a stem and with one, two or four alternatives) and read a paragraph related to the question. It was expected that subjects would answer the prequestions when they read each paragraph. KR was a form of post-acquisition or post-instruction confirmation. It was expected that subjects' mathemagenic responses to the KR would vary as a function of the timing and completeness of the KR.

Accordingly, IKR, DKR and no KR were compared as a within-subjects factor, type of KR. The DKR interval was determined by a trials-delay technique (Jones and Bourne, 1964). The trials delay procedure as the name implies, filled the time between acquisition and KR with acquisition trials over other unrelated items or content. This technique of KR delay was best suited to the prose learning situation in that subjects were allowed to pace their own activities. The self pacing procedure

didn't lend itself to the imposition of time constraints or mechanical pacing devices. It was expected that DKR would lead to greater retention than IKR or no KR.

A KR uncertainty factor consisting of complete KR or incomplete KR was also introduced as a within-subjects variable. The specific stimulus characteristics of KR (presentation only of the right response choices versus right plus wrongs, question stems versus no stems, or a cue to the correct alternative) have been shown to influence subjects' mathemagenic responses. The latter two of the above manipulations for example place constraints on subjects to restructure or locate the missing information. The research reviewed would seem to support the expectation that incomplete KR (the correct answer underlined but no question stem) would lead to enhanced acquisition and retention, in comparison to complete KR, as long as the material to be reconstructed was within the memory span of subjects.

Testing and Retention

In the review of the research on KR it was noted that several DKR studies confounded delayed testing with testing immediately after KR. The influence of this confounding on the DKR effect was uncertain. More (1969) controlled for this confounding but failed to provide an estimate of the influence or size, if any, of the effect of immediate testing. That immediate testing has an effect on subsequent retention has been well established (Spitzer, 1931; Tiedeman, 1948; and LaPorte and Voss, 1975). Spitzer (1939) concluded that an immediate test after a learning

trial was similar in effect to another learning trial. LaPorte and Voss (1975) reported that there were several types of testing and/or review activities which if presented immediately after acquisition, enhanced delayed retention in comparison to presenting no activities after acquisition.

A study by Patrick (1970) failed to find an interaction between repeated posttesting and question position. In that study delayed testing was intentionally confounded with immediate testing. This confounding however, may have possibly masked potential long term differences in retention between factual pre- and postquestions interspersed in text. A study by Morasky (1969) reported that adjunct text postquestions led to better delayed retention than adjunct text prequestions when interpolated recall or testing was not an intervening event. Morasky (1969) did not find a difference between pre- and posttesting on an immediate test.

The present study was designed to replicate Morasky's (1969) findings. Half of the pre-, post-, and no question control group subjects were given both immediate and delayed tests of retention. The remaining control subjects only received the delayed retention test. It was also expected that differences in long term retention between the various between- and within-subjects conditions would be greater when subjects did not receive an immediate test.

Summary and Hypotheses

The preceding review discussed the results and theoretical explanations of a number of prose learning studies and documented the progress in the results being reported in the more recent studies. The generally persistent but weak trend for factual postquestioning to lead to greater incidental and at times, relevant learning than prequestioning was cited. The methodological problems involved in demonstrating the generally facilitating effects of postquestioning (cf. Ladas, 1973) were examined as were the various theoretical explanations of the factual question-position effect. Several failures to replicate the factual question-position effect were also noted.

The role of uncertainty in learning from text was discussed in relation to the hypothesized role uncertainty plays in the case of adjunct postquestions. The effects of delayed knowledge of results (DKR) and incomplete KR were examined in relation to the potential influence of these two categories of stimulus events on subjects' mathemagenic behaviors. The idea of manipulating prequestion uncertainty and post-acquisition feedback was proposed. Finally, the potential effects, on mathemagenic behavior, of immediate post-acquisition testing and pre-acquisition guessing were discussed. The specific hypotheses that were tested are stated more formally below.

Hypothesis 1. It was expected that the utilization of essentially the same text materials and questions as used by Frase (1967, 1968d) would increase the chance that Frase's results would be replicated.

Namely, Frase found that postquestioning led to greater relevant and incidental learning than prequestioning.

Hypothesis 2. A second expectation was that there might be an interaction between the between-subjects factor of times tested and question position. That is to say, there might be no difference between pre- and postquestioning on relevant learning on an immediate posttest. However, if an immediate posttest were not given, differences in relevant learning might appear on a delayed retention test. These results would agree with those of Morasky (1969). A somewhat parallel phenomena appears also to exist in the DKR (also called the delay-retention effect - DRE) literature. Sassenrath (1972), for example, noted that several DKR studies failed to find a DKR effect on an immediate test but did show differences on a delayed retention test.

Both hypotheses 1 and 2 were tested by analyzing the data of the replication control groups.

Hypothesis 3. It was expected that the most uncertain of the combination of the levels of the question and response alternative uncertainty factors (prequestions without stems and with two or four response alternatives) would lead to relevant and incidental learning equivalent to the postquestion control group. It was intended that the performance of the postquestion control group would serve as the standard with which to compare the performance elicited by the prequestion uncertainty manipulations. If the postquestion control surpassed the prequestion and no question controls, on incidental and relevant learning, and was in turn equalled in performance by the prequestion groups that received two

or four question alternatives without a prequestion stem, this would have been viewed as supporting the hypothesis regarding the role of uncertainty in adjunct postquestioning. In order to assess the relative performance of the prequestion uncertainty groups and to test the above hypotheses, it was planned to compare the six between-subject question and response alternative uncertainty groups directly to the replication control groups on both relevant and incidental learning. It was expected that these differences would manifest themselves on questions for which no KR had been received.

Hypothesis 4. A directional prediction was not made in regard to the effects of guessing. The study offered the opportunity to estimate the effect and since the two existing studies of guessing (Berlyne, 1966; Peeck, 1970) obtained conflicting results, a two tailed test was deemed appropriate. This secondary hypothesis involved a subset of the treatment and control subjects.

Hypothesis 5. The next hypothesis was to have been concerned with estimating if there was an optimal sequence of immediate, delayed, and no KR, in a reinforcement sense. The testing of this hypothesis was compromised by an unanticipated confounding.

Finally, a series of hypotheses were considered which were predicated on the hypothesized effects of prequestion and KR uncertainty and their potential interaction. These hypotheses were as follows:

Hypotheses re Between-Subjects Variables: 6. (6a) It was expected that uncertain prequestions (without stems) would induce subjects to explore in depth all of the content in a paragraph and subsequently lead

to greater incidental, and possibly relevant, learning than certain prequestions (with stems). (6b) It was expected intuitively that prequestions with four response alternatives would evoke more text processing than prequestions with one or two response alternatives and hence lead to greater incidental learning and possibly enhanced relevant learning. (6c) It was hypothesized that response alternative uncertainty and question uncertainty might interact. The one response alternative condition might be too easy with both certain (stems) and uncertain (no stems) prequestions and lead subjects to prematurely cease their information processing in both uncertainty groups. However, the question uncertainty groups should differ on incidental learning when four response alternatives are involved. (6d) It was expected that subjects who received an immediate posttest would outperform subjects who did not receive such a test, on a delayed test of retention. (6e) It was also posited that an immediate test might wash out the effects predicted in 6a, b. It was felt that these effects might show up more strongly on the delayed retention test among subjects who had not received an immediate test. Thus, it was felt that there was a chance the times tested factor would interact with both question and response alternative uncertainty on the delayed retention test.

Hypotheses re Within-Subjects Variables: 7. (7a) It was expected that posttest one would surpass posttest two on both relevant and incidental learning. (7b) It was expected that relevant learning would surpass incidental learning. (7c) It was expected that KR would surpass no KR. (7d) It was predicted that delayed KR would surpass

immediate KR. (7e) It was expected that incomplete KR (no stem) would lead to greater relevant learning than complete KR. (7f) It was hypothesized that type of KR (immediate or delayed) might interact with KR uncertainty (presence or absence of question stem). Complete KR might lead to greater relevant retention when KR is delayed. Incomplete KR might be most effective when presented immediately after the learning trial. (7g) There might possibly be an interaction between KR uncertainty and type of learning. Incidental learning might be debilitated with certain prequestions (with stems) if subjects concentrate on remembering the question stems in order to be better able to reconstruct the incomplete KR.

Hypotheses re Between- and Within-Subjects Variables: 8. (8a) It was noted in hypothesis 6e that there might be an interaction between the times tested factor and question uncertainty. It was felt that questions with stems (certain questions) would lead to superficial text processing whereas uncertain questions would induce a greater degree or depth of original learning. These differences might not appear on an immediate test and might be washed out when subjects are tested twice. However, the expected greater depth of original learning by uncertain questions could lead to greater retention of relevant content, in comparison to certain prequestions, when subjects only receive a delayed test of retention. It was expected that the above first order interaction might vary over the levels of KR and hence result in a second order interaction between question uncertainty, times tested, and type of KR. That is, the expected interaction between the factors

of question uncertainty and times tested might only occur at the no KR level of the type of KR factor. (8b) In a similar fashion it was thought that there might be a second order interaction between the factors of question alternative uncertainty, times tested, and type of KR. Questions with four response alternatives might lead to greater relevant retention, than questions with one or two response alternatives, at the no KR level of the type of KR factor, among subjects who only received the delayed test. (8c) In a like manner it was also hypothesized that there might be a first order interaction between the factors of times tested, and type of KR. The DKR effect might show up more strongly among subjects who only received the delayed retention test. (8d) Finally, it was hypothesized that it was likely that the factors of question uncertainty, and KR uncertainty would interact. It was expected that prequestions without stems (uncertain questions) might benefit from certain or complete KR whereas the combination of certain questions and certain KR might be debilitating to relevant learning. It was expected that certain and uncertain prequestions would reflect more equivalent learning when KR was uncertain or incomplete.

It should be noted that the hypotheses noted in sections 6, 7 and 8 above were highly provisional. The hypotheses were derived largely by analyzing systematically the presumed main effects of the between- and within-subjects variables and then projecting one step beyond to the interactions that would logically seem to follow. The hypotheses were based mainly on the assumption that uncertain prequestions and uncertain KR would constitute a challenge to the subjects and constrain

them to process the text information more thoroughly thus resulting in a greater degree of original learning, both incidental and relevant.

The immediate retention test was viewed somewhat as an additional learning trial which would add to the degree of original learning, and which would differentially benefit the certain and uncertain question groups. Hence it was thought that if the effects of question and response alternative uncertainty were relatively small, they might be more likely to be evidenced on a delayed retention test, if an immediate test was not given.

It was anticipated that the functional relationship between the uncertainty manipulations of the present study and learning and subsequent retention was not necessarily linear. Both Berlyne (1957), and Salomon and Sieber (1970) noted or inferred that beyond a certain point uncertainty might be debilitating to learning. In the present study for example, it was thought there was a chance that uncertain prequestions with four response alternatives in combination with delayed uncertain KR, could possibly constitute too uncertain a learning situation. The study proceeded in order to obtain baseline data relevant to determining optimal levels or combinations of uncertainty, as operationally defined, in regard to factual prose learning.

METHOD

Subjects

The 216 subjects used in the study came from three different sources in western Massachusetts; Greenfield Community College (37), Westfield State College (84), and the University of Massachusetts. Of the 95 students from the University of Massachusetts, 34 were swing-shift freshmen, and 61 were students enrolled in an educational psychology course. All of the students were enrolled in summer courses and participated as a course requirement. A large proportion of the students enrolled in the educational psychology course and from Westfield State College were graduate students. The treatment groups utilized 144 subjects while the replication control groups accounted for the remaining 72 subjects.

Materials and Design

The materials consisted of 18 paragraphs of factual prose content regarding the life of William James as written by G. Miller (1962) in "Psychology: The Science of Mental Life". The materials were the same as those used by Frase (1967, 1968d) with the exception that 18, instead of 20, paragraphs were used in order to incorporate equal numbers of paragraphs in the levels of the within-subjects factors. Accordingly, two paragraphs containing relatively easy questions were not used. Two multiple-choice four alternative questions were used from each paragraph. The original Frase questions contained five response alterna-

tives. On the basis of item analysis data collected in an earlier study (Frase, Patrick and Schumer, 1970), the most ineffective distractor was deleted from each question. Appendix A presents a complete sample of the experimental materials (18 prose paragraphs and 36 multiple-choice questions) along with coded instructions and a description of the counterbalancing procedures which will, along with the present explanation, enable the reader to reconstruct the entire set of experimental and control prose material packets.

Variations in Prequestions. The treatment subjects saw the prequestions as follows. Question 4.2 (see Appendix A) is presented to illustrate the prequestion variations that were dictated by the six combinations of the between-subjects levels of the question uncertainty (stem or no stem) and response alternative uncertainty (one, two or four alternatives) factors.

Certain Questions:

Variation 1. Stem and One Alternative

How did William James' critics regard him?

1. as an American barbarian

Is the above alternative true or false?

Indicate by circling either T F

Variation 2. Stem and Two Alternatives

How did William James' critics regard him?

1. as an American barbarian
2. as a fine philosopher

Circle the correct alternative 1 2

Variation 3. Stem and Four Alternatives

How did William James' critics regard him?

1. as an American barbarian
2. as a fine philosopher
3. as an intellectual gypsy
4. as a fine writer but a poor physician

Circle the correct alternative 1 2 3 4

Uncertain Questions:

Variation 4. No-Stem and One Alternative

_____?

1. as an American barbarian

Is the above alternative true or false?

Indicate by circling either T F

Variation 5. No-Stem and Two Alternatives

_____?

1. as an American barbarian
2. as a fine philosopher

Circle the correct alternative 1 2

Variation 6. No-Stem and Four Alternatives

_____?

1. as an American barbarian
2. as a fine philosopher
3. as an intellectual gypsy
4. as a fine writer but a poor physician

Circle the correct alternative 1 2 3 4

Times tested was also a between-subjects factor. Seventy-two subjects saw the six prequestion variations (12 subjects per question variation) and were then given an immediate test followed by a one week delayed test. Seventy-two additional subjects saw the same prequestion variations and then received only the one week delayed test. A given subject saw the same prequestion variation throughout acquisition. All subjects saw a single prequestion (.1 or .2), as the relevant content, immediately before its respective paragraph, over the series of 18 paragraphs.

The materials were varied within-subjects as follows. The type of KR factor dictated that subjects receive either immediate, delayed or no KR across three sets of six paragraphs each, respectively. The type of KR received was presented in three different orders (see Appendix A, Figure 1). Immediate KR was presented on the page immediately following the paragraph to which the KR was relevant. Delayed KR (DKR) was presented at the end of a series of six question-paragraph combinations. The question (Q), paragraph (P) and DKR pattern was as follows:

Q1, P1, Q2, P2, Q3, P3, Q4, P4, Q5, P5,
Q6, P6, DKR1, DKR2, DKR3, DKR4,
DKR5, DKR6, Q7, P7 .....etc.

The number of pages of content interpolated between the initial exposure to a question and DKR for that question varied for each of the six questions in the series. For example, ten unrelated pages of material were interpolated between Q1, P1 and DKR1, whereas only five pages were interpolated between Q6, P6 and DKR6. The average amount of interpolated content in the DKR condition was 7.5 pages.

Variations in Knowledge of Results. The within-subjects KR uncertainty factor specified that subjects receive either complete (certain) or incomplete (uncertain) KR. Question 4.2 illustrates that KR was conveyed by presenting all four response choices with the correct response indicated by underlining and the presence of an asterisk. KR uncertainty was varied by either including or deleting the question stem.

Certain KR:

Variation 1. Complete KR

How did William James' critics regard him?

*1. as an American barbarian

2. as a fine philosopher

3. as an intellectual gypsy

4. as a fine writer but a poor physician

Uncertain KR:

Variation 2. Incomplete KR

_____?

*1. as an American barbarian

2. as a fine philosopher

3. as an intellectual gypsy

4. as a fine writer but a poor physician

The two levels of KR uncertainty crossed with the immediate and delayed KR levels of the type of KR factor but obviously did not cross with the no KR level of the type of KR factor.

The remaining within-subjects factors were posttests and type of learning. The 72 subjects who received both an immediate and a one week delayed test afforded the opportunity to analyze these posttests as a within-subjects repeated measure. A distinction was drawn for all 144 experimental subjects, between the acquisition and retention of relevant content (18 criterion test questions cued by questioning during reading) and incidental content (18 criterion test questions not cued by questioning during reading). The criterion posttest (see Appendix B) therefore consisted of 36 items, 18 of which the subjects had previously seen (relevant) and 18 of which the subjects had not previously seen (incidental).

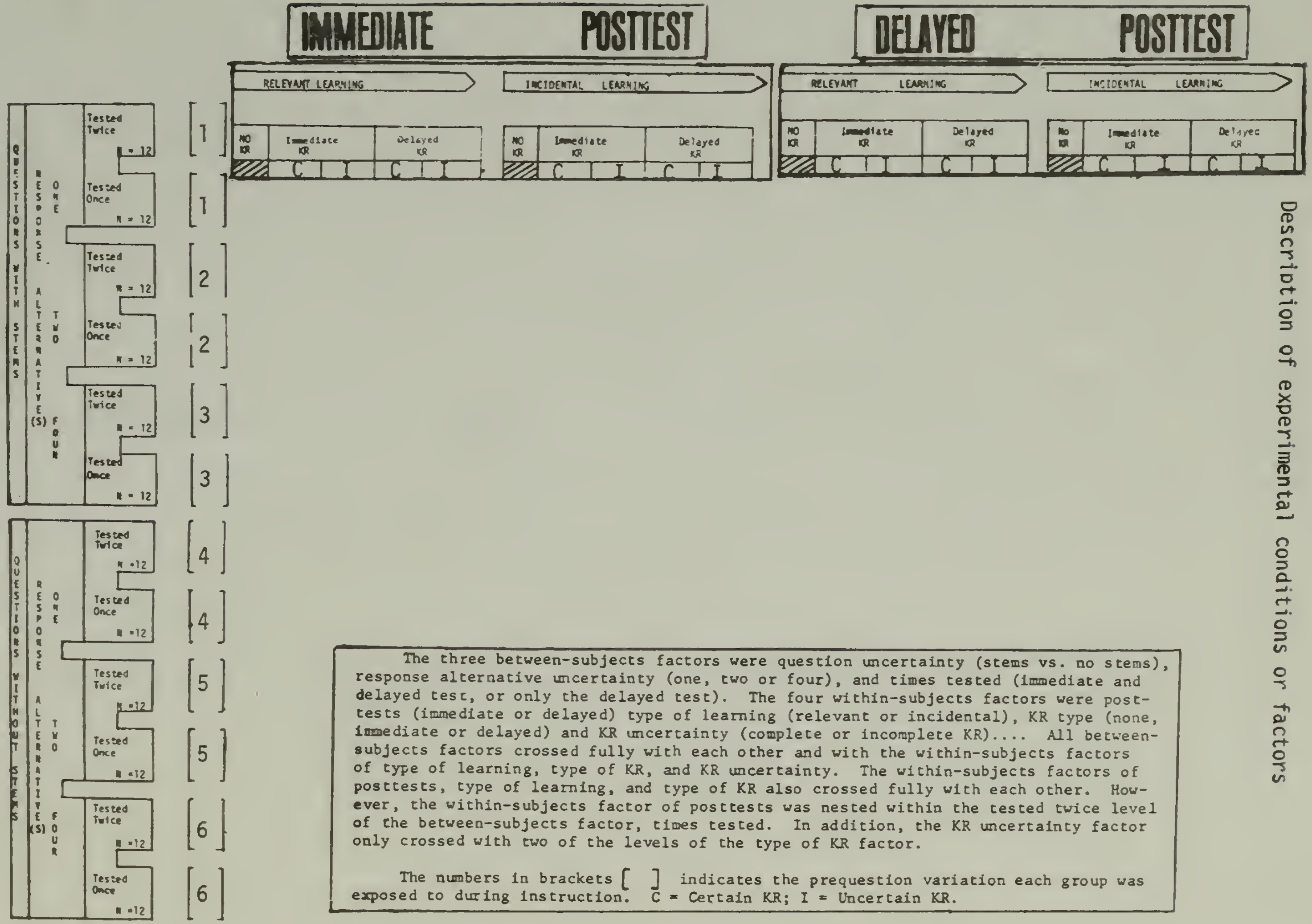
In summary the experimental materials were constructed so that one prequestion, of six possible variations, was presented before each of 18 paragraphs. Immediate, delayed or no KR, in either complete or

incomplete form, was presented after each paragraph or each set of six paragraphs, respectively. Several counterbalancing procedures were employed in the study to avoid a confounding of experimental effects with differences in individual question or item difficulty. The two questions from each paragraph served as both relevant and incidental content with equal frequency both within and between experimental groups. A single subject however, saw either all .1 questions or all .2 questions (see Appendix A question identification code) as the relevant content during acquisition or reading. Complete and incomplete KR was given with equal frequency for each question. The 18 paragraphs were divided into three consecutive subsets of six each. Within each experimental group each subset in turn served as the content for which immediate, delayed or no KR was received, respectively. The content over which the different types of KR was received was counterbalanced within as well as between groups. All subjects read the 18 paragraphs in the same order and then received either an immediate and a delayed posttest, or only a delayed posttest. The same 36 item posttest was used for both test administrations.

Experimental Groups Design. The experimental design of the study is implicit in the above description. Table 1 however, presents a more succinct description of the experimental conditions or factors. It can be seen that there were three between-subjects and four within-subjects factors in the experimental group design. Table 1 illustrates how the data were ordered for the statistical analysis but does not directly illustrate the sequence in which the 144 individual treatment

Table 1

Description of experimental conditions or factors



The three between-subjects factors were question uncertainty (stems vs. no stems), response alternative uncertainty (one, two or four), and times tested (immediate and delayed test, or only the delayed test). The four within-subjects factors were posttests (immediate or delayed) type of learning (relevant or incidental), KR type (none, immediate or delayed) and KR uncertainty (complete or incomplete KR).... All between-subjects factors crossed fully with each other and with the within-subjects factors of type of learning, type of KR, and KR uncertainty. The within-subjects factors of posttests, type of learning, and type of KR also crossed fully with each other. However, the within-subjects factor of posttests was nested within the tested twice level of the between-subjects factor, times tested. In addition, the KR uncertainty factor only crossed with two of the levels of the type of KR factor.

The numbers in brackets [ ] indicates the prequestion variation each group was exposed to during instruction. C = Certain KR; I = Uncertain KR.

group subjects encountered the materials. The sequence in which the subjects encountered the text materials can be visualized if Figure 1 from Appendix A is mapped on to Table 1. The number in brackets in Table 1 indicates the prequestion variation (see page 49) a between-subjects group saw during acquisition. If one keeps the prequestion variation in mind and then reconstructs or visualizes the 12 sequences of KR and KR uncertainty portrayed for the 12 subjects in Figure 1 (Appendix A), the acquisition experiences of the 12 subjects in each of the 12 between-subjects groups can be visualized.

Replication Control Design. For all practical purposes, the 72 subjects in the replication control group constituted a separate study. Table 2 presents a description of the replication control conditions or factors. Six between-subjects groups resulted from the combination of the question position and times tested factors, subjects received either questions immediately before or after the 18 paragraphs or no questions during acquisition. Subjects were given only the delayed test (tested once) or both the immediate and the delayed test (tested twice). Half the subjects in each of the pre- and postquestion groups saw the .1 questions during acquisition while the other half saw .2 questions as relevant content during acquisition. This counterbalancing equated for the effects of average item difficulty in the comparative levels of relevant and incidental learning.

The four pre- and postquestion groups saw question variation three as they read through the prose materials. The performance of the two between-subjects control groups, not exposed to questions during

Table 2

Description of replication control conditions or factors

Between Ss Conditions			Within Ss Conditions			
Question Position	Times Tested: Once or Twice		Posttests	Immediate Posttest		Delayed Posttest	
			Type of Learning	Relevant Learning	Incidental Learning	Relevant Learning	Incidental Learning
Pre Questions	Tested Twice N = 12	[3]					
	Tested Once N = 12	[3]					
Post Questions	Tested Twice N = 12	[3]					
	Tested Once N = 12	[3]					
No Questions	Tested Twice N = 12						
	Tested Once N = 12						

Both between-subjects factors, question position and times tested, cross with each other and with the within-subjects factor of type of learning. The within-subjects factors also cross with each other. However, the within-subjects factor of posttests is nested within the tested twice level of the between-subjects factor, times tested.

The number in brackets [ ] indicates the prequestion variation the groups saw during instruction.

acquisition, was arbitrarily labeled as relevant or incidental for the purpose of crossing the no question group with the within-subjects factor of type of learning in a repeated measure analysis of variance. Half of the subjects in each of the no question groups were randomly selected and their scores on the .2 test questions were arbitrarily labeled as relevant learning. For the remaining subjects the .1 test items were labeled as relevant learning. The 72 replication control subjects read the same paragraphs and received the same posttest as the 144 experimental subjects.

Procedure

For the purpose of presentation, the experimental materials were assembled in booklet form with each prequestion, paragraph, and KR item printed on a separate page (3½ x 8½). An instruction sheet was attached to the top of each packet. It was necessary to use three sets of instructions to accommodate the slight differences in procedure existing among the replication control subjects, and experimental subjects receiving one, or more than one, prequestion response alternative. Appendix C presents a sample of the three sets of instructions.

In brief, subjects were told: (a) that the study was concerned with how people learn from written materials, (b) that they were to read each page in order without looking back at a page, (c) that they could spend as long as they wanted on a page, (d) that they should guess at the correct response to each question prior to reading a paragraph and indicate their answer by circling the appropriate alternative (experimental subjects only), and (e) that they should proceed immediately

to the 36 item posttest or to the questionnaire upon completion of reading.

The instructional booklets and the other experimental materials (posttest and questionnaire) contained printed directives as needed. In that regard, Appendix C also presents a sample of the Cover Sheet (subject's name, identification code, and reading and quiz times) that was attached to each packet, and a sample of the first and last pages which were common to all instructional packets.

Apart from the instructions which subjects were asked to read for themselves, the following standardized directions were read to all groups:

> "As part of your course requirement you are being asked to participate in a study relevant to educational psychology. The study is concerned with how people learn from written materials. You will be asked to time yourself during the task, but time per se, isn't critically important. <u>You may take as much time as you need to complete the task</u>. Past subjects have taken anywhere from ½ hour to 1 hour to complete the task.
>
> "Not all of you will receive the same task, or the same instructions, for that matter.
>
> "The experimental materials that you will receive consist of:
>
> (DEMONSTRATE)

1. A Direction Sheet.....

   .....Read the direction sheet very carefully--- take 4 or 5 minutes if you have to. Especially attend to paragraphs two and three.

2. A Cover Sheet.....

   .....Which provides space to record your name, and the times requested. The cover sheet also contains a nine (9) digit code number which tells us who you are for the purposes of this study.

3. An Instruction Booklet.....

   .....Which contains the materials that you will be asked to read for the purposes of this study.

"That's about it.....I'll pass out the materials now... But I'd like to caution you again to take your time in reading the directions. Attend especially to paragraphs two and three on the direction sheet. If you have any questions after reading the instructions, raise your hand. OK.

"Thanks for your cooperation."

The experimenter then passed out the experimental materials which had been randomly ordered in advance.

After reading the instructional booklet the subjects were directed (last booklet page) to return their booklet to the experimenter in return for the posttest. On the basis of a predetermined code the subjects were then given either the 36 item criterion posttest

(see Appendix B) or the 17 item questionnaire (see Appendix D). All subjects however, read the materials under the impression they would be tested immediately. One week later the experimenter returned to the class groups for the delayed testing phase of the study. Subjects who were tested at time one were tested again (same criterion test) at time two and were also asked to fill out the experimental questionnaire. Subjects who received the questionnaire at time one were given the posttest at time two.

The entire study was conducted within a fifteen day period. Seventeen intact groups of subjects were involved. It took five days to schedule the 17 groups through the first phase of the study. The 216 experimental and replication control instructional booklets were randomly ordered in advance and were distributed in order to the subjects as the various groups were run. Each group was visited a week later and the second part of the study was completed. It was necessary to rerun eight of the instructional booklet conditions for the following reasons: it was suspected that three subjects had language problems; three subjects marked their booklets incorrectly, and misunderstood instructions; and, two subjects dropped out of their courses between time one and time two. Fourteen subjects received the delayed test from one to four days later than the planned seven day delay, due to the subjects absence from class at the time of the experimenter's second visit. In addition, one group of 11 subjects was tested after a delay of eight, instead of seven, days due to an unexpected change in class schedule. Thus, a total of 25 subjects received the delayed

test from 8 to 11 days after the first session. These subjects were randomly distributed among the experimental and replication control conditions and it was concluded this deviation from the planned delay period did not effect the purpose or results of the study.

RESULTS

Preliminary Considerations

Tests for Homogeneity of Variance. Cochran's test for homogeneity of variance (Myers, 1972) was applied to the time scores and to the relevant and incidental learning scores of the experimental and replication control subjects. Separate analyses were run on the dependent measures for both the immediate and the delayed test data. The units of analysis in each instance were the variances of the smallest cells represented in the factorial expansion of the levels of the between-subjects variables. In every instance the assumption of homogeneity of variance was supported.

Test-Retest Reliability. The test-retest reliability coefficient for the 72 experimental subjects who were given the immediate and delayed posttest was .82 for the relevant content, .78 for the incidental content, and .83 for the combined relevant and incidental content.

Data. The data that was generated from the study is presented in Appendix E. Table E.1 presents the group means, standard deviations and percent correct for the replication control subjects, along with a comparison of the level of relevant and incidental learning achieved in earlier studies. Tables E.2 and E.3 present the treatment group means, standard deviations, and percent correct for all treatment conditions, for the immediate and delayed posttests, respectively. Table E.4 presents the treatment and control reading time data. Table E.5 presents the treatment and control data in raw form.

Summary tables of the analyses of variance which were performed on the data are presented in Appendix F.

Analyses of Within Control Group Differences

Hypothesis 1. An analysis of variance (ANOVA) was performed on the immediate and delayed retention test data of the 36 replication control subjects who were tested twice in order to determine if Frase's (1967, 1968d) results would be replicated. The analysis incorporated the following factors: question position (prequestions, postquestions, or no questions), type of learning (relevant or incidental), and post-tests (immediate or delayed). The latter two factors were within-subjects factors. Table F.1 presents a summary of the above ANOVA. Table E.1 provides the means relevant to the analysis.

Contrary to earlier studies (Rothkopf 1966; Frase 1967, 1968a, d), postquestions did not lead to greater incidental or relevant learning than prequestions or no questions. This result, although not totally unexpected was still somewhat of a surprise. At the very least, it was expected that postquestions would lead to greater incidental, if not relevant, learning than prequestions. As was expected, the difference between the immediate and the delayed posttests was significant ($F = 19.78$, $df = 1/33$, $p < .01$; immediate and delayed posttest $\bar{X}$s = 11.75 and 10.76, respectively). Relevant learning also exceeded incidental learning ($F = 22.31$, $df = 1/33$, $p < .01$; relevant and incidental $\bar{X}$s = 12.37 and 10.13, respectively).

