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An analysis of spontaneous study strategies

MORE IMPORTANT than investigating the efficacy of a particular study technique, or tactic, is understanding the overall metacognitive strategy that a studier employs. A *strategy* is defined here as a configuration of study tactics used together in a purposeful way to accomplish a particular learning task. The authors collected verbal reports from U.S. college students as they studied a lengthy expository text, and used cluster analysis to develop an empirical typology of students' spontaneous study strategies. Three variables were used to categorize subjects: (a) the number of different study tactics they used, (b) whether they used them consistently, and (c) whether they spontaneously stated a purpose for using each tactic. The 14 study tactics cited by the students were grouped into text-noting tactics, mental-learning tactics, and reading tactics. Six clusters of studiers were identified, each representing a distinct strategy. The authors describe in detail the typical tactics used by each type of studier, and the consistency and purposefulness of their use. The six types are characterized generally as the Good Strategy User, the Information Organizer, the Flexible Reader, the Text Noter, the Mental Integrator, and the Memorizer. The authors did not find a significant difference between the six types of studiers in the amount of information recalled immediately from the text.

Analyse des stratégies d'étude spontannées d'étudiants de niveau collégial

AU DELÀ DES techniques d'études individuelles utilisées par les étudiants de collèges, il importe de comprendre les stratégies métacognitives sur lesquelles elles reposent. On définira une stratégie d'étude comme un ensemble de tactiques combinées entre elles en fonction d'un but à atteindre et d'une tâche particulière à accomplir. Les auteurs ont recueilli les verbalisations d'étudiants du collégial pendant qu'ils étudiaient un texte informatif long. Une analyse factorielle a permis d'établir une typologie de stratégies d'études spontanément utilisées par les étudiants observés. Trois variables ont été prises en compte pour l'établissement de la typologie: (a) le nombre de stratégies différentes utilisées; (b) le fait que les stratégies étaient ou non utilisées systématiquement; (c) le fait que les étudiants pouvaient ou non spontanément exprimer le but qu'ils poursuivaient en utilisant ces stratégies. Les 14 stratégies identifiées furent également classifiées en trois grandes catégories: annotations du texte, techniques mentales d'étude et techniques de lecture. Les étudiants ont ainsi été regroupés en six catégories en fonction des stratégies spécifiques qu'ils utilisaient soit: ceux qui utilisaient les stratégies de façon efficace, ceux qui organisaient les informations, les lecteurs flexibles, ceux qui prenaient des notes, ceux qui intégraient mentalement les

informations et ceux qui mémorisaient. Les auteurs décrivent les stratégies typiques utilisées par chaque catégorie d'étudiants ainsi que les buts poursuivis par chacun et la consistance de leurs comportements. Aucune différence significative n'a toutefois été trouvée entre les six catégories d'étudiants à une épreuve de rappel de texte.

Un análisis de las estrategias espontáneas de estudio entre estudiantes universitarios

MÁS IMPORTANTE que investigar la eficacia de técnicas de estudio individual, o las tácticas usadas, es el entender las estrategias metacognitivas generales que los estudiantes utilizan. Se define una estrategia aquí, como una configuración de tácticas de estudio usadas conjuntamente de manera intencional para llevar a cabo una tarea de aprendizaje específica. Los autores recogieron reportes verbales de estudiantes universitarios mientras éstos estudiaban un texto expositorio largo. Se usaron análisis estadístico de grupos *(cluster analysis)* para desarrollar una tipología empírica de las estrategias espontáneas de estudio. Tres variables para categorizar a los sujetos fueron utilizadas: (a) el número de las diferentes tácticas de estudio usadas, (b) si las usaron o no de forma consistente, y (c) si, espontáneamente, se declaró un propósito para el uso de cada táctica. Además las catorce tácticas de estudio citadas por los estudiantes fueron clasificadas como tácticas de subrayado, tácticas de aprendizaje mental y tácticas de lectura. Se identificaron seis grupos de estudiosos, cada uno representativo de una estrategia específica. Los autores describen con detalle las tácticas típicas usadas por cada tipo de estudiante, y la consistencia y empeño puestos en su uso. Los seis tipos se caracterizan generalmente de la forma siguiente: el usuario de buenas estrategias, el organizador de información, el lector flexible, el apuntador de textos, el intregrador mental y el memorizador. Los autores no encontraron ninguna diferencia entre los seis tipos de estudiosos en cuanto a la cantidad de información del texto que fue recordada.

Eine Analyse der spontanen Lernstrategien von Studenten

NOCH WICHTIGER als eine Untersuchung der Wirksamkeit einzelner Lernstrategien – oder Taktiken – ist das Verstehen der globalen metakognitiven Strategien, die von Lernenden angewendet werden. *Strategie* steht hierbei für die Konfiguration von Lerntaktiken, die gemeinsam auf sinnvolle Art und Weise benutzt werden, um eine bestimmte Lernaufgabe zu meistern. Die Verfasser sammelten mündliche Berichte von Studenten, während sie mit einem längeren Expositionstext arbeiteten, und verwendeten anschließend eine Gruppenanalyse, um eine empirische Typologie der spontanen Lernstrategien der Studenten zu entwickeln. Zur Kategorisierung der Teilnehmer wurden drei Variablen benutzt: (a) die Anzahl der verschiedenen Lerntaktiken, die sie benutzten, (b) ob sie regelmäßig von ihnen benutzt wurden, und (c) ob sie spontan für jede benutzte Taktik einen Anwendungsgrund angaben. Zusätzlich wurden die von den Studenten angegebenen 14 Lerntaktiken wie folgt klassifiziert: Textkennzeichnungstaktik, geistige Lerntaktik und Lesetaktik. Es wurden sechs Gruppen von Lernenden festgestellt, wobei jede Gruppe eine charakteristische Strategie darstellte. Die typischen Taktiken, die jeder Lernende benutzte, und die Beständigkeit und Zweckmäßigkeit ihres Gebrauchs werden hier von den Verfassern im Detail beschrieben. Die sechs Arten wurden allgemeim wie folgt klassifiziert: gute Strategiebenutzer; systematisieren der Informationen; flexible Leser; kennzeichnen des Textes; geistiges Integrieren; auswendiglernen. Die Verfasser stellten jedoch keinerlei Unterschiede zwischen den sechs Gruppen der Lernenden in bezug auf die Menge der Textinformation, an die sich die Lernenden erinnern konnten, fest.

