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ABSTRACT

Three variables (verbal aptitude, listening ability, and notetaking) that may mediate how much college students learn from a lecture were studied. Verbal aptitude was operationalized as a Verbal Scholastic Aptitude Test (VSAT) score. Listening ability was measured as the score on an auditory short-term memory task, using the serial running memory span task. Notetaking was judged by the length of notes students took during a lecture. Initial subjects were 498 students from the psychology department's subject pool at the University of California (Davis). The span task identified subjects with extremely good or very poor recall, resulting in samples of 51 students with low recall and 53 students with high recall. Learning was assessed using multiple-choice and short-answer examinations. The results provide support for the "encoding" function of notetaking, but only for some individuals. When few notes were taken, the short-answer performance of the high VSAT subjects was very similar to that of other subjects. With brief note lengths, the multiple-choice scores of the middle VSAT subjects were indistinguishable from those of the high VSAT subjects. With longer notes, the performance of these two groups in these test contexts was enhanced. High VSAT subjects performed better on short-answer items if they took medium length notes. Middle VSAT subjects benefited from longer notes when tested via a multiple-choice format, and middle VSAT subjects performed better on short-answer items if they took medium-length, as opposed to brief, notes. In contrast, the low VSAT subjects' scores were uniformly low, regardless of the amount of notes taken. These findings support an individualized approach to understanding notetaking functions. Two tables and three graphs provide study data. A 36-item list of references is included. (SLD)

NOTETAKING, VERBAL APTITUDE, & LISTENING SPAN: FACTORS INVOLVED IN LEARNING FROM LECTURES

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The present study focuses on three variables that may mediate how much college students learn from a lecture. More exactly, it concentrates on combinations of variables that may make learning at the time of the lecture (on-line processing) easier for some students and more difficult for others. The variables under consideration are: verbal aptitude, listening ability, and notetaking. "Verbal aptitude" was operationalized as a Verbal Scholastic Aptitude Test (VSAT) score and "listening ability" as a score on an auditory short-term memory task. The factor "notetaking" refers to the amount of notes students took during a lecture.

Initally, subjects were given the auditory task and grouped according to their performance on it and according to their VSAT scores. Then, subjects witnessed a video-taped lecture during which they took notes. In the week following, they did not have their notes to review since one question being asked was whether the act of notetaking helped some students to learn "on-line." (In other words, does notetaking serve an "encoding" function for some and not others?). The dependent variable was memory for the lecture after the one week delay.

The current research is based on ideas and data from three distinct areas of psychological inquiry: individual differences, short-term memory, and the psychology of studying. Therefore, in the sections following, individual differences in verbal aptitude, listening ability, and notetaking are discussed first, followed by a section on measuring short-term memory, and finally research on notetaking is summarized.

Individual Differences

In the context of discussions about study strategies, some students informally report that they can't learn very easily by listening to a lecture and that it is difficult to take lecture notes. Other students report a preference for the lecture format and claim that notetaking enhances their comprehension. What accounts for these disparate reports? In the current study, lecture learning was examined in relation to three individual differences variables in an attempt to understand the basis of these different experiences. Differences in listening ability, verbal aptitude, and the length of lecture notes were considered.

As a rule, cognitive psychologists take a nomothetic approach to the study of memory. They are concerned with describing and explaining how the average person codes, organizes, and retrieves information. A few cognitive psychologists, however, are concerned with delineating how individuals uniquely process and access information. They have, for example, drawn upon cognitive processing research and techniques to understand aging memory systems (Poon, Fozard, Cermak, Arenberg, & Thompson, 1980), visual vs. verbal coders (Hunt, Lunneborg, & Lewis, 1975; Hunt, 1978), chess experts (DeGroot, 1965), and professional mnemonists (Luria, 1968; Hunt & Love, 1972).

The work done with visual and verbal coders and with people exhibiting exceptional memory abilities has led to criticism of the concept of a "general" intelligence factor. In this work, components of mental aptitude are studied using tasks devised by cognitive psychologists. Furthermore, the functional value of different components is assessed by focusing on the way in which everyday tasks interact with particular component processes. According to Hunt (1983), the componential approach contrasts sharply with a "general aptitude" approach to intelligence. It focuses on maximizing individual potential, whether in terms of fitting strategy to cognitive constraint, or in terms of increasing the efficacy of a particular component process.

Which of the two approaches, a general aptitude or a componential approach, best explains different learning outcomes for students in a lecture situation? One possibility is that an automatic cognitive process like the rapid, accurate decoding of speech has a measurable influence on learning from lectures. This hypothesis was tested by measuring the auditory discrimination abilities of subjects who later witnessed a lecture. On the other hand, an automatic process like speech decoding may play an independent but trivial role in a complex learning activity like learning from lectures (Estes, 1974). In order to test the alternate hypothesis that general aptitude is the better predictor of individual differences in lecture learning, verbal aptitude data were used to group subjects.

A third individual difference variable included in the design was lecture note-length. As with cognitive psychologists, educational psychologists have tended to focus on how most students take notes and use them; little research exists on individual differences in notetaking behavior. Since data from pilot studies revealed lecture note-length to be a highly variable aspect of notetaking, it was treated as a potentially important mediator of memory for lecture material.

