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ABSTRACT

A study examined good and poor readers' inferencing strategies as they read unambiguous texts. Subjects, 42 fifth-grade students from 11 classrooms in a Boston metropolitan area urban school district, read 2 well-constructed mystery stories divided into 6 episodes--each episode ended with the introduction of a new clue related to solving the case. Subjects were asked general prompting questions at the end of each section. The verbal reports from each story were combined to form a protocol for each student. Protocols were examined to determine the type of inferencing strategies used. Results indicated that (1) children frequently engaged in a number of inferencing strategies; (2) good and poor readers appeared to use a similar repertoire of inferencing strategies; however, (3) poor readers appeared to accept unconventional interpretations of stories. Findings suggest that teachers may well be advised to emphasize a number of direct instructional activities which help students focus on textual materials rather than emphasizing strategy training. (Three tables of data are included; 24 references are attached.) (RS)

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Assessing Children's Inferencing Strategies

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Assessing Children's Inferencing Strategies

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It is widely accepted that the ability to draw inferences is critical for reading comprehension (Anderson & Pearson, 1984; Spiro, 1980). At the most general level, inferencing is a constructive thinking process, requiring the reader to elaborate upon the explicit information presented in a text. A large number of studies have demonstrated the integral role of inferencing in the comprehension of and memory for text (Bransford & Johnson, 1972; Goetz, 1977; Kintsch, 1986).

For many readers, however, inferential comprehension is more difficult than other comprehension processes (Hansen, 1981). Three explanations have been hypothesized to account for these difficulties. The first is that differences in prior knowledge may influence children's ability to make inferences. Pearson, Hansen and Gordon (1979), for example, found that children with greater prior knowledge on a topic were able to draw more inferences than those with weakly-developed schemata. Thus, deficiencies in prior knowledge may account for limited inferencing in certain situations.

Research by Paris and his colleagues offer a second explanation. They suggest that young children tend not to apply their inferential strategies thoroughly, unless specifically directed to do so (Paris & Upton, 1976; Paris & Lindauer, 1976). For example, seven-year old children failed to comprehend inferences spontaneously and could not use indirect cues to

access memory. Nevertheless, when these children were directly encouraged to dramatize the sentences, they could use both implicit and explicit cues equally well. These results suggest that while developmentally capable, young children may not naturally engage in strategies to "go beyond the text."

Evidence from classroom instructional practices suggests a third alternative. Studies report that students are not typically asked inferential questions in reading (Hansen & Pearson, 1983). Further, teachers tend to teach their good and poor readers differently (Allington, 1983) resulting in poor readers receiving even less instruction in inferential thinking than good readers.

Most of these studies, however, have examined inferencing at the point of retrieval or when an investigator imposes a task upon readers demanding such reasoning. These types of inferences may not be made routinely during the ongoing comprehension process. Further, as Frederiksen (1975) and Kintsch (1974) argue, inferencing may occur at the point when incoming data is encoded into memory. This suggests that studies measuring inferences at retrieval only may underestimate those that are made during the comprehension process itself.

The present study, designed to measure children's inferences, differs from those previously cited in several specific features. First, it examined inferencing strategies using a verbal recall technique as children are comprehending text. Second, unambiguous texts (two short mystery stories) were

used. It was reasoned that well-constructed mystery stories might enhance ecological validity by naturally encouraging children to predict and infer from text without direct probing. Third, good and poor readers were selected to analyze if differences occur in inferencing strategies. Fourth, the inferences strategies examined emerged from the subjects' reading of these texts, rather than a predetermined set of categories.

With these considerations in mind, this study was designed to address the following questions: 1) Do young readers generate inferences as they read stories?; 2) Which types of inferencing strategies do readers make during comprehension?; 3) Do low and high-proficiency students employ similar inferencing strategies?; and, 4) Are there differences in children's ability to successfully apply inferencing strategies?

Access to these comprehension strategies among adults and older children have been obtained in many cases through variations of verbal reporting techniques. Collins, Brown and Larkin (1980), for example, elicited verbal reports of skilled adult readers' thinking processes as they interpreted text. This technique, however, has not been regarded as most appropriate for young or poor readers who may be less able to introspect about their cognitive knowledge (Brown, 1980). Introducing a modification of verbal reporting, Phillips (1988) used a limited-probe-when-necessary technique, where clarification questions were used after students read bri episodes of text. This approach helped to increase the completeness of reporting as well

as to minimize the interval between processing and retrospection considered to be essential in obtaining reports of cognitive activity. Further, her approach combined aspects of retelling and verbal reporting. Students were first given opportunities to tell all they wished about a particular episode without probing; then, if or when necessary, clarification questions were asked. Norris (in press), in a validation study, found that these verbal reports did not alter subjects' comprehension processes or performance. Consequently, a similar approach was adopted in this study.