What does it mean to be a good studier? In teaching study skills, we have assumed that good studying means using specific techniques such as underlining, note-taking, outlining, summarizing, and self-questioning. However, researchers have produced no consistent empirical evidence that these techniques are any more effective than more passive techniques such as simple reading or rereading (Anderson & Armbruster, 1984; Reynolds & Shirey, 1988). Similarly, in a recent study of college students' self-selected study methods, we (Wade & Trathen, 1989) found that students' use of specific study techniques such as taking notes, underlining, and highlighting ideas was not causally related to their learning from a text. In other words, noting information appeared to have little effect on the recall of that information, once effects due to importance of the information were statistically removed.

In their efforts to understand the components of the learning process, a number of researchers have distinguished between *learning tactics* and *learning strategies* (e.g., Armbruster, Echols, & Brown, 1983; Derry & Murphy, 1986; Snowman, 1986). A learning tactic is an individual study technique such as underlining, notetaking, outlining, summarizing, visualizing, or using mnemonic devices. A learning strategy, on the other hand, has been defined as a "collection of mental tactics employed by an individual in a particular learning situation to facilitate acquisition of knowledge or skill" (Derry & Murphy, 1986, p. 2). Other researchers have added a metacognitive component to this definition of a strategy; for example, Armbruster, Echols, and Brown (1983) argue that "a technique becomes a strategy only if students have the metacognitive knowledge of when, where, and how to use it" (p. 18). Similarly, as Paris, Lipson, and Wixson (1983) describe it, "strategic behavior connotes intentionality and purpose on the part of the learner" (p. 294). In other words, a strategy is considered a deliberate action—the conscious selection of one alternative over another. Thus, it is accessible to introspection and conscious report.

Pressley, Borkowski, and Schneider (1987) describe the *Good Strategy User* as one who knows how to use a variety of goal-specific tactics, executes them in a planned sequence, and monitors their use. Monitoring is critical to efficient and effective learning because it provides information to the learner about whether his or her present strategies are working, whether comprehension is occurring, and whether information is being remembered (Ghatala, 1986). When good readers read for the purpose of learning the material in the text, they are aware of whether they are comprehending and learning the material. When they realize that they are failing to comprehend or remember, they adjust their tactics or select new ones. Conversely, if they are not experiencing problems, they are less likely to shift to new tactics (Pressley, Snyder, Levin, Murray, & Ghatala, 1987). Thus, the Good Strategy User is one who is able to use a variety of tactics and is flexible and purposeful in their use.

Despite this pioneering work at the theoretical level, we lack empirical evidence for the existence of such overall, intentionally used learning strategies. Without such a data base, researchers have tended to describe one generic "good" strategy, rather than describing readers' choices from a number of distinct strategies (e.g., Pressley, Borkowski, & Schneider, 1987). Although some studies have identified specific learning tactics actually used by studiers (e.g., Garner, 1982; Kavale & Schreiner, 1979; Olshavsky, 1976-1977), researchers have so far failed to categorize subjects systematically according to the collection of tactics they use in a purposeful way. Therefore, the concern of the present study is to address two critical issues identified by Schneider (1985): first, to gather data to help define the concept of a strategy, and second, to determine how strategy use is related to performance. Conceptualization of what constitutes a strategy is of primary concern in this paper because other studies have not achieved this goal empirically and because such conceptualization is preliminary to investigating the relationship between use of a strategy and performance.

The first goal of this study was to develop a

data-based taxonomy of complex study strategies that reflect different configurations of study behaviors, based on readers' conscious introspection. As defined above, a strategy consists of more than simply the use of a tactic. Rather, a strategy is a configuration of different tactics, deliberately selected for a particular purpose, and carefully monitored for effectiveness. Thus, readers' strategies may vary in the diversity of tactics used, in their purposefulness, and in the consistency or flexibility of their use.

Data about learners' study strategies were collected in this study by means of verbal reports produced while subjects studied a lengthy, difficult expository text. Verbal self-reports have been found to be an important source of information about cognitive processes that otherwise could be investigated only indirectly; furthermore, verbal reports allow access to the reasoning and purpose underlying cognitive behaviors (Afflerbach & Johnston, 1984; Brown, 1987; Ericsson & Simon, 1980; Genest & Turk, 1981). These data were analyzed using cluster analysis, a data reduction technique chiefly used when no a priori groups are known to exist. Thus, cluster analysis is an exploratory technique. It was used in the current study to provide an empirical taxonomy of distinct groups of studiers that were maximally similar within groups and maximally dissimilar from all remaining groups. In this study, subjects were clustered using geometric distances rather than correlations (Romesburg, 1984).

The second goal of the study was to examine in depth the characteristics of the resulting clusters of studiers. Specifically, we examined three variables—diversity, purposefulness, and consistency—to see which would best predict cluster membership and how effectively each variable would discriminate one cluster from another.

Our third goal was to use the empirical taxonomy we had developed to generate a corresponding descriptive taxonomy of the different strategies. As Yussen (1985) argues, researchers should keep definitions of concepts open rather than closed—to consider various possibilities, examples, and cases without setting strict interpretive boundaries. In this way we allow for, and expect, complexity. Yussen suggests that one way to keep our understanding open is to identify *prototypes* that exemplify the concept or event we are trying to describe. Such a prototype can offer more penetrating insights about concepts than can a formal definition or description. In fact, much of our understanding of everyday concepts consists of generalizations derived from prototypes. Therefore, in our descriptive taxonomy we sought to include prototypes of the attributes that best distinguished the various clusters, or strategies, from one another.

The final goal of the study was to address the second critical issue identified by Schneider: determining whether strategy use is related to recall performance. Current theories assume that the intentional use of a strategy should be accompanied by improved learning. For example, Pressley, Borkowski, and Schneider's (1987) use of the term *the Good Strategy User* implies not only executive control but also positive learning outcomes. Yet, reviews of the literature (e.g., Cavanaugh & Perlmutter, 1982; Schneider, 1985) have produced conflicting results—that is, many studies have revealed only weak or moderate positive relations between strategy use and performance, whereas other studies have found strong, positive relations. Therefore, the final purpose of this study is to determine whether any one strategy leads to higher recall than another.

Method

Subjects

Subjects were 67 undergraduate students (41 female and 26 male) ranging in age from 17 to 38. They were enrolled in either an introductory education course or a learning skills course at a large public university in Utah. They volunteered to participate in the study in return for extra credit. Prior to the experiment, information was collected about each subject, which included age, sex, grade-point average (GPA), and college major. Comparisons (*t* tests)

showed no significant difference ($p < .05$) between the education students and the learning skills students on GPA (education students: $M = 2.95$, $SD = 0.56$; learning skills students: $M = 2.76$, $SD = 0.60$). In addition, students were asked to rate their interest in reading and their background knowledge of science, in general, and of the ocean, in particular (the topic of the experimental passage). Subjects also completed a portion of the Wide Range Achievement Vocabulary Test and a portion of the Miller Analogy Test. No significant difference was found between the education students and the learning skills students in their percentage scores on vocabulary (education students, $M = 50.54$, $SD = 17.80$; learning skills students, $M = 42.20$, $SD = 17.98$) or analogies (education students, $M = 57.38$, $SD = 21.87$; learning skills students, $M = 52.40$, $SD = 15.89$). Furthermore, there was no difference between groups in ratings of their background knowledge; in fact, all subjects rated themselves as having little or no technical knowledge of the ocean.