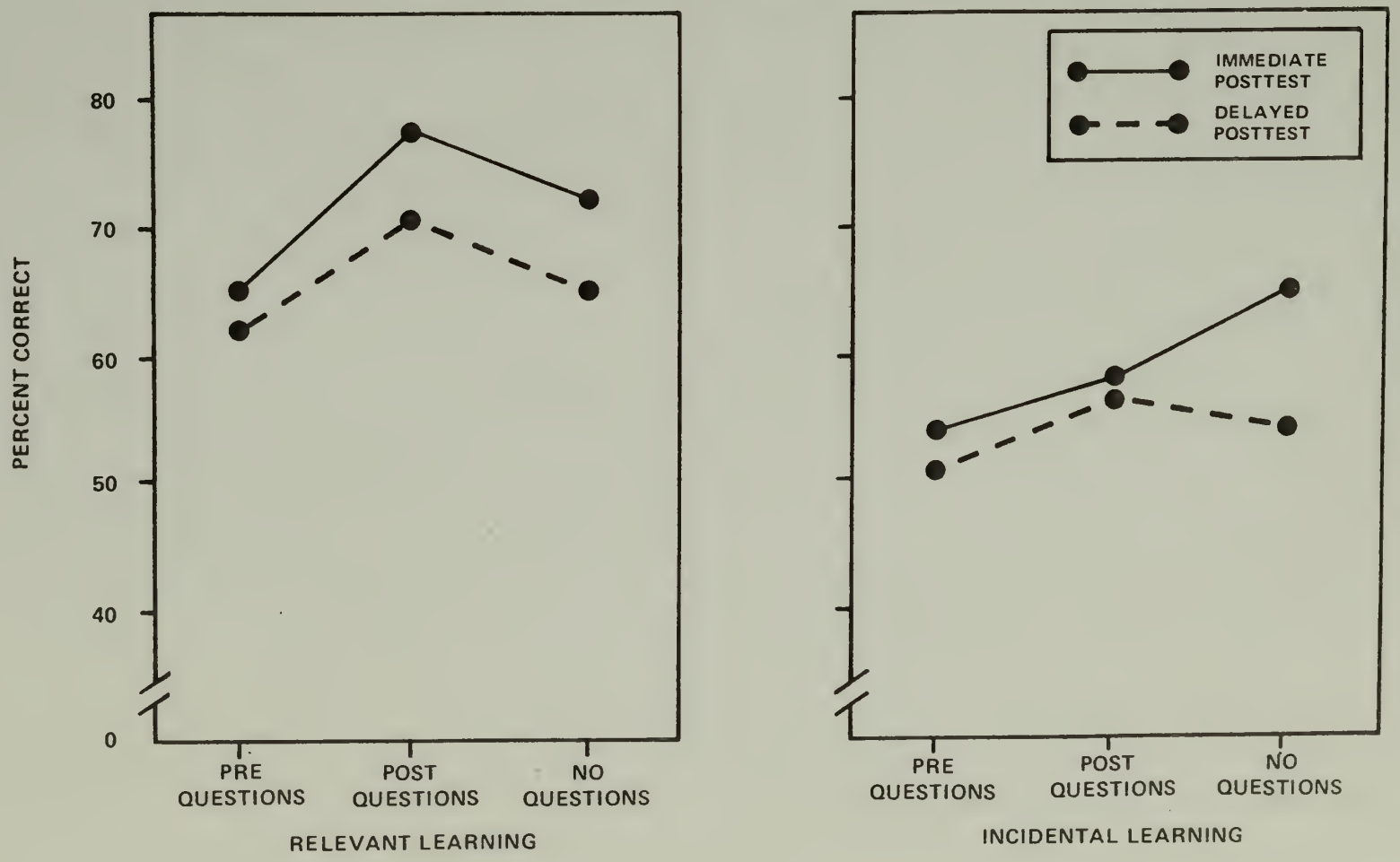
Table F.1 also shows that there were interactions between

posttests and type of learning ($F = 4.09$, $df = 1/33$, $p < .05$), and between posttests, type of learning and question position ($F = 3.75$, $df = 2/33$, $p < .05$). Figure 1 reveals the source of both interactions. Figure 1 shows that the replication control subjects' retention of the relevant content dropped more than their retention of the incidental content in the one week interval that separated the immediate and delayed posttests. This difference in retention of relevant and incidental content accounted for the posttests by type of learning interaction. The no question control group however proved to be the exception to this difference in retention of relevant and incidental content and was thus responsible for the interaction among posttests, type of learning and question type. The no question control group evidenced equivalent retention decrements in both types of learning.

Hypothesis 2. The present study postulated that an immediate test of factual retention constitutes an additional learning trial of sorts and as such might possibly wash out potential long term differences between pre- and postquestions. This hypothesis led to the expectation that differences between pre- and postquestions would be more likely to show up on a delayed retention test, if an immediate retention test were not given, especially if the effects were weak. This hypothesis was tested by an ANOVA consisting of the following factors: question position (prequestions, postquestions, or no questions), times tested (immediate and delayed test, or delayed test only), and type of learning (relevant or incidental). The latter factor was a within-subjects factor and the ANOVA was run on

FIGURE 1

INTERACTION BETWEEN QUESTION POSITION, POSTTESTS, AND TYPE OF LEARNING (CONTROL CONDITIONS)



the delayed posttest data (see Table E.1 for $\bar{X}$s and SDs).

The summary of the ANOVA presented in Table F.2 revealed that contrary to Morasky's (1969) findings, no differences in delayed retention were found among the pre-, post- or no question replication control groups, even though half of the between-subjects groups were being tested for the first time on the delayed test. In brief, there was no interaction between the factors of question position and times tested. There were significant main effects for the factors of times tested ($F = 35.30$, $df = 1/66$, $p < .01$; $\bar{X}$s for subjects tested twice or only once were 10.76 and 7.51, respectively), and type of learning ($F = 23.36$, $df = 1/66$, $p < .01$; $\bar{X}$s for relevant and incidental content were 10.00 and 8.27).

Comparisons of Experimental and Replication Control Groups

One of the major a-priori purposes of the study was to compare the performance of the six between-subjects treatment groups to the performance of the postquestion replication control group in order to arrive at an estimate of the predicted mathemagenic positive behaviors elicited by the uncertain question conditions. It was planned that the postquestion control would serve as a standard of mathemagenic positive behavior. It was expected that the postquestion control would evidence not only greater incidental, but also possibly greater relevant learning than the prequestion and no question replication control groups. The replication control ANOVAs summarized in Tables F.1 and F.2 revealed that the above expectation was not substantiated. There

were no significant differences among the prequestion, postquestion and no question replication control groups on either type of learning, on either the immediate or the delayed posttest. Hence, the postquestion control was not available as a referent of positive mathemagenic performance. If the between-subjects treatment groups' performance had been in the expected direction, this would have complicated one of the primary a-priori planned comparisons of the study.

The differences among the replication control group means, although not significant, were generally in the expected direction. In most cases the postquestion group mean was slightly greater than the no question group mean which in turn was usually either greater than or equal to the prequestion group mean. Given the outcomes that occurred with the treatment conditions, it was decided it would still be meaningful to proceed with the planned comparisons.

Hypothesis 3. Dunnett tests (Myers, 1972) were conducted to compare the six between-subjects treatment combinations with the postquestion control at each of six data points dictated by the combinations of the three factors; times tested, type of learning, and posttests. The former and latter factors were not fully crossed, hence six, and not eight, combinations were possible. Table F.3 presents the one-way ANOVAs that were conducted (six treatment, and one postquestion control group in each ANOVA) on the six data sets cited above to obtain the appropriate error terms for the six Dunnett tests. Table 3 provides the means which were involved in the analyses and indicates the Dunnett values which were required for significance

Table 3

Treatment and postquestion control means and SDs for groups compared in Dunnett tests

			Treatment Groups							
			Certain Question: One Alternative	Certain Question: Two Alternatives	Certain Question: Four Alternatives	Uncertain Question: One Alternative	Uncertain Question: Two Alternatives	Uncertain Question: Four Alternatives	Postquestion Replication/ Control Group	
Immediate Posttest: Ss tested twice	Relevant Content	$\bar{X}$	5.1	4.6	3.9	4.0	4.2	3.6*	4.7	(Data set 1)**
	Incidental Content	SD	(.90)	(1.38)	(1.56)	(.74)	(1.40)	(1.44)	(.65)	
	Relevant Content	$\bar{X}$	3.8	3.4	3.2	3.2	2.9	3.0	3.5	(Data set 2)
	Incidental Content	SD	(1.34)	(1.62)	(1.27)	(1.40)	(1.62)	(1.48)	(.74)	
Delayed Posttest: Ss tested twice	Relevant Content	$\bar{X}$	4.8	4.0	3.8	3.9	3.8	3.3	4.2	(Data set 3)
	Incidental Content	SD	(1.27)	(1.71)	(1.22)	(1.24)	(1.48)	(1.37)	(.93)	
	Relevant Content	$\bar{X}$	3.3	3.2	3.1	2.4	2.8	2.1*	3.5	(Data set 4)
	Incidental Content	SD	(1.67)	(1.90)	(1.16)	(1.08)	(1.54)	(.90)	(.84)	
Delayed Posttest: Ss tested only once	Relevant Content	$\bar{X}$	4.3*	3.4	3.3	3.5	2.5	2.4	3.1	(Data set 5)
	Incidental Content	SD	(1.14)	(1.16)	(1.48)	(1.51)	(1.93)	(1.16)	(.68)	
		$\bar{X}$	1.8	1.8	2.2	2.2	1.3*	1.8	2.2	(Data set 6)
		SD	(1.36)	(.87)	(1.27)	(1.11)	(.98)	(.75)	(.73)	

(* denotes individual comparisons which approached significance at dp <.D5 1-tailed)

(**see Table F.3: ANOVA 1 was performed on Data set 1, etc.)

Dunnett Statistic:	$\bar{Y}_T - \bar{Y}_C > [\sqrt{MSS/A\ (\frac{1}{n_T} + \frac{1}{n_C})}]\ d_{\alpha, a(n-1)}$
Dunnett Test re Data set 1:	$\bar{Y}_T - \bar{Y}_C > [\sqrt{1.45\ (\frac{1}{12} + \frac{1}{12})}]\ 2.34$ $\bar{Y}_T - \bar{Y}_C > 1.12$
Dunnett Test re Data set 5:	$\bar{Y}_T - \bar{Y}_C > [\sqrt{1.81\ (\frac{1}{12} + \frac{1}{12})}]\ 2.34$ $\bar{Y}_T - \bar{Y}_C > 1.25$

NOTE: $d.D5_{7,77} = 2.34$; $d.D25_{7,77} = 2.68$; $d.D1_{7,77} = 2.96$

	Values required for significance $\bar{Y}_T - \bar{Y}_C >$	
	$p < .05$ 1-tailed	$p < .05$ 2-tailed
Data set 1	1.12	1.29
Data set 2	1.29	1.48
Data set 3	1.24	1.43
Data set 4	1.26	1.45
Data set 5	1.25	1.44
Data set 6	.96	1.10

at $p < .05$ for both the one and two-tailed tests. The treatment group means in Table 3 represent performance on the six paragraphs for which no KR was given. The Dunnett comparisons were performed on the no KR data in order to avoid the additive effect KR contributed to the treatment group means.

Table 3 shows that only a few of the treatment control differences even approached significance. If the Type I error rate for the entire set of comparisons (error rate experimentwise [EW]) had been set at .10 or .12, and the criteria of a two-tailed test applied, it's fairly certain that none of the differences would have approached significance. It was interesting to observe however, that the differences that did approach significance, on the one-tailed criteria, were in the opposite direction than was predicted. The performance of the certain question (with stem) groups tended to be in a direction equal to or greater than the postquestion control. The performance of the uncertain question (without stem) groups tended to be in a direction less than the post-question controls.

The reversal in expected performance between the certain and uncertain questions is depicted in full, visually, in Figures 2, 3 and 4. These figures present separate plots of the performance of the between-subjects treatment groups on the KR-paragraphs (12) and on the no KR-paragraphs (6). The plots represent the percent of the total possible score, six or twelve, that was achieved. The between-subjects replication control group means for relevant and incidental performance are plotted at points along the side of each of the figures.

FIGURE 2
TREATMENT VERSUS CONTROL COMPARISONS
IMMEDIATE POSTTEST

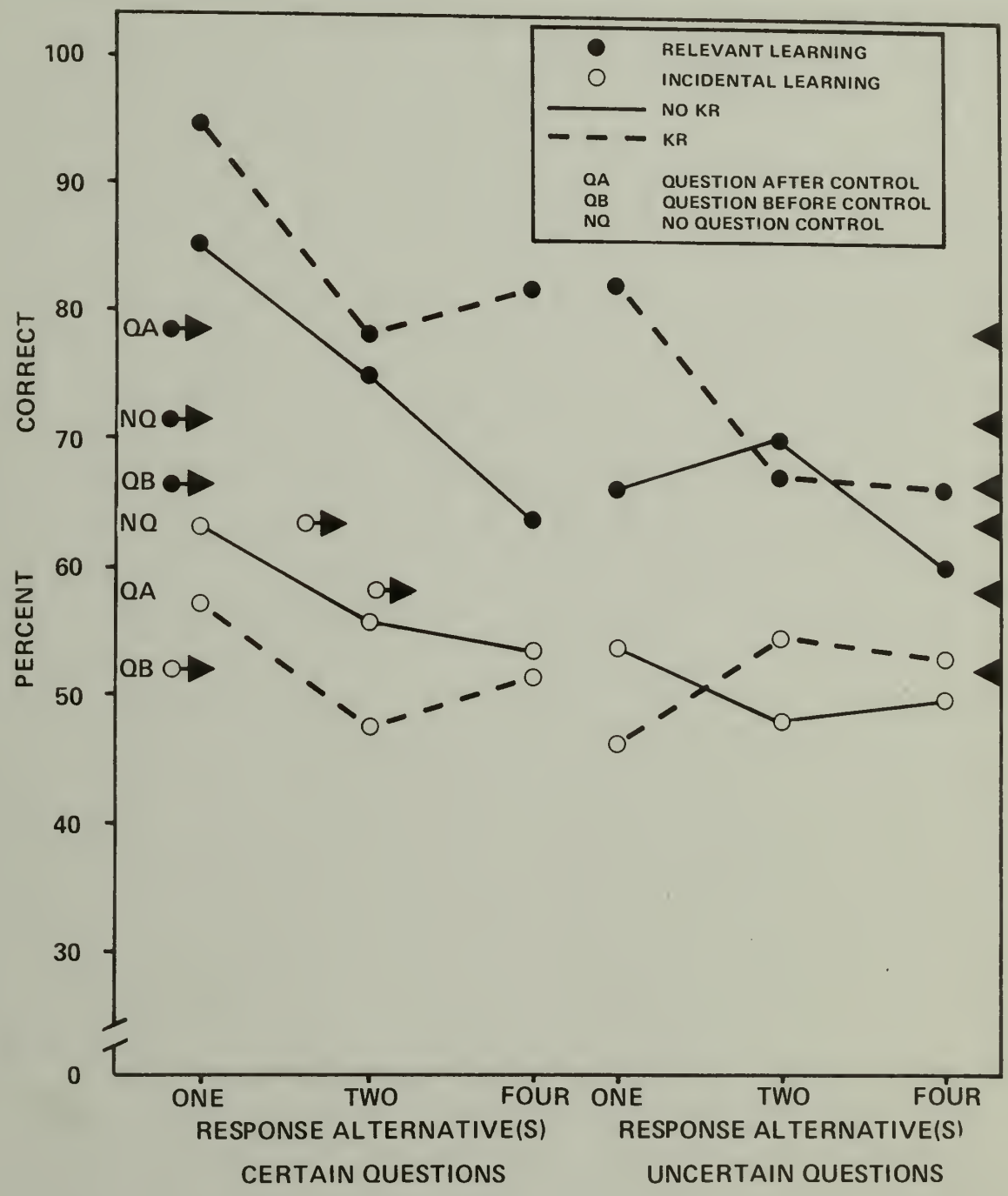


FIGURE 3
TREATMENT VERSUS CONTROL COMPARISONS
DELAYED POSTTEST: Ss TESTED TWICE

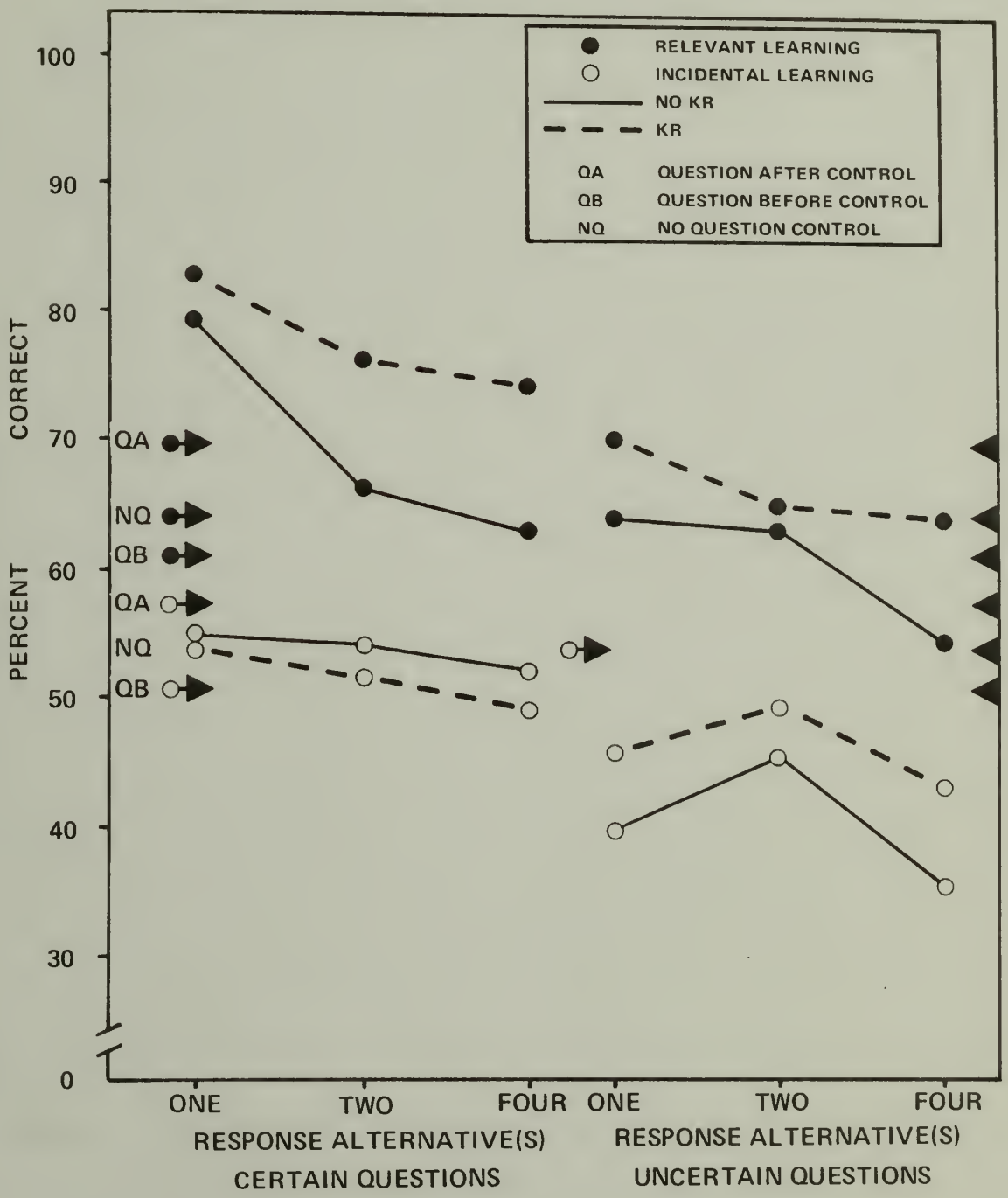
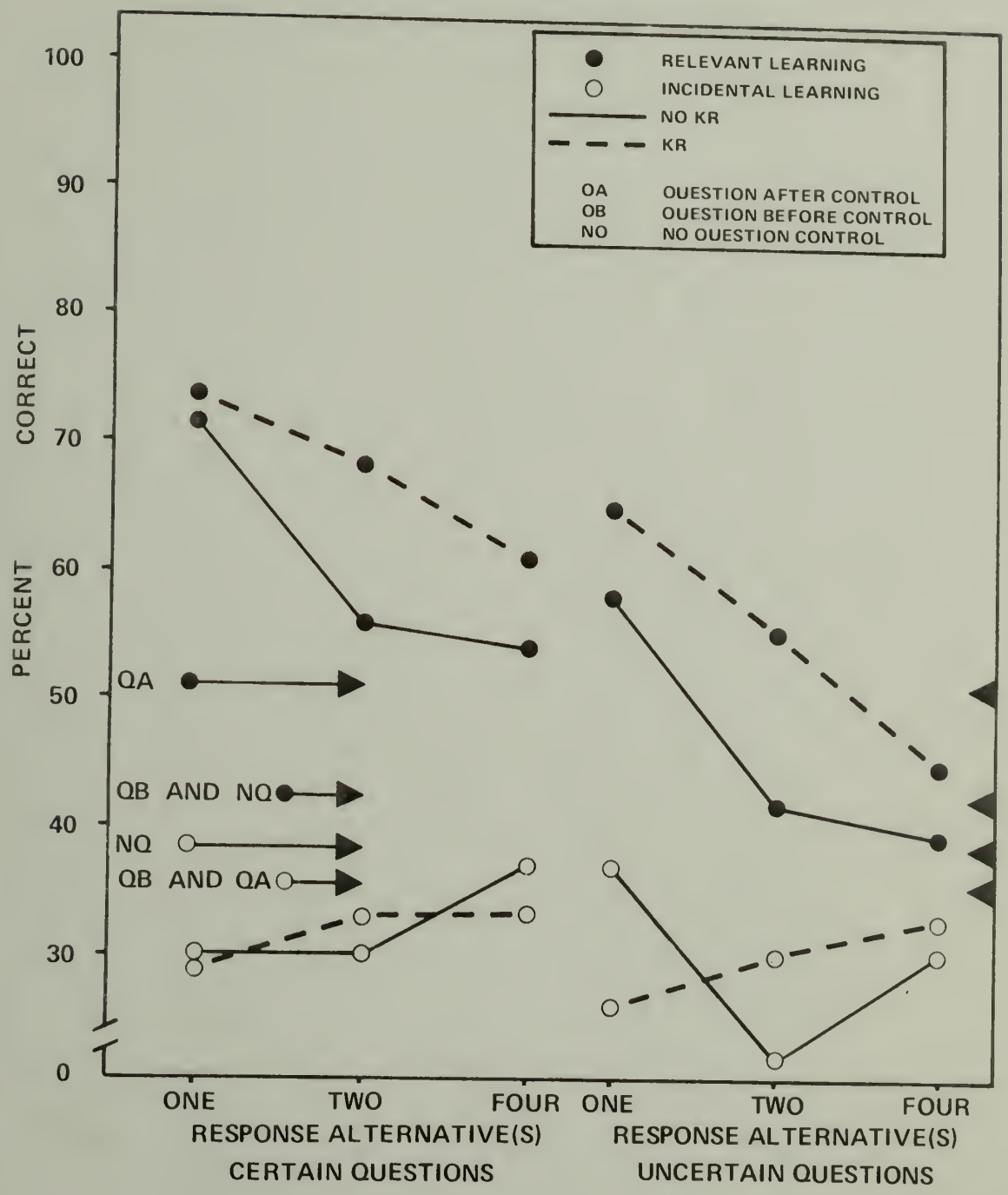


FIGURE 4
TREATMENT VERSUS CONTROL COMPARISONS
DELAYED POSTTEST: Ss TESTED ONCE



It can generally be seen that KR consistently benefited the relevant test performance of the treatment groups. It can also be seen that the uncertain question groups tended to fare less well than the certain question groups on both relevant and incidental learning. In addition, the uncertain question groups tended to perform less well than the replication controls on incidental learning.

In summary however, the major point relevant to hypothesis 3 was that the certain and uncertain question group means, based on content for which no KR was received, did not differ significantly from the postquestion control means on either relevant or incidental learning. This failure to find any differences was consistent for both the immediate and delayed posttest and also did not vary with regard to whether subjects were tested twice or only once.

Implicit within the data plotted in Figures 2, 3 and 4 are a number of post-hoc comparisons. Data sets, similar to those presented for the no KR treatment data and the postquestion control (36 separate comparisons in Table 3) could be generated for the treatment groups, and the prequestion, and no question replication controls. Preliminary analyses indicated that none of the potential 72 separate comparisons suggested above would be significant, especially if an EW rate of $p < .10$ or $p < .15$ were established for the entire set of post-hoc comparisons (Petrinovich and Hardyck, 1969). The preliminary analyses indicated that the only comparisons that might approach significance would be as follows. The delayed posttest, no KR, relevant learning of the certain question - one response alternative group that was

tested only once (see Figure 4) would tend to be greater than the relevant learning of the postquestion, prequestion and no question replication control groups.

Hypothesis 4. The effects of guessing were appraised by comparing treatment group subjects who received certain questions (with stems) with two or four response alternatives, to the prequestion replication control subjects who had not been instructed to guess. The immediate posttest performance of these two groups was compared on the data over which the treatment subjects had not received KR. No KR was experienced over different sets of paragraphs by different treatment subjects, therefore, paragraph set (see Appendix A: Figure 1) was included, in a forced manner, as a second between-subjects variable in order to check on differences in difficulty among paragraph sets. Table F.4 presents a summary of the ANOVA comparing the guess and no guess conditions. Table 4 presents the means and standard deviations for the groups that were compared. No significant differences were found for either guessing ($F = .40$, $df = 1/54$, $p < .50$) or paragraph sets ($F = 2.05$, $df = 2/54$, $p < .12$).

Given that the prequestion control means in Table 4 were not independent, a t-test was also conducted to compare the relevant performance of the 12 prequestion control subjects (averaged across paragraph sets) to the performance of the treatment group subjects (averaged across treatment groups and paragraph sets). The observed t of -.54 was not significant ($t < -2.1$ or $t > 2.1$ required for significance when $\alpha = .05$ two-tailed, and $N_1 + N_2 - 2 = 18$). It should

Table 4

Means and SDs for treatment guess conditions and control no guess conditions

		N	Mean	SD
Prequestion Treatment Subjects: Guess Condition	Paragraph Set 1	8	4.38	.74
	Paragraph Set 2	8	3.50	1.41
	Paragraph Set 3	8	4.88	1.88
Prequestion Control Subjects: No Guess Condition	Paragraph Set 1	12	4.17	1.26
	Paragraph Set 2	12	3.67	1.61
	Paragraph Set 3	12	4.17	1.64

be noted however, that the results reported in this section were based on a relatively small number of subjects. The design of the study did not permit a larger sampling relative to this hypothesis, hence the hypothesis was considered to be of secondary or exploratory interest.

Analyses of Experimental Groups

In order to assess the effects of the factors incorporated in the treatment group data presented in Tables E.2 and E.3, it was necessary to perform four separate ANOVAs. Table F.5 presents the results of a 2 x 3 x 2 between-subjects by 2 x 2 x 2 within-subjects factorial ($Q_2A_3T_2/L_2K_2C_2$). The factors were question uncertainty (Q: stems versus no stems), response alternative uncertainty (R: one, two or four response alternatives per prequestion), times tested (T: immediate and delayed test, or delayed test only), type of learning (L: relevant or incidental), type of KR (K: immediate or delayed KR), and KR uncertainty (C: KR with or without [complete or incomplete] the question stem). Table F.6 presents the results of a 2 x 3 x 2 between-subjects by 2 x 3 within-subjects factorial ($Q_2A_3T_2/L_2K_3$) similar in design to the above ANOVA with two exceptions. All three levels of the type of KR factor were included (K: immediate, delayed, or no KR) and the KR uncertainty factor was dropped. The analyses reported in Tables F.5 and F.6 were performed on the delayed posttest data.

Two further analyses were performed to compare immediate and delayed posttest performance and to check on interactions between the within-subjects factor of posttests (P: immediate or delayed) and the other factors. These ANOVAs were similar to the two reported above with the exceptions that the between-subjects factor of times tested (T) was dropped, and the within-subjects factor of posttests (P) was included, in both ANOVAs. Table F.7 thus presents the results of a 2 x 3 between-subjects by 2 x 2 x 2 x 2 within-subjects factorial ($Q_2A_3/P_2L_2K_2C_2$). Table F.8 presents the results of a 2 x 3 between-subjects by 2 x 2 x 3 within-subjects factorial ($Q_2A_3/P_2L_2K_3$). Table 6, which is presented later in this report, presents a summary of the sources of variance that were found to be significant in the ANOVAs reported in Tables F.5, F.6, F.7, and F.8. These ANOVAs will be referred to as ANOVAs 5, 6, 7, and 8.

These results will be reported in detail after the status of hypothesis 5 is explained. This hypothesis involved the order of KR factor which was dropped.

Hypothesis 5. The order of KR factor was expected to either have a reinforcement effect on the acquisition trials not involving KR or possibly to have no effect at all. That is, it was postulated that in terms of subjects' achievement on the set of six questions for which no KR was received, the three levels of the order factor (see Appendix A: Figure 1) would order themselves O_1, O_2, and then O_3, from most to least, in regard to both relevant and incidental achievement. Conversely it was hypothesized that the learning situation per se, might

not reflect enough length or task difficulty to necessitate any adaptivity in terms of subjects' mathemagenic responses and that an order effect would not turn up as a consequence of the differential reinforcement.

The initial analyses of the data, which included all of the between- and within-subjects factors, were confusing in that the order factor appeared to interact significantly with most of the other factors, in a manner that appeared unsystematic. An analysis was subsequently performed using only that test data for which no knowledge of results had been received. In this analysis the effect of order proved significant at the .01 level. Various interactions between order and the other factors also were significant. The results of the main effect were confusing because the third level of the order effect led to greater acquisition of the overall no KR content than the first or second orders; just the opposite of what was expected. The apparent potency and ambiguity of the order factor led to a reinspection of the design of the study. The 18 paragraphs had been broken up into three sequential sets of six each. It was discovered that the paragraph set - KR combinations were nested within levels of the order factor. In short, question sets and type of KR were confounded within levels of order. Table 5 presents a graphic display of the confounded situation and an example of what a nonconfounded setup would look like. In the present design the no KR condition does not occur at each one of the three sets of paragraphs within a given level of order. To avoid the confounding, the design in the

Table 5

Explanation of confounding of
type of KR and sets of paragraphs within levels of order

Example of Present Design:

	Paragraph Sets:		
	Set 1	Set 2	Set 3
Order 1	I-KR	D-KR	No-KR
Order 2	D-KR	No-KR	I-KR
Order 3	No-KR	I-KR	D-KR

Example of Nonconfounded Design:

	Paragraph Sets:				
	Set 1	Set 2	Set 3	(Set 1)	(Set 2)
Order 1	I-KR	D-KR	No-KR		
		I-KR	D-KR	No-KR	
			I-KR	D-KR	No-KR
Order 2	I-KR	D-KR	No-KR		
		I-KR	D-KR	No-KR	
			I-KR	D-KR	No-KR
Order 3	etc. . .				

Note: Type of KR: I-KR = Immediate KR, D-KR = Delayed KR, No-KR = Absence of KR.

Inspection of Table 5 shows that within the present design, type of KR and paragraph sets do not cross within each level of the order factor.

bottom half of Table 5 would have to be incorporated. Given that the order effect involves specific sequences of KR the latter design would require that the content material be logically amenable to being presented serially in different orders, once it has been divided into three sets.

Within the present design a significant order effect resulting from an analysis of the no KR data could mean two things, (1) either that the orders do significantly effect acquisition or (2) that the three different sets of paragraphs present at the three order - no KR combinations differed in average difficulty. In order to test the latter hypothesis a dummy analysis was run on the replication control group data.