METHOD

Subjects

The subjects were 42 fifth-grade students from 11 classrooms in an urban school district in the Boston metropolitan area. All student selected in the sample spoke English as their first language. None were identified as learning disabled. High achieving students, defined as those who scored above the 85th percentile on the Metropolitan Achievement Test (X= 90.81, S.D.=4.37), and low achieving students, those who scored below the 50th percentile (X=32.67, S.D.=8.85), were selected from each classroom.

Materials

Two stories were selected from the Bloodhound Gang mystery series to examine children's inferences: "The One-Ton Jewel," involving a mystery about a "white dwarf," a jewel supposedly from outer space that was to be auctioned for a great deal of

money, and "The Blob," a story of a stolen ice sculpture. The stories were well-structured, involving female and male characters appropriate to the children's age and interest level. "The Blob" included 931 words, and "The One-Ton Jewel," 1,294 words. Both stories were written at the fourth grade reading level according to the Fry Readability Formula.

Stories were each divided into six episodes; each ended with the introduction of a new clue related to solving the case. Colored pieces of paper were inserted in booklets containing each story to indicate the end of an episode.

General prompting questions were created to be used if or when a clarification of children's inferences was required. For example:

1) Did you find any clues in your reading?

2) What do you think will happen next? Why do you think so?

3) Does this give you any ideas?

Procedure

Students met individually with the researcher or one of two graduate research assistants in reading and language in a private room for one session of approximately 30-50 minutes. Using a sample protocol, the researcher described the verbal reporting procedures, emphasizing the open-endedness of the activity and assuring them that no corrections or grades would be given for their responses.

Following this introduction, each student was asked to read an episode of a story and immediately report on what they were

thinking about. Story selection for both groups was counterbalanced. Students were told to feel free to request the pronunciation of any unfamiliar word, and to read at their own pace. After each episode, the researcher asked each student what came to mind while reading the story, using the clarification questions only when the student was not clear or when he/she appeared to be hesitant to make inferences. In all, students were asked to verbally report on six episodes in each story for a total of 12 times. These sessions were audiotaped and later transcribed verbatim.

Data analysis

Verbal reports from each story were combined to form a protocol for each student. Each protocol was divided into idea units, defined as a proposition containing at least one relational concept and one argument. Two judges examined a sample of 10 protocols to determine whether it represented a recall idea unit, one that was stated directly from the story, or an inference level idea unit, one that might be suggested but not stated in the text. Percent of agreement between judges was 98%. The average frequency of recall and inference idea units was 36% and 64%, respectively.

Protocols were then examined by three judges to determine which types of inferencing strategies children used in comprehending the stories. The term strategy was defined here as a plan or technique used by readers for interpreting materials. Similar to Phillips' research (1988), it was considered

independent of the correctness of the actual interpretation.

From extensive discussions and analysis of the protocols, a typology was developed following Trabasso's basic distinction of two types of inferences: text-based and slot-filling (1980). Text-based inferences are those in which the individual finds semantic or logical relations between propositions expressed in a story. Slot-filling are those in which the individual fills in missing information to make connections between events discussed in a text. A third category, referring to miscellaneous strategies including reiterating and refraining from inferencing were also added. Eight strategies in all were identified.

It was also clear that students, on occasion, attempted a particular inference strategy, but misconstrued information. For example, in trying to bind together different propositions, the child might draw an incorrect conclusion, such as "That means that the guy is ruining space or something." Therefore, aside from categorizing the protocols for each of the 42 students according to the inference strategies attempted and the frequency of their use, an error rate was obtained, indicating the ratio of implausible inferences over attempts.

Two of these judges then independently coded 10 protocols; interrater reliability on the identification of strategies used was 85%. After establishing the reliability of the coding system, each inference idea unit in all protocols was classified by strategy.

RESULTS AND DISCUSSION

Two sets of analyses will be described in the following section. The first set addresses the types of inferencing strategies children use while reading stories, and analyzes whether there are differences between strategy use on the basis children's reading proficiency levels. The second set of analyses examines differences in the successful application of these strategies and qualitatively analyzes the types of errors that occurred when reading.

Types and frequency of inferencing strategy

Eight inference strategies were used by the fifth graders in this study to interpret stories. Table 1 lists each strategy and gives a typical example from the children's responses.

Insert Table 1 about here

Three types of inferences appeared to be text-based strategies. The first type, binding, referred to an attempt by the child to draw conclusions on the basis of a number of stated facts. The logic followed something like, "if "x" were there, and "y" were there, then they both must have been involved in the crime together." The second type, rebinding, similar to the strategy defined by Collins, Brown and Larkin (1980) and Phillips (1988), appeared when new information apparently led to a conflict in the student's understanding of the story. Here, the reader was forced to either adjust new information to fit the

past interpretation, or readjust their previous understanding with the new data. The third strategy, confirming, occurred when a new fact was used to explain a prior interpretation. This type of inferencing appeared to model the process of instantiating slots within a selected schema (Anderson & Pearson, 1984) as students attempted to provide a coherent overall representation of the story.