Materials

For the experiment, subjects studied a passage adapted from a chapter on tides from *The Sea Around Us* (Carson, 1951), which we copyedited to produce a shorter text (15 double-spaced pages). Using the Fry Readability Formula, we found the average readability level of the resulting passage was 11th-grade. Signals to stop reading and give a report of study strategies were inserted at eight points in the text where major shifts in topic occurred.

The recall test consisted of 32 short-answer questions, which assessed information of both high and low structural importance (cf. Wade & Trathen, 1989). The test questions were constructed from idea units in the text which had been rated for importance on a 4-point scale (1 = least important) by 6 volunteer raters (graduate students). The rating procedure was similar to the one described in Johnson (1970) and used by Brown and Smiley (1977). The raters first identified the least important idea units (about one-quarter of the total) by marking them with a pen of a certain color. This procedure was repeated using pens of different colors until all idea units had been rated. Agreement between raters was .87, and all discrepancies were settled by discussion and consensus of all 6 raters. Importance was then determined by calculating the mean score for each idea unit. Idea units with scores below the median (2.5) were categorized as of low importance, whereas scores above the median were categorized as of high importance. Equal numbers of questions were then constructed from the two types of idea units. The following are two sample questions, one from each level of importance:

> *High importance:* What is tidal friction doing to the earth?
>
> *Low importance:* How far does the Amazon bore travel?

The 32 questions were presented in random order on the test.

Procedure

Subjects were tested individually. To minimize the effect of the verbal reporting on cognitive processing, we employed a modified form of the retrospective verbal report: Students were asked to report retrospectively on their study methods after they had read a large segment of text. Students were informed that they were to read a chapter about the tides and that they would be given a recall test when finished. They were also told that they would be asked periodically to report any study methods used while reading. These verbal reports were recorded on audiotape; all of the students agreed to be recorded. The recorded sessions were transcribed later.

Subjects were instructed to read the passage silently, using whatever study techniques they normally used when studying. They were given their own copies of the text, and were told that they could mark these copies in any way they desired. Such materials as pencils, highlighters, and note pads were available for their use. We instructed the students to stop at each signal in the text. When the student stopped, we asked, *What study method(s) have you been using to understand and remember information you think is important?* The student answered

the question orally. In order to elicit as much detail and reasoning as possible, we asked nondirective questions (e.g., *Can you tell me more about what you just said?* or *Is there anything else you would like to say?*) as the student gave each report. On completing the chapter, the student was given a 5-minute interpolated task consisting of vocabulary items from the Nelson-Denny Reading Test. The recall test and then a short debriefing session followed the task.

Scoring

Information gleaned from the students' verbal reports provided much of the data used in this study. A series of procedures were followed in scoring the verbal reports to generate the derived scores used in our data analysis. Scores on the recall test were also compiled for analysis.

Raw verbal report scores. Based on preliminary analysis of the verbal report data, we created a scoring matrix. The columns of this matrix consisted of the 14 separate reading and learning tactics, or study methods, that were reported during the experiment. The rows of the matrix represented the 8 times subjects were asked to describe their study methods. We also added a row on which we indicated whether the student ever spontaneously mentioned a purpose for using a particular study tactic. Copies of this matrix (one per subject) were then used to code the transcripts of the verbal reports. The result was a set of frequency counts for each tactic reported over the eight rows. We (the three authors) coded all transcripts, and settled disputes by discussion. (See Table 1 for study tactics identified and scoring criteria.)

Study tactic categories. Next, the 14 study tactics were grouped into three categories to distinguish between qualitatively different types of study tactics. The first category consisted of *text-noting tactics,* which produce artifacts, or physical records. This category included (a) underlining or highlighting, (b) verbatim copying, (c) paraphrasing in notes, (d) outlining, and (e) diagramming. Because these are directly verifiable, students' reported text-noting tactics were checked for accuracy with the physical evidence of their actual use. The high degree of correlation (.95) between the physical evidence and the statements made in the verbal reports provides evidence that the verbal reports used in this study were reliable.

The remaining two categories—*mental-learning tactics* and *reading tactics*—represented cognitive processes that are not easily observed, and thus could not be verified. Mental-learning tactics consist of study techniques studiers use to learn and store information they consider important to remember. This category includes (a) rote learning (including reviewing notes and highlighted or underlined information), (b) mental integration, (c) imagery, (d) relating information to background knowledge, and (e) self-testing or questioning. Reading tactics represent adjustments in reading rate that either facilitate comprehension or increase efficiency. These include (a) reading-only, (b) skimming, (c) reading slowly, and (d) rereading.

Derived scores. From these data we then derived scores for three variables that describe students' use of study tactics: diversity, consistency, and purposefulness. Scores for diversity represented the number of individual study tactics used by each subject over the 8 verbal reports. For the diversity score, we counted each study tactic only once, even if subjects used certain tactics over and over; thus, this score provided a conservative measure of study tactic variation. The consistency score, on the other hand, measured subjects' repeated use of study tactics. Each tactic was judged to be used consistently (and assigned 1 point) if it was reported during at least 4 of the 8 verbal reports. Finally, for the purposefulness score, the subject received 1 point for each study tactic if he or she spontaneously described a reason for using the tactic in any of the 8 verbal reports. (See Appendix A for scoring criteria and examples used in scoring purposefulness.) Scores for diversity, consistency, and purposefulness were compiled separately for the three categories of study tactics. The maximum scores on the three variables were 5 for text-noting tactics, 5 for mental-learning tactics, and 4 for reading tac-