<u>Measuring Short-Term Memory - Serial Running Memory Span</u>

The "serial running memory span" task was used in this study to measure auditory short-term memory, one component of listening. The rationale for using a span measure rests on two assumptions. The first is that there are components of listening (for example, the ablity to attend to auditory stimuli, the efficiency with which such stimuli are encoded and retrieved, and the ability to organize what is heard) that are measurable and non-trival. They are non-trivial because they could each impact on the ability to learn from an auditorially presented lesson. Secondly, it is assumed that one of these components of listening involves attention and, therefore, impacts on the attentional resources available for engaging in other activities, activities like taking lecture notes. This component was measured using the serial running memory span task.

There are various interpretations of the memory span phenomenon, but the best known interpretation rests on the notion of limited memory space. In 1890, William James characterized "primary memory" as a finite register for a person's "sense impressions." Since then, memory over short delays has been extensively studied by experimental psychologists. In the recent past, multi-store memory models have been used to explain the results of such research (cf., Atkinson & Shiffrin, 1968). Specifically, the results of memory span studies have been interpreted with reference to the limits of a "short term store" (STS). In other words, a subject's "span" is an indicator of the size of his or her STS.

According to a different interpretation, the span phenomenon is related to the ability to time-tag or discriminate between items in a temporally coded array (Bjork & Whitten, 1974; Cohen & Sandberg, 1980; Glenberg & Swanson, 1986). The phenomenon of the "release" from proactive interference supports this interpretation. Proactive interference (PI) occurs when previously encountered information interferes with memory for information that follows. According to a multi-store memory model, this is a function of a limited capacity STS; traces of old information remaining in STS and thereby reduce the amount of "space" available for new information (Keppel & Underwood, 1962). Under some circumstances, this explanation will not suffice. When PI is allowed to build in a list-learning task (e.g., when a series of word lists is given) the presentation of a list of novel stimuli (e.g , words from a new category) results in a "release" from PI (Wickens, 1972; Gardiner, Craik, & Birtwhistle, 1972). Novelty, the researchers hypothesize, increases the distinctiveness of items that were in the last list, so that memory for preceding stimuli does not interfere with their recall. In related experiments, the intervals between test stimuli (lasting sometimes as long as two minutes) were filled with a distractor task. Although the estimated duration limit of STS was exceeded and the interpolated tasks were potentially interfering, the test stimuli were recalled well (Kincaid & Wickens, 1970; Bjork & Whitten, 1974; Glenberg, et al, 1983). Again, one could say that the test stimuli were made more distinct, this time because of their temporal distance from one another or the difference in their "time-tags." These experimental manipulations enable the subject to discriminate more easily among time-tagged items in a mental array (Glenberg & Swanson, 1986).

In the study being reported here, a serial running memory span task (Cohen & Sandberg, 1980) was used to measure time-tagging ability. In a speech train, change over time is what specifies meaningful sound entities. The decoding of speech (i.e., the process of getting meaning from speech) requires the listener to relate memory for the pattern of recent auditory events to ongoing auditory events. The serial running memory task appears to tap this component of speech processing. The task involves the ordered recall of the last few items in a rapidly delivered, rapidly changing auditory array.

The auditory array consists of digit strings (i.e., sets of numbers) that vary randomly in terms of length. Subjects cannot predict when a particular digit string will end because of the variation in string lengths, so they must attend to the entire string. The stimuli (digits) are presented at a rapid rate (4 per second), which is slow enough to allow for perception of the digits, but so rapid as to make it difficult to rehearse or chunk the items (Cohen & Sandberg, 1980). Traditional memory span tasks do not preclude the use of these strategies because of their relatively slow presentation rate (1 per second). Therefore, a conventional estimate of span reflects both the use of strategies and an individual's ability to discriminate among items in recent memory. In contrast, a serial running memory span estimate is not confounded by strategy use. The task taps the ability to attend to auditory patterns and to discriminate among items in recent auditory memory. Both of these abilities are involved in speech processing at its most elementary levels.

In sum, the research design included the use of the serial running memory span task to group subjects. They were categorized as having a short, medium, or long span (i.e., a span of 3, 4, or 5, respectively) based on their span task performance. Then, equal numbers of subjects who had short and long spans were instructed to take notes while listening to a lecture. The goal in using the span task was to relate the ability to discriminate among recent auditory events to the effect of concurrent notetaking on memory.

Notetaking

Although notetaking has been studied a great deal, there is little consensus regarding its value and function. Notetaking researchers debate whether notetaking helps or hinders students; some find it has a positive effect (DiVesta & Gray, 1972; Barnett, DiVesta, & Rogozinski, 1981), while others do not (McClendon, 1958; Carter & Van Matre, 1975). Sometimes the act of taking notes (encoding), in and of itself, appears to facilitate learning (Aiken, Thomas, & Shennum, 1975; Annis & Davis, 1975). At other times, the products of the activity (the notes) and their review are apparently the source of benefit (Rickards & Friedman, 1978; Kiewra, 1985).

This wide assortment of results may exist, in part, because notetaking helps some students learn and not others, or because it helps different people in different ways. Many researchers in the psychology of studying agree that a focus on individual differences is overdue (Ladas, 1980; Annis, 1981; Brown & Day, 1983). The current experiment was designed to illuminate the interactions between individual differences in auditory processing, verbal ability, and notetaking.