The replication control group data was analyzed as if the levels of KR had been present for the different sets of paragraphs. That is, a false within-subjects factor, KR was included in the analysis. The false KR factor proved to be significant ($p < .01$) with the no KR level surpassing the immediate and delayed levels of KR. Of course, since KR was not a real factor this result simply corroborated the fact that the first set of six paragraphs was a little easier than the second and third sets, which were about equal in difficulty.

The latter result cleared up the earlier confusion in that the third level of the order factor was confounded with the first set of six paragraphs at the no KR level of the KR factor, thus accounting for the significant order effect that occurred in the preliminary analyses. Given that the order factor was confounded with paragraph

set - KR combinations it was decided to delete it from the analysis. The subsequent analyses of the major experimental factors did not include the order factor.

Hypotheses re Between-Subjects Variables: 6. Table 6 presents a summary of the between-subjects sources of variance that were significant and also indicates the level of significance. The main effect for question uncertainty was significant in all analyses. The combined general learning (relevant and incidental) of the groups exposed to the certain questions with stems, surpassed that of the groups exposed to the uncertain questions without stems ($\bar{X}$s = 20.15 and 17.08 respectively, for certain and uncertain question groups on the delayed test; ANOVA 6). This result was just the opposite of what was expected.

The a-priori hypotheses regarding the effects of response alternative uncertainty on relevant and incidental learning also were not supported. The main effect for response alternative uncertainty was significant only on the analyses of the delayed test data ($\bar{X}$s = 19.95, 18.51, and 17.37 for the questions with one, two and four alternatives, respectively; ANOVA 6). A Scheffé test revealed that questions with one response alternative led to significantly greater general learning than questions with four alternatives. Questions with two and four alternatives did not differ significantly in the amount of induced general learning. The response alternative uncertainty factor was not significant when the data under analysis consisted of both the immediate and the delayed test scores (ANOVAs 7 and 8) of only those subjects who were tested twice, even though the means were of

Table 6

Analyses of variance over all between- and within-Ss treatment group data: Summary of significant sources of variance

Source of Variance	Analyses of Delayed Test Data		Analyses of Immediate and Delayed Test Data	
	Anova 5 ($Q_2A_3T_2/\underline{Ss}/R_2L_2C_2$)	Anova 6 ($Q_2A_3T_2/\underline{Ss}/L_2K_3$)	Anova 7 ($Q_2A_3/\underline{Ss}/P_2L_2K_2C_2$)	Anova 8 ($Q_2A_3/\underline{Ss}/P_2L_2K_3$)
Q: Question Uncertainty (Certain or uncertain questions)	.01	.01	.05	.01
A: Response Alternative Uncertainty (One, two or four response alternatives)	.05	.01	NS	NS
T: Times Tested (Once or twice)	.01	.01		
P: Posttests (Immediate or delayed)			.01	.01
L: Type of Learning (Relevant or Incidental)	.01	.01	.01	.01
K: Type of Knowledge of Results (K_2 :immediate & delayed) (K_3 :none, immediate & delayed)	NS	.05	NS	NS
C: KR Uncertainty (Certain and uncertain KR)	NS		NS	
QL:	.01	.05	.06	NS
AP:			.05	NS
AL:	.01	.01	.08	.07
QC:	NS		.07	
PL:			.05	NS
TL:	.05	.01		
LK:	NS	.06	NS	.05
QTL:	NS	.07		
QPL:			NS	.05
LKC:	.05		.01	
QALKC:	.07		NS	

Key -- .01 Table entries indicate level of significance

-- NS Indicates that a source of variance was not significant

-- ▨ Indicates that the source of variance was not relevant to a given analysis

the same magnitude and in the same direction as the means above. The reason for this disparity is uncertain. The error variances may have been greater in the latter analyses.

Subjects who were tested twice retained more information on the delayed test than subjects who only received the delayed test ($\bar{X}$s = 21.20 and 16.02; ANOVA 6). This main effect was consistent with a-priori expectations whereas the effects involving both question and response alternative uncertainty were just the opposite of what had been predicted.

Hypotheses re Within-Subjects Variables: 7. As was expected, there was a significant decrement in the retention of the general (relevant and incidental) content from the immediate to the delayed posttest ($\bar{X}$s = 23.01 and 21.20; ANOVA 8). Relevant learning surpassed incidental learning in all analyses ($\bar{X}$s = 13.60 and 9.43 on the immediate posttest).

There was a main effect for the type of KR factor in the ANOVA 6 analysis of the delayed test data ($\bar{X}$s = 5.88, 6.44 and 6.28 for the no KR, immediate KR and delayed KR conditions, respectively). This main effect was also averaged over both relevant and incidental learning (general learning). The means showed that the general learning of the immediate and delayed KR groups surpassed the no KR group on general learning. However, the immediate and delayed KR means did not differ from each other. This main effect however, was not significant in ANOVA 8 when the three means were averaged over the immediate and the delayed test results. No main effect was found

for type of KR on ANOVAs 5 or 7. These two ANOVAs only included immediate and delayed KR. ANOVAs 5 and 7 also revealed that the main effect for KR uncertainty (KR with or without the question stem) was not significant.

Hypotheses re Between- and Within-Subjects Variables: 8. Figure 5 shows that the response alternative uncertainty factor interacted with type of learning, but in a manner opposite to that which was expected, on the delayed test ($F = 8.67$, $df = 2/132$, $p < .01$: ANOVA 6). The most certain questions, those with only the one correct response alternative, led to better relevant learning and retention than questions with all four response alternatives on the delayed test. Contrary to what was predicted there were no significant differences among the incidental learning means of the three levels of the response alternative uncertainty factor.

Several additional interactions also proved to be significant. Question uncertainty and type of learning interacted ($F = 7.1$, $df = 1/132$, $p < .01$: ANOVA 5). Figure 6 shows that questions with stems (certain questions) led to greater relevant, but not incidental, learning than questions without stems (uncertain questions). This interaction was the opposite of what had been predicted.

Type of learning also interacted with the number of times the subjects were tested ($F = 5.9$, $df = 1/132$, $p < .05$; ANOVA 5). In Figure 7 it can be seen that subjects who were tested twice retained more of the incidental content than subjects who were only given the delayed test. The lack of an immediate test appeared to negatively

FIGURE 5

INTERACTION BETWEEN RESPONSE ALTERNATIVE UNCERTAINTY AND TYPE OF LEARNING (DELAYED TEST)

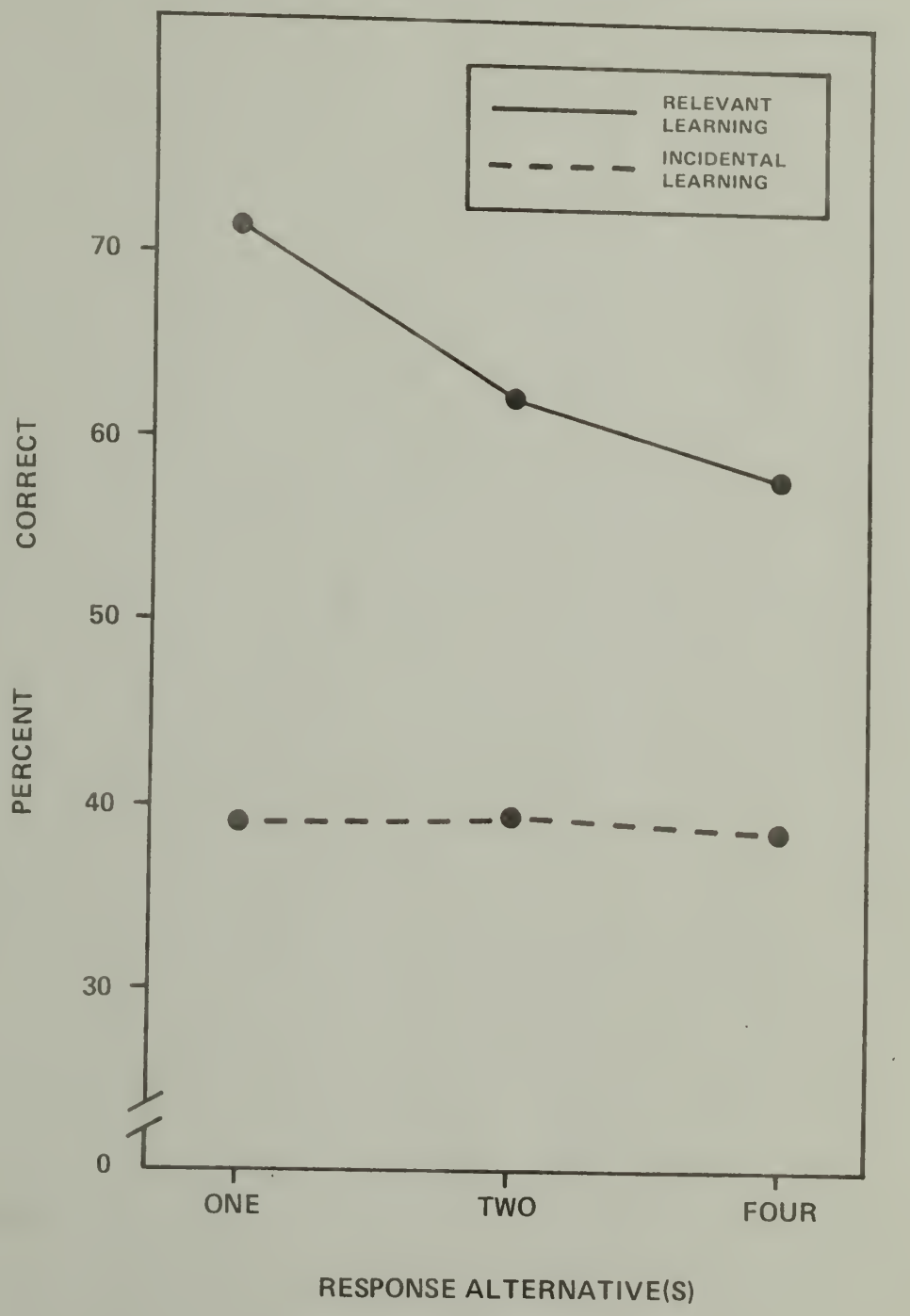


FIGURE 6

INTERACTION BETWEEN QUESTION UNCERTAINTY AND TYPE OF LEARNING (DELAYED TEST)

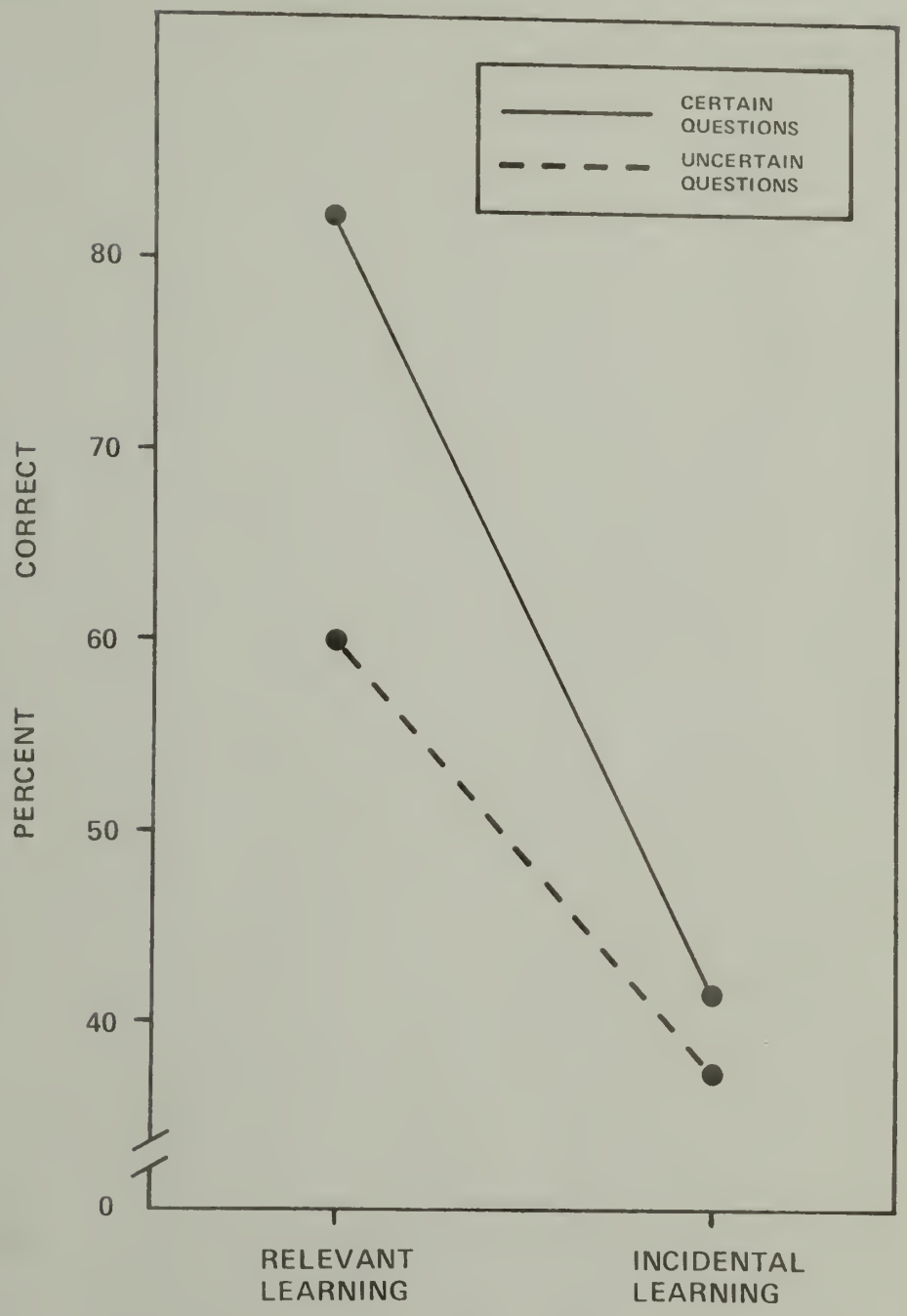
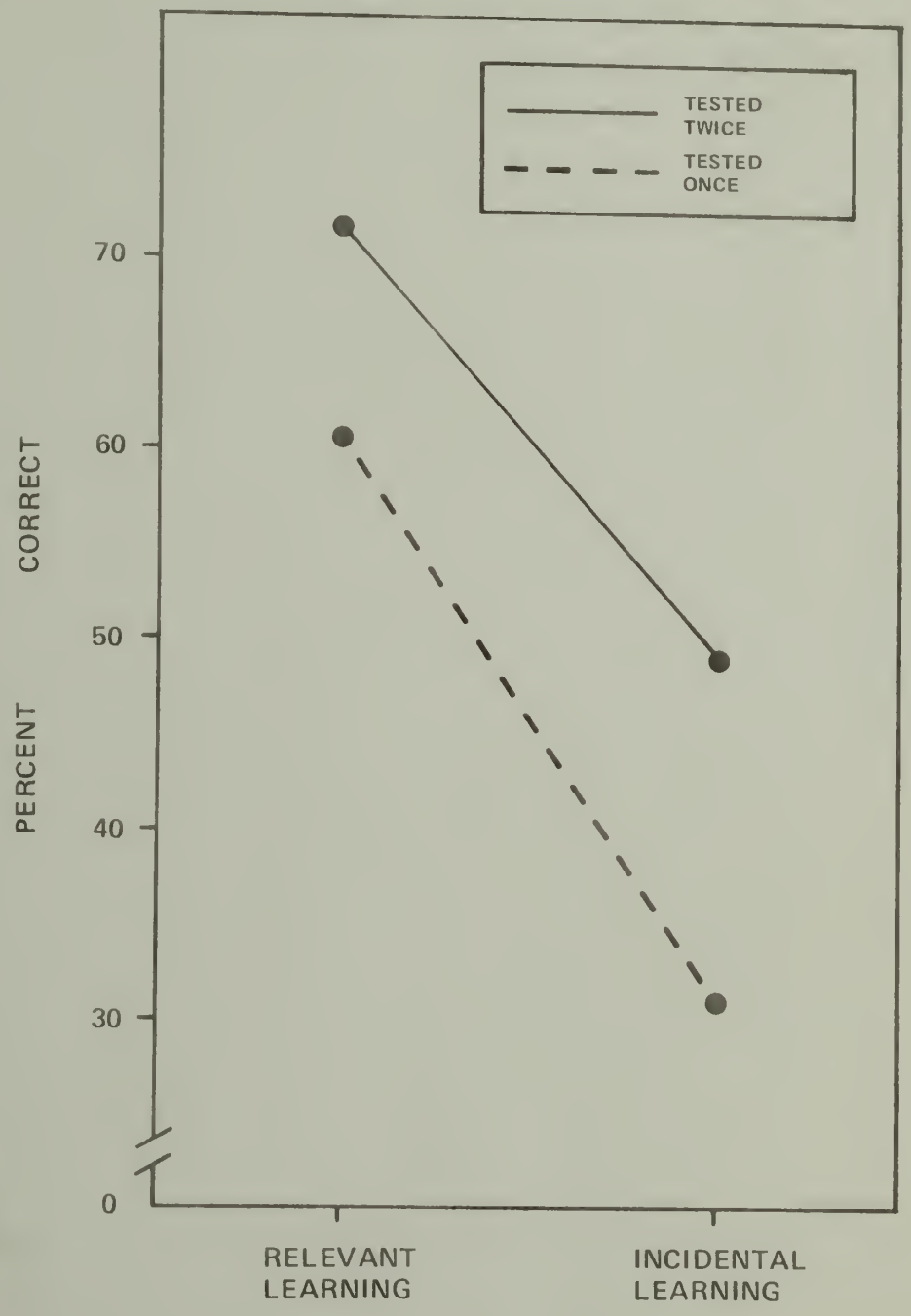


FIGURE 7
INTERACTION BETWEEN TIMES TESTED
AND TYPE OF LEARNING (DELAYED TEST)



effect the long term retention of the incidental content to a greater degree than it effected the long term retention of the relevant content.

In addition, Figure 8 shows that the factors of question uncertainty, type of learning and times tested interacted ($F = 3.17$, $df = 1/108$, $p < .07$; ANOVA 6). Certain questions generally exceeded uncertain questions on both types of learning and under both conditions of testing, with one exception. When subjects were only tested once the two different questions groups performed the same on incidental learning. Again, these results were contrary to what had been predicted; increased question uncertainty did not lead to enhanced relevant or incidental learning, even when the testing of subjects was delayed. Figure 9 shows that there was an interaction between type of learning and type of KR ($F = 2.8$, $df = 2/264$, $p < .06$; ANOVA 6). When performance was averaged across all between-subjects groups, immediate and delayed KR did not differ on relevant learning and both led to better performance than no KR. Type of KR did not vary in its effect on incidental learning, hence, the above interaction occurred.

Type of KR and KR uncertainty interacted with type of learning, ($F = 5.4$, $df = 1/132$, $p < .05$; ANOVA 5). Figure 10 shows that, immediate certain (complete) KR facilitated the retention of incidental content in comparison to delayed certain KR. Uncertain KR had the same effect on incidental retention regardless of whether it was immediate or delayed. Type of KR (immediate or delayed) and KR timing did not effect relevant learning. Inasmuch as KR was given in regard to relevant learning, this effect on the delayed retention of the

FIGURE 8

INTERACTION BETWEEN QUESTION UNCERTAINTY
TIMES TESTED, AND TYPE OF LEARNING (DELAYED TEST)

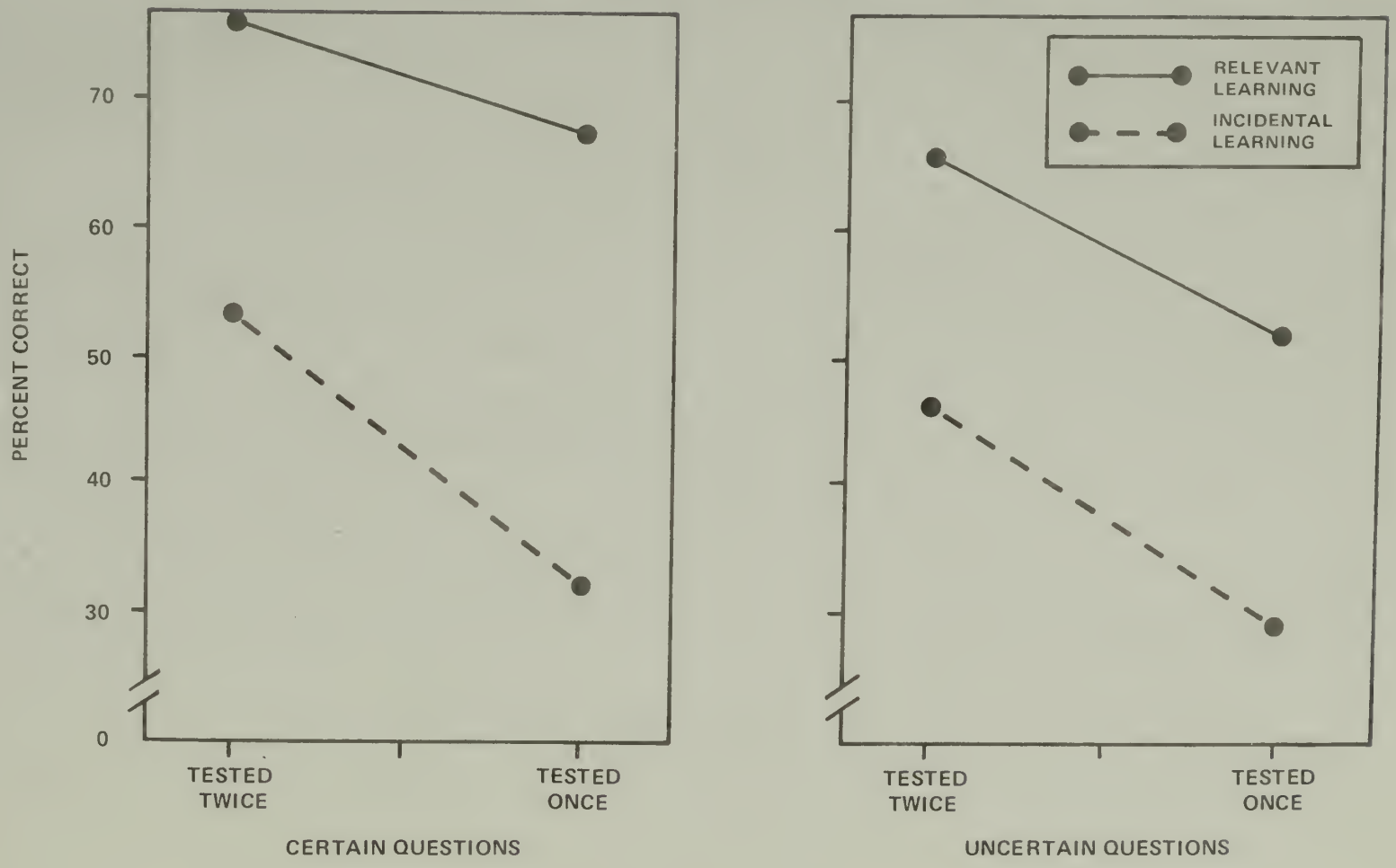


FIGURE 9

INTERACTION BETWEEN TYPE OF KR
AND TYPE OF LEARNING (DELAYED TEST)

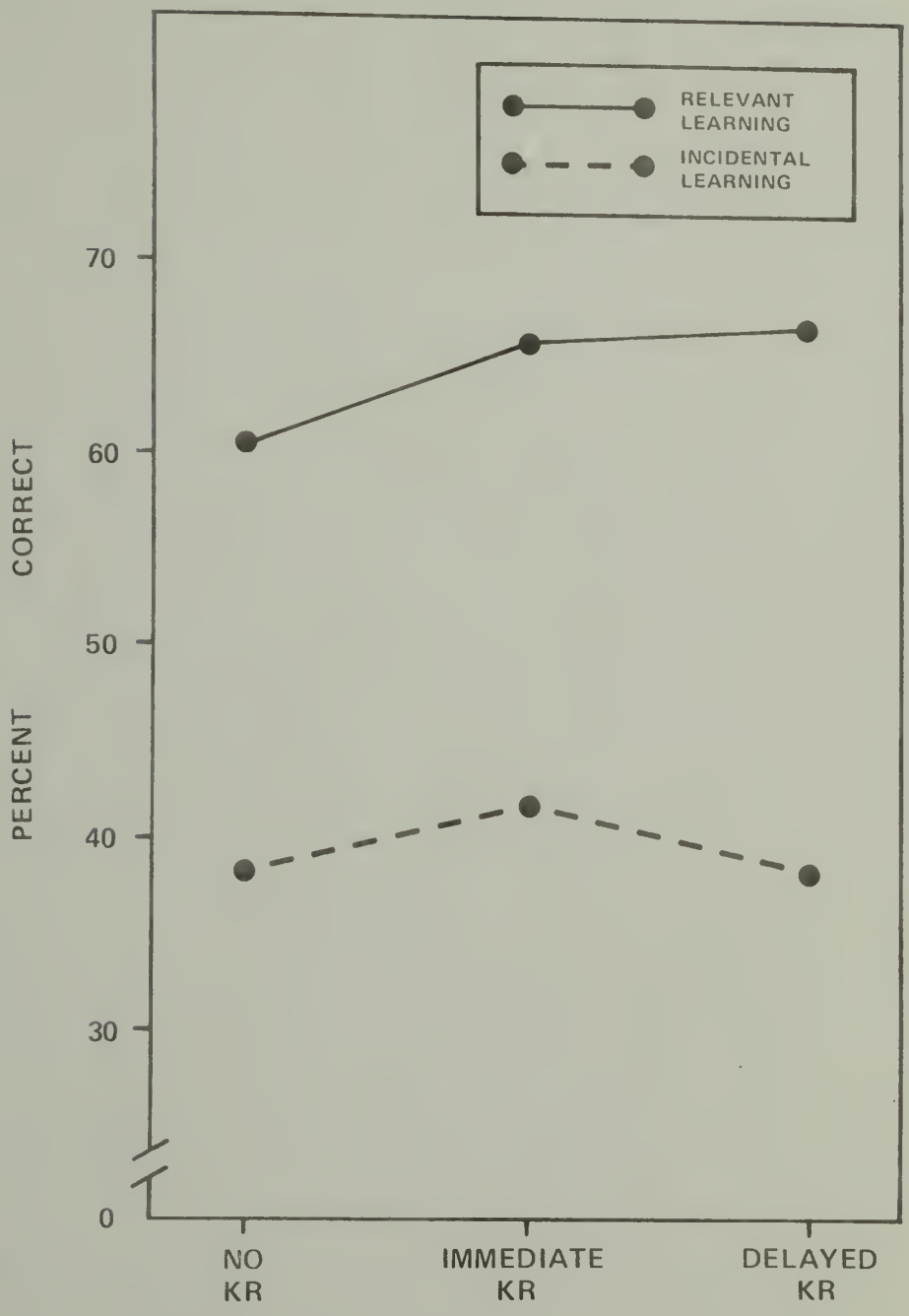
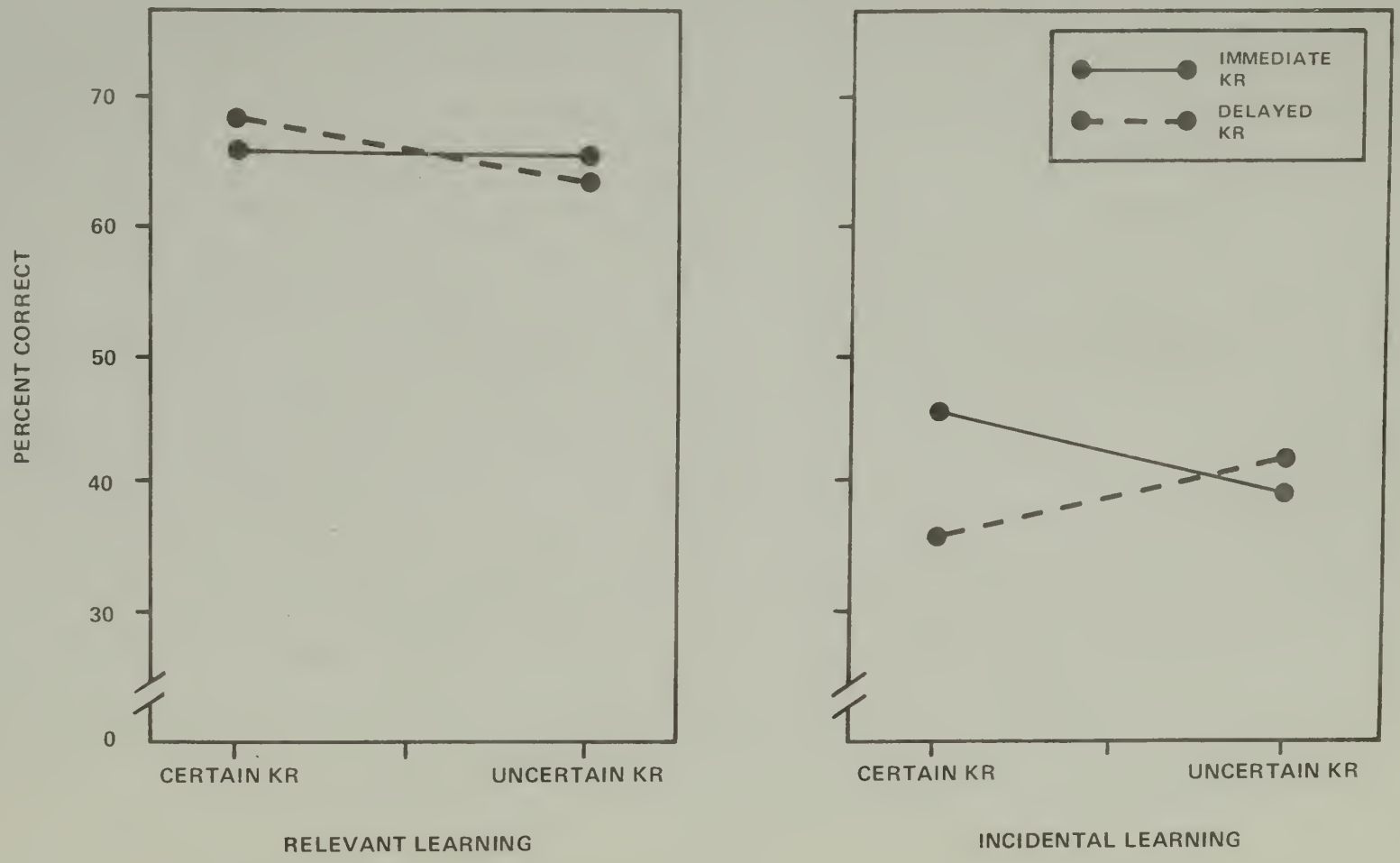


FIGURE 10

INTERACTION BETWEEN TYPE OF KR,
KR UNCERTAINTY, AND TYPE OF LEARNING (DELAYED TEST)



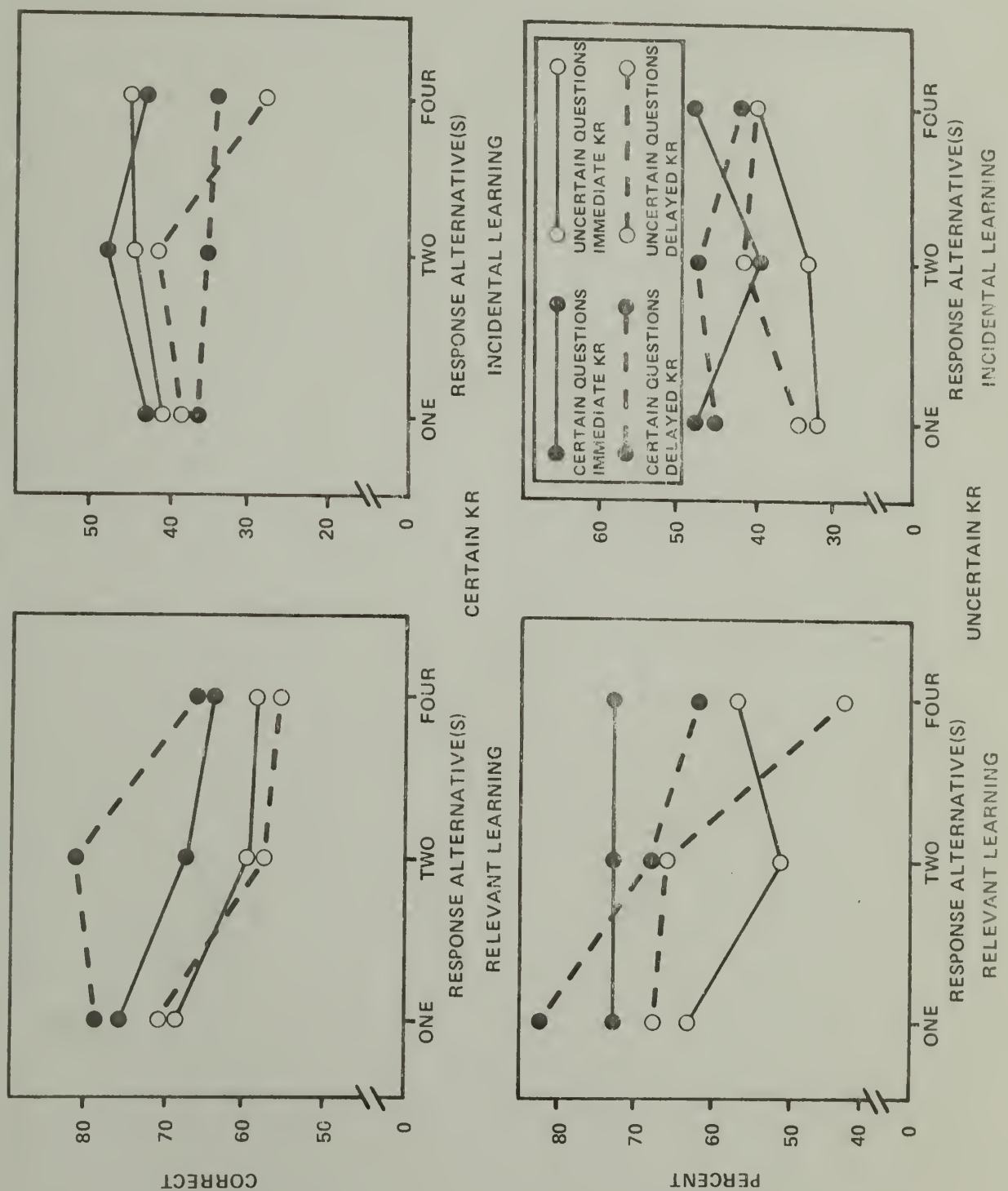
incidental content was unanticipated. This interaction also occurred in the analysis which included the immediate and the delayed test data (ANOVA 7).