Table 1 Fourteen study tactics identified (by category) and scoring criteria

Study tactic	Scoring criteria
	Study methods that produce artifacts
Text-noting tactics	
Highlighting, underlining, circling	
Copying key words, phrases, or sentences	Verbatim copying.
Paraphrasing in notes	Rewrites in the subject's own words.
Outlining	May be as informal as showing a hierarchical arrangement of ideas.
Diagramming	Key word diagrams, graphic organizers, any spatial array of information.
	Study methods that do not produce artifacts
Mental-learning tactics	
Rote learning of specific information	Reciting material mentally, concentrating on specific information, memorizing, reading aloud, reviewing notes or underlining, etc.
Mental integration	Stopping to get the whole picture, to mentally summarize, to draw connections between ideas in the text. Involves a transformation of information and occurs after reading the relevant segment of text.
Relating information to background knowledge or experience	May also include creating associations between a known idea and a new idea.
Imaging, visualizing	Generating mental pictures; imagining oneself in a scene.
Self-questioning/self-testing	Generating questions and answering them; testing one's comprehension and/or knowledge using notes or underlining.
Reading tactics	
Reading only	Reading at an average rate. No adjustment of reading rate to different types of information in the text is indicated.
Skimming	A very fast type of reading. May involve reading only for the gist or searching for the main point, creating an advanced organizer, or moving very quickly over unimportant information.
Reading slowly	Slowing down reading rate for particular types of information, often for better concentration.
Rereading selected portions of the text	Regressing to an earlier point in the text.

tics. These derived scores were used in all subsequent analyses of verbal report data.

Recall scores. Four trained scorers evaluated the responses to the recall test. They assigned 0 points for an incorrect answer or no answer, 1 point for a partially correct answer, and 2 points for a complete and correct answer. Agreement between scorers for a subset of the tests was .96. Any differences in scoring were settled by discussion between the four scorers. Responses to questions about important information were scored separately from responses to questions about unimportant information. The result was two recall scores for each subject, each having a maximum score of 32 points.

Results

We will describe first the cluster analysis, discriminant analyses, and subsequent orthogonal contrasts. Next, we will describe prototypes of each cluster in order to profile its characteristic attributes. Finally, we will examine the performance of students in each cluster on the recall test.

Cluster analysis and discriminant analyses

The three sets of derived scores for diversity, consistency, and purposefulness were entered into a *K*-means cluster analysis using BMDP computer software (PKM subroutine; Dixon, 1985). Solutions were fitted using unstandardized Euclidean distances (i.e., the geometric distance from each observation to the center of the cluster it belonged in); all scores were measured along the same mathematical scale (cf. Romesburg, 1984). Solutions were not calculated from seed points because no a priori assumptions were made concerning the number of clusters or their magnitude. In the first step of this process, the original sample was split into two clusters that were maximally dissimilar. In each of a series of additional steps, the sample was split again, and each case was moved to the cluster whose center it most resembled. The number of iterations required to partition the sample generally increased as the number of clusters specified in the solution increased. Once this process was complete, it was assumed that observations in any one cluster were more typical of that cluster than of any other.

The computer-generated solutions ranged from three to eight clusters. To select one of those solutions, we evaluated the ratio of the mean between-cluster distance to the mean within-cluster distance for each solution. This ratio resembles the judgment criterion used in the standard analysis of variance. The mean between-cluster distance for an *n*-cluster solution consists of the mean weighted distance across all $n(n - 1)/2$ pairs; for the six-cluster solution, the value obtained was 5.645. The mean within-cluster distance for an *n*-cluster solution was calculated by finding the grand mean of *n* separate weighted means; its value was 2.886 in the six-cluster solution. The ratio of those two distances was largest in the six-cluster solution ($5.645/2.886 = 1.955$). The six-cluster solution required eight iterations, which formed non-overlapping clusters of 6, 7, 15, 7, 11, and 21 cases. Cluster means for each of the diversity, consistency, and purposefulness scores over all three sets appear in Table 2. Mean distances between each of the six clusters can be found in Table 3.

Table 2 Mean scores for each cluster on diversity (D), consistency (C), and purposefulness (P) by study tactic category

		Text-noting tactics			Mental-learning tactics			Reading tactics		
Cluster	*n*	D	C	P	D	C	P	D	C	P
1	6	3.50	1.66	2.00	2.50	1.00	0.33	2.66	0.50	1.66
2	7	2.42	1.71	2.28	2.57	0.85	0.14	0.28	0.00	0.14
3	15	1.13	0.80	0.53	2.06	0.86	0.06	1.86	0. 60	0.86
4	7	2.14	1.42	1.71	0.71	0.28	0.00	0.71	0.14	0.14
5	11	1.09	1.00	0.45	3.72	1.63	0.45	0.90	0.18	0.63
6	21	1.23	1.19	0.57	1.28	0.95	0.14	0.38	0.04	0.00

Note. Maximum score was 5 for text-noting tactics, 5 for mental-learning tactics, and 4 for reading tactics.

Table 3 Mean distances (nonstandardized Euclidean) between cluster centroids

Cluster	1	2	3	4	5	6
1	–					
2	3.087	–				
3	3.173	3.037	–			
4	3.471	2.118	2.653	–		
5	3.848	2.891	2.166	3.777	–	
6	4.135	2.514	2.012	1.764	2.701	–

Next, we performed a stepwise discriminant analysis of the six-cluster solution to determine which of the three dependent variables (diversity, consistency, or purposefulness) was the best predictor of cluster membership. For this analysis, we entered total scores for each variable summed across the text-noting, mental-learning, and reading categories. Diversity and purposefulness were found to be significant predictors of cluster membership at the $p < .001$ level of probability. Consistency did not reach statistical significance, $p < .10$. Diversity provided the best predictability, approximate $F(5, 61) = 28.49$, followed by purposefulness, approximate $F(10, 120) = 14.18$. These results indicate that the primary distinction between the six clusters was the diversity of study tactics used. The finding that purposefulness was a statistically significant predictor of cluster membership had not been anticipated, because students had not been asked to report their purpose for using a given study tactic.

We then conducted a series of orthogonal contrasts, a procedure in which we contrasted each cluster with all other clusters (using the 7M option of the BMDP program), to determine which variables were important in isolating each cluster from the remaining sample. Each predictor variable (diversity, consistency, and purposefulness) entered the equation in a stepwise fashion, as in an ordinary discriminant analysis. The "*F* to enter" value for each step indicated how well any one variable predicted membership in a single cluster. Tests of statistical significance were made on "*F* to remove" values, which reflected the importance of each variable after adjusting for all other variables (Tabachnick & Fidell, 1983). Alpha was set at $p < .001$ in order to control for the number of variables used in each of the five orthogonal contrasts. The entry order of each variable in the discriminant equation and its statistical significance are presented in Table 4. Diversity was a significant predictor of cluster membership for Clusters 1, 4, and 5. In addition, purposefulness discriminated Cluster 1 from the other clusters.

