

PRIOR KNOWLEDGE AND ITS RELATIONSHIP TO COMPREHENSION

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A major concern among classroom teachers is that subject area textbooks are too difficult for students to comprehend. Criteria for making decisions about text difficulty are generally vague and often based on teachers' assumptions regarding student knowledge of the content and vocabulary contained in a specific text. This study develops a text specific prior knowledge measure which predicts the likelihood of a student's success in recalling the content of a reading passage.

In recent years, prior knowledge and its effect on recall of text has become the focus of a number of research studies. Some of the findings suggest that the graphic representations depicted on a page of print are only symbols and do not, in and of themselves, carry meaning. Rather, it is the reader's prior knowledge that leads to comprehension and recall of text (Adams and Collins, 1979). New ideas and information are learned and retained most efficiently when relevant and related ideas are already available within the reader's memory. Prior knowledge serves a subsuming role by furnishing "ideational anchorage" during new learning experiences (Ausubel, 1968).

A large body of research related to the organization of memory and how prior knowledge relates to comprehension and recall has been conducted. This has substantially increased our understanding of how reader/text interactions may facilitate or impede comprehension and/or recall. The organization and accessing of knowledge influences the manner in which the reader organizes the information provided by the author and the reader's organization, in turn, affects the quality of that knowledge in recall. Comprehending a text requires readers to relate the elements in the text to knowledge characterizations in their own memory structures. Information retrieval and the recall of text are affected by the manner in which prior knowledge has been organized in memory (Anderson, Pichert and Shirey, 1977; Anderson, Reynolds, Shallert, and Goetz, 1977).

The manner in which knowledge is structured facilitates the learning and remembering of information (Anderson, Spiro, and Anderson, 1978), and may provide a plan which helps readers to retrieve information (Pichert and Anderson, 1977). Pearson, Hansen and Gordon (1979) suggest that comprehension involves the integration of new information with existing schemata. If the schemata are weakly developed, comprehension is difficult. In a related study, Tannen (1979) found that anticipatory structures are based on past experience and that these

structures can be seen in the retelling of a passage. Further, the structures of expectation which support the processing and the comprehension of stories also serve to filter comprehension and influence recall. Anderson and Freebody (1979), in their review of the role of vocabulary knowledge in reading comprehension, conclude that word knowledge is a prerequisite for comprehension and suggest that the development of improved methods for assessing the breadth of vocabulary knowledge is needed.

This study investigates a prior knowledge measure (Langer, 1981 a, b, in press) which reflects the strength of organization of existing knowledge as it relates to key concepts and vocabulary contained in content area texts. The purpose is to elicit prior knowledge using written free associations to key concepts in the text, to categorize this knowledge into broad levels, and to statistically examine the nature of the relationships between the overall level of prior knowledge and the organization of recall. This study is based on the view that text specific concept and vocabulary knowledge affect the processing and recall of text and that a measure of this knowledge might assist teachers in determining whether a reader possesses adequate background to successfully comprehend and recall a particular text. (For a more comprehensive view of this framework see Langer, in press .)

METHOD

Subjects

The subjects for this investigation were 36 high school seniors from a middle class suburban school district on Long Island, New York. All were college bound students enrolled in an advanced placement course in English literature.

The 36 subjects were from two classrooms. Total IQ scores from the Cognitive Abilities Test, Form 3 were available for one class ($n = 20$). Separate verbal, quantitative, and nonverbal sub-scores were also available.

Two passages were chosen from those Meyer (1975) used in her work on the organization of prose and structure of recall. The passages dealt with schizophrenia and parakeets, and the with-signaling target paragraph high version of each was used (copies are available in Meyer, 1975). This was done to provide passages which were similarly organized for "readability." Each subject was tested with both passages.

Three key content words were selected for each free association task. Meyer's (1975) analysis of each passage was used to list the content words in the top half of the content hierarchy of each passage. Using this list, the judges selected the concept words each believed to represent the three most central ideas of each passage. The judges independently agreed on four concepts and selected the other two through negotiation. For the schizophrenia passage, the three concepts were: schizophrenia, ability to process information, and anti-S protein. For the parakeet passage they were: parakeet, breeder, and barb.

The subjects were told that they would be asked to free associate with stimulus content words selected from two passages they would later be asked to read and recall. After a practice session on an unrelated concept the subjects were given each content word separately and told "Write anything that comes to mind when you hear the word (or phrase) . . ." The free association stimulus was used to access from memory knowledge related to the content word.

After the three words for a passage had been given and all free associations elicited, the subjects read the passage silently and then were asked to write all they could remember about the passage. The same procedure was then followed for the second passage.