Among competent university students, differences in cognitive processing may limit the types of lecture-learning strategies that will be useful for any particular person. According to Hunt (1978), students scoring high on the Verbal Scholastic Aptitude Test (VSAT) perform differently on certain cognitive processing tasks than those who score high on the Quantitative SAT. This finding led Hunt to hypothesize that some people tend to encode or mentally represent the world either in a verbal or a visuo-spatial way. Expanding on this, one might say that whether a student tends to operate in a verbal (or speech oriented) mode may determine whether learning from a lecture is easier than learning from a lab demonstration or from a textbook. More specifically, a highly verbal student may process speech more rapidly and effectively than a less verbal student, giving the former an edge in the lecture situation. (This assumes that proficiency with spoken language is at the root of verbal ability.)

The average lecture rate is much faster than the average notetaking rate (120 versus 20 words per minute or wpm). Furthermore, the more rapid the delivery, the more difficult it is for students to take notes (Ladas, 1980). The problem most students have even taking notes with fast lecture rates ("fast" meaning only 15 wpm faster than average) could serve as a parallel to a daily dilemma faced by some "low verbal" students. At average lecture rates, such a student might experience difficulty processing the auditory stream and, therefore, find it hard to take careful or even useful notes. In the research being reported here, the serial running memory span task was used to identify slow and fast auditory processors and VSAT scores were used to identify levels of verbal ability. It was thought that their effects on lecture memory might interact with the effect of a simple dimension of notetaking - notelength.

Notetaking researchers have tried to explain how the process of notetaking might help students. Peper & Mayer (1978) describe three different potential "encoding" benefits of notetaking: it serves to enhance attending; it encourages assimilation of new information into existing knowledge; it encourages effortful or meaningful encoding. It is possible that only some students reap one or more of these benefits and that they experience them only some of the time. For example, students probably aren't experiencing encoding benefits when struggling to take notes during a rapidly delivered lecture. Similarly, "low verbal" students probably aren't experiencing encoding benefits when taking notes at average lecture rates.

In general, then, if a student able to rapidly and accurately decode speech and translate it into written form, the encoding benefits of notetaking may be experienced. Rapid decoding may essentially "buy time" for the student to meaningfully process the lecture. In a relevant study, Bretzing and Kulhavey (1979) gave students notetaking instructions that were meant to vary the extent to which a written passage was processed for meaning. Students who were asked to take summary notes significantly outperformed those asked to take verbatim notes, even though a week had passed and they had no opportunity to review notes during the delay. The researchers associated the "depth of processing" engendered by summarizing or paraphrasing the lecture in the "summary notes" condition with superior recall. It seems likely that the verbatim notes subjects did not experience encoding benefits from taking notes because they were engaged in a task that was more akin to copying or taking dictation than to notetaking; meaningful processing was minimized. Similarly, low verbal students or those who are slow auditory processors may be, on an everyday basis, performing a recording task that keeps them from meaningfully processing lecture material. If so, they should not benefit from notetaking per se, but perhaps from the review of notes.

Work on lecture notetaking has not often focused on student differences in terms of how notes are formed or used. The results of pilot studies indicated that lecture note-length varies greatly across students and is a relatively stable attribute of an individual's notetaking. In one pilot study, college students noted from 60 to 500 words per lecture hour. In a content analysis of notes taken by two "experts" (graduate students), note-length remained fairly stable across several courses' contents. Based on this preliminary work, note-length was treated as a potential mediator of memory for lecture material.

This study was designed to test the possibility that an encoding benefit from notetaking would only accrue to those subjects with high verbal ability and/or those who are fast auditory processors and that the length of notes should interact with these verbal ability factors. In other words, longer notes were expected to maximize the encoding benefit for "high verbal" or long span subjects. Shorter notes, in contrast, were expected to increase the liklihood that an encoding benefit would be experienced by "low verbal" or short span subjects.

METHOD

Subjects

Subjects were taken from the University of California, Davis, psychology department's subject pool. A total of 498 subjects participated in the first phase of the study and received extra-credit for doing so. A subset of these subjects were included in the rest of the study and received additional extra-credit. These subjects allowed us to gain access to their VSAT scores.

Subjects were dropped for various reasons throughout the study. For nine subjects, the tape for the running span task was inadvertently played at a low volume, making it difficult to interpret their performance. Two subjects failed to complete the study. Fourteen other subjects were dropped either because they reported having limited command of English or because they lacked VSAT scores.

Serial Running Memory Span

During the first phase of the study, all subjects were given the running span task (Cohen & Sandberg, 1980) and their performance determined whether they would continue as subjects. Traditional span tasks do not preclude the use of chunking and rehearsal strategies. In contrast, running span only reflects the ability to attend to auditory patterns and to discriminate among items in recent memory.

In the running span task, subjects were asked to recall the last n digits (3, 4, 5, or 6) in a series or string that they had just heard. Two features of these digit strings are important to note. First, the rate of presentation is very fast, 4 digits per second. Second, each string could be anywhere from twenty to thirty digits long; in other words, the length of any one string could not be predicted. The unpredictability of string length together with the rapid delivery of the digits made it difficult, if not impossible, to do more than just attend to each digit string and "read out" those aspects of the auditory pattern that had been perceived.

There were four levels of recall in the span task. At the simplest level, the last 3 digits in every string were recalled. At the most difficult level, the last 6 digits were recalled. Subjects received 20 trials at each level of recall. As with any span task, the highest level at which 50% or more of the trials were successfully completed was treated as that person's span. According to the running span task results, 25% of the subjects had a span of three, most (61%) had a span of four, and 12% had a span of five. Very few subjects had spans either less than three or greater than five.