Characteristics of the clusters

We next examined each cluster to determine its characteristic attributes, or distinctive features. We then identified prototypes of the attributes that were most representative of the cluster and least representative of other clusters (Rosch, 1978). To identify the attributes that distinguished each cluster, we copied the verbal reports of all its members onto a matrix, which was similar to the one used in the quantitative analyses. We then selected the verbal reports that represented the prototypes, or clearest cases, of each attribute. All decisions were made by all three authors in conference, with disputes settled by discussion.

In this section, we will first discuss the overall use of various tactics by all of the members of each cluster. Next, we will present the prototypical verbal reports we selected to exemplify the attributes of that cluster. We start

Table 4 Order of entry in orthogonal contrasts and statistical significance of each variable as a predictor of cluster membership

Variable	1	2	3	4	5	6
Diversity	1*	3	3	1*	2	1*
Purposeful	2*	1	1	3	1	3
Consistency	3	2	2	2	3	2

$p < .001$.

with Cluster 1 because its characteristic attributes are closest to the features of Pressley, Borkowski, and Schneider's (1987) model of the Good Strategy User. The other clusters are presented in order of their increasing geometric distance from Cluster 1. Tables 5, 6, and 7 present an overview of how frequently subjects in each of the six clusters used specific tactics.

Cluster 1: The Good Strategy User. The students in Cluster 1 surpassed all of the other subjects in this study in their tendency to use a diversity of tactics and their tendency to state their purpose for using each tactic (see Table 2); thus, the attributes of Cluster 1 best fit the model of a Good Strategy User (Pressley, Borkowski, & Schneider, 1987). The Good Strategy Users showed the greatest use of text-noting tactics: Each member of this cluster underlined or highlighted the text in some way and copied information verbatim, either in the margins or on note cards. Other text-noting tactics employed by many of the Good Strategy Users included paraphrasing parts of the text, developing informal outlines, and constructing diagrams. Reading tactics were also used heavily by these students: Each Good Strategy User occasionally reread sections of the text, and most skimmed the text at some times and read slowly at other times. Most Good Strategy Users used the mental-learning tactic of mental integration, and at least one third of this group reported using any given one of the other mental-learning tactics. Flexibility was also a characteristic of the Good Strategy Users: These students used text-noting and mental-learning tactics consistently less than half the time. They were even more flexible in their use of reading tactics (Table 2).

The following examples reveal the complexity, flexibility, and purposefulness with which the typical Good Strategy User applied a variety of reading and study tactics. As she read, one subject searched for the text's structure and thought of questions that might be on the recall test. She underlined or circled information (usually definitions, names, and relations between ideas) when she thought that it might be on the test.

> I stopped and read it very, very slowly and then tried to develop what I thought was the meaning. Then I wrote it down as a question and looked for the answer. I underlined the first half, which was already explained in prior sections. Then I circled the second part of it because that was the point they were going after—the main topic. That's what I think they're going to discuss next. Then I wrote down examples that support the main idea here and circled it once again. (#54)

This subject believed that discovering the structure helped her remember the material better. She tried to capture that structure in her mind, in informal outlines, in diagrams, and in summary notes.

> My approach is changing. I think the text is getting a little easier to read. I was thinking, hey, this all fits together. I'm looking for topic sentences—for structure indicators. I should have used them earlier. I can see the topic in this section and supporting information, which are good examples. Then another topic sentence, which supports the first one.... But the structure so far wouldn't mean anything unless I went

Table 5 Percentage of subjects in each cluster who reported using tactic at least once: Text-noting tactics

Cluster	*n*	Highlighting/ underlining	Verbatim copying	Paraphrasing	Outlining	Diagramming
1	6	100	100	66	33	50
2	7	100	100	14	14	0
3	15	67	40	7	0	0
4	7	100	100	14	0	0
5	11	64	45	9	9	0
6	21	95	14	5	0	0

Table 6 Percentage of subjects in each cluster who reported using tactic at least once: Mental-learning tactics

Cluster	*n*	Rote learning	Mental integration	Relating to background knowledge	Imaging/ visualizing	Self-question/ self-testing
1	6	50	83	33	33	33
2	7	57	86	43	29	29
3	15	80	67	13	7	33
4	7	14	0	0	29	33
5	11	82	100	64	64	55
6	21	86	33	5	5	0

Table 7 Percentage of subjects in each cluster who reported using tactic at least once: Reading tactics

Cluster	*n*	Reading only	Reading slowly	Rereading	Skimming
1	6	17	83	100	83
2	7	0	0	29	0
3	15	0	53	80	47
4	7	0	14	57	0
5	11	9	18	45	27
6	21	0	0	29	10

> back and envisioned it—I'm trying to picture the structure in my head. I circle what I think is a main idea. Then I underline supporting details. Here I numbered them—1, 2, 3, 4 reasons or causes.... In this section, I drew lines between the relationships to connect them together. For example, this says that tidal friction is gradually slowing down the rotation of the earth. Well, that's a cause-and-effect relationship. Then on the next page, it said that tidal friction will be exerting a second effect. So, when it said a second effect, I realized that was an important thing. The author was listing something. That was the thing that clued me into coming back and making sure I had that as an arrow.... In this section I did a lot of note-taking in the margins. I summarized points, both main and supporting. Had it been written very clearly and concisely, I would have underlined it. But, because it was expressed in quite a few sentences and with a lot of examples, I summarized instead of underlining. (#54)

In contrast to the subject above, who decided what was important and constructed the relations between ideas while she read, another typical Good Strategy User read through a section once, then reviewed it to identify important information, and finally processed that information further.

> I read through a section quickly. I try to figure out why it was put there and then I'll go back and underline as few words as possible that would describe the whole section. Then after each section I go back and read through everything I've highlighted up to this point. I write down the main ideas on 3 × 5 cards to consolidate it so that it's easier to study. Then I recite everything when it gets time to review it more. I go back and just read it over again, looking at the key words and trying to remember the definitions for them. (#31)

Many of the Good Strategy Users said that review was an efficient process because they used a complex text-marking system. One student described such a system as follows:

> When I have to review for a test, I will go back and look at my own underlinings and marginal notes. It's a fairly quick process and I feel I can remember what is most important to remember that way. Usually, when I go back and review, I find that these two types of markings form a kind of coherency in and of themselves—a whole chain of thought, which gives me what I need to have. I feel quite lost, usually, if I'm borrowing a book or an article from someone else and I don't dare put any markings in. I feel less confident in what I can remember. (#15)

Cluster 2: The Information Organizer. Because the students in Cluster 2 sought the main ideas of the text, marked details to be remembered or made notes of them, and then summarized those main ideas in writing, we have labeled the typical student in this cluster as the Information Organizer. These students were similar to the Good Strategy Users in that they used a large number of text-noting tactics and mental-learning tactics; however, they rarely mentioned using reading tactics. The Information Organizers relied heavily upon the text-noting tactics of underlining/highlighting and verbatim copying. Their primary mental-learning tactics were mental integration, rote learning, and relating information to background knowledge. On the rare occasion that they mentioned a reading tactic, it was rereading. The Information Organizers used text-noting tactics more consistently than they used mental-learning tactics, and they stated a reason more frequently for using text-noting tactics than for using mental-learning tactics.

