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Assessment of the Process of Reading Through the Use of Think-Aloud Protocols With Elementary Students

Jacqueline F. Holdorf

ASSESSMENT OF THE PROCESS OF READING THROUGH THE USE OF THINK-ALOUD PROTOCOLS WITH ELEMENTARY STUDENTS

An Abstract of a Thesis

Submitted

In Partial Fulfillment

of the Requirements for the Degree

Specialist in Education

Jacqueline F. Holdorf

University of Northern Iowa

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ABSTRACT

This study was undertaken to investigate the ability of elementary students to generate verbal reports during a reading task, and to determine whether differences in protocols produced exist between readers of differing ability and verbal activity.

The 20 experimental subjects were 5th and 6th grade students from one classroom in an Iowa school district. The subjects were classified as good and poor readers, and verbal and less verbal. Reading ability classifications were based on the Iowa Tests of Basic Skills. Verbal activity classifications were based on teacher judgment.

The subjects were asked to read a passage and then to verbalize their thoughts as they attempted to understand it. Their responses were subsequently categorized as either cognitive or text-restricted.

The study found that elementary students can give verbal reports in response to a think-aloud request during a reading task, a significant difference exists in the number of responses given by good and poor readers, no significant difference exists between good and poor readers in number of text-restricted responses, a significant difference exists in the number of cognitive responses given by good and poor readers, and no significant difference exists in number of responses given by verbal and less verbal activity readers.

The results of the study indicated that good readers use and report strategies during reading processing differently than poor readers. The study has implications for intervention if readers' processing characteristics and use of strategies can be assessed and used in improving reading skills.

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has been approved as meeting the thesis requirement for the

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Barry J. Wilson

8-3-90
Date — Chairman, Thesis Committee

John K. Smith

8/3/90
Date — Member, Thesis Committee

Jack Yates

8-6-90
Date — Member, Thesis Committee

John W. Somervill

1-3-91
Date — Dean of the Graduate College

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CHAPTER I

THE PROBLEM

Introduction

According to current theories and research, effective learning requires active participation by the learner in the learning process. These perspectives have led to renewed interest in process assessment among school psychologists (Meyers & Lytle, 1986; Olshavsky, 1976-1977). Process assessment (Meyers, Pfeffer, & Erlbaum, 1985) refers to an assortment of assessment procedures which focus not only on learner characteristics, but also on links among assessment, intervention, environment and processes employed by the learner. Protocol analysis, specifically think-aloud protocol analysis, is one example of process assessment.

Traditional approaches to psychoeducational assessment have been primarily used to provide information relevant to decisions on special education placement for children. Assessment useful for placement in special programs can fail to provide information that is useful for teaching children with academic difficulties (Spear & Sternberg, 1986). Meyers, Pfeffer, and Erlbaum (1985) state the following: "Standardized assessment assumes that the child has learned, and seeks to determine how much he has learned in comparison to his peers" (p. 81). Mercer (1987) in his text on learning disabilities states that formal test results are frequently unrelated to tasks and behaviors required in the classroom. Teaching requires

specificity and formal tests (achievement and diagnostic) yield quantitative data but lack the specificity needed for classroom teaching on a daily basis.

Current theory and research suggest process assessment as an alternative or supplement to traditional psychoeducational assessment. Emphasis is placed on linking assessment with intervention in order to implement successful changes in individual functioning (Meyers, 1988; Bergen, 1988). According to Meyers, Pfeffer, and Erlbaum (1985), the goals of process assessment are to determine the learning process characteristic of an individual, the degree to which modifications can be made in that process, and the appropriate approach for creating that modification. Because learning and comprehension cannot be directly observed, behaviors are used as indicators of those processes. Broadening the concept of assessment beyond that of standardized procedures and instruments can facilitate the determination of specific interventions to help a child and directly impact instructional decisions and program placement decisions. "In addition to giving diagnosticians and teachers valuable information about the ways able and less able readers use various strategies as they process text, thinking-aloud protocols provide information about the causes of students' comprehension problems" (Randall, Fairbanks, & Kennedy, 1986, p. 247).

Lytle (1982 in Meyers & Lytle, 1986) presents "think-aloud protocol analysis" as an example of process assessment used in the

assessment of reading comprehension. In this procedure the subjects are asked to read a text one sentence at a time and verbalize what they are thinking as they attempt to comprehend the passage.