About 60 subjects with spans of three and 60 with spans of five or six were included in the lecture and memory test phases of the study. Because of attrition, the final sample sizes used in the analyses were 51 and 53, respectively.

VSAT

All of the final pool of subjects permitted access to their VSAT scores. (A procedure for preserving their anonymity was devised in cooperation with the UCD registrar.) It was assumed that an individual's speech decoding capacity (as measured by the running span task) contributes to the VSAT score (Hunt, 1978), but that the score is a function of many other components of verbal processing as well (e.g., visual attention, lexical access, semantic knowledge base). One aim of the study was to learn whether span alone could accurately predict memory test performance. A contrasting aim was to discover whether a verbal aptitude score could predict performance.

Lecture & Memory Test

Members of the two extreme span groups took notes during a videotaped lecture. The lecture was titled "The Psychology of Reading" and, according to self-report data, subjects were not familiar with the lecture content. The lecture lasted about 43 minutes, approximating a common lecture duration. Afterwards, subjects turned in their notes and were asked to return in one week. They were not given an opportunity to review their notes since the focus of the study was on the encoding function of notes. One week after the lecture, subjects took a memory test on the material. The test format included both multiple-choice and short-answer items.

ANALYSIS & RESULTS

Span served as a blocking factor having two levels representing extremes of the population. Verbal ability was treated as a three level factor, with group VSAT mean scores of 390, 487, and 598 respectively. Actual note-length (a tally of words, abbreviations, and word-like symbols) was calculated for the collected notes and became a three level factor; mean note-lengths at each level were 143, 354, and 672 words. Finally, the items types on the memory test, multiple-choice and short-answer, formed a two level within-subjects factor. An analysis of variance whas performed on the memory test data. In summary, three between-subjects factors (VSAT, span, note-length) and one within-subjects factor (question type) were included in the analysis. The analysis was carried out using a "MANOVA" procedure within SPSS-X on the U.C.D. VAX/VMS system.

Main Effects

The between-subjects factor VSAT impacted significantly on memory test performance ($F=20.38$, $p<.001$). Refer to Table 1.

TABLE 1 - Mean proportion correct on memory test for three VSAT levels

	n	mean	std. dev.
LOW VSAT	35	43.3	14.5
MIDDLE VSAT	35	54.5	19.9
HIGH VSAT	34	67.1	14.1

In contrast, the span factor did not have a significant impact on memory test scores (F=3.09, p<.08), although long span subjects' scores were higher at every VSAT and note-length level. (Correlational analyses revealed that span is independent of VSAT, r=.14, and of note-length, r=.06.) Span may not have predicted memory test performance because it taps auditory processing that is automatic in nature (as per Schneider & Shiffrin's 1978 formulation) and of minor importance relative to comprehension processes. As the main effect of VSAT implies, verbal comprehension skills were an important influence on learning from the lecture.

It came as little surprise that the within-subjects factor, question type, should be statistically significant (F=175.23, p<.001). Generally, although not neccesarily, multiple-choice items are easier to answer than are short-answer items (Postman & Rau, 1957; Crowder, 1976). The former provides the examinee with more cues for retrieval of the appropriate information from memory and a pool of responses from which the most familiar can be selected. On the other hand, the latter requires that retrieval proceed with fewer cues, that the examinee generate a set of possible responses, and identify the best one. Refer to Table 2.

TABLE 2 - Mean proportion correct and standard deviations for two test item types

	mean	std. dev.
multiple-choice	66.4	17.8
short-answer	43.0	22.2

Three-way Interaction

VSAT, question type, and note-length interacted significantly (F=3.03, p<.02). Tests for trend revealed that the source of interaction was the short-answer scores of the high VSAT subjects. The high VSAT subjects who wrote more were more likely to generate correct responses to short-answer items, up to a point. (That is, when taking very extensive notes, their scores were lower.) There were significant linear (p<.015) and quadratic (p<.001) trends in their scores across the three levels of note-length (see Figure 1). While there appears to be a linear trend for the middle VSAT subjects across note-lengths, that trend only approached significance (p<.07). It is interesting to note that with brief notes, the short-answer scores of high VSAT subjects and middle VSAT subjects were very similar.

FIGURE 1 - Short-answer scores varying as a function of note-length for three VSAT groups