In addition to engaging in the easily observable processes of marking text and taking notes, the Information Organizers reported interacting with the text mentally, in ways that facilitate integration. The following excerpts describe the process by which typical subjects isolated important information and then arranged it in terms of superordinate and subordinate concepts:

> I've been underlining just the main points. I just read through a section and whatever I think fits—is important—I underline. I go back and read through that which I underline, and try and picture in my mind what's happening. I repeat that a few times. I use my imagination a little so I can see what's happening.... This time, there

> were more specific places and, after kind of going over the generalities, I noted down those specific places. (#23)
>
> I just read sections and highlight, then take notes from my highlights, trying to summarize in my mind what it was saying. In my notes, I jot down the general meaning of the entire theme. Also, what I don't think I can remember, I write down. I jot down the facts and get the general story line from that. If I write it down, I generally remember it better than if I just read it. Then, right before the test, I can skim the main ideas. (#38)

The following example further illustrates how dynamically some of these studiers interacted with the text. This typical Information Organizer arranged information hierarchically by means of a complex system of highlighting and notetaking:

> I underlined with the highlighters. I used two colors. I wanted to give one color more importance than the other. It would mean more to me later. I used yellow for the general information to remember. I used the pink for backup definitions—where it seems to explain what the yellow just said—what wasn't as important, probably, in the long run. Then I used some of these cards here to list the answers to probable questions, the key definitions, and things like that. What I have underlined seem to be the key words or phrases of a sentence. If I had just the stuff I've highlighted on a piece of paper and you were to go back and just read what I've highlighted, I would hope that you would be able to get what everything is saying. If you wanted more information, you can go read it in more detail.... On the next page I also have some in green. It says that it will take more time for the earth to turn or the moon to go around the earth. It's all new to me and I was thinking, "no way." I don't believe it. It's like I'm learning something that I find more interesting or more debatable. Now it's something that seems to affect me. (#9)

Cluster 3: The Flexible Reader. Each student in this cluster placed a heavy emphasis on reading tactics in his or her verbal reports. This emphasis was due mainly to the fact that members of Cluster 3 used relatively few text-noting and mental-learning tactics. The reports of these students showed that they used a variety of reading tactics throughout the course of their reading and with a high degree of purposefulness; these students also mentioned changing their reading tactics in response to changes in their understanding of the text. Therefore, the label of *Flexible Reader* fits the typical student in Cluster 3 well.

The favorite reading tactic of these students was rereading, but many of them also adjusted their reading rate, slowing down for certain portions of the text and skimming other portions. The mental-learning tactic most commonly selected by the Flexible Readers was rote learning. Some of the Flexible Readers also employed mental integration and self-questioning. They tended to use only one text-noting tactic (either underlining/highlighting or verbatim copying), and used that tactic consistently.

The following transcript of a Flexible Reader's verbal report reveals the use of a combination of reading tactics that was typical of the members of this cluster:

> I skim through the reading, and then I go back and reread it more slowly, searching for important points that stand out and highlighting those. Then I read it through again.... I read it a couple of times, and when I come across a point that I think is important, I slow down and study that information and reread it a couple of times. (#47)

A number of Flexible Readers also skimmed those sections of the text that did not require careful study. At other times, these studiers read and reread difficult sections carefully and used text-noting and mental-learning tactics selectively. Both reading tactics are illustrated below:

> I skipped a whole bunch of examples of how the different topography would affect the tides. I'm not a good example person. I try to get the [general] idea as opposed to the specific, unless I know that the instructor likes that. (#29)
>
> What I found in reading this is that I'm getting more familiar with the subject matter. It's getting a little easier to understand. Therefore, I can read a little faster. There's an accumulation

> of knowledge that's starting to build up.... In this section, I found the material a little bit more difficult. I did read one whole page and then I found I had to go back and try to gather a little bit more information so I can connect it all together. (#52)

Finally, many of the Flexible Readers read slowly or regressed as soon as they realized that they were having difficulty understanding the information. That technique was generally profitable, but these studiers occasionally found it necessary to get more context by continued reading. These tactics are apparent in the following excerpts from verbal reports:

> I couldn't figure out what a node was, so I had to read over that a couple of times before I felt kind of comfortable with whether or not I understood it. (#32)

> I thought I had misunderstood something. I guess I should have kept on reading, but I went back and tried to figure it out. If I had just kept on reading, which I didn't, I would have found out [that] what I thought was happening, did happen. But I panicked, and thought I misunderstood. (#6)

Cluster 4: The Text Noter. The students in Cluster 4 were very consistent in their use of text-noting tactics, and expressed a purposeful use of those tactics. Every studier in Cluster 4 underlined or highlighted the text and took verbatim notes. We have labeled these students Text Noters because they relied almost exclusively upon text-noting tactics as they studied. The Text Noters seldom reported using mental-learning tactics or reading tactics: No single mental-learning tactic was characteristic of these students, and the only reading tactic used by more than one member of this cluster was rereading.

The Text Noters tended to underline key words as a way to focus their attention and to develop an overview of the major propositions in the text. They also tended to take notes on information they wanted to remember. However, they shared those attributes with all of the other subjects. The feature that distinguished the Text Noters from other subjects in our study was their inclination to postpone reviewing their underlinings or notes until after they had finished reading the text. The other subjects typically reviewed their underlinings or notes as they read. The following excerpts show the tendency of the Text Noters not to interrupt the first reading with review:

> First of all, I use a pencil and I underline words or phrases that I think are the important parts. This helps focus my attention on what I'm reading. I write notes in the margin of new words that I don't know or points that I think are important and that I have to remember. Writing in the margin is basically for me to review later on. When I get ready to take a test, I go through and read the margin notes. I basically have most of the information I need. If it's not real clear in the margin, I go back and read the body of it. (#62)

> I'm underlining and taking notes in the margin. Usually paragraphs talk about key things. You just pick out one word or a little phrase that refers to the main point. Underlining the key words groups everything. I just kind of shortened it. When I go back, I don't have a whole bunch of underlined stuff. I have little key words that tell me what is in the paragraph.... This time I wrote a little bit of a definition for diurnal rhythm. For review, I would just go along and look at these words that I have written out to the side. Then see if I couldn't remember what it was. If I don't remember, I would go back and read the underlining. (#41)

Cluster 5: The Mental Integrator. Our label for Cluster 5 stems from the fact that these students used the greatest diversity of mental-learning tactics, which they relied on far more than on text-noting or reading tactics. Every Cluster 5 member used mental integration. As a group, the Mental Integrators used every other mental-learning tactic identified in this analysis, too. About half of these tactics were used consistently by the Mental Integrators; however, these students did not often spontaneously state a purpose for using mental tactics. The Mental Integrators used only a few text-noting tactics; in fact, some of them reported using no text-noting tactic whatsoever. Most of these students used either underlining/highlighting or copying as their sole text-noting tactic, and used that

tactic consistently. However, the Mental Integrators stated a purpose for using a text-noting tactic only about half the time. Most of these students employed one reading tactic (usually rereading), which they used flexibly and purposefully.