Analysis

Each free association response was categorized to indicate the level of prior knowledge it

reflected using a system developed by Langer (1980). Responses were scored from 3 (much prior knowledge) to 1 (little prior knowledge) using the following categories:

MUCH (3)

superordinate concepts—higher class category

e.g. schizophrenia—"one of a group of severe mental disorders..."

definitions—precise meaning

e.g. schizophrenia—"a psychotic disorder characterized by withdrawal from reality including behavioral disturbances"

analogies—substitution or comparison for a literal concept or expression

e.g. schizophrenia—"schizophrenia is a god-demon"

linking—connecting one concept with another

e.g. schizophrenia—"schizophrenia is like living in two worlds because..."

SOME (2)

examples—equal class, but more specific

e.g. schizophrenia—"split personality"

attributes—subordinate to larger concept

e.g. schizophrenia—"character disorder"

defining characteristics—defines a major aspect of the concept

e.g. schizophrenia—"withdrawal from reality"

LITTLE (1)

associations—peripheral cognitive links

e.g. schizophrenia—"Jekyll and Hyde"

morphemes—echoes smaller unit of meaning such as prefixes, suffixes or root words

e.g. schizophrenia—"schizoid"

sound alike—similar phonemic units

e.g. schizophrenia—"Lotte Lenya"

first hand experiences—peripheral responses based on recent exposure

e.g. schizophrenia—"crazy—like in the movies"

A fourth category entitled "no prior knowledge" had been included in the pilot study. When only 3 out of 216 recorded responses were assigned to this category, this was included as a sub-category of "little prior knowledge." When more than one response was given to a stimulus word, the highest response level was tabulated.

This was done because even one high response indicated that higher organized knowledge was available to that subject. The scores for responses to each passage's three stimulus content words were averaged. Actual prior knowledge score averages ranged from 2.67 to 1.00.

To score the recall protocols, Meyer's (1975) system was used. Recall of content words, lexical predicates, role relations and rhetorical predicates were separately scored. Meyer's hierarchy of idea units was listed on lined paper. When an idea was recalled in a protocol, it was located in the content hierarchy and that line was marked to indicate that the unit had been recalled. A unit was scored as present if either exact or paraphrased words appeared in the recall protocol. These units were scored as present whether or not that item was presented in the same relationship to other information as it appeared in the text.

The number of items included from the top, middle and lower third of Meyer's content hierarchy were separately computed. A weighted recall score was then compiled by scoring one point for the content words, lexical predicates and roles, and two points for the rhetorical predicates (which represented the superordinate structures). Finally, a total summed recall score was computed with each of the first four variables assigned one point.

Two judges (the principal researcher and a trained research assistant) scored the prior knowledge and recall items separately. They were not aware of each other's scores until the data were analyzed.

Interrater agreement revealed a relatively high percentage of agreement on the recall scores (.94) and somewhat lower on the levels of prior knowledge score (.82). In cases of disagreement, an average of the two scores was computed for the prior knowledge measure, and the decisions were negotiated for the recall analysis. A Pearson product moment correlation for all variables (level of prior knowledge, recall and IQ) was done on four separate sets of data; two passages each analyzed separately for classes with and without IQ measures.¹ The matrices for different passages for the same class differed while the matrices for the same passage from different classes were not different. As there were no apparent class differences, the remaining analyses were done with the two classes combined.

To determine the relationship between level of prior knowledge, the recall measures (excluding weighted and unweighted totals) and the IQ measures (see Tables 1 and 2) a varimax rotated principal components based factor analysis was performed for each passage. Factors having eigen values reflecting at least 10% of the explained variance were rotated.

TABLE 1
Principal Component Factor Loading Pattern
for Schizophrenia Passage

Variable	Component 1	Component 2	Component 3
Level of Prior Knowledge	.90	.12	.24
Verbal IQ	-.14	.89	.15
Quantitative IQ	-.15	-.70	-.19
Nonverbal IQ	-.10	.12	.74
Content Words	.94	.21	.05
Lexical Predicates	.54	.04	.68
Roles	.79	-.01	.44
Rhetorical Predicates	.86	.13	.04
Top 1/3 Responses	.57	.72	-.02
Middle 1/3 Responses	.75	-.51	-.04
Bottom 1/3 Responses	.46	.36	.69
Cumulative Portion of Variability	47%	68%	78%

To generate a single variable which could be used as a measure of recall a varimax rotated principal components based factor analysis was performed on the content word, lexical predicate, role and rhetorical predicate measures of the recall analysis. Lastly a set of Pearson product moment correlations was calculated for the IQ measures, the level of prior knowledge measure, the resulting factor scores of the recall measures, and the sum of the individual recall measures (see Table 3).

¹Tables of correlations available from the author on request.