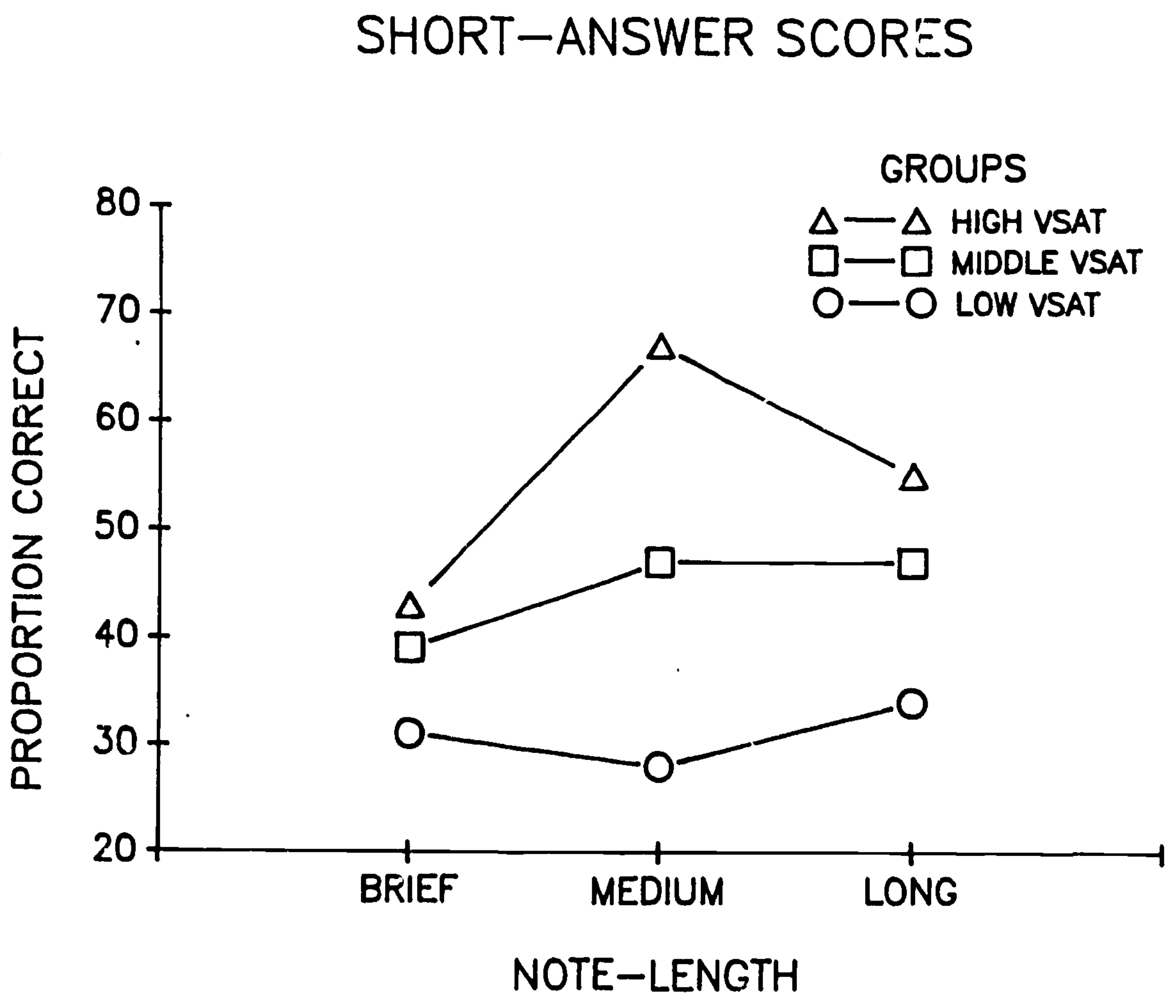
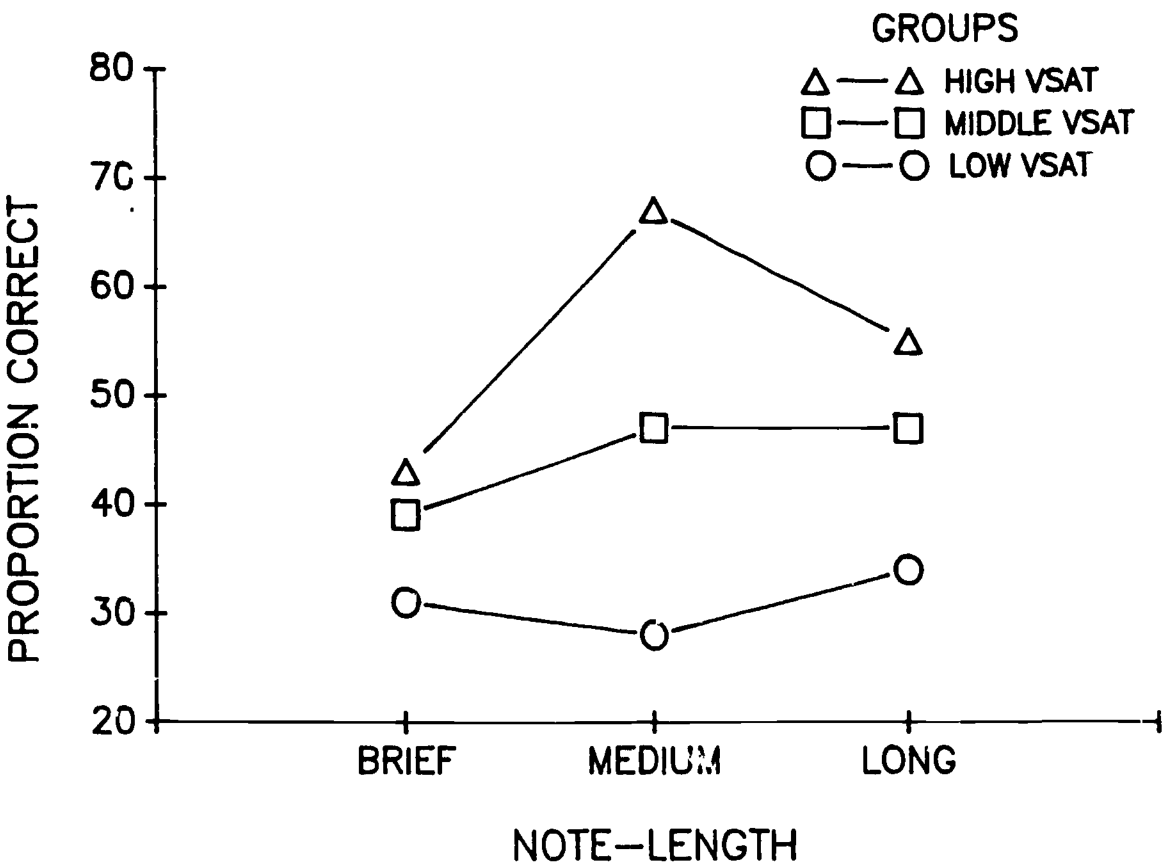