The Mental Integrators interacted with the text actively. Most described efforts to link sections of the text together into a whole. Below are several descriptions of this process:

> I guess I mentally picture the information. I have a mental model that I just apply this information to. I've always had a good memory. I rely on it. That's why I don't underline or mark anything. If it fits in, then it's going to stay in my memory. If it doesn't, it's useless information. It's like a model made out of Lego blocks. Each piece of information from the text put together is like a build-up of all these Legos. If it happens to fit because it is the same color or the right size, then it will fit in the model and stay there. Otherwise, you just chuck it out. So, I'm sticking blocks in my mental model. (#16)

> My usual strategy in studying is to read the material first for a brief overview—a pretty general idea of what the author is saying. I go through the whole thing on a first reading because I like to see how it fits and jives together. Then I go back and summarize it in my mind. I highlight and try to paraphrase it out loud when I study. I ask myself if I can list this, this, and this. Do I know what this means? So I study out loud, carrying on a discussion with myself. (#61)

Related to the process of linking parts of the text together to form a mental whole is the technique of self-questioning and self-checking. This process was employed frequently by the Mental Integrators. The following descriptions of how and why they asked themselves questions reveal a good deal of metacognitive awareness:

> I think I remember things better when there is a purpose for reading and studying. So I ask myself questions and then study what I need to remember about tides, or what they do, when they happen, where different things occur. Just a who, what, when, why question.... I'm thinking about the test that will follow and what kinds of questions will be asked. To be able to answer questions at the end, I need to know how tides work. If the questions aren't too specific, I'll be able to answer them. So, the information I'm gathering is to make a whole picture instead of just little bits of information that you can't remember because they don't tie in with anything. (#36)

> I really try to keep myself tuned into what I'm reading because sometimes my mind will wander. I make sure I focus right in on the text. I'll be aware. I go back and ask myself questions. I read a couple of sentences. Then I kind of quiz myself. What is this about? What am I reading? Could I reiterate this when I talk about it? (#27)

Also, Mental Integrators often used visualization as a way to form a mental whole, as in the following example:

> I tried to put in my mind visual pictures of tides rising, ebbing. Picturing the things that the author is saying about the strait, how the waters come together in the opposing forces of the different tides, what happens to the fish. Putting myself on the different beaches that they were talking about—trying to relate the ideas that they were talking about with personal experiences that I've had in order to make the ideas seem more realistic. (#12)

Finally, these students frequently related information in the text to their own background knowledge and prior experience.

> Mainly, background knowledge has helped me. I remember the differences in the tides because I lived in Panama. I understand the differences between the Pacific side and the Atlantic side of Panama. I went to beaches on both sides. I can use my background knowledge of what I remember about the tides. It helps me make a mental image of the contrasts. I can outline it and put it in linear form, so on the test I can jump from one side to the other. (#42)

> I think the most important thing to me is being able to connect it to something in my past. I had a physics class not long ago. We were talking about the pull of the moon on the tides, the tidal friction causing the moon to recede, and stuff like that. I could attach meaning to this so it was easier to understand. Therefore, it was more interesting. If it is interesting to me, I automatically remember it. (#57)

Cluster 6: The Memorizer. The largest cluster of students in this analysis, which comprised nearly one-third of the sample, was also the farthest from the Good Strategy User in its characteristics. Our label for this cluster was inspired by the observation that most of these students consistently relied upon a single text-noting tactic (almost always underlining/highlighting) and one mental-learning tactic (usually rote learning). Some Memorizers used mental integration, and only a few of them copied information in the margins or on note cards. The Memorizers ranked last among all clusters in frequency of using reading tactics.

The Memorizers did not seem to interact with the text as actively as studiers in the other clusters. Instead, they confined their study behavior to underlining/highlighting and reviewing. They frequently mentioned focusing their attention on factual material and on the text's major propositions. Furthermore, the rationale by which they determined importance was not stated clearly, as shown by the following excerpt:

> I'm just basically reading it, picking out anything that seems to stick out as a fact, as a cold, hard fact. And, you know, the major points and topics—anything that sounds important. If anything really sticks out, I go back and pick it up with the highlighter. Then I recite back the facts that I've highlighted. I get the gist of the reading through the highlighted facts (#64).

Usually, the Memorizers' stated purpose for underlining/highlighting was review. Two such students described a review process that involved concentrating attention on particular words in an attempt to get the overall picture (#57), or on memorizing facts and figures, including the spelling of key words (#26). The reports of other Memorizers described similar techniques for review:

> I look back and notice the key words in the statements. I just review each one a couple of times or just think about it for a second in my mind. I try to make a mental note of what it is so I can remember it. If I kind of have the general idea, then I just figure that's close enough. (#25)

> I go back over what I've underlined and try and remember. I close my eyes and say it over in my head a few times—usually just terms, key words. If it's not real easy to remember, if it's fairly complicated, it takes more effort. Then I mentally repeat it to myself a couple more times. (#4)

Mnemonic devices helped other Memorizers, such as the one below, to remember information from the text:

> I generally use a mnemonic device, relating a word to something that I know—to link it to other things, or words, or places, or people. I'll give you an example: *Charybdis.* I took the first part of it—*Char*—and memorized that. I thought I could just remember the last part of it if I remembered the first part. (#13)

However, some students found that the technique of memorizing factual material was neither efficient nor effective in a text this long. That problem is illustrated in the following excerpt:

> I underline, then I go back and read over what I've marked. I'm trying to memorize. I review to try to tie it all together—mostly, just touching on the overall meaning. [*Eventually, however, she stopped underlining and just read.*] I thought that trying to memorize all these names would take a lot of time. I wouldn't be able to remember them. (#49)

Recall performance

Finally, we performed a 6 × 2 repeated-measures analysis of variance with cluster membership (1 through 6) and importance of information (high or low) as independent variables and the number of correct answers on the recall test as the dependent variable. We found that the only statistically significant main effect was for level of importance, $F(1, 61) = 189.68$, $p < .001$: Each cluster recalled more important than unimportant information. Although no other effects reached significance, the trend was for Cluster 1, the Good Strategy Users, to recall more information. The means and standard deviations associated with each cluster can be found in Table 8.