There was also a higher order interaction between question and response alternative uncertainty, type of learning, type of KR, and KR uncertainty ($F = 2.7$; $df = 2/132$; $p < .07$, ANOVA 5 on the delayed test). Figure 11 presents this interaction. The upper half of Figure 11 presents the KR certain condition and the lower half, the KR uncertain condition. The solid lines portray immediate KR while the dashed lines represent delayed KR. The solid circles denote certain questions while the empty circles denote uncertain questions. Although interpretation of such a higher order interaction is dubious at best, there were several things that appeared to be happening that were worthy of note. Incidental learning for the certain question groups was about the same whether immediate KR was certain or uncertain. With the uncertain question groups though, immediate uncertain KR systematically inhibited incidental learning in comparison to immediate certain KR. In the case of certain questions, immediate uncertain KR generally led to better intentional learning than immediate certain KR.

With certain questions, delayed certain KR led to a reduction in the retention of the incidental content in comparison to immediate certain KR. In the case of uncertain questions, delayed certain KR led to a reduction in incidental learning in comparison to immediate certain KR, when four response alternatives were involved. In the case of intentional learning and retention, delayed certain KR led to greater

FIGURE 11

INTERACTION BETWEEN QUESTION UNCERTAINTY, RESPONSE ALTERNATIVE UNCERTAINTY, KR UNCERTAINTY, TYPE OF KR, AND TYPE OF LEARNING (DELAYED TEST)



retention than delayed uncertain KR with those certain question groups that saw two response alternatives. There were no differences in intentional learning and retention due to the timing of certain KR when questions were uncertain.

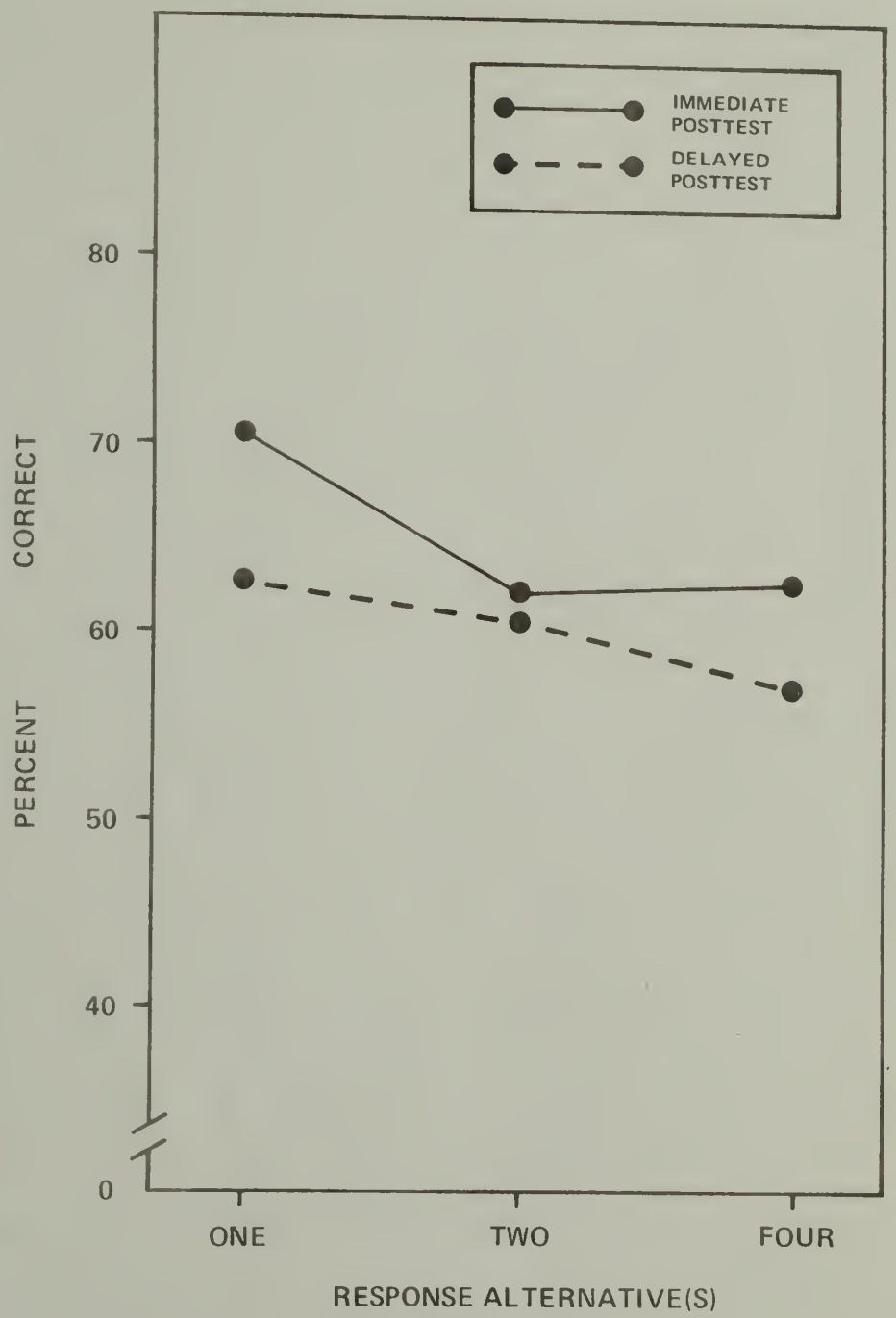
The intentional learning of certain questions varied depending on the timing of incomplete KR. The one alternative certain question group did best when uncertain KR was delayed. The two and four alternative certain question groups however, retained the most intentional content when uncertain KR was immediate. The above effect tended to be reversed for uncertain questions. The one and two alternative uncertain question groups retained more intentional content when uncertain KR was delayed as opposed to immediate. This result is difficult to assess. Just the reverse occurred with the four response alternative groups.

Figure 12 presents the interaction between posttests and response alternative uncertainty ($F = 3.2$, $df = 2/66$, $p < .05$; ANOVA 7). It can be seen that in two of the three response alternative uncertainty conditions there was a drop from posttest one to posttest two. In the two alternative condition, general performance remained about the same across posttests. On the immediate posttest the best performance was exhibited by the one alternative group. On the delayed test the one and two response alternative groups turned in about equal performances. The performance advantages concomitant to receiving one question alternative appeared to be short lived.

Posttests and type of learning also interacted ($F = 6.5$,

FIGURE 12

INTERACTION BETWEEN RESPONSE ALTERNATIVE UNCERTAINTY AND POSTTESTS



df = 1/66, $p < .05$; ANOVA 7). Figure 13 shows that retention of relevant content decreased on the delayed test while retention of the incidental content remained about the same across posttests. The interaction between question uncertainty, and KR uncertainty also approached significance ($F = 3.3$, df = 1/66, $p < .07$; ANOVA 7). Figure 14 revealed that when KR was certain there was little difference in the general test performance (relevant and incidental averaged over posttests) of the question certain and question uncertain groups. The performance of the question uncertain group was debilitated by uncertain KR. The same differences were reflected in ANOVA 5 but they were not statistically significant.

Question uncertainty, posttests, and type of learning also interacted ($F = 4.0$, df = 1/66, $p < .05$; ANOVA 8). Figure 15 shows that the drop in retention of relevant content between posttests one and two was about the same for the question certain and question uncertain groups. The question certain group however, exhibited less of an incidental learning retention loss between posttests than did the question uncertain group.

In perspective, it must be remembered that the preceding effects occurred in a larger context in which the great majority of the above effects did not differ greatly from the comparison replication control groups.

FIGURE 13
INTERACTION BETWEEN POSTTESTS
AND TYPE OF LEARNING

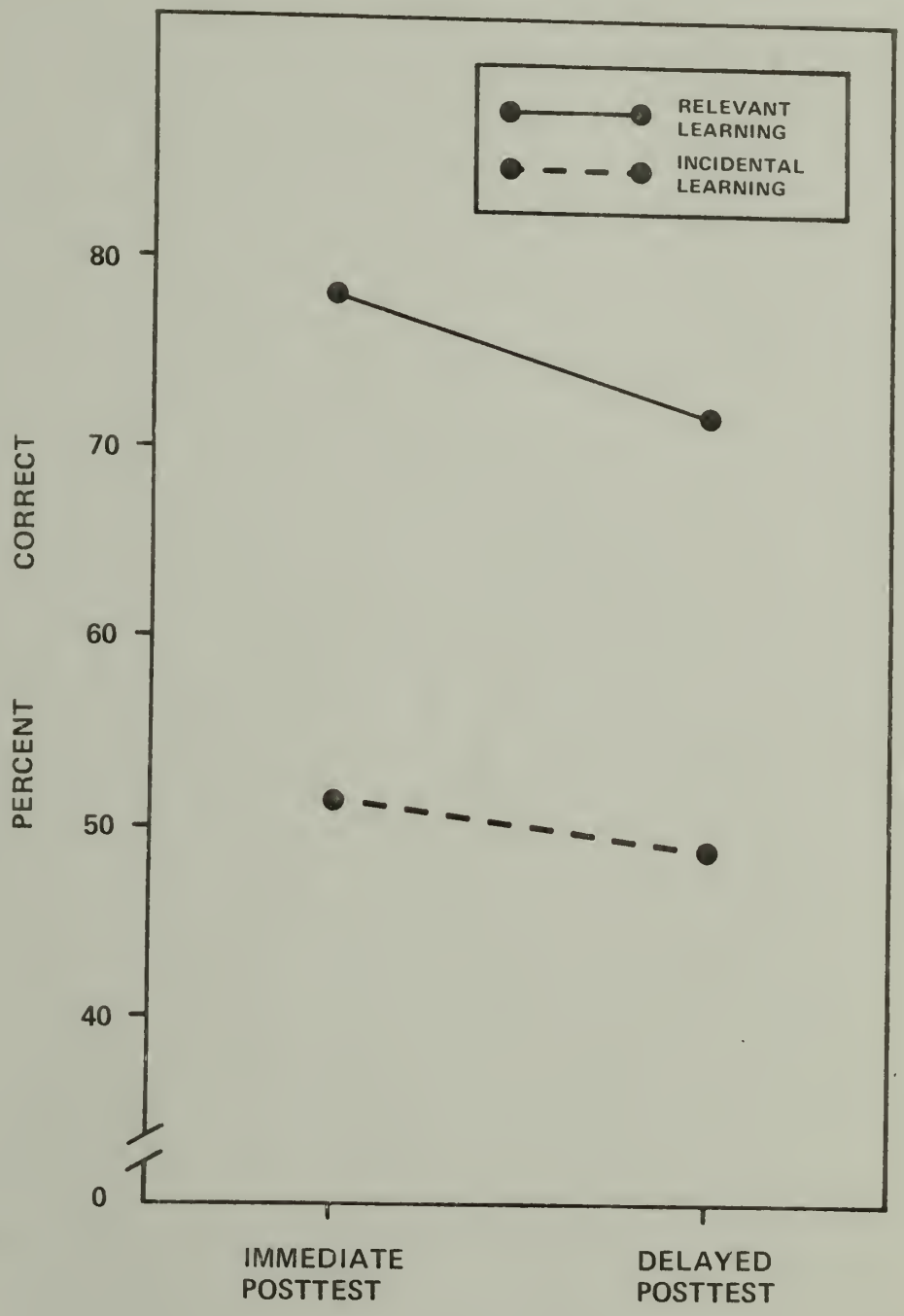


FIGURE 14
INTERACTION BETWEEN QUESTION UNCERTAINTY AND KR UNCERTAINTY

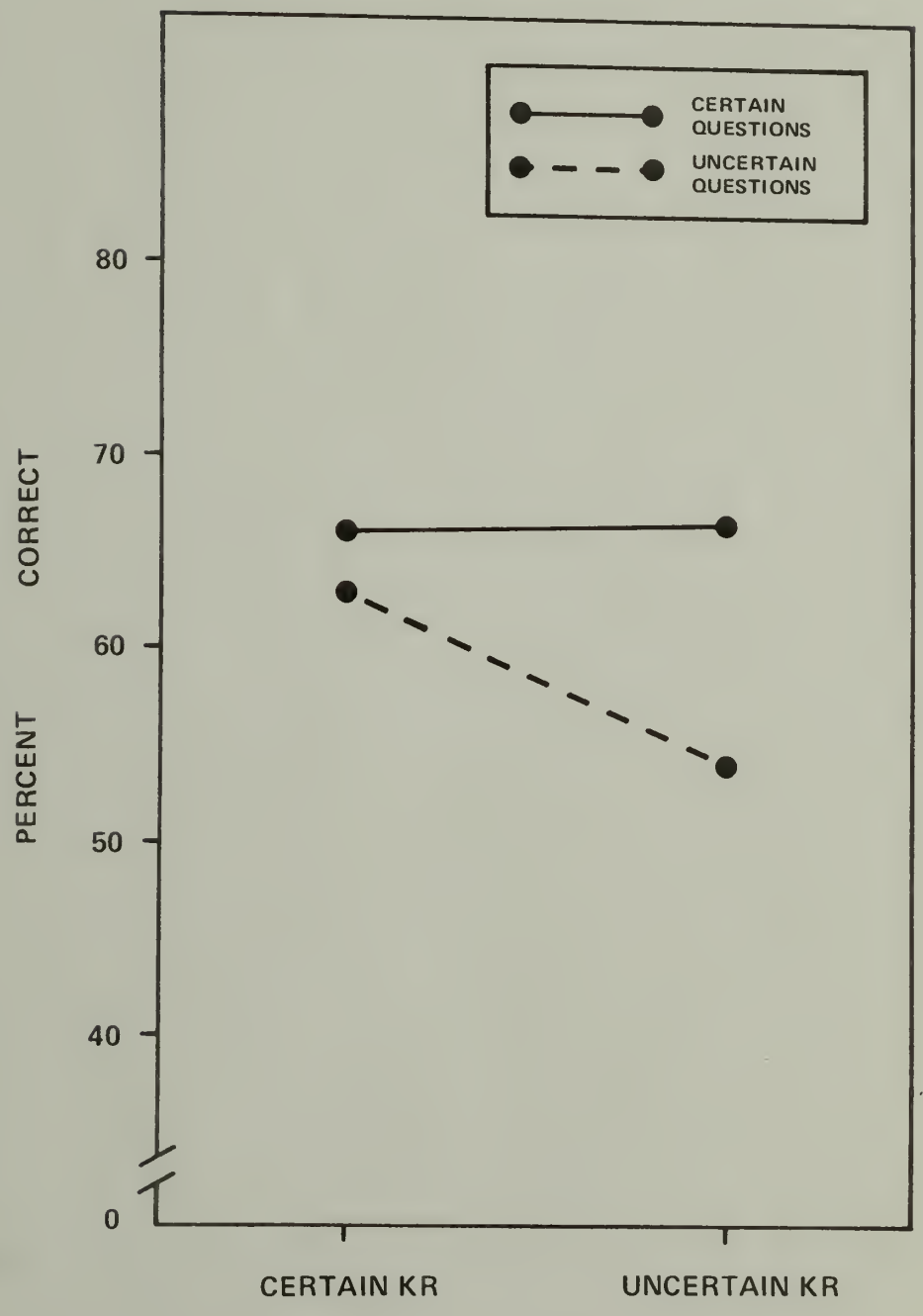
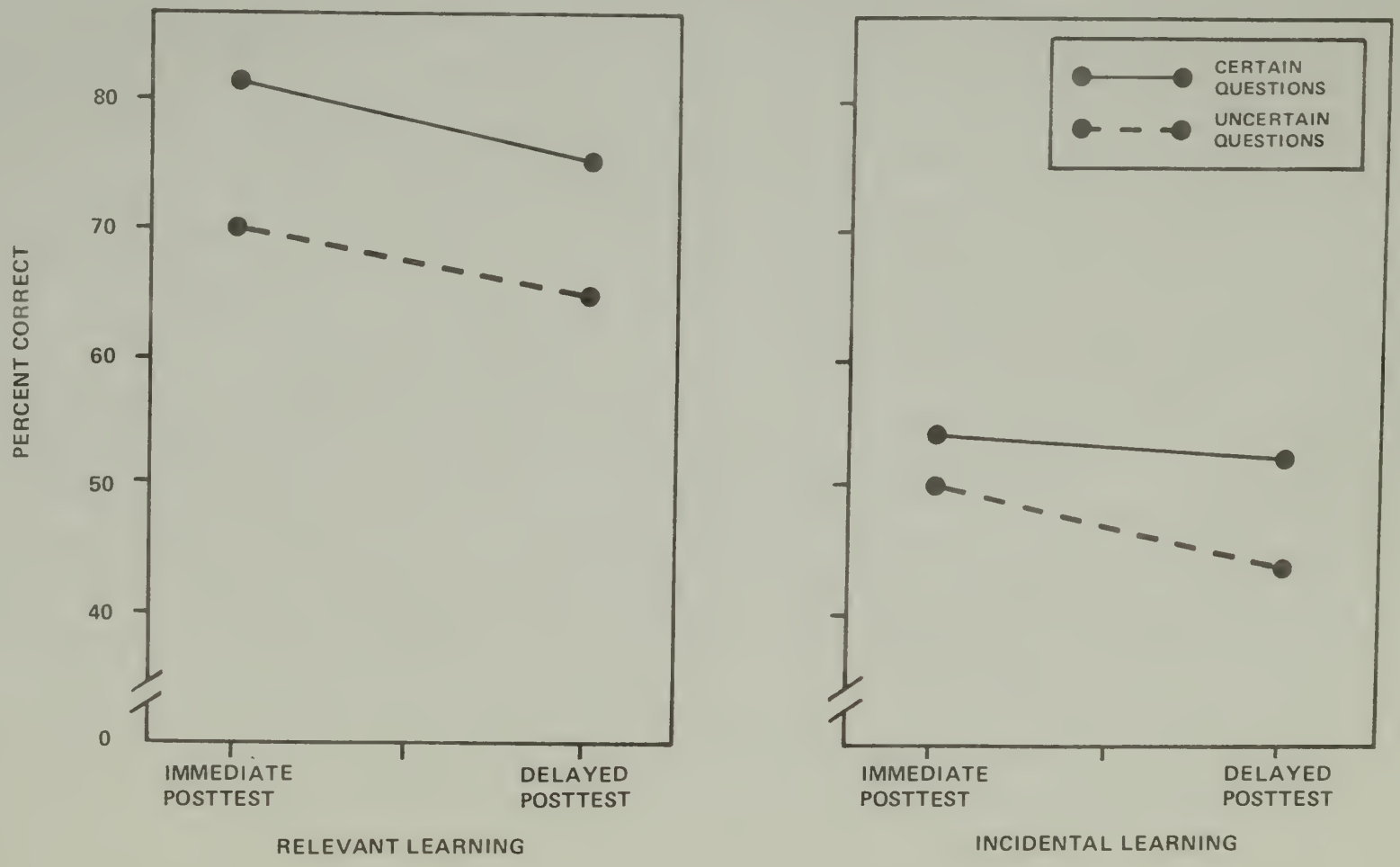


FIGURE 15

INTERACTION BETWEEN QUESTION UNCERTAINTY, POSTTESTS, AND TYPE OF LEARNING



Analyses of Time Scores

The subjects' reported reading time scores were analyzed in a 2 x 3 x 2 between-subjects factorial ($Q_2A_3T_2/\underline{S}s$). The factors were question uncertainty (Q: prequestions with or without stems), response alternative uncertainty (A: one, two or four alternatives per question), and times tested (T: immediate and delayed test, or only delayed test). Table F.9 presents a summary of the results of the ANOVA. The mean reading times of the question certain and question uncertain groups ($\bar{X}$s = 20.3 and 18.9 minutes, respectively) did not differ. A main effect was found for response alternative uncertainty ($F = 4.36$, $df = 2/132$; $p < .05$). The one response alternative group spent less time reading the content ($\bar{X}$ = 17.8 minutes) than the two or four response alternative groups ($\bar{X}$s = 20.6 and 20.4). The times tested factor also proved significant ($F = 10.87$, $df = 1/132$, $p < .01$). The group that was eventually tested twice reportedly spent more time reading the material than the group that was tested once ($\bar{X}$s = 21.0 and 18.2 minutes). Subjects from the two groups represented in the times tested factor, those tested once and those tested twice, sat together in the same experimental session and differed only in that subjects from the former group received a questionnaire after reading the booklets while subjects from the latter group received the test after reading the booklets. Since the subjects did not know which group they were in until after they had finished reading, this difference in reading time was unanticipated.

Figure 16 revealed that question uncertainty interacted with the times tested factor ($F = 4.14$, $df = 1/132$, $p < .05$). Among those subjects who were to be tested twice, those in the question certain group reportedly spent an average of three minutes more on the content than those in the question uncertain group. The question certainty groups did not differ when they were to be tested only once.

Figure 17 presents a second order interaction between the question uncertainty, response alternative uncertainty and times tested factors ($F = 3.5$, $df = 2/132$, $p < .05$). It can be seen that moderate differences (1 - 2 minutes) between the levels of the times tested factor (once or twice) occurred at two of the six, question uncertainty - response alternative uncertainty combinations. Substantial differences (5 - 6 minutes) occurred at three of the six question uncertainty - response alternative uncertainty combinations. On an a-priori basis reading time differences involving the times tested factor should not have occurred at any of these conditions.

The reported reading times of the control group subjects were analyzed in a 3 x 2 between-subjects factorial ($Q_3T_2/\underline{S}s$) in which the factors were question position (Q: prequestions, postquestions or no questions), and times tested (T: immediate and delayed test or delayed test only). The results of the ANOVA are presented in Table F.10. The mean reading times of the three levels of the question position factor differed significantly ($\bar{X}s$ = 20.8, 14.9 and 18.5, respectively: $F = 10.80$, $df = 2/66$, $p < .01$). A Scheffé test revealed that the three means differed significantly from one another. Contrary to the treatment

FIGURE 16
INTERACTION BETWEEN QUESTION UNCERTAINTY AND TIMES TESTED

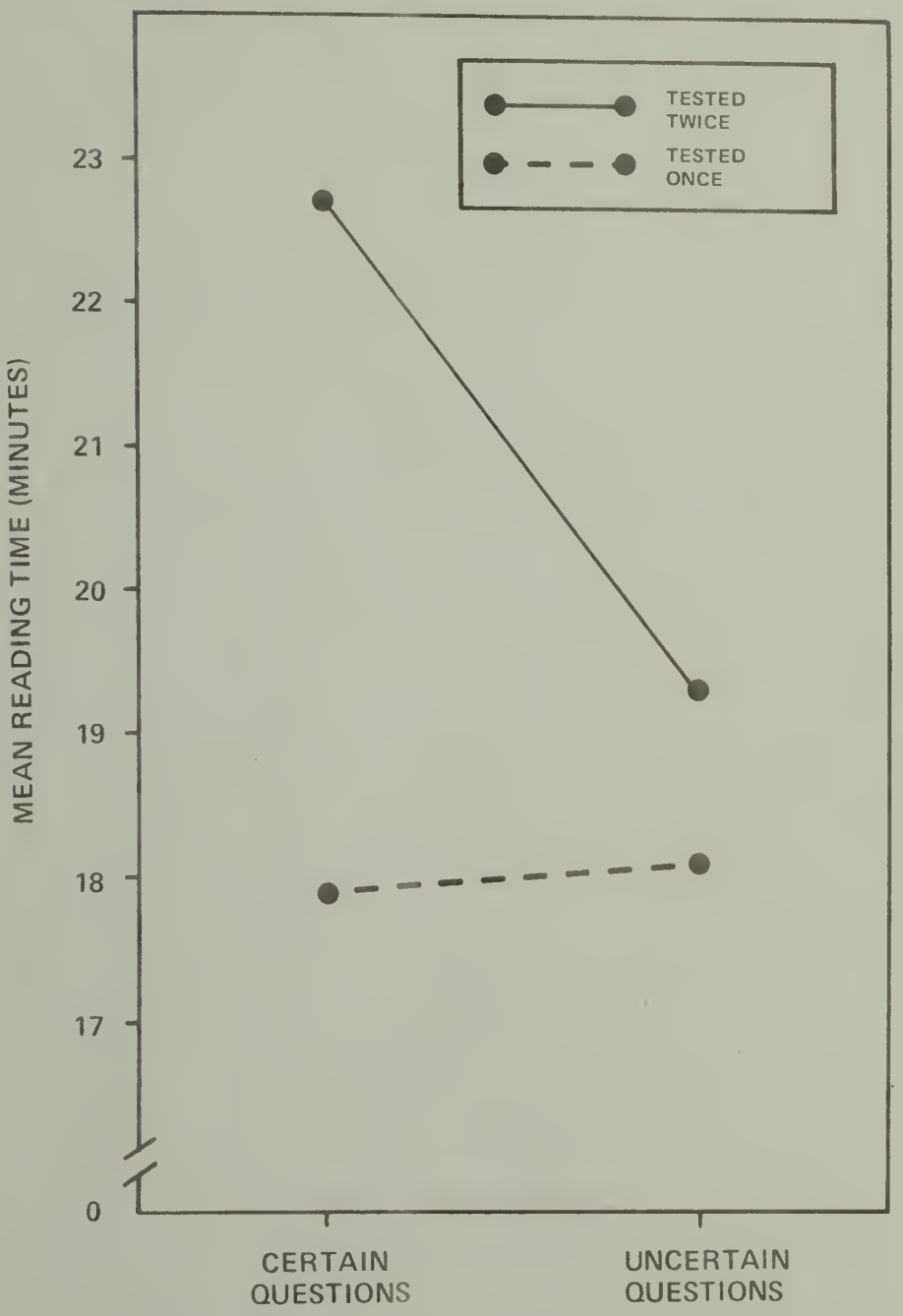
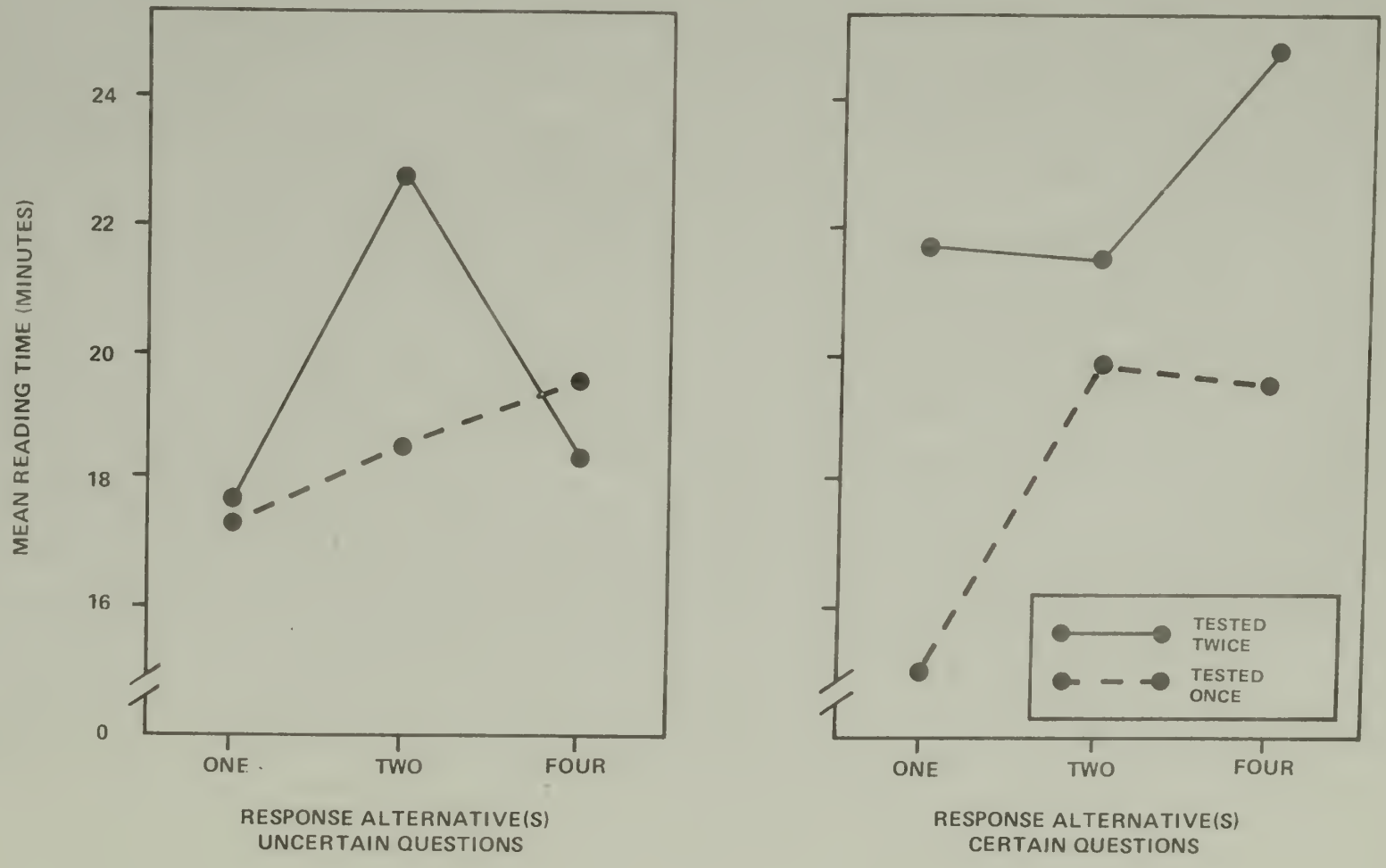


FIGURE 17

INTERACTION BETWEEN QUESTION UNCERTAINTY,
RESPONSE ALTERNATIVE UNCERTAINTY, AND TIMES TESTED



groups, no differences in reading time were found between the levels of the times tested factor.