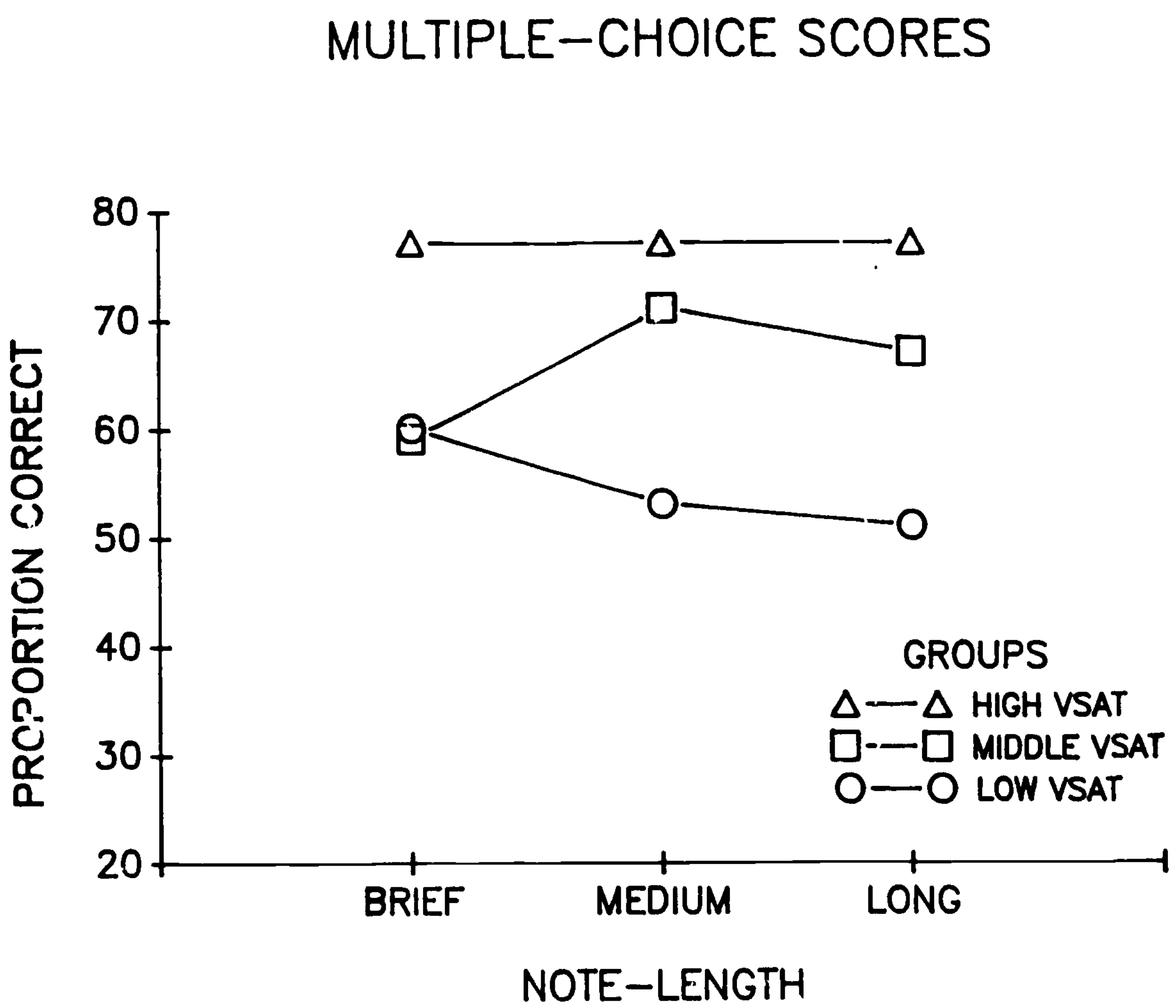
FIGURE 1 - Short-answer scores varying as a function of note-length
for three VSAT groups

SHORT–ANSWER SCORES



A post-hoc comparison of the multiple-choice scores of the middle VSAT group was conducted after examining the data (see Figure 2). The comparison indicated that, for this group, medium-length notetakers scored significantly higher ($p<.03$) than short-length notetakers. In fact, the middle VSAT subjects performed the same as did the low VSAT subjects when brief notes were taken. It is interesting to note that the mulitple-choice scores of the high VSAT subjects do not appear to be affected by increasing note-length, while those of the low VSAT subjects appear to be negatively affected.

FIGURE 2 - Multiple-choice scores varying as a function of note-length for three VSAT groups



DISCUSSION

The finding that note-length affected performance in some cases is congruent with current views of the "encoding" function of notes, where the act of notetaking itself benefits the student. As Peper & Mayer (1978) suggest, the source of this benefit could be either that notetaking serves to focus attention, that it promotes the assimilation of new information into old knowledge, or that it encourages effortfu. and meaninful encoding. In this study, generating notes of different lengths had specific impacts on subjects at different levels of verbal achievement. These specific impacts on subjects from each level will be discussed in terms of different encoding functions.