Table 8 Means and standard deviations for recall scores of students in each cluster

Cluster	1	2	3	4	5	6
Important text						
M	24.00	20.40	21.36	19.57	19.24	20.71
SD	5.14	5.85	4.70	7.96	4.79	4.61
Unimportant text						
M	15.83	13.73	15.09	11.86	14.14	13.57
SD	7.41	6.34	4.32	6.04	5.11	2.15

Note. Maximum recall score was 32 for each level of importance.

Discussion

The purpose of this study was to address two major issues in the area of learning strategies: the need to conceptualize the notion of a strategy and the need to investigate the relationship between strategy use and performance outcomes (Schneider, 1985). To address the first issue, we analyzed verbal report data provided by college students during the study process to determine whether one or more distinct study strategies exist, to describe them in detail, and to compare these empirical results to the theoretical constructs that have been developed by others in the field. To address the second issue, we investigated whether membership in any one strategy cluster was significantly related to recall performance.

We found that different strategies do exist, each reflecting different ways of studying the same text under identical conditions. The resulting taxonomy provided a framework for qualitative analyses to identify prototypes of the attributes that are most distinctive of each strategy and differentiate it from the remaining strategies. These qualitative analyses provided rich descriptions of how, why, and under what conditions studiers in each cluster use various tactics.

One of the clusters we identified validates Pressley, Borkowski and Schneider's (1987) model of the Good Strategy User. Students of this type use a wide variety of tactics in a purposeful way, and adjust their tactics to accommodate changes in their interaction with the text. However, we also identified five other types of strategy users, each of which looks different from the Good Strategy User. The characteristics that differentiated these clusters from each other were degree of diversity in the use of study tactics and the inclination to state a purpose for using a given tactic at a given time. The consistency with which a student used any given tactic was not a significant predictor of that student's cluster membership. We also found no relation between cluster membership and short-term recall of information presented in a text. This finding is consistent with other studies that have found no relation between use of a particular study tactic and learning outcomes (e.g., Fowler & Barker, 1974; Hoon, 1974; Howe & Singer, 1975; Idstein & Jenkins, 1972; Stordahl & Christensen, 1956; Todd & Kessler, 1971; Wade & Trathen, 1989). Thus, at least for college students, a number of strategies might be equally effective for the immediate recall of information from a new and relatively difficult text.

This taxonomy of study strategies provides empirical support for current definitions and examples of strategic learning. Our data extend the theoretical construct of strategy by illustrating different ways in which it can be manifested. However, we caution teachers not to classify students by this taxonomy nor to attempt to change students' strategies to conform to any of those in the taxonomy. At least for skilled readers, the issue might be how well they use any given strategy to learn text information, not the particular strategy they use.

Thus, rather than requiring students to use any particular study tactic, teachers should encourage students to consider the kinds of learning strategies available, the reasons these strategies are useful, and how to employ each strategy most effectively.

Several methodological factors limit the generalizability of the findings of this study. First, the students' own reports were considered to be the only viable means of data collection. These reports were found to be reliable when compared to the artifacts of studying; however, although valuable in acquiring information about complex phenomena such as studying, verbal reports only provide measures of conscious, statable knowledge of cognitive processes. Unconscious, automatic processes, especially those involved in the monitoring and control of cognition, remain hidden.

Moreover, verbal reports can change the course and structure of the cognitive processes being investigated. They can also affect subsequent recall performance. However, the specific procedure used in this study (i.e., asking nonleading questions to encourage students to verbalize information that is easily encoded in a verbal form) should produce little interference (Ericsson & Simon, 1980). This sort of periodic questioning and verbal reporting appear to reinforce strategies that students have already adopted rather than causing students to alter their strategies or to select new ones (Wade & Trathen, 1989).

The type of text and task used in our study and the experimental nature of the learning situation might also limit the generalizability of our findings. The technical, expository nature of the text and our use of an immediate, short-answer recall test might have affected the recall results. Both of these factors encourage short-term memorization. Even though we did not find performance differences between clusters, such differences might arise under different learning and testing situations. For example, members of different clusters might have different degrees of success on a test of information obtained from a variety of texts over a lengthy period of time. Under such testing conditions, the observed trend for Good Strategy Users to recall more information might become a statistically significant difference between the clusters.

We wish to emphasize the exploratory nature of this study. It represents only the beginning of an extended line of research into study strategies. The result of this study is a data-based taxonomy of various strategies that appear to be equally effective when used by a particular group of college students under specific task conditions. However, given different populations and different task demands, we cannot assume that similar strategies would be found, nor can we assume that any strategies found would be equally effective.

Researchers have come to view studying as a complex phenomenon involving a number of cognitive processes that must be coordinated and monitored for effectiveness and efficiency. This study has investigated only a few of the variables that affect performance. As Schneider (1985) has pointed out, memory behavior and performance are affected by how and when subjects are assessed; by the subjects' age, memory capacity, and information-processing speed; by the length and difficulty of the text; and by the complexity of the task. In addition, some studiers may be superior to others in analyzing the task, selectively attending to relevant information, processing that information at a deep enough level to accomplish the criterion task, and monitoring their learning (Anderson & Armbruster, 1984; Reynolds & Shirey, 1988; Reynolds, Wade, Trathen, & Lapan, 1989). Therefore, a comprehensive research program investigating study strategies should use a variety of methods to examine the interaction of the many variables involved in the processing of text information. Such variables include the role of selective attention in learning different types of information for different task requirements and the ability to monitor cognitive processes and learning. These variables should be investigated for learners at various levels of ability and development.

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APPENDIX

Scoring criteria for purposefulness

Statements indicating that the reader is aware of his or her interaction with the text or the demands of the task; any reason spontaneously given for using a particular tactic.

1. Awareness of failure to comprehend or concentrate.
2. Awareness of when the information is coming in easily (e.g., "The material is more interesting, so I don't have to take as many notes").
3. Awareness of characteristics of the text (e.g., "too many facts to remember").
4. Awareness of one's strengths and weaknesses and the need to compensate for them (e.g., "I'm not a good example person," "I'm not good at physics," or "I'm not reading as carefully as I was").
5. Any verbalized intention that drives the use or selection of a study method; the reason a reader takes some particular action.