Analysis of Questionnaire Data

Table 7 presents an analysis of the questionnaire the subjects responded to after participating in the study. Part I of Table 7 provides a breakdown of the responses, by response choice, to 12 major questions (see sample questionnaire--Appendix D). Questions 5 and 17 had only four choices. For questions 6, 7 and 15 the third alternative was the midpoint with the choices decreasing or increasing in valence as one proceeded to the left or to the right of center, respectively.

In brief, less than three percent of the subjects reported even moderate familiarity with the content on William James and, none of these subjects felt that their familiarity influenced their performance. Close to seventy percent of the subjects reported reading each page only once while approximately thirty percent said they read the pages either two or three times. About seventy percent of the subjects reported that the reading content was easier than their regular college material. Some thirty percent of the subjects found James intrinsically dull. Thirty-four percent said James was okay and the remaining thirty-six percent found James to be intrinsically interesting. Only fifty percent of the subjects, who received one response alternative, reported spending any noteworthy effort in deciding whether a response choice was true or false. However, eighty-five percent reported spending a moderate or greater amount of time on checking whether their true or

Table 7
Analysis of student questionnaire data

Part 1: Distribution of Responses to Student Questionnaire

		Little → to → Very Much / Less ← or → More 1 : 2 : 3 : 4 : 5					Content of Key Questions * in Student Questionnaire		
(3)	a.	87	10	1	1	0	(3) Ss familiarity with William James	FAMJAMS	1.
(5)	a.	71	26	3	0	N/A	(5) Average number of times S read each page	READPAGE	2.
(6)	b.	30	39	23	6	1	(6) Ss rating of difficulty of content	DIFFREAD	3.
(7)	b.	6	24	34	32	4	(7) Ss rating of intrinsic interest of content	EVALJAMS	4.
(9)	a.	4	46	42	6	2	(9) Effort S spent deciding whether a response choice was true or false	SER1GES	5.
(10)	a.	4	12	42	31	12	(10) Effort S spent on checking if true or false guess was correct	CHEK1GES	6.
(12)	a.	3	38	48	10	2	(12) Effort S spent deciding which response alternative was correct	SER2GES	7.
(13)	a.	1	23	35	34	7	(13) Effort S spent checking if chosen (guesaed) alternative was correct	CHECK2GES	8.
(14)	a.	9	22	54	9	7	(14) Effort S spent on completing incomplete KR	SERKRGES	9.
(15)	b.	4	13	47	27	9	(15) Ss report of the interest of this study	RATESTDY	10.
(16)	a.	2	17	38	31	11	(16) Ss report of self-motivation during the study	MTIVATED	11.
(17)	a.	60	33	5	2	N/A	(17) Ss report of anxiety about being timed	ANXIOUS	12.

Key: Parts 1 and 2

-- * Numbers in parenthesis indicate the number of the question as it appeared on the student questionnaire (see Appendix D)

-- Numbers not in parenthesis indicate the numbering (rows and columns) that were adopted for the purpose of this cross-tabulation table

Key: Part 2

-- Treatment Group Crosstab:
NS = X^2 Not Significant
◯ = X^2 Significant

-- Control Group Crosstab:
□ = X^2 Not Significant
△ = X^2 Significant

-- .05 or .01 = Significance level achieved: one-tailed test

TABLE 7

Analysis of Student Questionnaire Data

Part 2: Crosstabulation Analysis of Questionnaire and Test Data

	Content of Key Questions * in Student Questionnaire		
(3)	Ss familiarity with William James	FAMJAMS	1.
(5)	Average number of times I read each page	READPAGE	2.
(6)	Ss rating of difficulty of content	DIFFREAD	3.
(7)	Ss rating of intrinsic interest of content	EVALJAMS	4.
(9)	Effort S spent deciding whether a response choice was true or false	SER1GES	5.
(10)	Effort S spent on checking if true or false guess was correct	CHEK1GES	6.
(12)	Effort S spent deciding which response alternative was correct	SER2GES	7.
(13)	Effort S spent checking if chosen (guessed) alternative was correct	CHECK2GES	8.
(14)	Effort S spent on completing incomplete KR	SERKRGES	9.
(15)	Ss report of the interest of this study	RATESTDY	10.
(16)	Ss report of self-motivation during the study	MTIVATED	11.
(17)	Ss report of anxiety about being timed	ANXIOUS	12.
--	Ss immediate posttest intentional learning score	PT1R1	13.
--	Ss immediate posttest incidental learning score	PT1R2	14.
--	Ss immediate posttest total learning score	PT1TOT	15.
--	Ss delayed posttest intentional learning score	PT2R1	16.
--	Ss delayed posttest incidental learning	PT2R2	17.
--	Ss delayed posttest total learning score	PT2TOT	18.
--	Ss reported reading or study time	READTIME	19.
--	Time Ss spent on quiz	QUIZTIME	20.

false guess was correct. Sixty percent of the subjects, who received multiple response alternatives, reported giving noteworthy consideration to deciding which alternative was correct. Over seventy-five percent of these same subjects reported spending a moderate to a considerable amount of effort to determine if their guess was correct. In addition, seventy percent of all subjects reported expending moderate to considerable effort to determine if their guess was correct. In addition, seventy percent of all subjects reported expending moderate to considerable effort to complete or fill in information when they were exposed to incomplete knowledge of results.

Seventeen percent rated their participation in the study as dull or boring. Forty-seven percent said it was okay and thirty-six percent rated their involvement as pretty good or interesting. Approximately forty-four percent reported being seriously motivated. Close to twenty percent said they did not take the study very seriously. Only seven percent of the subjects reported any anxieties about being timed that were worthy of note. Over thirty percent said they were a little anxious but the great majority said they were not at all anxious.

Part II of Table 7 presents the results of a crosstabulations analysis (Nie, Bent and Hull, 1970) involving 23 questionnaire and performance variables. Separate crosstabulations were performed on the experimental and control subjects. In each case the comparison was reduced to a 2 x 2, or fourfold, contingency table by combining frequencies over the categories of each of the variables. Part II summarizes the results of the chi-square tests for independence

(Siegel, 1956) for the indicated comparisons. Depending on the comparisons involved, the N's for the fourfold tables ranged from 36 to 144. The chi-square values are corrected for continuity and the significance values are based on one-tailed tests.

Three sets of data interrelationships can be examined in Part II of Table 7.

Intra-Questionnaire Relationships. Subjects who reported reading each page two or more times on the average, more frequently reported that they were both more motivated and more anxious about being timed than subjects who reported reading each page only once. Subjects who found James more intrinsically interesting, more frequently reported that they; spent more effort at completing incomplete KR, found the study more interesting, and were more motivated, than subjects who reported they did not find James intrinsically interesting. Subjects who reported that they spent considerable effort in deciding whether a response choice was true or false, also more frequently reported that they; were more serious about checking whether their true or false guess was correct, and were more highly motivated, than subjects who reported they did not spend much effort on deciding whether a response choice was true or false. Subjects who reported they spent a good deal or more effort on checking if their true or false guess was correct, more frequently reported that they; found the study more interesting, and were more motivated than subjects who reported spending moderate to little amounts of time on checking if their guess was true or false.

Subjects who reported they gave more consideration to guessing which response alternative was correct, more frequently reported that they; spent more effort in checking if their guess was correct, spent more effort at completing incomplete KR, and were more motivated than subjects who reported they spent little or no effort in guessing which response alternative was correct. Subjects who reported they gave more consideration to checking if a guessed alternative was correct more frequently reported that they, spent more effort at completing incomplete KR, found the study more interesting, and were more motivated about the study, than subjects who reported they gave little or no consideration to checking if a guessed alternative was correct.

Subjects who reported they spent more effort at completing incomplete KR, more frequently reported that they; found the study more interesting, and were more motivated than subjects who reported giving less attention to completing incomplete KR. Finally, subjects who reported they found the study more interesting, more frequently reported that they were more highly motivated than subjects who said the study was less interesting.

The logical relationships between the variables cited lends credence to the internal consistency of subjects' responses to the questionnaire.

Questionnaire-Dependent Variable Relationships. Treatment group subjects who reported reading each page two or three times, placed above the seventieth percentile on all delayed posttest measures

(intentional, incidental and total learning scores) more frequently than subjects who only read each page once. This didn't hold true for control subjects. In addition, subjects who reported they read the pages more than once placed above the median reading time more frequently than subjects who read each page once. Control subjects who rated James as being intrinsically interesting placed above the median on both the immediate and delayed measures of incidental learning more frequently than subjects who reportedly did not find James interesting.

Treatment subjects who reported they were serious about completing incomplete KR, more frequently scored above the median on the delayed test of intentional learning than did subjects who said they were not serious or only a little serious about completing incomplete KR. Subjects' ratings of how interesting they found the study were related to subjects' performance. Subjects who reported they found the study pretty good or interesting more frequently placed above the median on intentional and total, immediate and delayed posttest performance, than subjects who reported that the study rated from okay to boring. The above findings held only for the treatment subjects.

The control subjects' reported motivation however, was related to their test performance. Subjects who reported they were seriously or quite seriously motivated placed above the median on all immediate posttest measures more frequently than subjects who reported they were somewhat to only a little motivated during the study. Subjects

who reported being anxious about being timed, more frequently spent more time reading during the study than subjects who said they were not anxious.

Questionnaire-Independent Variable Relationship. Subjects in the question certain condition placed above the total test score medians for both the immediate and delayed tests more frequently than question uncertain subjects. Subjects who were tested twice placed above the median reading or study time more frequently than subjects who were tested only once. Subjects who were tested twice also placed above the median on the delayed posttest more frequently than subjects who were tested once.

DISCUSSION

The present study had several purposes. One major purpose (Hypothesis 1) was to attempt to replicate the results of the Frase (1967, 1968a, d) studies. In the Frase studies the relevant and incidental factual learning of the postquestion group surpassed that of the prequestion group. However, there have been a sufficient number of nonreplications of these results (Patrick, 1970; Morasky, 1970; Boyd, 1973; Sanders, 1973; and Shavelson et al., 1974) to justify further examination of the effects of question position on relevant and incidental factual learning and retention. Both the Patrick (1970) and Sanders (1973) studies used the same text materials and questions about William James as were used by Frase (1967, 1968a, d). Similar to the results of Patrick (1970), the analysis reported in Table F.1 revealed that the replication control groups in the present study again failed to replicate Frase.

Table E.1 shows that there were further anomalies in the absolute levels of learning evidenced among the pre-, post- and no question groups. In the Patrick (1970) study the relevant and incidental learning of these three groups was significantly greater than the learning of the equivalent groups in the Frase (1968d) study. In the present study the incidental learning of both the pre- and postquestion groups dropped a good degree below the levels evidenced in the Patrick (1970) study while the relevant learning of these two groups remained at approximately the same level. In the present study, as in the

Boyd (1973) study, the postquestion group's incidental learning was below the level of the control group. The postquestion group's incidental learning was also less than that of any of the three comparison studies cited in Table E.1 ($N_1 = 1$ and $N_2 = 3$, $U = 0$, $p < .25$; Mann-Whitney U Test).

In the Patrick (1970) study it was suggested that the heightened levels of learning were possibly due to increases in subjects' motivation. If there was an increase in motivation in the present study, as there may have been, why did it only effect relevant learning? It should be noted that the Frase, Patrick and Schumer (1970) study, which showed that increases in incentive can negate the effects of question position, was not replicated by Frase (1971).

The conclusion to be drawn from the above discussion is that the factual question position phenomena is not as straightforward or replicable an effect as it first appeared to be. There seems to be considerable variance between independent studies in the amount of variance or reactivity exhibited by subjects in the various question position conditions. Frase (1971) noted that there might possibly have been a competition of sorts between his incentive and nonincentive subjects which ultimately resulted in no difference in their performance. Some of the subjects in the Frase et al. (1970) study reported, in unsystematic post experimental conversations, that even though they were in the incentive conditions they didn't really believe they would be paid. Other subjects in the nonincentive condition reported that they had worked very diligently anyway even though they were not

being paid. The replication control subjects of the present study might have been spurred on if they noted that the other subjects were responding to prequestions during the study.

The questionnaire data also indicated that close to 70 percent of the subjects felt that the text content was easier than their regular college material. Close to 65 percent of the subjects rated their participation in the study as just OK (or less), as opposed to being pretty good or interesting. Close to 60 percent of the subjects reported that they took the study somewhat (or less) seriously, as opposed to seriously or quite seriously. Given the entering abilities of the subjects in various prose learning question position studies, and their attitudes during the studies, one has to wonder what would happen if all subjects were told that they would be tested on both relevant and incidental content, and that their course grade would in part be determined by their performance on the test. It's more than likely that if the subjects had been informed of the specific goals of instruction as operationalized by the posttests, differences between groups due to question position would have been attenuated if not washed out.

Variations in subjects' commitment to, and interpretation of the requirements of the experimental situation, appear to be major sources of variance in factual prose learning studies. Frase and Kreitzberg (1975) noted the difficulties involved in overtly informing subjects of learning goals relative to text processing. Mayer (1975) provided evidence to support the fact that questions

serve as cues which influence subjects' expectations regarding the goals of instruction. Samuels and Dahl (1975) cited past difficulties in communicating directions to subjects to establish that subjects have flexible reading rates, and Ladas (1973) suggested that Es might ask subjects to write out the answers to questions interspersed in text (cf. Bruning, 1970) in order to insure the face validity of the treatments.

In light of the above results and considerations it is suggested that the factual question position effect with prose materials is not a particularly stable effect. The effect, where it has been found has been small or weak. The effect seems to be subject to variations in subjects' motivation and/or subjects' interpretation of the de facto goals of instruction as represented by the types of questions subjects are exposed to during instruction. The educational implications, if any, of the effect need to be re-examined.

The main effects for posttests and type of learning (Table F.1) were consistent with previous studies. The interaction (Figure 1) between question position, posttests and type of learning however, was of interest in that it suggested that relevant and incidental learning are subject to different rates of forgetting. The division of the no question group's performance into the categories of relevant and incidental learning was accomplished arbitrarily by the random assignment of test items to either category for the purpose of analyzing the three replication control groups in one analysis of variance. The no question group provided baseline data with which to compare the

mathemagenic effects of questions. The similarity in the retention decrement from posttest one to two for the relevant and incidental no question group means was to be expected in that the distinction between relevant and incidental learning was arbitrary and not real. In effect, the no question group's rate of forgetting paralleled that of the pre- and postquestion groups for relevant content. The interaction between posttests and type of learning was intrigueing in that it suggested that relevant and incidental learning may involve different encoding or input procedures, which subsequently influence retention. This interation was not found by Patrick (1970) or Morasky (1969) and stands in need of replication.

Another expectation (Hypothesis 2) was that differences in learning and retention might show up between different question position groups on a long term retention test if no immediate posttest were given. The hypothesis was suggested by the conjecture that prequestion subjects engage in relatively cursory inspection behaviors (Patrick, 1967) which result, in all probability, in encoding and storage procedures which do not facilitate long term retention. An immediate posttest might thus favor the prequestion subjects to a greater degree than the postquestion subjects. The latter subjects presumably rehearse the relevant associations, at the time of adjunct questioning, in a manner conducive to a longer term of retention. This hypothesis was also suggested or supported in part by Boyd's (1973) data which reported differing degrees of original learning or immediate storage between pre- and postquestion groups.

The replication control group analysis reported in Table F.2 however, revealed that there was no interaction between the times tested factor, question position, and/or type of learning. That is, there were no differences among the question position groups on either relevant or incidental learning on the delayed test, within each of the levels of the times tested factor. The hypotheses regarding the differences, between pre- and postquestions, in degree of original learning were therefore not supported, nor were the results of Morasky (1969) replicated. The significant main effect for the times tested factor replicated the findings of Spitzer (1939), Sones and Stroud (1940), Tiedeman (1948), and LaPorte and Voss (1975). The effect of the immediate test activity significantly facilitated the retention of all question groups on both types of learning. This effect seems to be quite stable and can in all likelihood be attributed to the process of rehearsal or practice at retrieving stored information.

The analysis regarding the effects of guessing (Table F.4) was certainly not definative. Nevertheless, the results do not tend to provide any support for Berlyne's (1966) findings and hypotheses regarding the effects of guessing. In a similar vein, the findings in regard to question and response alternative uncertainty (questions with no stems and two or four response alternatives) were also inconsistent with hypotheses that might be extrapolated from Berlyne's (1954b) work regarding expected increases in learning and retention as a function of increases in response alternative competition and concomitant increases in epistemic curiosity.

The failure of the postquestion replication control group to surpass significantly the prequestion or no question control groups, on either type of learning, resulted in a situation in which the postquestion group was unable to serve as a referent of positive mathemagenic behavior and concomitant achievement. The comparisons between the postquestion control group and the certain and uncertain question treatment groups were nevertheless of interest in that they domonstrated that in the absence of KR there were no differences between the between-subjects treatment groups and the replication control groups. The comparisons also revealed that the treatment group outcomes generally tended to be the reverse of what had been predicted. Several of the uncertain question groups came close to being significantly less than the postquestion control (see Table 3, and Figures 2-4).

Overall, even though the postquestion control groups' performance could not serve as a referent for positive mathemagenic behavior, it was obvious that the uncertainties introduced by incomplete questions generally tended to lead to mathemagenic negative learning behaviors (Rothkopf, 1970). Therefore, although the expectations expressed in hypothesis three were not conclusively supported or refuted, the trend apparent in the data tended to support the conclusion that uncertain (incomplete) prequestions do not generate the same type of uncertainty that had been suggested as one of the major factors responsible for the positive performance of postquestion groups in past studies.

The trend apparent in the Dunnett test data was confirmed in the

analysis of the treatment group data. Table 6 revealed that there were significant main effects for the between-subjects variables of question uncertainty, response alternative uncertainty and times tested. In the first two cases however, the differences were the reverse of what had been predicted (between-subjects hypotheses: 6). The certain question group surpassed the uncertain question group, and questions with one response alternative led to greater general learning and retention than questions with four response alternatives. These results did not support the hypothesis that certain (complete) prequestions lead subjects to engage in perfunctory types of responses, nor were they consistent with the hypothesis that uncertain (incomplete) prequestions would generate relevant uncertainty and lead to enhanced incidental and relevant learning.

The overall results tended to be contrary to the general thrust of the hypothetical model or explanation of subjects' prose learning behaviors implicit in hypotheses sets 6 through 8. The expected interactions between response alternative uncertainty and question uncertainty (see hypothesis 6c) and times tested and question and response alternative uncertainty (see hypothesis 6e) did not materialize. Overall, the uncertainty conditions appeared to debilitate learning when compared to the effects of the certain question conditions. The interactions that did occur, indicated more specifically that the different levels of the question and response alternative uncertainty factors led to differences in relevant but not incidental learning, when the results were collapsed over the other variables in

the study. These differences, contrary to expectations, favored the certain question and one response alternative groups (see Figures 5 and 6).

The times tested factor led to an interesting finding. Figure 7 revealed that, in the absence of an immediate test, the retention of incidental content appeared to decrease to a greater degree than the retention of relevant content. This phenomena, at first glance, appeared to vary as a function of the type of question, complete or incomplete, subjects saw. Among subjects who were tested twice, incidental learning or retention was greater on the delayed test for subjects in the certain, as opposed to the uncertain, question group (see Figure 8). Figure 15 however, revealed that the greater incidental retention of the certain question group on the delayed test in Figure 8, was attributable in part to a very small decrease in incidental learning on the part of the certain question group from the immediate to the delayed test. In actuality however, if one extrapolates and uses the immediate test incidental learning scores (see Figure 15) as estimates of the amount of initial incidental learning, the absolute amount of the retention loss experienced in Figure 8 by the certain and uncertain question groups on incidental learning, in the absence of an immediate test, was approximately equal.

The above findings seem to lead to two conclusions. First, the very slight or nonsignificant decrease in incidental learning experienced by the certain question group between the immediate and delayed posttests (Figure 15) replicated the prequestion part of the interaction

between posttests and type of learning, cited earlier in this discussion section, that occurred with the replication control groups. Similarly, the treatment groups who were tested twice also replicated the posttests by type of learning interaction (Figure 13) when learning was averaged across question types. Apparently therefore, the incidental learning that occurs with pre- and postquestions is more resistant to forgetting than relevant learning, when both types of learning are tested for immediately after acquisition. The reason for this is uncertain, and the effect needs to be replicated further.

Second, when an immediate test is not given, the data in Figure 7 (and Figure 8 via extrapolation) support the conclusion that the loss in incidental retention surpasses the loss in relevant retention. Both of the above results could point to a possible qualitative difference in the encoding and/or storage procedures involved in incidental and relevant learning and retention. An explanation, that might be closer to the data, could be stated as follows. In the present study the retention of the incidental content appeared to decay at a faster rate than the retention of the relevant content when no immediate test was given. When an immediate test was given, the surprise factor associated with seeing unanticipated items and the satisfaction of being able to answer these items, may have served to have fixed or enhanced the items in subjects' minds, thus facilitating long term retention performance.

Analysis of the data regarding the within-subjects hypotheses (hypotheses 7a through 7g) revealed that the hypotheses were supported

only in part. Relevant learning surpassed incidental and performance decreased significantly from the immediate to the delayed posttest. The expectations regarding type of KR and KR uncertainty were not supported. Immediate and delayed KR did not differ (ANOVAs 5 and 7) but both exceeded no KR. In addition, the main effect for KR uncertainty was not significant. The failure to find main effect differences between immediate and delayed KR, and between certain (complete) and uncertain (incomplete) KR might possibly be attributed to the de facto, as opposed to direct, test nature of the uncertain question conditions and to the trials delay technique of delayed KR. Both of these differences represent departures from previous DKR studies (Sturges, 1969, 1972; Kulhavy and Anderson, 1972). Still another consideration, regarding the timing and completeness of KR variables, may have been the occurrence of opposing simple effects which tended to average out to zero. Some evidence for the latter interpretation was afforded by the occurrence of a higher order interaction which will be discussed subsequently.

There was no evidence of an interaction between type of KR and KR uncertainty (hypothesis 7f). Nor was there evidence of an interaction between type of learning and KR uncertainty (hypothesis 7g). There was a second order interaction between type of learning, type of KR (immediate or delayed) and KR uncertainty. However, the differences projected in the first order interactions, expected in hypotheses 7f and 7g, were not reflected or supported in the second order interaction shown in Figure 10. When the results were averaged

over the between-subjects variables, type of KR (immediate or delayed) and KR uncertainty did not vary in their effect on relevant learning. Incidental learning appeared to be facilitated or depressed if certain (complete) KR was immediate or delayed, respectively. The fact that KR effected incidental learning or retention was surprising. The reduction in incidental learning with delayed complete KR can only be attributed to the trials delay technique at this point in time. Perhaps the cluster of six massed items of KR following six paragraphs, set up conditions of inter paragraph interference which resulted in the incidental learning decrement. Why this did not also occur with uncertain KR is not clear.

There were two additional interactions between within-subjects variables. Type of learning interacted with KR (Figure 9). Immediate and delayed KR led to equivalent relevant learning and both surpassed the relevant learning of the no KR group. Incidental learning did not vary significantly across the levels of KR when averaged over the other variables in the study. Aside from the fact that delayed KR was expected to surpass immediate KR, this interaction conformed to expectations. The interaction between posttests and response alternative uncertainty (one, two or four response alternatives) reported in Figure 12 seems to indicate that independent of the question uncertainty factor, the stimulus conditions inherent in the two response alternative condition appear to facilitate long term retention to a greater degree than the conditions inherent in the one or four response alternative conditions.

It could be that the presentation of prequestions with two response alternatives induces a state of original learning that is more resistant to interference from other response alternatives than the one or four response alternative conditions. Studies in the area of delayed and partial knowledge of results (Sturges, 1969, 1972; Sassenrath and Yonge, 1969) have reported that the number of distractors included in KR influences learning and subsequent retention. The interaction between response alternatives and posttests occurred in ANOVA 7 but did not occur in ANOVA 8, indicating that the effect might also be due to sampling variability. The effects of varying numbers of distractors or response alternatives in factual adjunct prequestions needs to be studied further.

Some of the interactions expected between between- and within-subjects variables have already been discussed in those instances (Figure 7, 8 and 15) where the apparent relationships among the outcomes made it expedient to do so. The within- and between-subjects interactions posited in hypotheses 8a, b and c generally received no support. However, two further interactions occurred between the between- and within-subjects factors which put the outcomes of the study into a fuller perspective. First, the interaction between question uncertainty and KR uncertainty (Figure 14) indicated that uncertain (incomplete) KR was quite debilitating to the uncertain (incomplete) question group when averaged over all of the other factors in the study. This outcome partially supported the expectation that some levels of the combinations of incomplete questions

and incomplete KR might constitute too uncertain a learning situation and lead to confusion, as opposed to resolution or clarification, in regard to the content to be learned.

The interplay among the variables was quite complex, as was evidenced by the finding that certain interactions might be significant in one analysis but not another (cf. Figures 6, 8, 11, 12, 13, and 14). It should be noted however, that of the subjects who were involved in ANOVAs 5 and 6 (see Table 6), only half of these same subjects were involved in ANOVAs 7 and 8. Fluctuations in sampling variability between the partially overlapping subsets of subjects may have contributed to the inconsistency in significant findings between ANOVAs 5 and 6, and ANOVAs 7 and 8. In any event, the complexity of the interplay among the variables in the study was attested to by the presence of a fourth order interaction which approached the .05 level of significance, between question uncertainty, response alternative uncertainty, type of learning, type of KR, and KR uncertainty (Figure 11). The interaction could be interpreted as being partly contrary to, and partly supportive of the hypotheses of the study.

It was generally expected that the certain (complete) and uncertain questions might both benefit from immediate incomplete KR at all levels of response alternative uncertainty. It was expected that delayed incomplete KR might even be superior to delayed complete KR for certain and uncertain question groups exposed to only one response alternative. As the alternatives a group saw increased to two and four it was suspected that delayed complete KR might be more effective than

delayed incomplete KR.

Given the ultimate strengths of the uncertainty manipulations on subjects' attention it was also thought there was a chance that immediate complete KR might also be more effective with the uncertain questions. That is, with uncertain questions there was uncertainty regarding the hypothesis about which type of immediate KR, complete or incomplete, might lead to the best relevant learning and retention. Overall, it was thought there was a good chance question uncertainty and KR uncertainty would interact (hypothesis 8d). Some concern was also voiced as to whether the combination of uncertain (incomplete) questions with four response alternatives and incomplete delayed KR, might not constitute too uncertain a learning situation and lead to debilitated learning.

The near significant interaction reported in Figure 11 revealed trends which were relevant to the resolution of the above expectations. With uncertain questions incomplete immediate KR tended to lead to poorer relevant learning than complete immediate KR. With certain (complete) prequestions incomplete immediate KR tended to lead to better relevant learning than complete immediate KR. These trends partially supported expectations. Also, with certain prequestions, delayed complete KR tended to lead to better relevant learning than delayed incomplete KR. This was generally consistent with expectations. However, the finding that, with uncertain prequestions, delayed incomplete KR tended to lead to relevant learning equivalent to that achieved with immediate or delayed complete KR, and better learning than

that achieved with immediate incomplete KR, seemed incompatible or inconsistent with the above findings and the rationale underlying the hypothesis regarding uncertainty and mathemagenic behavior.

Unexpectedly, type of KR and KR uncertainty effected incidental learning. With certain (complete) questions, delayed complete KR tended to reduce incidental learning in comparison to immediate complete KR. This same trend was present to a lesser degree with uncertain prequestions. It appeared therefore, that the slight increase in the certain prequestion group's relevant learning with delayed complete KR, occurred at the expense of the group's incidental learning. Uncertain (incomplete) KR interacted differently with incidental learning. Immediate uncertain KR tended to reduce the uncertain question group's incidental learning in comparison to immediate complete KR. Thus, immediate complete KR tended to facilitate the incidental learning of both the certain and uncertain question groups. Delayed complete KR and immediate incomplete KR interfered with the incidental learning and/or retention of the certain and uncertain question groups, respectively.

Overall, the trends present in the fourth order interaction presented in Figure 11, supported the conclusion that there was a relationship between the level of existing retention or acquisition of relevant content, and the content or information value of KR. When prose information was apparently still within the immediate retention span of subjects, immediate incomplete KR seemed to elicit mathemagenic positive responses. When the retention of information was in all likelihood

weakening, the information value of delayed complete KR appeared to establish heightened levels of learning and retention. The positive effect of delayed incomplete KR on relevant learning with uncertain prequestion, was the exception to the explanations advanced for the above pattern of outcomes.

The analyses of the time scores indicated that the certain and uncertain question groups did not differ overall, in time spent on reading. Treatment groups exposed to only one response alternative spent significantly less time on reading, and retained more, than subjects exposed to two or four response alternatives per prequestion. Therefore, prequestions with one response alternative led to the most efficient learning.

Finally, the significant differences in reading time among the replication control groups could in part account for the failure to find the question position effect with factual questions. The replication control prequestion groups spent more time on the average, reading the text than the no question groups which in turn spent more time than the postquestion groups. Given the importance of the amount of time spent on the reading task (Carver, 1972), the reported difference in study time could have served to neutralize any potential question position effects. The variable of reading time has generally been a neglected factor in many prose learning studies and conflicting results have been obtained in studies where reading time has been permitted to vary. For example, Rothkopf and Bisbicos (1967) reported no difference in overall reading time between their pre- and post-

question groups. Morasky and Willcox (1970) found that differences in reading time, among pre-, post- and no question groups, were inconsistent in consecutive studies which employed the same subjects. It is suggested that the effects of reading time be monitored systematically in future prose learning studies in that between group differences in acquisition time ultimately reflect upon the efficiency (Carver, 1972) of the various treatments.

CONCLUSIONS AND IMPLICATIONS

It would have to be concluded that the major expections of the study were not realized. The failure to replicate Frase (1967, 1968a, d) would seem to support the conclusion that the factual question position effect is not very robust. The size of the effect, where it has occurred, would appear to limit its relevance or potency in applied educational situations. In addition, the apparent variation in the reactivity or performance of subjects from study to study would seem to have methodological implications for future prose learning studies. A number of crucial methodological concerns have been cited by Carver (1972) and Ladas (1973). Among those concerns relevant to between study variability, more consistent attention should be paid to the factors of study time and the face validity of the treatment or learning strategy subjects are induced to adopt during prose learning studies. Samples of subjects might even be debriefed systematically regarding their understanding of the goals of the situation and the learning strategies they adopted in order to check on the validity or consistency of the treatments. Subjects might be run individually to allay nonsystematic instances of competition which inflate error variance. Systematic attempts might also be made to control, or at least to appraise, subjects' commitment to the study. Control of these factors would add to the precision of the studies.