TABLE 2
Principal Component Factor Loading Pattern
for Parakeet Passage

Variable	Component 1	Component 2	Component 3
Level of Prior Knowledge	.70	.16	.34
Verbal IQ	-.10	.88	.22
Quantitative IQ	-.14	-.80	.10
Nonverbal IQ	-.01	.30	.84
Content Words	.92	-.14	.29
Lexical Predicates	.84	-.23	-.03
Roles	.91	-.20	.22
Rhetorical Predicates	.79	.30	.07
Top 1/3 Responses	.76	.04	-.02
Middle 1/3 Responses	.81	.11	-.02
Bottom 1/3 Responses	.36	-.38	.74
Cumulative Portion of Variability	47%	64%	76%

RESULTS

The varimax rotated principal components based factor analysis on the levels of prior knowledge, IQ measures and recall measures for the 19 subjects with all scores available indicated that although slightly different patterns are observed in the two passages, the level of prior knowledge and the various measures of recall have major loadings in the first component for both passages while none of the IQ scores have major loadings in that component. It can be concluded that level of prior knowledge is related to the measures of recall.

When analyzing the scores from the recall tasks, only the first principal component met the criteria for rotation. Thus the rotations were not performed. In both passages, the four measures contribute approximately equally to the overall measure. In the schizophrenia passage, the one component accounted for 72% of the variability and the scoring coefficients (not presented) ranged from .28 to .31. In the Parakeet passage, the first component accounted for 79% of the variability with scoring coefficients between .25 and .30 (not presented). Loadings were $\geq .80$ for both passages.

The correlation between level of prior knowledge and the first principal component score of the four recall measures was .75 for the schizophrenia passage and .70 for the parakeet passage. The highest correlation with the principal component score and the IQ measures was .28 for the quantitative IQ measure on the schizophrenia passage and .13 for the nonverbal IQ measure on the parakeet passage. These results are presented in Table 3.

To further consider the relation between level of prior knowledge and total recall, partial correlation was determined for the three IQ measures. For the schizophrenia passage the correlation coefficient was .91 and the partial correlation was also .91; for the parakeet passage, the corresponding values were .39 and .41. This provided further evidence that level of prior knowledge is related to recall.

The IQ scores, for the subjects who took the Cognitive Abilities Test, indicate that the subjects fall in the upper half of the population. The mean for the verbal subtest was 121 with

TABLE 3

Correlations With First Principal Component of Text Passages
 (Above the Diagonal are for the Schizophrenia Passage,
 Below are for the Parakeet)

Level of Prior Knowledge (1)	Principal Component (2)	Total Recall Responses (3)	Verbal IQ (4)	Quantitative IQ (5)	Nonverbal IQ (6)
(1)	.75 $p < .001$ $n = 36$	.74 $p < .001$ $n = 36$	.03 $p < .88$ $n = 20$	-.13 $p < .58$ $n = 20$	.07 $p < .78$ $n = 19$
(2) .70 $p < .001$ $n = 36$		.99 $p < .001$ $n = 36$	.04 $p < .88$ $n = 20$	-.28 $p < .23$ $n = 20$	.15 $p < .53$ $n = 19$
(3) .54 $p < .001$ $n = 36$	.84 $p < .001$ $n = 36$		.03 $p < .89$ $n = 20$	-.31 $p < .19$ $n = 20$	.11 $p < .65$ $n = 19$
(4) .19 $p < .42$ $n = 20$	-.11 $p < .65$ $n = 20$	.02 $p < .93$ $n = 20$		-.41 $p < .07$ $n = 20$	.33 $p < .16$ $n = 19$
(5) -.05 $p < .84$ $n = 20$	-.05 $p < .83$ $n = 20$	-.20 $p < .40$ $n = 20$	-.41 $p < .07$ $n = 20$		-.19 $p < .43$ $n = 19$
(6) .21 $p < .38$ $n = 19$	.13 $p < .61$ $n = 19$	.13 $p < .60$ $n = 19$	.33 $p < .16$ $n = 19$	-.20 $p < .43$ $n = 19$	

scores ranging from 100 to 145, while the quantitative subtest scores produced a mean of 130 and ranged from 105 to 175. The mean on the nonverbal subtest was 124 and scores ranged from 95 to 150. Although these scores are restricted relative to the general population, the range of IQ scores is sufficiently broad to conclude that prior knowledge predicts recall independent of IQ at least within normal and above average IQ students.

DISCUSSION

The correlation between the prior knowledge scores for the two passages was .38. This low correlation between the prior knowledge scores indicates that the measure is passage dependent. In a prior study, Langer (1980) also found that the prior knowledge measure tended to be passage dependent.

Findings indicate that level of prior knowledge, as measured in this study, is strongly related to the recall of a passage as measured by Meyer's analysis of prose. This result is independent of the subject's IQ.

Although this relationship held even when effects of verbal, nonverbal, and quantitative IQ were partialled out, the full pattern of relationships among prior knowledge, recall, and IQ

varied between passages. It would be interesting, in future studies, to see if other statistical procedures applied to a larger sample yield the same results. If this is the case it would be important to determine what factors account for the relationships between prior knowledge, IQ, and recall.

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