Middle VSAT subjects (mean VSAT score of 489) benefited from longer notes when tested via a multiple-choice format. In fact, those that took brief notes (about 150 words long, at a rate of 3 words per minute -- wpm) did no better than the low VSAT subjects (mean VSAT of 390). While it is impossible to say exactly how notetaking mediated performance, it is reasonable to assume that it at least served to focus their attention on the material being presented. If subjects paid closer attention to the lecture, they would be more likely to recognize material from it if encountered again; when responding to multiple-choice items, recognition or a sense of familiarity can be the basis of a correct answer. Following this line of reasoning, the uniformly good multiple-choice scores of the high VSAT subjects, regardless of note-length, may reflect a tendency to focus attention during lectures. (While it is possible that these scores also reflect greater prior familiarity with the lecture content, self-report data indicate that this was not the case.) One additional finding regarding middle VSAT subjects indicates that notetaking may have served to not only focus their attention, but to enhance meaningful encoding; the middle VSAT subjects tended ($p<.07$) to perform better on short-answer items if they took medium-length as opposed to brief notes.

Given the difference between lecture rates and notetaking rates, notes must neccesarily be summaries (adequate or not) of what was said. Paraphrase and summarization (processes that are entailed by notetaking) require the interaction of existing knowledge, which includes relevant concepts and their associations, with the information being presented. The process of distilling lecture material and putting it into one's own words may, for some people, provide a way to incorporate new material into existing knowledge structures. The better integrated the new is with the old (and, incidentally, the more the resulting structure matches that of the tester), the better performance will be on qurstions that are designed to tap organized knowledge. Short-answer responses, more than multiple-choice item responses, depend on a well-organized, accessible set of concepts.

When responding to short-answer items, cues within the item activate related concepts in the same way the word "cat" activates an internal representation of a furry animal that purrs. Following network models of memory, this activation then spreads to associated concepts. The pattern of activation is determined by how often and how strongly concepts have been associated with each other in the past, whether incidentally (as when two events co-occur) or intentionally (as when a student actively searches for associations between new and old knowledge). It seems reasonable to assume that if associations between concepts are made in a systematic, organized way as learning proceeds, the knowledge activated at time of testing will have structure and be cohesive. In other words, activating one concept that is part of an organized knowledge structure (or schema) gives access to the whole.

High VSAT subjects performed better on short-answer items if they took medium length notes (notetaking at a rate of approximately 7 wpm) and there was a similar tendency for the middle VSAT subjects. Relative to brief notetaking, the greater amount of time spent paraphrasing or interacting with the lecture material while taking longer notes may have led to stronger associations between concepts and a greater sensitivity to the inherent structure of the material. As a result, a more cohesive set of concepts was available for constructing short-answer responses at the time of the test. On the other hand, when subjects took very long notes (mean length of 672 words, taken at a rate of 13 wpm), performance on short-answer items suffered (refer to the curvilinear trend in the high VSAT subjects' data). Not surprisingly, tilting the balance sharply toward the task of notetaking (as opposed to the task of deep and meaningful learning) negatively affects recall. High notetaking rates could be equated with taking dictation, the process of translating sound into symbol, without regard for meaning. In this case, concepts would not be inter-related in an organized way, and there would be no structure that could act as a sound basis for short-answer responses. This is like what Kiewra (1985) calls "note listing" and may reflect what is true in general for the low VSAT subjects.

Scores for low VSAT subjects were uniformly poor, with an overall mean of 43%. They were not affected by note-length, although the multiple-choice scores appeared to drop with longer notes (refer to Figure 2). Since all subjects took notes of some kind, it is difficult to know whether low VSAT subjects experienced even a small encoding benefit from notetaking; a no-notes baseline is required to make that judgement. However, given the findings regarding the other VSAT groups, if notes benefit these subjects in any way, perhaps it is through their use as a stored representation of the lecture (the "storage" function of notes). Given that this study was limited to an examination of the "encoding" function of notes, that possibility was not addressed. In the future, it would be interesting to focus on the function of note review specifically for low VSAT subjects. It would probably be important to consider the quality of the notes being reviewed, perhaps comparing the effect of reviewing their own (possibly inadequate) notes with an instructor's notes, as researchers like Kiewra (1985) have done with more general populations.

CONCLUSIONS

The results of this study provide support for the "encoding" function of notetaking, but only for some individuals. When few notes were taken, the short-answer performance of the high VSAT subjects was very like other subjects' performance; similarly, at brief note-lengths, the multiple-choice scores of the middle VSAT subjects were indistinguishable from those of the low VSAT subjects. With longer notes, the performance of these two groups in these test contexts appears to have been enhanced. In contrast, the low VSAT subjects' scores were uniformly low, regardless of the amount of notes taken. At the very least, these findings support an individualized approach to understanding notetaking functions. A critical question to ask next is whether notetaking might interact with note review differently for different students.

REFERENCES

Aiken, E.C., Thomas, G.S., & Shennum, W.A. (1975) Memory for a lecture: Effects of notes, lecture rate, and informational density. Journal of Educational Psychology, 67, 439-444.