The hypothesis that differences between pre- and postquestion groups (and certain and uncertain question groups) might be more pronounced if subjects received only a delayed test, received no support

from either the replication control or the treatment group analyses. In a like manner, uncertain questions and questions with four response alternatives failed to induce subjects to significantly greater levels of incidental (and/or relevant) learning than certain questions and questions with one response alternative, respectively. Taken as a whole the above results suggest that the hypothetical explanations or model of expected mathemagenic behaviors, as a function of question and response alternative uncertainty, did not receive any empirical support.

The results seem to support a hypothetical model or explanation that is contrary to the original rationale. Namely, the results seem to suggest that as prequestions increase in uncertainty (e.g., incomplete questions and increasing numbers of response alternatives) the number of potentially relevant question stems and/or answers increases to the point where there are just too many potential alternatives for a subject to deal with. Cunningham (1972) noted that any passage can answer an indefinitely large number of questions. In a similar vein, a question without a stem and several response alternatives leads to a potentially unspecifiable set of potentially relevant questions and relevant answers. Perhaps, the unanticipated complexity of this situation led subjects to entertain a number of potential question and response associations prior to each passage which were irrelevant to and which may have interfered with subjects' acquisition of the subsequent content in the passage. This hypothesized preoccupation of uncertain group subjects with sets of potentially relevant questions and answers could also be posited to have interfered with the

incidental learning of the uncertain question group subjects once they began the task of processing a passage. In any event, in a normative or comparative sense, and in retrospect, the certain (complete) questions with the fewest numbers of response alternatives seem to have constituted the learning situation in this study which represented a reasonable path of effort (Anderson, 1970) for subjects. Consequently, certain questions with one response alternative consistently led to greater relevant learning.

In addition the results of Kulhavy and Parsons (1972) would suggest, in retrospect, that learning contexts in which subjects are allowed to make errors and are not provided with the clear instructional means to rectify them, can be expected to lead to decreased learning. The combination of uncertain questions and uncertain KR in the present study would appear to correspond to these conditions especially if the learner never figured out the real question during the study period.

The hypotheses regarding the factors of delayed and incomplete KR received only weak support. The trends, present in the fourth order interaction, for immediate incomplete KR and delayed complete KR to facilitate relevant learning were consistent with a-priori expectations. Immediate incomplete KR presumably induces subjects to attend to the relevant associations and reconstruct them from immediate working memory. Delayed complete KR presumably induces greater attention as a direct function of the interval of delay. Delayed incomplete KR presumably receives a like amount of attention but, if the relevant

association is not within subjects' working memory, new information cannot be transmitted. Similarly, when incomplete KR is delayed, incorrectly held associations may not be recognized as such and corrected. The failure to find main effects for these two factors may possibly be attributable to the fact that the simple effects of the factors, when examined across the levels of the other factors, tended to cancel each other out. Figure 11 partially supports this interpretation.

The weakness of the above effects may somehow have been due to the overall complexity of the learning situation. The within-subjects combinations of no, immediate and delayed KR, alternating between complete and incomplete KR, across a relatively short grouping of three sets of six paragraphs, may have been too novel and/or complex a situation for subjects to accommodate in a brief time span. The fact that the certain (complete) prequestion groups, exposed to questions with two and four response alternatives did not appear to surpass the replication control groups on the immediate test of relevant learning even when they had the advantage of KR, would appear to bear out this conjecture. Within the gestalt afforded by a relatively short group of paragraphs, it might be advisable to study the effects of timing and completeness of KR as between-subjects, and not within-subjects variables.

The finding that KR effected incidental learning was surprising. The reason why delayed certain (complete) KR should debilitate incidental learning or retention is uncertain. It is suggested that this

result be replicated before it is given further consideration.

The finding that incidental learning appeared to be more resistant to forgetting than relevant learning when subjects were tested twice and less resistant when subjects were only tested once also stands in need of replication. This finding has no precedent in the literature and could suggest that incidental learning may be subject to different encoding processes than relevant learning, especially insofar as working short-term memory is concerned.

In summary, the analyses of the data support the following conclusions. Incomplete prequestions do not induce so called mathemagenic positive behaviors. They would appear to have no utility in applied situations. The hypothetical explanation or model implicit in the hypotheses advanced regarding the factors of question and response alternative uncertainty and their expected interaction with KR and KR uncertainty received little support. The factual question position effect appears to be relatively fickle. Given the relatively small size of the effect, and the apparent inter-study variability in subjects' interpretation of the de facto goals of the pre-, post-, and no question situations, the educational significance of the effect should be reappraised. No conclusive data was obtained on the effects of guessing. Weak support was obtained for the delayed KR and incomplete KR effects. The direct effects of these factors and their possible interactions might profitably be studied in less complex and more straight-forward designs. Several comparisons in the present design were contingent upon the replication of the factual question-

position effect. Given the outcomes of this study it is suggested that this is too tenuous a procedure in which to invest a large number of subjects and a large amount of time. More direct ways should be found to study the effects under investigation. The Kulhavy and Anderson (1972), and the McGaw and Grotelueschen (1972) studies for example, represent instances of studies that more directly tied hypothesized prose learning processes to observable events that were directly and logically contrived to support or refute the proposed hypotheses. Finally, it was suggested that greater attention be paid to the validity of the treatments and the reading time of the subjects in future prose learning studies.

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Appendix A

Experimental Materials and Question Counterbalancing

Experimental Materials and Questions Counterbalancing

This appendix presents the 18 paragraphs and 36 questions that were used as the experimental materials. The appendix does not show directly, on a one to one basis, how the materials were presented in the study but rather, presents a coding system which enables the reader to reconstruct the numerous experimental conditions. In this appendix each paragraph and its two respective questions are presented together. For the coding purposes of the appendix a decimal system was used to label the paragraphs and questions (1.1 = paragraph one, question one; 1.2 = paragraph one, question two). The first number identifies the paragraph and the second (.1 or .2) identifies the two questions developed from the paragraph. Counterbalancing procedures were employed so that the .1 and .2 questions served equally frequently as relevant and incidental content in each of the factorial combinations of the between-subjects conditions. The frequency of complete and incomplete KR was also counterbalanced across the .1 and .2 questions for each paragraph.

The nature of the study also necessitated, for the explanatory purposes of this appendix, the coding of the response alternatives to each question. Subjects who received only one response alternative saw the alternative indicated by the number (1). This was always the correct alternative. Subjects who received two response alternatives saw the alternatives numbered (1) and (2). Subjects who received all four question alternatives saw all four (a through d) alternatives. It should be noted that the position in which the response alternatives

appeared was independently randomly determined for the prequestions and KR given during acquisition and for the posttest questions. Thus, subjects were not able to use systematically position cues to assist them in identifying the correct response. The latter pages of this appendix present the 36 questions and 18 paragraphs used in the study, coded as described above.

Several counterbalancing procedures were followed in order to balance out the effects of differences in the average difficulty of questions. Figure 1 depicts the question counterbalancing that occurred within each of the 12 combinations of the levels of the between-subjects factors of question uncertainty, response alternative uncertainty and times tested. Each of the 12 between-subjects combinations had 12 subjects. Figure 1 shows that subject one saw the .1 questions as the relevant content during reading and also received the first order or sequence of KR. This involved receiving complete immediate KR over the first three prequestion-paragraph combinations, and incomplete immediate KR over the second three question-paragraph combinations. The second subset, paragraphs 7-12, involved complete and incomplete DKR over paragraphs 7-9 and 10-12, respectively. No KR was given for the third and final subset of six paragraphs. Subject two received the same relevant questions (.1) and the same order of KR as subject one but the sequence of complete and incomplete KR was reversed. For subjects one and two the .2 question from each paragraph was incidental content. If Figure 1 were duplicated beside each of the 12 combinations of the levels of the three between-subjects factors cited above, the experimental materials for the experimental subjects

could be reconstructed in their entirety. It should be noted however, that the fourth between-subjects variable, KR order, was deleted from the analysis due to a confounding oversight.

Appendix A: Figure 1

Outline of Counterbalancing Procedures

KR Order and Source of Relevant Questions: .1 or .2 from Paragraph		Paragraphs		
		Subset One (1-3) (4-6)	Subset Two (7-9) (10-12)	Subset Three (13-15) (16-18)
KR Order One: .1 Question = Rel.	S1:	C1 C2*	C1 C2	
	S2:	C2 C1	C2 C1	
KR Order One: .2 Question = Rel.	S3:	C1 C2	C1 C2	
	S4:	C2 C1	C2 C1	

		Delayed KR	No KR	Immediate KR
KR Order Two: .1 Question = Rel.	S5:	C1 C2		C1 C2
	S6:	C2 C1		C2 C1
KR Order Two: .2 Question = Rel.	S7:	C1 C2		C1 C2
	S8:	C2 C1		C2 C1

		No KR	Immediate KR	Delayed KR
KR Order Three: .1 Question = Rel.	S9:		C1 C2	C1 C2
	S10:		C2 C1	C2 C1
KR Order Three: .2 Question = Rel.	S11:		C1 C2	C1 C2
	S12:		C2 C1	C2 C1

Key: C1 = Complete KR (Certain)
C2 = Incomplete KR (Uncertain)
*See method section for sample of KR variations C1 and C2.

1.1 Which of the following is true regarding William James' father?

a. he inherited a fortune from his uncle

2. b. he enrolled the boys in a local debating club

1. c. he didn't have to work for a living

d. he was born in New York

1.2 How many children were there in the James' family?

2. a. six

b. four

1. c. five

d. he was an only child

Paragraph 1

William James was born in 1842 in New York, the first of five children. Second born was Henry, the novelist; third, Garth Wilkinson; fourth, Robertson; and last, Alice, who was only six years younger than William.

Their father, Henry James, Sr., was wealthy enough to live on his income, which left him the leisure to write tracts on Swedenborg and to be a devoted parent. He organized his family into one of the most high-spirited and exclusive debating clubs in all history; the atmosphere he created for them was vividly recalled by Edward Emerson.

2.1 As a youth, how could William James best be characterized?

1. a. he was affectionate

   b. he argued vindictively with his brother Henry

2. c. he refused to argue with his father

   d. he had a thin scholarly look

2.2 How would you best describe Mrs. James?

   a. the text didn't mention her

   b. she was quite plain

1. c. she was conventional but bright

2. d. she was concerned over the continual family bickering

Paragraph 2

"The adipose and affectionate Wilkie," as his father called him, would say something and be instantly corrected or disputed by the cocksparrow Bob, the youngest, but good-naturedly defend his statement, and then, Henry (Junior) would emerge from his silence in defense of Wilkie. Then Bob would be more impertinently insistent, and Mr. James would advance as moderator, and William, the eldest, join in. The voice of the moderator presently would be drowned by the combatants and he soon came down vigorously into the arena, and when, in the excited argument, the dinner knives might not be absent from eagerly gesticulating hands, dear Mrs. James, more conventional, but bright as well as motherly, would look at me, laughingly reassuring, saying, "Don't be disturbed, Edward; they won't stab each other. This is usual when the boys come home."

3.1 What was the result or effect of William James' home environment?

a. it resulted in much personal animosity

2. b. it demonstrated that arguing can have an effect on personal affections

1. c. it turned out to be a good way of fostering independent thinking

d. it made the children over-critical

3.2 How did the James children act when they matured?

a. they went their separate ways

1. b. they wrote each other frequently

2. c. they remained together

d. they gradually drifted apart

Paragraph 3

It would be difficult to devise a better way to learn to think for oneself, or to learn that intellectual combat need not interfere with personal affection. Even when the children grew up their debate continued. Throughout their lives they wrote frequent, voluminous, fascinating letters that fortunately for the many biographers attracted to this amazing family - they were wise enough to preserve for posterity. Few families remain so close so long.

4.1 How would you characterize the later schooling of the James children?

a. it was very well planned by the father

2. b. it was conducted by several governesses

c. it was like a series of accidents

1. d. it was acquired mainly by absorption

4.2 How did William James' critics regard him?

2. a. as a fine philosopher

1. b. as an American barbarian

c. as an intellectual gypsy

d. as a fine writer but a poor physician

Paragraph 4

The schooling of this precocious brood seems to have been a series of accidents. Until he was nine, William passed from one governess to another; then he started to school, but after he had tried several, his parents decided that American schools were not good enough, and in 1855 the family set off for Europe. For five years they traveled like a pack of intellectual gypsies through England, Switzerland, France, and Germany while the children absorbed the languages and any other aspects of European culture that took their fancy. Whatever else might be said for it, this unconventional program of studies left William anything but the backwoods American barbarian that critics later assumed him to be.

5.1 Which of the following is false?

1. a. the James family sometimes could not travel because of illness

   b. the James children traveled abroad several times

2. c. the James children were usually sick

   d. William James knew the best people on the continent

5.2 What did William do in 1860?

1. a. he began his study of art

   b. he began his study of psychology

2. c. he obeyed his father's wishes in choosing a career

   d. he became interested in philosophy

Paragraph 5

William James was literally a man of the world, and throughout his life he was, through reading, correspondence, and frequent journeys abroad, in constant contact with the best that England and the Continent could offer. The overseas voyages were in large part the result of a unique Jamesian formula: when someone in the family became ill he was sent not to a hospital, but to Europe. Since their health was seldom good, the Jameses all became great travelers.

In 1860 William announced that he was going to be an artist. His father was not a little grieved, for he had always counted on a scientific career for Willy.

6.1 Why did William James' father bring the family home to America?

2. a. so that William could study chemistry

b. because he was grieved over his son's choice of a career

1. c. so William could study art

d. so that Henry might change his mind

6.2 What did the text have to say about William James' teacher, Charles W. Eliot?

a. he later became Yale's president

1. b. he criticized William's lack of industry in studying chemistry

2. c. he thought William was better suited for a career in philosophy

d. he later became director of the Lawrence Scientific School

Paragraph 6

But he believed in liberty, so he agreed to take his family back to America and to William Morris Hunt. As the younger Henry expressed it, "We went home to learn to paint."

Fortunately, the vocational experiment was a complete success, and the autumn of 1861 found William a student of chemistry in the Lawrence Scientific School at Harvard. His teacher was Professor Charles William Eliot, who a few years later was to become Harvard's president. In later years Eliot recalled William as a very interesting and agreeable pupil, but not wholly devoted to the study of chemistry. He was inclined toward unsystematic excursions in unpredictable directions - his personal notebooks during those years ranged over the whole field of literature, history, science and philosophy.

7.1 Which of these statements about William James is true?

a. he never considered medicine seriously as a career

1. b. he thought medical practice was mostly a farce

2. c. he thought that doctors should be moral people

d. he studied under Lange

7.2 Which of the following is true of William James?

2. a. he criticized the study of chemistry as too narrow

b. he failed in his study of chemistry

c. he entered the Yale medical school

1. d. he became interested in the study of natural science

Paragraph 7

After two years of chemistry, he decided that his interests lay more in the direction of natural history, and so, with the notion of coupling this with a possible medical career, he entered Harvard Medical School.

Except for his work under the saintly Jeffries Wyman, medical studies did not please William James. His first impressions were that there is a great deal of humbug in the practice of medicine. "With the exception of surgery, in which something positive is sometimes accomplished," he commented in a letter to his cousin, "a doctor does more by the moral effect of his presence on the patient and family, than by anything else. He also extracts money from them."

8.1 What did William James do in 1865?

2. a. he went on an expedition to Africa

1. b. he studied biology

c. he studied art

d. he traveled the Amazon with the Zoologist, Wyman

8.2 What did William James do when the Thayer Expedition ended?

a. he studied classification schemes

1. b. he resumed his medical studies

2. c. he sent his zoological reports to Agassiz

d. he returned to Europe

Paragraph 8

He kept at it, however, until the spring of 1865, when he took a year off to join the Thayer Expedition to Brazil. He saw the expedition up the Amazon as an opportunity to work with the famous Swiss-American zoologist, Agassiz, and to try yet another possible career, biology. Once again the vocational experiment was instructive, and long before the expedition was over he knew that a life filled with careful collection and orderly classification was not for him. Somewhat reluctantly, he resumed medical studies.

9.1 What did William James study and why?

2. a. Chemistry, because his father demanded it

b. philosophy, because he was fascinated by it

1. c. medicine, because nothing else attracted him

d. surgery, because it was worthwhile

9.2. What determined James' choice of career?

1. a. ill health

b. his family

c. fear of failure

2. d. insatiable philosophical enquiry

Paragraph 9

The subject was no more attractive to him than when he began it - indeed, he rather dreaded the prospect of becoming a doctor - but until he discovered something else that really would attract him as a career, there seemed no alternative to the medical school. His next choice would have to be the right one; his two previous mistakes were already more than he felt he should allow himself.

Not all choices are deliberate, however, James' future was shaped by ill health. Insomnia, digestive disorders, eye trouble, weak back, and deep depressions combined to produce a new interruption of his medical studies.

10.1 What did William James do after his return from Germany?

2. a. he went to South America

1. b. he returned to Cambridge

c. he received his Ph.D.

d. he set up medical practice

10.2 What did William James do in Dresden and Berlin in 1867?

a. he attempted to take his life

b. he took courses in German Literature

2. c. he took baths for his legs

1. d. he suffered from homesickness

Paragraph 10

It was obvious to everyone that he was suffering from America; Europe was the only cure. In 1867 he went to Dresden and Berlin, where he took baths for his back, read widely in German and other literature, toyed with thoughts of suicide, displayed his loneliness and homesickness by the tremendous volume of his correspondence, and remained just as miserable as he had been at home. After a sojourn of almost two years he returned to Cambridge, took up his medical courses once again, and in the spring of 1869 received his degree.

His M.D. was the only academic degree he ever acquired by passing the necessary examinations.

11.1 What was the mainstay of William James early philosophy?

2. a. materialism and determinism

1. b. the will to believe

c. the causal interdependence of events

d. the effect of the subconscious on free will

11.2 When did the turning point come for William James?

a. when he discovered a book by Renoir

1. b. when he realized that the mind can effect the body

2. c. when he rejected the materialistic physiology of the day

d. when he realized that all events have a cause which can be found.

Paragraph 11

His spirits continued their steady decline, and the spring of 1870 found him in the deepest melancholy. His will to live was at its lowest ebb.

The turning point came when he discovered a number of essays on free will by Charles Renouvier. Renouvier convinced him that the activities of the mind have causal effects on the body - a possibility that the materialistic physiology of the day wholly rejected - and that these activities can be controlled by deliberate choice. "My first act of free will", he recorded in his diary at the time he first read Renouvier, "shall be to believe in free will." From then on James' philosophy was identified with his personal convictions. And his first conviction was that he must believe in the efficacy of the will, believe that by sheer belief he could cure himself.

12.1 What did James begin teaching in 1872?

a. natural science

2. b. psychology

c. philosophy

1. d. physiology

12.2 What was James convinced of, concerning his emotional difficulties?

1. a. that they had been relieved by philosophic insight

2. b. that they could only be cured by spiritual rebirth

c. that they could not be quickly overcome

d. that they could be cured by therapy

Paragraph 12

His gospel of belief was a cheerful success. No one knows what cures mental illness; approximately two out of every three cases recover regardless of the therapy, or even as in his case, without therapy. But whatever the reason, he was convinced that his personal difficulties had been relieved by philosophic insight, and the insight involved a new conception of freedom. Renouvier was perhaps the greatest individual influence on the development of James' thought, and with that help he slowly fought his way back to health and full activity once more.

By 1872 he was well enough to accept Eliot's offer of a teaching position - he agreed to teach physiology to the undergraduates in Harvard College.

13.1 What did James do in the year that Wundt established a laboratory in Leipzig?

2. a. he began his teaching career

1. b. he established demonstrations in psychology

c. he wrote Synthetic Philosophy

d. he borrowed $300 from the Harvard Treasury

13.2 What text did James use when he introduced his experimental psychology course in America?

a. a text in psychology

2. b. a text in physiology

1. c. a text in philosophy

d. a text in laboratory procedures.

Paragraph 13

He proved to be a satisfactory teacher and having a job to do turned him away from further morbid self-examination. In 1875-76 he offered a course on "The Relations between Physiology and Psychology" which marked the first American introduction to the new, experimental psychology. The undergraduate version of that course, offered in the following year, was known as the "new Spencer elective," since it used as a text the 1200-page Synthetic Philosophy of Herbert Spencer. He was able to extract $300 from the Harvard Treasurer for use in purchasing laboratory and demonstrational equipment for the course, a munificence bestowed during the same year that Wundt established an informational demonstrational laboratory in Leipzig.

14.1 In which department was James professorship?

a. psychology

2. b. physiology

c. physiological psychology

1. d. philosophy

14.2 What occured in the year that James was married?

1. a. he agreed to write a psychology text

2. b. he established the first experimental lab in America

c. he completed his theory of emotion

d. he was stricken with illness and didn't finish his book

Paragraph 14

James had moved from pure physiology and anatomy into physiological psychology and, because psychology was at that time the responsibility of the Department of Philosophy, James' professorship was in philosophy, rather than physiology. Thus he continued his slow but inevitable migration away from medicine through physiology to philosophy.

In 1878, the year of his marriage, James agreed to write a text on psychology for Henry Holt and Co. He felt he could finish it in two years, but as a matter of fact, the composition of the book took twelve - and Holt waited.

15.1 How would you best describe James' text of psychology?

1. a. it grew with his classroom experiences

   b. it was criticized for being too polemical

2. c. it was mainly concerned with habit

   d. it was animated and contained many pictures

15.2 What did James' psychology text say about "habits"?

2. a. they are always useful

1. b. they are a good means of social control

   c. they complicate our behavior patterns

   d. they diminish fatigue and accuracy

Paragraph 15

The manuscript grew in close connection with the author's classroom instruction, and an animated, polemical style was a natural result. The chapter on "Habit" is an excellent example, one that has been reprinted repeatedly in anthologies. It is in lay sermon:

--Habit simplifies the movements required to achieve result, makes them more accurate and diminishes fatigue.

--Habit is the enormous flywheel of society, its most precious conservative agent. It alone is what keeps us all within the bounds of ordinance, and saves the children of fortune from the envious uprisings of the poor.

16.1 What did James say that one should not do in developing new habits?

a. one shouldn't overexercise the habit

b. one shouldn't willfully condition his nervous system

2. c. one shouldn't make a wide variety of actions automatic

1. d. one shouldn't allow an exception to occur

16.2 What did James have to say about a person's character?

2. a. it always remains plastic

1. b. it is set by the time one is thirty

c. it is set at birth, but can be modified through effort

d. it is set at 20, but can be modified through effort

Paragraph 16

--In most of us, by the age of thirty, the character has set like plaster, and will never soften again.

--The great thing, in all education, is to make our nervous system our ally instead of our enemy. We must make automatic and habitual, as early as possible, as many useful actions as we can.

--In the acquisition of a new habit, or the leaving off of an old one, we must take care to launch ourselves with as strong and decided an initiative as possible. Never suffer an exception to occur until the new habit is securely rooted in your life.

17.1 Upon what did James base his theory of habit?

2. a. introspective analysis

b. Renouviers essays on free will

1. c. observations of life around him

d. the views of European philosophers

17.2 What did the text state about James' treatise on habit?

1. a. it is wise advice

b. it is too narrow a view of habit

c. it cannot be improved upon

2. d. it is highly complex theory

Paragraph 17

--Seize the very first possible opportunity to act on every resolution you make, and on every emotional prompting you may experience in the direction of the habits you aspire to gain.

--Keep the faculty of effort alive in you by a little gratuitous exercise every day.

The chapter is full of wise advice to the young student. Of course, one might ask what manner of science this is. On what experiments did he base his generalizations? What scientifically controlled observations did he make? The answer would be, none whatsoever. James' psychology, at its best, came from his own sharp observations of life around him.

18.1 What would James advise those who are trying to overcome an undesirable emotion?

2. a. avoid all situations which might elicit the emotion

1. b. go through the outward motions of a contrary action

c. try not to show emotion

d. avoid temptation because the habit is ingrained

18.2 What did James publish in 1884?

2. a. his Principles

1. b. an article, "What is an Emotion?"

c. a treatise on habit

d. "Synthetic Philosophy"

Paragraph 18

In 1884 he published an article, "What is an Emotion?" that must have been conceived during his deepest grief and prepared for publication in the following year. It gives us some hint of the device he had discovered. "There is," he wrote, "No more valuable precept in moral education than this, as all who have experience know; if we wish to conquer undesirable emotional tendencies in ourselves, we must assiduously, and in the first instant cold-bloodedly, go through the outward motions of those contrary dispositions we prefer to cultivate." If we act cheerful and kindly, those emotions will replace the depressions and sullenness we wish to be rid of. It is an application of the principle he had learned from Renouvier; we can will to believe what we should believe.

Appendix B

Sample of Posttest

SAMPLE OF POSTTEST

INSTRUCTIONS - Please comply with the following:

A. CHECK YOUR COVER SHEET - - -

Did you REMEMBER to record: (1) the time you finished reading, and (2) the time you started this quiz???

Please RECORD that information on your COVER SHEET, NOW.....

B. ALSO, there are 2 THINGS to be ENTERED on your IBM ANSWER SHEET.

(1) On your COVER SHEET you will find a 9 DIGIT CODE NUMBER. PLEASE RECORD that number on your IBM Answer Sheet in the section at the LOWER RIGHT, in the space designated by STUDENT NUMBER. PLEASE DO THAT NOW. MAKE SURE THAT YOU HAVE ENTERED ALL 9 DIGITS AND FILLED IN THE APPROPRIATE BOXES (hash marks).

(2) PRINT your name (last and first) in the appropriate section (upper right).

THANK YOU . . . . . .

C. FINALLY, check to see if this EXAM BOOKLET is COMPLETE.

There should be 36 questions. Choose the one alternative, from among the 4 possible alternatives, which best answers the question.

PLEASE DO NOT MARK THIS EXAM BOOKLET .....

BEGIN ------

1. What did William do in 1860?
   1. he became interested in philosophy
   2. he began his study of psychology
   3. he began his study of art
   4. he obeyed his father's wishes in choosing a career

2. In which department was James' professorship?
   1. philosophy
   2. physiological psychology
   3. physiology
   4. psychology

3. What was James convinced of, concerning his emotional difficulties?
   1. that they could only be cured by spiritual rebirth
   2. that they had been relieved by philosophic insight
   3. that they could be cured by therapy
   4. that they could not be quickly overcome

4. What would James advise those who are trying to overcome an undesirable emotion?
   1. try not to show emotion
   2. avoid temptation because the habit is ingrained
   3. go through the outward motions of a contrary action
   4. avoid all situations which might elicit the emotion

5. Which of the following would James agree with, regarding the development of new habits?
   1. one shouldn't overexercise the habit
   2. one shouldn't willfully condition his nervous system
   3. one shouldn't make a wide variety of actions automatic
   4. one shouldn't allow an exception to occur

6. How would you best describe Mrs. James?
   1. the text didn't mention her
   2. she was conventional but bright
   3. she was quite plain
   4. she was concerned over the continual family bickering

7. Which of the following is true of William James?
   1. he failed in his study of chemistry
   2. he entered the Yale medical school
   3. he criticized the study of chemistry as too narrow
   4. he became interested in the study of natural history

8. Why did William James' father bring the family home to America?
   1. because he was grieved over his son's choice of a career
   2. so William could study art
   3. so that Henry might change his mind
   4. so that William could study chemistry

9. What did William James do in 1865?
   1. he studied biology
   2. he went on an expedition to Africa
   3. he traveled the Amazon with the Zoologist, Wyman
   4. he studied art

10. Which of the following is false?
   1. the James children traveled abroad several times
   2. the James children were usually sick
   3. William James knew the best people on the continent
   4. The James family sometimes could not travel because of illness

11. What text did James use when he introduced his experimental psychology course in America?
    1. a text in physiology
    2. a text in philosophy
    3. a text in psychology
    4. a text on laboratory procedures

12. What did James do in the year that Wundt established a laboratory in Leipzig?
    1. he established demonstrations in psychology
    2. he borrowed $300 from the Harvard Treasury
    3. he began his teaching career
    4. he wrote Synthetic Philosophy.

13. When did the turning point come for William James?
    1. when he rejected the materialistic physiology of the day
    2. when he discovered a book by Renoir
    3. when he realized that all events have a cause which can be found
    4. when he realized that the mind can affect the body

14. What did William James study and why?
    1. medicine, because nothing else attracted him
    2. philosophy, because he was fascinated by it
    3. surgery, because it was worthwhile
    4. chemistry, because his father demanded it

15. What did James publish in 1884?
    1. his Principles
    2. a treatise on habit
    3. "Synthetic Philosophy"
    4. an article, "What is an Emotion?"

16. How many children were there in the James family?
    1. four
    2. six
    3. five
    4. he was an only child

17. How did the James children act when they matured?
    1. they remained together in America
    2. they gradually drifted apart
    3. they went their separate ways
    4. they wrote each other frequently

18. What did James begin teaching in 1872?
    1. natural science
    2. philosophy
    3. psychology
    4. physiology

19. As a youth, how could Garth Wilkinson James best be characterized?
    1. he was affectionate
    2. he had a thin scholarly look
    3. he argued vindictively with his brother Henry
    4. he refused to argue with his father

20. Which of these statements about William James is true?
    1. he thought medical practice was mostly a farce
    2. he thought that doctors should be moral people
    3. he studied under Lange
    4. he never considered medicine seriously as a career

21. What did James' psychology text say about "habits"?
    1. they are always useful
    2. they complicate our behavior patterns
    3. they are a good means of social control
    4. they diminish fatigue and accuracy

22. What did the text state about James' chapter on habit?
    1. it is wise advice
    2. it is highly complex theory
    3. it cannot be improved upon
    4. it is too narrow a view of habit

23. What did William James do in Dresden and Berlin in 1867?
    1. he suffered from homesickness
    2. he attempted to take his life
    3. he took baths for his legs
    4. he took courses in German literature

24. What did James have to say about a person's character?
    1. it is set at 20, but can be modified through effort
    2. it always remains plastic
    3. it is set by the time one is thirty
    4. it is set at birth, but can be modified through effort

25. What did the text have to say about William James' teacher, Charles W. Eliot?
    1. he criticized William's lack of industry in studying chemistry
    2. he thought William was better suited for a career in philosophy
    3. he later became director of the Lawrence Scientific School
    4. he later became Yale's president

26. What was the result or effect of William James' home environment?
    1. it demonstrated that arguing can have an effect on personal affections
    2. it resulted in much personal animosity
    3. it made the children overly critical
    4. it turned out to be a good way of fostering independent thinking

27. How would you characterize the later schooling of the James children?
    1. it was very well planned by the father
    2. it was conducted by several governesses
    3. it was acquired mainly by absorption
    4. it was like a series of accidents

28. What did William James do after his return from Germany?
    1. he set up medical practice
    2. he returned to Cambridge
    3. he received his Ph.D.
    4. he went to South America

29. What occurred in the year that James was married?
    1. he agreed to write a psychology text
    2. he was stricken with illness and didn't finish his book
    3. he completed his theory of emotion
    4. he established the first experimental lab in America

30. What did William James do when the Thayer Expedition ended?
    1. he returned to Europe
    2. he resumed his medical studies
    3. he studied classification schemes
    4. he sent his zoological reports to Agassiz

31. Which of the following is true regarding William James' father?
    1. he was born in New York
    2. he didn't have to work for a living
    3. he enrolled the boys in a local debating club
    4. he inherited a fortune from his uncle

32. Upon what did James base his theory of habit?
    1. the views of European philosophers
    2. introspective analysis
    3. observations of life around him
    4. Renouvier's essays on free will

33. What was the mainstay of William James' early philosophy?
    1. the will to believe
    2. materialism and determinism
    3. the causal interdependence of events
    4. the effect of the subconscious on free will

34. How did William James' critics regard him?
    1. as an intellectual gypsy
    2. as a fine philosopher
    3. as an American barbarian
    4. as a fine writer but a poor physician

35. What determined James' choice of career?
    1. ill health
    2. his family
    3. fear of failure
    4. insatiable philosophical enquiry

36. How would you best describe James' text of psychology?
    1. it was criticized for being too polemical
    2. it was animated and contained many pictures
    3. it grew with his classroom experiences
    4. it was mainly concerned with habit

Please comply with the following :

CHECK OUT PROCEDURE

(1) Please enter the TIME that you FINISHED THIS quiz on your COVER SHEET.
(2) A REMINDER --- Please keep the details of your experience today, CONFIDENTIAL (for at least 2 weeks). Other classes have yet to participate in this study, and any information that they receive in advance will bias their performance and the study as well. A full report and discussion of this project will be given in the near future, at a date to be announced.