Three types of slot-filling inferences were identified. Assigning default values occurred in the absence of any specifically substantiating information in the text. In this type of strategy, students constructed hypotheses about the events of the story based on their background information, and/or their knowledge of story structure. For example, one student assumed that the "white dwarf", which was supposedly a dead star from outer space, was actually a "dead rock and roll singer" from the band "White Dwarf." The second type, empathizing, involved a personal response from the reader. Here, children seemed to emotionally place themselves in the story, attributing feelings to the characters on the basis of their own beliefs and responses. Proposing solutions, the third slot-filling strategy, referred to attempts by students to invent new solutions not related to any information presented thus far in the text.

Children also used two other strategies in interpreting stories. The first was simply reiterating a previously made inference without adding any new explanation or interpretation. And the final strategy included refraining from responding, by

saying "I'm not sure," or "I don't know." Though reflecting a lack of knowledge, this strategy appeared at times to express children's tolerance for ambiguity or ability to remain open to multiple interpretations.

The average frequency of strategies used and standard deviations across the two groups are reported in Table 2.

Insert Table 2 about here

Clearly the slot-filling strategy of assigning default values was employed most often, accounting for approximately half of all reported inferences among subjects. Others strategies used frequently were text-based, including binding story elements together and confirming prior interpretations with new information. Perhaps due to the nature of the task, there was little evidence of rebinding or empathizing with characters or character actions among any of the groups. Reiterating and refraining strategies were used with relative frequency, indicating a lack of knowledge or an unwillingness for various reasons to draw inferences.

To examine differences in strategy uses among high and low readers, a multivariate analysis of variance (MANOVA) was performed with the frequencies of the uses of the eight strategies as dependent variables. No significant differences were reported between groups ($F = (1, 40) =$ Wilks Lambda, 1.25, $p < .30$). These results suggest that similar strategies appear

to be used by both good and poor readers when constructing meaning from text.

Examining children's errors

Though employing similar strategies, an analysis of the mean frequencies of errors indicated striking differences in their successful application between good and poor readers. With an average of over 18 errors per protocol, poor readers clearly misconstrued information on a more frequent basis than good readers. A one-way analysis of variance indicated that these differences were statistically significant ($F = (1, 40) = 25.53$, $p < .001$).

These errors were qualitatively analyzed to examine the nature of these difficulties. Three categories of difficulties appeared to account for students' incorrect responses:

1) Over-reliance on background knowledge: A reliance on intuition or prior knowledge of an idea or character trait in the face of conflicting textual information. For example, one student, considering that a "Blob" must be worthless, did not understand that it was actually the name of a precious ice sculpture in the story.

2) Over-reliance on short-term memory: A focus on decoding specific facts or words in a story while ignoring the relations or meanings among these facts. For example, a student reported, "There's like a bloodhound, its made out of ice from the Colorado River," remembering individual facts, yet not in a meaningful fashion.

3) Inability to impose order on text. Poorly organized incoming textual information led to erroneous conclusions. For example, one student reported that Vickie, actually the heroine of the story, would probably go to jail "for giving the guy a fake thing."

Interrater reliability, established for error categorization, was .89. Once reliability was established, judges independently coded a total of 554 inferencing errors. Table 3 describes the number and percentage of errors by category for good and poor readers.

Insert Table 3 about here

Over-reliance on background information to the detriment of considering all the textual information appeared to be the most common source of error. In qualitative terms, it also represented the most serious kind of distortion, often guided by schema contrary to the story's actual events and intended meaning. For example:

> The kids found the rock from outer space and Mr. Oliver said the rock came from the crab Nebula and so the gang is going to get it back in space.

Given the poor match between schema selection and textual information, students had difficulty slotting incoming information, tending to rely on their short-term memory rather than in forming a consistent interpretation. With inefficient schema and inconsistency among incoming facts, the relationships

among the parts and the whole were rather arbitrary and insufficient. The following coded example describes such a pattern in response to the first episode of "The Blob":

> There's a blob in the water (1). They bought it at an auction for 6,000 dollars (2). [What do you think might happen now?] They will clean up the blob in the river (3).

These results, together with the previous analysis, suggest that while similar strategies appear to be employed by good and poor readers, poor readers are more apt to ignore the text in favor of their own intuitive responses, often rather arbitrarily recalling facts without evidence of consolidating them into a consistent and satisfying interpretation.