Annis, L.F. (1981) Effect of preference for assigned lecture notes on student achievement. Journal of Educational Research, 74, 179-182.

Annis, L.F., & Davis, J.K. (1975) Effect of encoding and an external memory device on notetaking. Journal of Experimental Education, 44, 44-46.

Atkinson, R.C., & Shiffrin, R.M. (1968) Human memory: A proposed system and its control processes. In K.W. Spence & J.T. Spence (Eds.), The psychology of learning and motivation: Vol. 2. New York: Academic Press.

Barnett, J.E., DiVesta, F.J., & Rogozinski, J.T. (1981) What is learned in notetaking? Journal of Educational Psychology, 73(2), 181-192.

Bjork, R.A. & Whitten, W.B. (1974) Recency-sensitive retrieval processes. Cognitive Psychology, 6, 173-189.

Bretzing, B.H. & Kulhavey, R.W. (1979) Notetaking and depth of processing. Contemporary Educational Psychology, 4, 145-153.

Brown, A.L. & Day, J.D. (1983) Macro-rules for summarizing texts: The development of expertise. Journal of Verbal Learning and Verbal Behavior, 22, 1-14.

Carter, J.F. & Van Matre, N.H. (1975) Note taking versus note having. Journal of Educational Psychology, 67, 900-904.

Cohen, R.L. & Sandberg, T. (1980) Intelligence and short-term memory: A clandestine relationship. Intelligence, 4, 319-331.

Crowder, R.G. (1976) Principles of learning and memory. Hillsdale, NJ: Lawrence Erlbaum & Associates.

De Groot, A. (1965) Thought and choice in chess. The Hague: Mouton.

DiVesta, F.J. & Gray, G.S. (1972) Listening and notetaking. Journal of Educational Psychology, 63, 8-14.

Estes, W.K. (1974) Learning theory and intelligence. American Psychologist, 29, 740-749.

Gardiner, J.M., Craik, F.I.M., & Birtwistle, J. (1972) Retrieval cues and release from proactive inhibition. Journal of Verbal Learning and Verbal Behavior, 11, 778-783.

Glenberg, A.M., Bradley, M.M., Kraus, T.A., & Renzaglia, G.J. (1983) Studies of the long-term recency effect: Support for a contextually guided retrieval hypothesis. Journal of Experimental Psychology: Learning, Memory, & Cognition, 9, 231-255.

Glenberg, A.M. & Swanson, N.G. (1986) A temporal distinctiveness theory of recency and modality effects. Journal of Experimental Psychology: Learning, Memory, and Cognition, 12, 3-15.

Hunt, E. (1978) Mechanics of verbal ability. Psychological Review, 85, 109-130.

Hunt, E. (1983) On the nature of intelligence. Science, 219, 141-146.

Hunt, E. & Love, T. (1972) How good can memory be? In A.W. Melton & E. Martin (Eds.), Coding Processes in Human Memory. Washington, D.C.: Winston.

Hunt, E., Lunneborg, C., & Lewis, J. (1975) What does it mean to be high verbal? Cognitive Psychology, 7, 194-227.

James, W. (1890) Principles of Psychology. New York: Holt, Rinehart, & Winston.

Keppel, G. & Underwood, B.J. (1962) Proactive inhibition in short-term retention of single items. Journal of Verbal Learning and Verbal Behavior, 1, 153-161.

Kiewra, K.A. (1985) Investigating notetaking and review: A depth of processing alternative. Educational Psychologist, 20, 23-32.

Kiewra, K.A. (1985) Providing the instructor's notes: An effective addition to student notetaking. Educational Psychologist, 20, 33-39.

Kiewra, K.A. (1985) Students' notetaking behaviors and the efficacy of providing the instructor's notes for review. Contemporary Educational Psychology, 10, 378-386.

Kincaid, J.P. & Wickens, D.D. (1970) Temporal gradient of release from proactive inhibition. Journal of Experimental Psychology, 86, 313-316.

Ladas, H.S. (1980) Summarizing research: a case study. Review of Educational Research, 50, 597-624.

Ladas, H.S. (1980) Notetaking on lectures: An information processing approach. Educational Psychologist, 15(11), 44-53.

Luria, A.R. (1968) The Mind of a Mnemonist. New York: Basic Books.

McClendon, P.I. (1956) An experimental study of the relationship between notetaking practices and listening comprehension of college freshmen during expository lectures. (Doctoral dissertation, University of Iowa.) Dissertation Abstracts International, 16, 1736. (University Microfilms No. 56-2735.)

Peper, R.J. & Mayer, R.E. (1978) Notetaking as a generative activity. Journal of Educational Psychology, 70, 514-522.

Poon, L.W., Fozard, J.L., Cermak, L.S., Arenberg, D., & Thompson, L.W. (Eds.) (1980) New directions in memory and aging: Proceedings of the George Talland memorial conference. Hillsdale, NJ: Lawrence Erlbaum Associates.

Postman, L. & Rau, L. (1957) Retention as a function of the method of measurement. University of California Publications in Psychology, 8, 217-270.

Rickards, J.L.P., & Friedman, F. (1978) The encoding versus the external storage hypothesis in notetaking. Contemporary Educational Psychology, 3(2), 136-143.

Wickens, D.D. (1972) Characteristics of word encoding. In A.W. Melton & E. Martin (Eds.), Coding processes in human memory Washington, D.C.: Winston.