REMINDER

(3) Your participation in the follow-up phase of this study (one week from today - 20 min.) will be sincerely appreciated.
(4) Please return your EXAM BOOKLET, IBM SHEET, COVER SHEET, DIRECTION SHEET, and PENCIL to your instructor.

THANK YOU FOR YOUR COOPERATION.

Appendix C

Sample of Experimental Instructions

SAMPLE OF EXPERIMENTAL INSTRUCTIONS

INSTRUCTIONS COMMON TO ALL SUBJECTS

DIRECTION SHEET Please read these directions from start to finish before asking any questions DIRECTION SHEET

OVERVIEW: Today we are asking you to participate in a study that is relevant to the management of instruction. We are interested in finding out how people learn from written materials. The instructional content that you will be asked to read has been taken from an introductory psychology text and is concerned with the life of William James. Your cooperation in complying with the following instructions is sincerely requested.

.....Insert Instruction Variation A Here.....

.....Insert Instruction Variation B Here.....

.....Insert Instruction Variation C Here.....

There is one restriction however. We would ask you to read the pages in order (from front to back), as they appear in the INSTRUCTIONAL BOOKLET, and not to look back at a page once you have read it. You may spend as long as you like on a given page, but once you turn it over, don't go back to it. . .OK.

There are several instructional conditions, so don't be concerned with your neighbor's behavior. He may have a different task, and/or different instructions than you, and therefore, he may take more or less time, than you, to finish. We would also request that you keep the nature of your experience today CONFIDENTIAL (for at least 2 weeks). Other students have yet to take part in this study and if they were to receive advance information it would bias their performance and bias the study as well. In addition, you will be asked to participate in a brief follow-up phase of this study, a week from now. Discussion of today's session would bias that performance as well ... THANK YOU...

Finally, you will be requested to time various parts of your performance. Instructions relating to timing will be interjected at different points in the course of the task. If you have any questions raise your hand. Don't ask them aloud. Your instructor will come over and you can communicate your question silently... OK ...

FIRST Print your name on your COVER SHEET.

SECOND Record the time (RIGHT NOW) on your Cover Sheet, beside the heading "Start Reading" (_____:_____).

NOW, turn to the INSTRUCTION BOOKLET and start reading. .BEGIN.

(P.S. Remember, don't look back at a page once you have read it._)

INSTRUCTIONS SPECIFIC TO DIFFERENT EXPERIMENTAL GROUPS

INSTRUCTION VARIATION A

(SEEN ONLY BY CONTROL GROUP SUBJECTS)

INSTRUCTIONS: The task for today involves reading several paragraphs of material. Immediately upon completion of the reading you will be asked to take a test on the content that you have read.

INSTRUCTION VARIATION B

(SEEN ONLY BY THOSE SUBJECTS WHO WERE PRESENTED WITH ONLY ONE PREQUESTION RESPONSE CHOICE DURING READING)

INSTRUCTIONS: The task for today involves reading several paragraphs of material. During reading, each paragraph will be preceded by a COMPLETE or INCOMPLETE (modified) question. PRIOR to reading each paragraph, you will be asked to *GUESS*, in the absence of any advance information, if the response choice is TRUE or FALSE. You will be directed to use your pencil to indicate your guess or response. Information feedback or knowledge of the correct response may, or may not, be given in the course of instruction. Immediately upon completion of the reading you will be asked to take a test on the content that you have read.

WE REPEAT, some of the pages that you will be asked to read may be incomplete or lacking in information. Try to fill in (MENTALLY) the missing information on these pages. And, as noted above, you may be asked to write during the reading portion of this task. If you are asked to write, you will SEE A STATEMENT TELLING YOU to use your pencil to WRITE, MARK, OR CIRCLE, something. If you DON'T SEE such a statement on a page, then you DON'T HAVE to write on that page.....

INSTRUCTION VARIATION C

(SEEN ONLY BY THOSE SUBJECTS WHO WERE PRESENTED WITH TWO OR FOUR PREQUESTION RESPONSE CHOICES DURING READING)

INSTRUCTIONS: The task for today involves reading several paragraphs

of material. During the reading, each paragraph will be preceded by a COMPLETE or a MODIFIED (multiple-choice question without a stem) question. PRIOR to reading the paragraph, you will be asked to *GUESS*, in the absence of any advance information, which of the question response-choices is correct (i.e; circle the correct choice or alternative). You will be directed to use your pencil to indicate your GUESS or response. Information feedback or knowledge of the correct response may, or may not, be given in the course of instruction. Immediately upon completion of the reading you will be asked to take a test on the content that you have read.

WE REPEAT, some of the pages that you will be asked to read may be incomplete or lacking in information. Try to fill in (MENTALLY) the missing information on these pages, and, as noted above, you may be asked to write during the reading portion of this task. If you are asked to write, you will SEE A STATEMENT TELLING YOU to use your pencil TO WRITE, MARK, or CIRCLE, something. If you DON'T SEE such a statement on a page, then you DON'T HAVE to write on THAT Page.....

SAMPLE OF COVER SHEET

COVER SHEET COVER SHEET COVER SHEET

CODE NUMBER 1 3 2 0 1 2 0 2 6

NAME _____
(Last) (First)

TIME RECORD	Hr.	Min.
Started Reading	(_____	:_____)
Finished Reading	(_____	:_____)
Started Quiz	(_____	:_____)
Finished Quiz	(_____	:_____)

SAMPLE OF FIRST PAGE OF INSTRUCTIONAL BOOKLET

INSTRUCTION BOOKLET

(Please do not mark any of the pages in this booklet unless you are directed to do so.)

SAMPLE OF LAST PAGE OF INSTRUCTIONAL BOOKLET

When you turn to this page you should be finished with reading this INSTRUCTION BOOKLET. Note the time (NOW) and record the time by the heading "Finished Reading" - on your cover sheet...

Then, bring the booklet up to your instructor (Keep the COVER SHEET AND THE DIRECTION SHEET FOR NOW)

Your instructor will take the INSTRUCTION BOOKLET from you and give you an EXAM BOOKLET, and an IBM Scoring Sheet. Please return to your seat and follow the instructions listed on the first page of the exam booklet.....

Appendix D

Sample of Questionnaire

SAMPLE OF QUESTIONNAIRE

NOTE

The group to which you have been assigned has been selected to receive a DELAYED POSTTEST, ONE WEEK FROM TODAY. In lieu of an immediate posttest today, we are asking you to fill out a QUESTIONNAIRE regarding your reactions to the conditions of the study.

INSTRUCTIONS - Please comply with the following:

A. Check Your Cover Sheet ---

Did you REMEMBER to record the time you finished reading? If you haven't done so, please RECORD that information on your COVER SHEET, NOW ...
Forget about the time for the quiz.

B. Also, there are 2 THINGS to be ENTERED on this QUESTIONNAIRE.

(1) On your COVER SHEET you will find a 9 DIGIT CODE NUMBER. Please record that number in the space below:

CODE NUMBER

___ ___ ___ ___ ___ ___ ___ ___ ___

(2) Make sure you have recorded all 9 digits. Print your name in the space below.

NAME _____ _____
Last First

C. Finally, check to see that this QUESTIONNAIRE is complete. There should be 17 questions. CHECK the one alternative from the responses offered which best answers the question.

BEGIN ---

1. Is English your native language?
CHECK ONE ( ) YES
( ) NO

2. If you answered "NO" to question 1, please rate yourself on your reading comprehension (i.e.; how well do you feel you read and comprehend English?)

CHECK ONE
( ) Poor
( ) Fair
( ) Good
( ) Excellent

3. Prior to reading the instructional booklet, how familiar were you with the content on William James?

CHECK ONE
( ) Unfamiliar
( ) A little familiar
( ) Moderately familiar
( ) Familiar
( ) Quite familiar

4. If you didn't check "Unfamiliar" in question 3, answer the following.

If you were previously familiar with the material, do you feel that your advanced knowledge of the content biased your participation in this study?

CHECK ONE
( ) I think my previous knowledge of James biased my participation
( ) I don't think that my previous knowledge of James was sufficient enough to have biased my participation

NOTE: If you are uncertain ask the instructor when you turn in this questionnaire.

5. On the average, how many times did you read each paragraph before you turned to the next page?

CHECK ONE
( ) Once
( ) Twice
( ) Three times
( ) Four or more times

6. Compared to your regular college texts, how would you rate the difficulty of the reading materials in this study?

CHECK ONE
( ) Much less difficult
( ) Somewhat less difficult
( ) About the same difficulty
( ) Much more difficult

7. Insofar as intrinsic interest is concerned, how would you rate the content on William James used in this study?
CHECK ONE
( ) Very boring
( ) Dull
( ) O.K.
( ) Pretty good
( ) Very interesting

8. Did the instructional task require that you guess whether a prequestion response - alternative was true (T) or false (F)?
CHECK ONE
( ) YES
( ) NO

NOTE: If you answered "YES" to the above, answer questions 9 and 10.

9. On the average, how much consideration did you give or how much effort did you expend, in deciding whether the alternative was True or False?
CHECK ONE
( ) No consideration
( ) A little consideration
( ) A moderate amount of consideration
( ) A good deal of consideration
( ) Very much consideration

10. On the average, after guessing the Truth or Falsity of the alternative, how much consideration or effort did you devote, when reading the paragraph, to determine if your guess was correct?
CHECK ONE
( ) None
( ) A little
( ) A moderate amount
( ) A good deal
( ) Very much

11. Did the instructional task require that you guess, and circle the number of the prequestion response - alternative that you thought was correct?
CHECK ONE
( ) YES
( ) NO

12. On the average, how much consideration did you give, or how much effort did you expend, in deciding which response - alternative was correct?
CHECK ONE
( ) No consideration
( ) A little consideration
( ) A moderate amount of consideration
( ) A good deal of consideration
( ) Very much consideration

13. On the average, after guessing the number of the correct alternative, how much consideration or effort did you devote, when reading a paragraph, to determine if your guess was correct?
CHECK ONE
( ) None
( ) A little
( ) A moderate amount
( ) A good deal
( ) Very much

14. On the average, when you received incomplete information feedback (i.e.; the correct response was underlined but the lead-in or question stem was missing), how much effort or attention did you devote to determine or guess at a plausible question or question stem that would appropriately fit the given correct response?
CHECK ONE
( ) No effort or attention
( ) Very little effort or attention
( ) Moderate effort or attention
( ) Much effort or attention
( ) Very much effort or attention

15. Overall, did you find this study to be very interesting?
CHECK ONE
( ) Very boring
( ) Dull
( ) O.K.
( ) Pretty Good
( ) Very interesting

16. This next question is asked in the interst of generalizing the results of this study to other studies in the same research area that have concerned themselves with the effects of motivation or incentive on learning from written materials. Your answer will in no way bias your mark in this course, and will in no way be construed against you - -

In short, how seriously or diligently did you attend to the experimental materials (instructional booklet, etc.) in this study? (Relative to, say, the way you attend to one of your regular study assignments - -)
CHECK ONE
( ) Not seriously
( ) A little seriously
( ) Somewhat seriously
( ) Seriously
( ) Quite seriously

17. Did the fact that you were asked to time yourself make you anxious in any way? (and possibly interfere with your reading in some way)

CHECK ONE

( ) Didn't feel anxious about it
( ) Felt a little anxious about it
( ) Felt fairly anxious about it
( ) Felt quite anxious about it

18. Feel free to comment on any aspect of the study - -

_____

_____

_____

_____

_____

Please comply with the following - - - -

CHECK OUT PROCEDURE

(1) A REMINDER - - - Please keep the details of your experience today, CONFIDENTIAL (for at least 2 weeks). Other classes have yet to participate in this study, and any information that they receive in advance will bias their performance and the study as well. A full report and discussion of this project will be given in the near future, at a date to be announced.
(2) Your participation in the follow-up phase of this study (one week from today - 20 MIN.) will be sincerely appreciated.
(3) Please return your QUESTIONNAIRE FORM, COVER SHEET, DIRECTION SHEET, and PENCIL to your instructor.

THANK YOU FOR YOUR COOPERATION

Appendix E

Data

TABLE E.1

Replication/Control group means, SD's and percent correct: Immediate and delayed tests ..and ... Comparison with earlier studies

PRESENT STUDY

			Immediate Posttest: Relevant Learning	Immediate Posttest: Incidental Learning	Immediate Posttest: Grand Total	Delayed Posttest: Relevant Learning	Delayed Posttest: Incidental Learning	Delayed Posttest: Grand Total
[illegible]	Tested Twice N = 12	$\bar{X}$	12.00	9.50	21.50	11.08	9.08	20.16
		SD	3.64	3.39	6.28	3.77	3.14	5.73
		%	66.66	52.77	59.72	61.55	50.44	56.00
	Tested Once N = 12	$\bar{X}$	7.75	6.66	14.41			
		SD	2.86	2.53	4.54			
		%	43.05	37.00	40.02			
[illegible]	Tested Twice N = 12	$\bar{X}$	14.16	10.58	24.75	12.66	10.50	23.16
		SD	1.94	2.23	3.04	2.80	2.54	4.34
		%	78.66	58.77	68.75	70.33	58.33	64.33
	Tested Once N = 12	$\bar{X}$	9.25	6.66	15.91			
		SD	2.05	2.18	3.39			
		%	51.38	37.00	44.19			
[illegible]	Tested Twice N = 12	$\bar{X}$ **	12.83	11.41	24.25	11.50	9.75	21.25
		SD	3.21	2.50	5.52	3.26	2.05	4.88
		%	71.27	63.38	67.36	63.88	54.16	59.02
	Tested Once N = 12	$\bar{X}$	7.75	7.00	14.75			
		SD	2.98	2.48	4.63			
		%	43.05	38.88	40.97			

EARLIER STUDIES

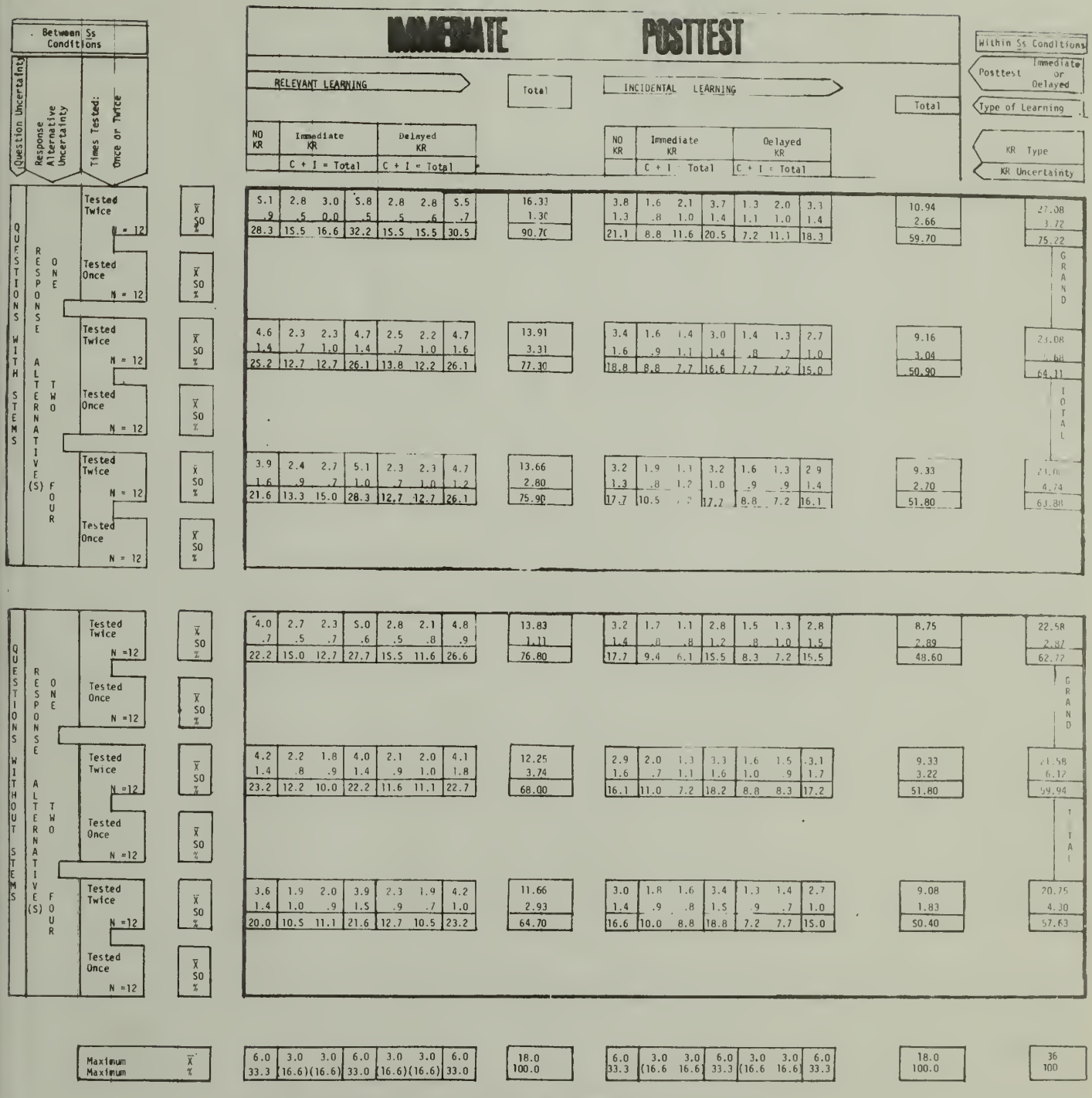
	Immediate Posttest: Relevant Learning			Immediate Posttest: Incidental Learning		
	Frase 67	Frase 68	Patrick 68	Frase 67	Frase 68	Patrick 68
Pre-Q: %	61.0	55.9	69.4	54.0	43.7	66.1
Post Q: %	79.0	74.4	76.1	73.0	63.5	63.3
No-Q: %	68.0	58.0	66.6	61.0	58.0	66.4

Note * The percentages from the Frase study are based on N's of 20 relevant and 20 incidental questions (Frase, 1967, 1968d, 1970). In the present study the maximum mean ($\bar{X}$) that can be achieved is 18...

** The distinction between relevant (R) and incidental (I) learning is artificial in the case of the No Question condition. Half the questions were randomly grouped as either R or I. The difference reflected is due to differences in average item difficulties. This was also the case in the Frase 67 study.

TABLE E.2

Treatment group means, SDs, and percent correct for each condition: Immediate posttest



*KEY: (C=Complete KR) (I=Incomplete KR) (KR=Knowledge of Results)

TABLE E.3

Treatment group means, SDs, and percent correct for each condition: Delayed posttest

Between Ss Conditions				DELAYED POSTTEST														Within Ss Conditions: Posttest Immediate or Delayed
Question Uncertainty	Response Alternative Uncertainty	Times Tested: Once or Twice		RELEVANT LEARNING					TOTAL	INCIDENTAL LEARNING						TOTAL		Type of Learning
				NO KR	Immediate KR		Delayed KR			No KR	Immediate KR		Delayed KR					KR Type
					C & I = Total		C & I = Total*				C & I = Total		C & I = Total					KR Uncertainty
QUESTIONS WITH STEMS	RESPONSE ALTERNATIVE(S)	ONE	Tested Twice	$\bar{X}$	4.8	2.3	2.4	4.8	2.5	2.6	5.1	14.66	3.3	1.6	1.9	3.5	1.3	1.8	3.0	9.03	24.50
				SD	1.3	.7	.8	1.0	.8	.7	1.0	2.01	1.7	.8	.0	1.2	1.0	.6	1.0	2.24	4.01
				%	26.6	12.7	13.3	26.6	13.8	14.4	28.3	81.40	18.3	8.8	10.5	19.4	7.2	10.0	16.6	54.60	68.05
			Tested Once	$\bar{X}$	4.3	2.3	2.0	4.3	2.3	2.3	4.6	13.08	1.8	.9	.9	1.8	.9	.9	1.8	5.41	18.50
				SD	1.1	.9	.9	1.5	.8	.8	1.1	2.71	1.4	.8	.8	1.3	1.0	1.1	1.0	2.39	4.37
				%	23.8	12.7	11.1	23.8	12.7	12.7	25.5	72.07	10.0	5.0	5.0	10.0	5.0	5.0	10.0	30.00	51.38
		TWO	Tested Twice	$\bar{X}$	4.0	2.4	2.2	4.6	2.5	2.1	4.6	13.16	3.2	1.9	1.4	3.3	1.3	1.6	2.9	9.41	22.58
				SD	1.7	.9	.7	1.4	.7	1.1	1.4	3.68	1.9	.7	1.1	1.1	.9	.9	1.3	2.39	5.48
				%	22.2	13.3	12.2	25.5	13.8	11.6	25.5	73.10	17.7	10.5	7.7	18.3	7.2	8.8	16.1	52.20	62.72
			Tested Once	$\bar{X}$	3.4	1.7	2.3	3.9	2.3	1.9	4.3	11.58	1.8	1.0	.9	1.9	.8	1.2	2.0	4.86	17.25
				SD	1.2	.9	.8	1.2	.8	.9	1.2	1.92	.9	1.0	1.1	1.5	.7	.8	1.1	1.9	2.80
				%	18.8	9.4	12.7	21.6	12.7	10.5	23.8	64.30	10.0	5.5	5.0	10.5	4.4	6.6	11.1	31.40	47.91
		FOUR	Tested Twice	$\bar{X}$	3.8	2.1	2.3	4.4	2.3	2.0	4.3	12.41	3.1	1.6	1.8	3.3	1.3	1.3	2.6	9.00	21.41
				SD	1.2	.9	.9	1.2	.8	.9	1.1	2.35	1.2	1.1	.9	1.6	.9	.8	1.0	3.01	4.75
				%	21.1	11.6	12.7	24.4	12.7	11.1	23.8	69.80	17.2	8.8	10.0	18.3	7.2	7.2	14.4	50.00	59.47
			Tested Once	$\bar{X}$	3.3	1.8	2.1	3.9	1.8	1.7	3.4	10.58	2.2	1.0	1.0	2.0	.8	1.2	1.9	6.08	16.66
				SD	1.5	.8	.9	1.3	.8	1.0	1.3	1.37	1.3	.9	1.0	1.4	.6	.8	1.1	2.81	3.57
				%	18.3	10.0	11.6	21.6	10.0	9.4	18.8	58.58	12.2	5.5	5.5	11.1	4.4	6.6	10.5	31.80	46.27
QUESTIONS WITHOUT STEMS	RESPONSE ALTERNATIVE(S)	ONE	Tested Twice	$\bar{X}$	3.9	2.4	2.0	4.4	2.1	1.9	4.0	12.33	2.4	1.6	1.0	2.6	1.4	1.5	2.9	7.91	20.25
				SD	1.2	.9	1.0	1.6	.9	.7	1.3	2.05	1.1	.9	.7	.9	.9	.9	1.2	1.83	2.63
				%	21.6	13.3	11.1	24.4	11.6	10.5	22.2	68.50	13.3	8.8	5.5	14.4	7.7	8.3	16.1	43.90	56.25
			Tested Once	$\bar{X}$	3.5	1.8	1.8	3.5	2.2	2.1	4.3	11.25	2.2	.8	.9	1.6	.8	.6	1.4	5.33	16.58
				SD	1.5	.8	1.0	1.1	.7	.8	1.0	2.41	1.1	.7	.8	1.1	.7	.7	.8	1.82	2.39
				%	19.4	10.0	10.0	19.4	12.2	11.6	23.8	62.50	12.2	4.4	5.0	8.8	4.4	3.3	7.7	29.60	46.05
		TWO	Tested Twice	$\bar{X}$	3.8	1.8	1.7	3.5	2.1	2.3	4.3	11.58	2.8	1.8	1.1	2.9	1.7	1.4	3.1	8.75	20.33
				SD	1.5	.8	.9	1.5	.8	.9	1.4	3.05	1.5	.8	1.2	1.9	1.0	1.0	1.8	3.30	5.69
				%	21.1	10.0	9.4	19.4	11.6	12.7	23.8	64.30	15.5	10.0	6.1	16.1	9.4	7.7	17.2	48.60	56.47
			Tested Once	$\bar{X}$	2.5	1.8	1.4	3.3	1.5	1.8	3.3	9.00	1.3	.8	.9	1.8	.8	1.0	1.8	4.91	13.91
				SD	1.9	.8	1.0	1.2	.8	1.1	1.0	2.79	1.0	.8	1.0	1.7	1.1	.9	1.7	2.53	4.46
				%	13.8	10.0	7.7	18.3	8.3	10.0	18.3	50.00	7.2	4.4	5.0	10.0	4.4	5.5	10.0	27.20	38.63
		FOUR	Tested Twice	$\bar{X}$	3.3	2.0	1.8	3.8	2.2	1.6	3.8	10.91	2.1	1.7	1.2	2.8	1.0	1.3	2.3	7.25	18.16
				SD	1.4	1.0	.9	1.4	.9	.8	1.3	2.60	.9	.9	.7	1.1	1.0	.8	1.4	2.22	4.30
				%	18.3	11.1	10.0	21.1	12.2	8.8	21.1	60.60	11.6	9.4	6.6	15.5	5.5	7.7	12.7	40.30	50.44
			Tested Once	$\bar{X}$	2.4	1.5	1.6	3.1	1.3	.9	2.2	7.66	1.8	1.0	1.2	2.2	.7	1.0	1.7	5.58	13.25
				SD	1.2	1.0	.9	1.0	1.1	.7	1.5	2.96	.8	.7	.8	1.1	.8	.7	1.2	1.88	3.79
				%	13.3	8.3	10.0	17.2	7.2	5.0	12.2	42.50	10.0	5.5	6.6	12.2	3.8	5.5	9.4	31.00	36.80
			Maximum	$\bar{X}$	6.0	3.0	3.0	6.0	3.0	3.0	6.0	18.00	6.0	3.0	3.0	6.0	3.0	3.0	6.0	18.00	36.0
			Maximum	%	33.3	16.6	16.6	33.3	16.6	16.6	33.3	100.00	33.3	16.6	16.6	33.3	16.6	16.6	33.3	100.00	100.0

*Key: (C=Complete KR)(I=Incomplete KR) (KR=Knowledge of Results)

TABLE E.4

Replication/Control group and treatment group means and SD's for reported reading time

Questions with stems	One response alternative(s)	Tested Twice N = 12	$\bar{X}$	21.58
			SD	5.77
		Tested Once N = 12	$\bar{X}$	15.08
			SD	5.99
	Two response alternative(s)	Tested Twice N = 12	$\bar{X}$	21.33
			SD	5.08
		Tested Once N = 12	$\bar{X}$	19.00
			SD	5.23
	Four response alternative(s)	Tested Twice N = 12	$\bar{X}$	24.91
			SD	4.20
		Tested Once N = 12	$\bar{X}$	19.16
			SD	3.61
Questions without stems	One response alternative(s)	Tested Twice N = 12	$\bar{X}$	16.58
			SD	3.96
		Tested Once N = 12	$\bar{X}$	17.41
			SD	4.94
	Two response alternative(s)	Tested Twice N = 12	$\bar{X}$	22.83
			SD	8.89
		Tested Once N = 12	$\bar{X}$	18.41
			SD	4.73
	Four response alternative(s)	Tested Twice N = 12	$\bar{X}$	18.16
			SD	4.91
		Tested Once N = 12	$\bar{X}$	19.50
			SD	4.50

Pre Questions	Tested Twice N = 12	$\bar{X}$	20.00	
		SD	6.03	
	Tested Once N = 12	$\bar{X}$	17.08	
		SD	3.31	
Post Questions	Tested Twice N = 12	$\bar{X}$	20.83	
		SD	4.36	
	Tested Once N = 12	$\bar{X}$	20.83	
		SD	5.09	
No Questions	Tested Twice N = 12	$\bar{X}$	14.33	
		SD	3.02	
	Tested Once N = 12	$\bar{X}$	15.41	
		SD	4.35	

TABLE E.5

Raw data: Treatment and control groups

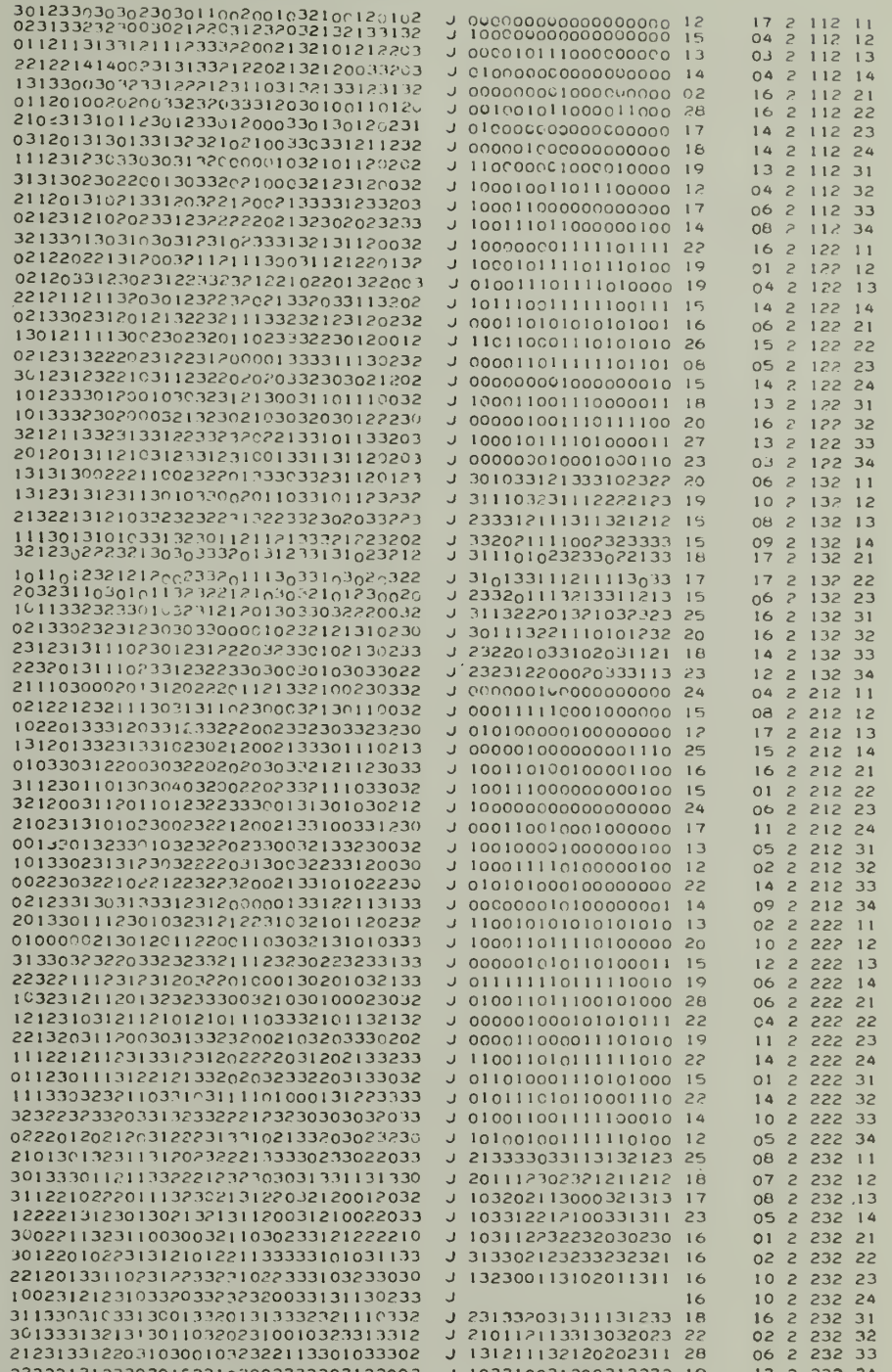
Treatment Ss -- Posttest 1 -- Ss Tested Twice