CONCLUSIONS

While an integral part of the comprehension process, inferencing has been found to be difficult for many children. Several studies have indicated that these difficulties may lie in deficiencies in prior knowledge (Pearson, Hansen & Gordon, 1979; Phillips, 1988). Others, however, report that children may not be predisposed to inference on their own (Paris & Lindauer, 1976), or may lack the opportunities to do so in instructional contexts (Hansen & Pearson, 1983).

In contrast to these assumptions, this study found that children frequently engaged in a number of inferencing strategies. Inferencing occurred during the encoding process, as children were interpreting incoming data. This finding suggests that studies analyzing inferencing during retrieval alone may be seriously underestimating the frequency of inferences utilized by

children in comprehending stories.

Good and poor readers appeared to use a similar repertoire of inferencing strategies. This finding supports and extends research by Oakan, Wiener, & Cromer (1971), and Olshavsky (1976-1977), who found that the strategies employed and the frequency of their uses in comprehending materials did not significantly differ among high and low proficiency groups.

However, poor readers clearly appeared to accept unconventional interpretations of stories. For example, never questioning her assumption, one student suggested that the meaning of putting a robber away or "in" ice as she remembered, meant that the robber was going to be "placed in an ice bucket." Since she did not appear to comprehend to the story to begin with, she was not able to detect when the meaning of the sentence had, indeed, become anomalous.

Qualitative analyses of errors between the two groups suggests that, in contrast to the lack of prior knowledge, many poor readers adopted inefficient schema, allowing them to accurately slot only a portion of text. When the text did not conform with their existing interpretation, it would tend to be either be overlooked or "rewritten." Therefore, it was not the lack of prior knowledge, as much as the wrong prior knowledge that students' brought to the text. This view supports Nicholson and Imlach's finding (1981) that children's prior knowledge often compete for priority in children's inferencing, with intuitive knowledge at time interfering with the complex process of

constructing meaning from text.

In summary, rather than strategy training, teachers may well be advised to emphasize a number of direct instructional activities which help student focus on textual materials. Discussion of the topic to be read subsequent to comprehension might be one the more efficient way of enhancing children's understanding of stories. For example, as little as 10 minutes of general discussion prior to reading appears to significantly effect children's comprehension (Neuman, 1988). Further, techniques that encourage children to attend to the text and justify their responses on the basis of text information are important. For those readers with low expectations of print in particular, instruction and practice may have direct consequences on their inferencing performance.

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Table 1

Types of Inferencing Strategies

Inference types	Examples
Text-based inferences	
Binding	The student recalls that Vickie had said the wind direction was the wrong way so Hastings' couldn't have smelled chocolate. ["He must of been going to meet Smiling Jimmy"].
Rebinding	Following her decision that Smiling Jimmy stole the Blob, the student says, ["Well, wait I think there probably never was a Blob."]
Confirming	The student thinks that the rock or star is fake ["because Vickie said that she could lift it up with one hand."]
Slot-filling inferences	
Assigning default values	The student recalls that the Bloodhound Gang are at the auction for the White Dwarf. After the Gang meets the secretary, he says ["They're using that lady to get some words out of the guy--some evidence."]
Empathizing	The student reports that Vickie is saying that the White Dwarf is a fake and only worth 10 cents. ["Everybody's gonna be surprised when she picks it up."]
Proposing new solutions	After recalling that it was probably Smiling Jimmy who stole the Blob, the student reports that ["Jimmy could just dispose of the Frozen Blob in the river.]

Miscellanous

Reiterating	The student reports that Smiling Jimmy is suspicious. ["Yea, I think he did it."]
Refraining from responding	The student recalls that Vickie bids ten cents for the White Dwarf, then in response to the question of what might happen next, ["well, probably, well, I don't know."]

Table 2

Means and standard deviations for frequency of strategy use for good and poor readers

Strategy	Good readers		Poor readers	
	Mean	S.D.	Mean	S.D.
Text-based Inferences				
Binding	18.55	10.75	13.00	6.98
Rebinding	.95	1.99	1.55	2.11
Confirming	12.25	4.45	14.23	6.00
Slot-filling Inferences				
Assuming defaults	47.80	15.12	50.41	12.93
Empathizing	1.45	2.28	.95	1.59
Proposing new solutions	3.65	3.28	4.77	4.93
Other				
Reinterating	5.60	3.49	6.95	5.08
Refraining	9.75	9.31	8.14	9.06

Table 3

Number and percent of errors by category for good and poor readers

Error category	Good readers		Poor readers	
	No.	%	No.	%
Overreliance on background knowledge	64	7%	156	15%
Overreliance on recall	43	5%	137	13%
Inability to impose order on text	41	4%	113	11%
Total errors	148	16%	406	39%
No. of inferences	934		1065	