0012313103103032320020220321011202 32	J	10010010C0000010000	30	12	06	1	111	11
1013313002111031111003311032301130102	J	1100011110000000100	16	10	13	1	111	12
2012313102213232312070020333011302 03	J	1000010100000000000	21	13	15	1	111	13
2022113120113032332020220321211302 03	J	1000110110000000110	33	13	15	1	111	14
3012313323203232320030220321011202 32	J	1001111110010010101	24	12	06	1	111	21
0013312020202032320311020321111201 02	J	1001111110000111101	20	20	06	1	111	22
2012313100123032322020021031010232 22	J	0101000000000000000	23	15	14	1	111	23
2012313121103027333020020331011102 02	J	0000000000000000000	19	10	10	1	111	24
0012313107003022311200002032101110032	J	0101001C1210010100	20	12	04	1	111	31
0012313103003032320022000321011202 02	J	1001101010100100000	22	15	15	1	111	32
2212313120113122330020020331010202 33	J	0100100101010000001	11	20	05	1	111	33
2002313113103032320020020331011202 02	J	0110110111000000000	20	08	14	1	111	34
0102311222003033310022120321011202 33	J	1100110111111001100	24	17	15	1	121	11
3011210123003032330100120321011112 32	J	0100111011110031001	22	09	04	1	121	12
2012213133113032332000020331011132 02	J	1101100000110111100	17	13	17	1	121	13
0012313112113202310702213313121202	J	1101101000110111110	22	13	04	1	121	14
1011313021213032330023030321001202 32	J	1000110011100011101	19	12	09	1	121	21
0012310023323111220131320321201202 33	J	1000000111110011011	17	11	15	1	121	22
3031012033113102032001212103230231 13	J	0000000101110030000	34	14	06	1	121	23
2212110122113012331020220330031332 00	J	0101111000000100000	15	12	15	1	121	24
2012310123001032330022020321011202 32	J	1100000011101010103	26	13	15	1	121	31
2012312123213032330023000321011302 03	J	1000111010101011100	19	15	08	1	121	32
2022311102113102320020033101122203	J	1000100111111C00010	22	15	13	1	121	33
2012113101113032322320023331011332 00	J	1001111110011011100	19	08	14	1	121	34
0013313113213030320131020321011202 33	J	3113122123211323203	30	11	15	1	131	11
0001210223011032310030023321001202 06	J	1113033213021320103	31	08	04	1	131	12
2222113122111232320030022333011232 03	J	2330010130110311111	22	10	11	1	131	13
2212213103012032332320023332011202 30	J	2444120113322010031	26	11	06	1	131	14
2012313003013032330000120321011202 02	J	3211130033110200233	20	13	15	1	131	21
1012313113003030330020320311001210 02	J	3111020102012011202	22	09	15	1	131	22
3022013302002231322021321331020100 01	J	2333000310103113O1	25	12	11	1	131	23
2212212122113032323120020331012232 30	J	1322101110003111131	21	14	14	1	131	24
1011303111111132211212223310102013 2	J	3033002312210100 21	20	10	15	1	131	31
1012313113201031310121023331000202 02	J	1111120111112221113	31	14	07	1	131	32
2022313103103032320020023321011232 00	J	0331211330013111111	23	06	09	1	131	33
2312223131111311232233202032301030202	J	1332333131021122201	28	43	14	1	131	34
0013310222023031230011202321331232 02	J	1000111010000000100	15	10	09	1	211	11
3012310123103030322020000321001202 33	J	1000010000000C00100	14	13	16	1	211	12
2012313102013032332020021333311200 02	J	1101000000000000000	16	08	13	1	211	13
2332213121013012332120021323312023 3	J	1000011100000C00000	15	18	09	1	211	14
3010330133213030330020132322011222 32	J	1000010000000000000	20	15	01	1	211	21
2012310123113130311030000321013102 02	J	0000010010000000100	20	13	04	1	211	22
3012313323113032312020023213001112 32	J	0001111100000000000	22	15	13	1	211	23
0112313123213132322020021331011302 33	J	0011011001000000000	08	15	05	1	211	24
0013312113303030311201123032100030 132	J	1001110001000000000	22	16	05	1	211	31
3013312002203032123001323323001200 02	J	1101100100000000100	17	10	16	1	211	32
2013013002230231321023020122011302 03	J	0101010001000000000	15	08	10	1	211	33
2012313133103114331320021321001232 32	J	0100010100010000000	15	12	10	1	211	34
0211330322121032322010210321011201 02	J	0001101010111101010	20	10	01	1	221	11
2013213122013012311312321322011212 33	J	0100100110100001011	40	05	05	1	221	12
2012013330101101133202102113101133 203	J	0101000001111111111	25	15	14	1	221	13
2112113103101132312000013331031212 33	J	0010011101111101100	15	08	10	1	221	14
2111313133213022322023010331011232 12	J	1100110010101010000	20	12	12	1	221	21
3113302311211133222013112102103320 10	J	0101110011011110110	24	14	02	1	221	22
2012313132113112332020021321010212 32	J	0000010101111101110	10	07	10	1	221	23
2012313113213133233233200203210112020 2	J	0000011000111000011	15	12	10	1	221	24
3001203123011030022111320132012332 12	J	0011101011110000000	21	14	07	1	221	31
2011311103204032333320020301011202 22	J	1000110011011000010	22	09	16	1	221	32
2012313103110012331020021331001202 02	J	0000110001001000011	39	18	13	1	221	33
2233013133013302320001020301011302 33	J	1100111110101110011	23	10	09	1	221	34
0213033123111002220021223031001330 03	J	0033010322332222002	19	09	03	1	231	11
2212311122320303133002012030231112020 2	J	2111333321202320 13	20	13	02	1	231	12
0132313311313132313330223321010202 02	J	1233000113013311123	12	07	15	1	231	13
2032313123023032333233002333103121 202	J	2133120330010123O1	17	10	15	1	231	14
0113023112333232030011111321012232 31	J	3323233121102032 23	17	08	05	1	231	21
1012312201001232010020120331010232 22	J	3011100020100313 20	18	12	01	1	231	22
2000312130003132311303020321010212 32	J	0020003010032320 30	19	15	06	1	231	23
0032313131113032322321020331010232 32	J	1333100032010312 31	21	14	08	1	231	24
3312311323013032320103011031110320 32	J	3131133330111313 32	30	15	01	1	231	31
2012302333013031320020220333311202 32	J	3013100132220320 12	10	09	10	1	231	32
0232012111301012330033022232010200 33	J	3303001123003133 31	16	11	09	1	231	33
0012311113013312322030020323013202 22	J	1331101110010012 11	19	11	09	1	231	34

Treatment Ss -- Posttest 2 -- Ss Tested Twice

000231310310303222033022032101123232	16	2	111	11
101331230210103:212013313323011331C2	13	2	111	12
101231330212313232102002233301130200	15	2	111	13
203201312011303231201102032121133203	15	2	111	14
000231230332323232003222032101123212	06	2	111	21
231321201130033232033120301001202133	06	2	111	22
202231310300301232202002133101021222	14	2	111	23
201231210210302233302002233131110202	10	2	111	24
101231311300302232200030032101120032	04	2	111	31
101231311303303231003220032101120002	15	2	111	32
221231311311310233302002133101120233	05	2	111	33
200231311311301232002002033101120202	14	2	111	34
030331102202303031002112032121111233	15	2	121	11
301111012310303233011202032101130232	04	2	121	12
201231303311303233233002033131133202	17	2	121	13
201231311311233023102022213333312220C2	04	2	121	14
101131302110303231002323332100120232	09	2	121	21
001231000312011232013132032130120233	15	2	121	22
302101121321113212230122310330123133	06	2	121	23
211201212013303233302202332123122203	15	2	121	24
101331330131103233202012033301111222	02	2	121	31
201231232001003233002300032101130202	08	2	121	32
302231310311300232002002033101122203	13	2	121	33
201221310011302232332002333101132203	14	2	121	34
231331212311203031010102033101133232	15	2	131	11
000221031301:032310010023321001232C0	04	2	131	12
211221311331123233003002033101122202	11	2	131	13
220221320000301233232002133201133230	06	2	131	14
121231300331303231012112032301120002	15	2	131	21
101231311300303303200203203110121202	15	2	131	22
302221321100303133220213213320010300C1	11	2	131	23
001221212222302233233302033101222230	14	2	131	24
001333132110112221011302203100020133	15	2	131	31
121231111331103133012332033031020202	07	2	131	32
203231310310301232002323321010202C0	09	2	131	33
331242211110310232213202323011332C3	14	2	131	34
031331201312312122201103132133123232	09	2	211	11
201333012330303131232006003210112C232	16	2	211	12
001231211201303232032000133331120002	13	2	211	13
212331312101331232212012132133120243	09	2	211	14
221333030331202732002123332201130230	01	2	211	21
201231211311313032103113330101333232	04	2	211	22
201231133311313432202002323300111232	13	2	211	23
231231312330311232222002333101130233	05	2	211	24
201331231310303211003123032100330132	05	2	211	31
131341200329302222130213302101120032	16	2	211	32
201301302312302132203002033301223003	10	2	211	33
001231213310311231132002133100323232	10	2	211	34
011323032212303232201121032101120002	01	2	221	11
201311112031303231232332031101032220	05	2	221	12
323321213200102203333102133331133233	14	2	221	13
201211312313313231200001332103122233	10	2	221	14
311101210321311232201301033101123232	12	2	221	21
311230200133133323013112332103130013	02	2	221	22
201231212001301231232002332101013233	10	2	221	23
201231213222313233232C020322011202C2	10	2	221	24
331230231301103012112022012231131232	07	2	221	31
300231112130303232302312030101123222	16	2	221	32
201231310310003233102002133101120202	13	2	221	33
223221312300033232C331020321001332333	09	2	221	34
001103310331102231002302203130133233	03	2	231	11
021201312330303132002030032131120202	02	2	231	12
013231231303311232323020132121023232	15	2	231	13
213231112302321233133002112302113023	15	2	231	14
231122C311313232010031111321012232C	05	2	231	21
001001230300123401200312133101023222	01	2	231	22
003231211123331432021032033101023232	08	2	231	24
331231232131303232010311333230030032	01	2	231	31
201230230301303133002022033131120232	10	2	231	32
222221210101102232003302233101023000	09	2	231	33
301231111301331232223002002101320222	09	2	231	34

Treatment Ss -- Posttest 2 -- Ss Tested Once



Control Ss -- Posttest 1 -- Ss Tested Twice

20123231030030323200200203013112103 2	J	24 09 06 1 611 01
20123231030030323320300203310102000 2	J	20 15 02 1 611 02
20123101232120333320200003320113020 2	J	21 15 01 1 611 03
30123130030130323200211203210113202 0	J	15 10 08 1 611 04
21121231230110321120130103210112323 2	J	28 11 08 1 611 05
30103301031030323303310103310112001 2	J	16 10 14 1 611 06
00130132232130320323213233210103020 3	J	18 11 03 1 621 01
20123112231130323330000233320112020 3	J	23 22 14 1 621 02
20123131230130323120011233210113020 2	J	27 14 09 1 621 03
20123131202130323203200203310112220 2	J	23 15 13 1 621 04
22121131232301333320203223210103300 3	J	20 11 13 1 621 05
20320131221130323303300203330102120 2	J	15 10 14 1 621 06
21125131231030323320300213310112020 2	J	15 15 01 1 701 01
30122131030130323323300103310113023 2	J	14 11 03 1 701 02
20123131033130323320210023310112023 2	J	20 22 09 1 701 03
21111131231030323320100113210112023 2	J	17 19 06 1 701 04
20023131031133332332030320321011302 0 2	J	13 13 15 1 701 05
10123121033030323320202213310112003 0	J	15 20 02 1 701 06
20121131331131313223133333312003013 3	J	12 14 13 1 701 07
20110121030110303310300203210113022 2	J	13 12 13 1 701 08
20122131230130123200200103310113020 2	J	18 13 09 1 701 09
22123101200220311323203333210112323 0	J	10 10 09 1 701 10
20123131031130313310300213310112012 0	J	15 14 09 1 701 41
20114132230130122303311333333011103 1	J	10 14 08 1 701 42
20122133231010303000101233210112213 2	J	35 16 06 1 811 01
20123131231030103113233203310112023 2	J	20 20 05 1 811 02
13320211123211320133110333310112302 0	J	21 15 06 1 811 03
21123121231130333300200223310133020 2	J	20 15 13 1 811 04
30123131231030313300000233213112000 2	J	17 14 14 1 811 06
21023131230110323222300213310112020 3	J	17 09 04 1 821 01
20120130230130123220032223010113321 3	J	10 14 09 1 821 02
11020323310111220233133210210113333	J	18 13 03 1 821 03
20021131020130323320000233210113020 0	J	21 16 15 1 821 04
20323133221131323223001203310102010 2	J	21 14 12 1 821 05
21323131021230123221203223200202023 2	J	15 13 08 1 821 06

Control Ss -- Posttest 2 -- Ss Tested Twice

20113131033030323200200213010112103 2	06 2 611 01
22123221030030323320300203310102020 2	02 2 611 02
22323101203123303323210033201130212	01 2 611 03
10123320231110223200211213210113203 0	08 2 611 04
21121233231110322211113003210113323 3	08 2 611 05
00113303031030323323301033101120232	14 2 611 06
23110130233130320103213233210102320 3	03 2 621 01
20123112201100323210000233201110203	14 2 621 02
20123131230130323220331213210112020 2	09 2 621 03
20123131232130323203200203310112020 2	13 2 621 04
00122131231001323120213213110123023 3	13 2 621 05
20122121201110223303200203330102320 2	14 2 621 06
22123131211030323322303213310112021 2	01 2 701 01
22120131030132323320300103310113023 2	03 2 701 02
20123131333130373220210003310113023 2	09 2 701 03
21112121131030323220113113220112023 2	06 2 701 04
22023131231231323320303203310013320 3	15 2 701 05
20123121233030223210213233330131203 2	02 2 701 06
20132131131131313223113333311002303 3	13 2 701 07
02112131030010203310110203220113022 2	13 2 701 08
20120131033130123230300103310113320 2	09 2 701 09
02122101231211322223212303010112323 0	09 2 701 10
22123131231130313310330223310112012 0	09 2 701 41
22133133210130212313311323320311203 0	08 2 701 42
01120120131032223201101003213211003 2	06 2 811 01
20123131210030103213203203310112023 2	05 2 811 02
33202001220112033321110333101123202	06 2 811 03
21123121231130303300200223320233020 3	13 2 811 04
30123131220030313302100233233112303 2	14 2 811 06
21023131232130323220300233310112020 2	04 2 821 01
20323131231130123120232223010113321 2	09 2 821 02
02001113112310210223113210210001213 3	03 2 821 03
20020131225 30323320000233212113320 0	15 2 821 04
02323132131031323223211233320103010 2	12 2 821 05
21323131021230123231203223230201022 2	08 2 821 06

Control Ss -- Posttest 2 -- Ss Tested Once

00113321330132123223010023030111032	J	20	04 2 612 01
13122312230010220222311133210022201 3	J	25	03 2 612 02
10113022203330321120110113210121313 3	J	23	01 2 612 03
22123033211230323100230203213113020 2	J	34	06 2 612 04
10302111230230323301101323212123113 2	J	16	13 2 612 05
30123101232130213300321043210111023 3	J	23	13 2 612 06
11020233120233223203113203200321313 3	J	11	10 2 622 01
31322131230000323220112203210103332 2	J	17	10 2 622 02
23120131202110123210310033210111023 2	J	22	05 2 622 03
02130123200211323320211233311303223 2	J	30	13 2 622 04
13222121111131223120230033210111303 3	J	18	08 2 622 05
22223111230230313303301233330123320 3	J	19	10 2 622 06
32121030130131003100211233220301323 0	J	10	04 2 702 01
11123033232330200223321103020311300 3	J	14	04 2 702 02
33110300110131022323110103322131303 3	J	20	06 2 702 03
10123111231020103100013333302113023 2	J	07	14 2 702 04
10331133123121301233101032010312110 3	J	15	06 2 702 05
01123031230131123121200203313313313 2	J	18	07 2 702 06
21122022231331321121002233320322023 2	J	14	09 2 702 07
21123122131032323322003233210101033 2	J	22	12 2 702 08
21101031231130303320201323310012001 2	J	19	11 2 702 09
31123011330213030102111333212021003 2	J	19	15 2 702 10
12123101030130203223200033330033202 2	J	14	15 2 702 41
20310011230313323023112331323313200 2	J	13	09 2 702 42
03230012223133121313133030223113330 3	J	17	06 2 812 01
12133022032330213321102033310013033 0	J	17	04 2 812 02
12310133230300223303223333232112021 0	J	25	03 2 812 03
12222121230110102320213213230133130 1	J	22	08 2 812 04
11014012211233322120122130113212213 1	J	15	08 2 812 05
01033323110122303231113323310022010 2	J	17	10 2 812 06
22120131210011323221332213213113323 0	J	14	13 2 822 01
23120301223030323123103113330023320 0	J	14	10 2 822 02
00123321133230323122121332301323001	J	17	03 2 822 03
01123300020010113323200233210013103 2	J	17	09 2 822 04
22211211033031323323322133113033033	J	14	15 2 822 05
22123130210030223300002203310313220 0	J	16	13 2 822 06

Appendix F

Summaries of Analyses of Variance Results

Table F.1

Replication/control ANOVA over immediate and delayed posttests

Source	df	MS	F
Question Position (Q)	2	29.79	1.23
Subjects (S) /Q	33	24.06	
Type of Learning (L)	1	180.00	22.31 **
QL	2	5.00	.62
SL/Q	33	8.06	
Posttests (P)	1	35.00	19.78 **
QP	2	2.42	1.37
SP/Q	33	1.76	
LP	1	2.50	4.09 *
QLP	2	2.29	3.75 *
SLP/Q	33	.61	

* $p < .05$

** $p < .01$

Table F.2

Replication/control ANOVA over delayed posttest

Source	df	MS	F
Question Position (Q)	2	15.88	1.47
Times-Tested (T)	1	380.25	35.30 **
QT	2	1.68	.15
Subjects (S)/QT	66	10.77	
Type of Learning (L)	1	106.77	23.36 **
QL	2	4.09	.89
TL	1	2.25	.49
QTL	2	1.89	.41
SL/QT	66	4.57	

* $p < .05$
** $p < .01$

Table F.3

Summary of one-way ANOVAs conducted on the six between Ss treatment conditions and the postquestion control condition

ANOVA 1: Immediate posttest, relevant content, Ss tested twice.

Source	df	MS	F
Conditions (C)	6	3.22	2.22 *
Subjects (S)/C	77	1.45	

ANOVA 2: Immediate posttest, incidental content, Ss tested twice

Source	df	MS	F
C	6	1.61	.83
S/C	77	1.91	

ANOVA 3: Delayed posttest, relevant content, Ss tested twice

Source	df	MS	F
C	6	2.60	1.45
S/C	77	1.78	

ANOVA 4: Delayed posttest, incidental content, Ss tested twice

Source	df	MS	F
C	6	3.05	1.66
S/C	77	1.83	

ANOVA 5: Delayed posttest, relevant content, Ss tested only once

Source	df	MS	F
C	6	4.73	2.61 *
S/C	77	1.81	

ANOVA 6: Delayed posttest, incidental content, Ss tested only once

Source	df	MS	F
C	6	1.22	1.13
S/C	77	1.07	

* $p < .05$

Table F.4

ANOVA comparing guess versus no-guess conditions

Source	df	MS	F
Conditions (C)	1	.90	.40
Paragraph sets (P)	2	4.52	2.05
CP	2	.92	.42
Subjects (S)/CP	54	2.19	

(F = 3.18 required for significance at $p < .05$ df 2/54.)

Table F.5 (Part 1)

Analysis of treatment group data: Delayed Posttest ($Q_2A_3T_2/\underline{S}s/L_2K_2C_2$)

Source	df	MS	F	
Question Uncertainty (Q)	1	16.77	16.04	***
Alternative Uncertainty (A)	1	3.44	3.29	**
Times Tested (T)	2	54.68	52.30	***
QA	2	.02	.02	
QT	1	$.09^{-02}$	8.60^{-04}	
AT	2	$.06^{-01}$	5.80^{-03}	
QAT	2	.18	.18	
Subjects (S)/QAT	132	1.04		
Type of Learning (L)	1	179.70	273.86	***
QL	1	4.13	6.29	***
AL	2	3.52	5.37	***
TL	1	3.89	5.93	**
QAL	2	.23	.36	
QTL	1	.54	.82	
ATL	2	1.46	2.23	
QATL	2	.26	.40	
SL/QAT	132	.65		
Type of KR (K)	1	.45	.46	
QK	1	.07	7.16^{-02}	
AK	2	2.33	2.37	
TK	1	.02	2.21^{-02}	
QAK	2	.23	.24	
QTK	1	1.06	1.08	
ATK	2	.22	.22	
QATK	2	.29	.30	
SK/QAT	132	.98		
KR Uncertainty (C)	1	.45	.59	
QC	1	1.91	2.49	
AC	2	.19	.25	
TC	1	1.75	2.28	
QAC	2	.28	.37	
QTC	1	.73	.94	
ATC	2	.75	.98	
QATC	2	.48	.62	
SC/QAT	132	.76		
LK	1	1.06	1.80	
QLK	1	.14	.24	
ALK	2	.18	.31	

Table F.5 (Part II)

Analysis of treatment group data: Delayed Posttest ($Q_2A_3T_2/\underline{S}s/L_2K_2C_2$)

Source	df	MS	F	
TLK	1	.25	.42	
QALK	2	.06	.10	
QTLK	1	.45	.77	
ATLK	2	.99	1.69	
QATLK	2	.86	1.46	
SLK/QAT	132	.58		
LC	1	.73	1.24	
QLC	1	.10	.17	
ALC	2	.28	.49	
TLC	1	.07	.12⊙	
QALC	2	.48	.83	
QTLC	1	.54	.92	
ATLC	2	.28	.49	
QATLC	2	.32	.55	
SLC/QAT	132	.58		
KC	1	.54	.65	
QKC	1	.73	.88	
AKC	2	.43	.52	
TKC	1	.63	.76	
QAKC	2	.23	.28	
QTKC	1	.45	.55	
ATKC	2	.23	.28	
QATKC	2	.83	1.00	
SKC/QAT	132	.82		
LKC	1	2.82	5.38	**
QLKC	1	.31	.59	
ALKC	2	.78	1.49	
TLKC	1	.31	.59	
QALKC	2	1.41	2.69	*
QTLKC	1	.83	1.59	
ATLKC	2	.11	.22	
QATLKC	2	.13	.26	
SLKC/QAT	132	.52		

⊙ Indicates negative exponent

* $p < .07$

** $p < .05$

*** $p < .01$

Table f.6

Analysis of treatment group data: Delayed Posttest ($Q_2A_2T_2/Ss/L_2K_3$)

Source	df	MS	F	
Question Uncertainty (Q)	1	56.52	19.71	***
Alternative Uncertainty (A)	2	13.40	4.67	***
Times Tested (T)	1	161.02	56.14	***
QA	2	.14	5.13^{-02} ⊛	
QT	1	.19	6.82^{-02}	
AT	2	.72	.25	
QAT	2	1.56	.54	
Subjects (S)/QAT	132	2.86		
Type of Learning (L)	1	469.64	371.43	***
QL	1	8.36	6.61	**
AL	2	10.96	8.67	***
TL	1	8.76	6.92	***
QAL	2	.05	4.48^{-02}	
QTL	1	4.02	3.18	*
ATL	2	3.29	2.60	
QATL	2	.41	.33	
SL/QAT	132	1.26		
Type of KR (K)	2	5.89	3.36	**
QK	2	.25	.14	
AK	4	3.04	1.73	
TK	2	.03	2.04^{-02}	
QAK	4	.27	.15	
QTK	2	1.21	.69	
ATK	4	.79	.45	
QATK	4	.59	.33	
SK/QAT	264	1.75		
LK	2	3.45	2.78	*
QLK	2	.54	.43	
ALK	4	.19	.15	
TLK	2	.46	.37	
QALK	4	.61	.49	
QTLK	2	.99	.80	
ATLK	4	1.11	.89	
QATLK	4	.96	.77	
SLK/QAT	264	1.24		

⊛ Indicates negative exponent

* $.05 < p < .07$

** $p < .05$

*** $p < .01$

Table F.7 (Part 1)

Analysis of treatment group data: Immediate and delayed posttests ($Q_2A_3/\underline{S}s/P_2L_2K_2C_2$)

Source	df	MS	F	
Question Uncertainty (Q)	1	14.89	6.64	**
Alternative Uncertainty (A)	2	4.26	1.90	
QA	2	.84	.37	
Subjects (S)/QA	66	2.24		
Posttests (P)	1	5.14	17.55	***
QP	1	.07	.23	
AP	2	.94	3.23	**
QAP	2	.17	.59	
SP/QA	66	.29		
Type of Learning (L)	1	158.27	164.84	***
QL	1	3.66	3.81	*
AL	2	2.53	2.64	*
QAL	2	.58	.61	
SL/QA	66	.96		
Type of KR (K)	1	1.60	.94	
QK	1	.94	.55	
AK	2	.80	.47	
QAK	2	.09	5.65^{-02}	
SK/QA	66	1.70		
KR Uncertainty (C)	1	4.13	3.51	
QC	1	5.69	4.84	*
AC	2	1.04	.89	
QAC	2	2.67	2.27	
SC/QA	66	1.17		
PL	1	1.32	6.47	**
QPL	1	.38	1.87	
APL	2	.44	2.15	
QAPL	2	.25	1.23	
SPL/QA	66	.20		
PK	1	.19	.55	
QPK	1	.10	.30	
APK	2	.14	.42	
QAPK	2	.32	.94	
SPK/QA	66	.34		
LK	1	1.60	2.12	
QLK	1	.07	9.31^{-02}	
ALK	2	.40	.53	
QALK	2	.89	1.18	
SLK/QA	66	.75		
PC	1	$.09^{-02}$	3.80^{-03}	
QPC	1	.02	9.18^{-02}	
APC	2	.01	4.78^{-02}	

Table F.7 (Part II)

Analysis of treatment group data: Immediate and delayed posttests ($Q_2A_3/Ss/P_2L_2K_2C_2$)

Source	df	MS	F	
QAPC	2	.58	2.47	
SPC/QA	66	.23		
LC	1	.10	.44	
QLC	1	.25	.34	
ALC	2	.83	1.16	
QALC	2	1.41	1.95	
SLC/QA	66	.72		
KC	1	1.06	.82	
QKC	1	1.32	1.02	
AKC	2	.48	.37	
QAKC	2	.02	1.80^{-02}	
SKC/QA	66	1.29		
PLK	1	.07	.30	
QPLK	1	.63	2.72	
APLK	2	.01	7.82^{-02}	
QAPLK	2	.23	1.01	
SPLK/QA	66	.23		
PLC	1	.07	.25	
QPLC	1	.31	1.15	
APLC	2	.50	1.85	
QAPLC	2	.14	.52	
SPLC/QA	66	.27		
PKC	1	.25	1.13	
QPKC	1	.14	.66	
APKC	2	.22	1.01	
QAPKC	2	.43	1.95	
SPKC/QA	66	.22		
LKC	1	5.41	7.70	***
QLKC	1	.10	.14	
ALKC	2	.14	.20	
QALKC	2	.41	.59	
SLKC/QA	66	.70		
PLKC	1	$.78^{-02}$	3.43^{-02}	
QPLKC	1	$.09^{-02}$	3.94^{-03}	
APLKC	2	.10	.44	
QAPLKC	2	.18	.83	
SPLKC/QA	66	.22		

⊛ Indicates negative exponent

* $.05 < p < .08$

** $p < .05$

*** $p < .01$

Table F.8

Analysis of treatment group data: Immediate and delayed posttest ($Q_2A_3/Ss/P_2L_2K_3$)

Source	df	MS	F	
Question Uncertainty (Q)	1	54.00	8.24	***
Alternative Uncertainty (A)	2	15.63	2.38	
QA	2	3.21	.49	
Subjects (S)/QA	66	6.55		
Posttests (P)	1	19.56	29.41	***
QP	1	.37	.56	
AP	2	1.36	2.05	
QAP	2	.21	.32	
SP/QA	66	.66		
Type of Learning (L)	1	386.67	191.20	***
QL	1	4.44	2.20	
AL	2	5.59	2.76	*
QAL	2	.43	.21	
SL/QA	66	2.02		
Type of KR (K)	2	5.43	1.79	
QK	2	1.38	.45	
AK	4	1.39	.46	
QAK	4	.19	6.37^{-02} ⊛	
SK/QA	132	3.02		
PL	1	.90	2.43	
QPL	1	1.50	4.01	**
APL	2	.34	.93	
QAPL	2	.46	1.23	
SPL/QA	66	.37		
PK	2	.43	.74	
QPK	2	.12	.21	
APK	4	.41	.70	
QAPK	4	.66	1.12	
SPK/QA	132	.59		
LK	2	6.12	3.80	**
QLK	2	1.52	.94	
ALK	4	.77	.48	
QALK	4	1.40	.87	
SLK/QA	132	1.61		
PLK	2	1.14	2.07	
QPLK	2	.65	1.18	
APLK	4	.74	1.35	
QAPLK	4	.34	.61	
SPLK/QA	132	.55		

⊛ Indicates negative exponent

* $p < .07$

** $p < .05$

*** $p < .01$

Table F.9

Analysis of treatment group time scores ($Q_2A_3T_2/\underline{S}s$)

Source	df	MS	F
Question Uncertainty (Q)	1	69.44	2.61
Response Alternative Uncertainty(A)	2	115.89	4.36 *
Times Tested (T)	1	289.00	10.87 **
QA	2	33.04	1.24
QT	1	110.24	4.14 *
AT	2	3.93	.14
QAT	2	93.06	3.50 *
Subjects (S) QAT	132	26.58	

* Significant at $p < .05$

** Significant at $p < .01$

Table F.10

Analysis of control group time scores ($Q_3T_2/\underline{S}s$)

Source	df	MS	F
Question Position (Q)	2	216.79	10.80 *
Times Tested (T)	1	6.72	.33
QT	2	25.68	1.29
Subjects (S)/QT	66	20.08	

* Significant at $p < .01$