In order to analyze the data generated by the verbal report procedure, a variety of coding systems have been developed by researchers. Coding or categorizing responses provides a framework within which to examine the subjects' responses to text.

Lytle developed a coding system which classified subject responses as moves, strategies, or style. According to Randall, Fairbanks, and Kennedy (1986), protocols are descriptions of subjects' behaviors while engaging in a task. The transcript of their verbal report provides a record of their observable behaviors from which teachers can begin to perceive the processes and strategies used by the subject. Randall, Fairbanks, and Kennedy (1986) developed a system of categorizing college students' protocol responses which classified responses as metacomments or meaning-relevant responses. Metacomments were comments which related to the protocol session but not to the task, such as "How much longer will this take?" The meaning-relevant category included affective, cognitive, and metacognitive responses related to text and made as the subject attempted to understand the material read.

Because of the unique and qualitative nature of verbal report data, special methods of analysis are needed to reflect commonalities and differences in subjects' reporting of cognitive processes (Garner, 1982; Afflerbach & Johnston, 1984). Classification of responses provides for analyses of individual subjects' use of

strategies and systems of processing. Various classification systems have been found to be useful in assessing subjects' use of strategies and providing implications for intervention (Meyers & Lytle, 1986; Randall, Fairbanks, & Kennedy, 1986; Olshavsky, 1976-1977; Christopherson, Schultz, & Waern, 1981; Marr, 1983).

Ericsson and Simon (1980) consider verbal reports reliable valuable sources for data about cognitive processes. Research continues to investigate the ability of verbal reports to access invisible cognitive processes. There are additional questions to consider if the procedure is to be used with young subjects. Some subjects, especially if they are young, may be unaware of their reading processes and thus be unable to report them, and some may have difficulty giving verbal reports in general (Afflerbach & Johnston, 1984). In assessment of younger subjects it is particularly important to justify time used in testing by knowledge gained which is relevant to teaching and intervention (Spear & Sternberg, 1986). The classification system used should lend itself to practical application and academic interventions.

Research on the use of think-aloud protocols with younger subjects has been less extensive. Meyers (1988) hypothesized that the think-aloud procedure would be most effective with bright, verbal, middle-class subjects who would find it relatively easy to comply with the think aloud instructions, and less effective with nonverbal, low-ability, lower-class subjects who might respond less effectively to the task.

This study focuses on the use of think-aloud protocols with elementary children of varying levels of reading ability and verbal expressiveness. If it can be determined that younger subjects respond differentially and with varying degrees of effectiveness to a think-aloud task, it may be possible to draw on the information derived from the protocol to assist young disabled or poor readers to develop effective strategies for comprehension, resulting in more positive attitudes toward both reading and themselves.

Statement of the Problem

The purpose of this study was to investigate process assessment by the use of think-aloud protocols with a group of elementary students to determine if young students have the ability to generate verbal reports of their thoughts during a reading task and, if so, whether differences exist between readers of differing ability levels. Differences in protocols between highly verbal and less verbal students were also examined.

Research Questions

This study addressed the following questions:

1. To what extent are older elementary students capable of generating verbal reports during processing of written text?

2. Is there a difference in the verbal reports generated by above average and below average readers as reflected by quantity and type of responses?

3. Is there a difference in the verbal reports generated by highly verbal and less verbal students as reflected by quantity and type of responses?

Definition of Terms

Process Assessment: Individualized evaluation including evaluation of learning processes.

Verbal Reports: Subjects' verbalizations of their thoughts during a problem solving or reading task.

Think-Aloud Protocol: A record of verbally expressed thoughts of a subject during an assigned task. (The term "thinking-aloud" is used by some researchers.)

Significance of the Study

Although interest in verbal reporting as an alternative assessment procedure and as a means of assessing cognitive processes has increased with the interest in cognitive psychology, many questions remain concerning methodology and practice. The extent of applicability of the procedure with young subjects has been undetermined.

Results of this study will provide additional information on the potential for use of the procedure with different groups of subjects.

Assumptions

1. It was assumed that the Iowa Test of Basic Skills provided valid estimates of a student's abilities and academic achievement.

2. It was assumed that teacher's informal assessment of reading ability and verbal activity were valid.

Limitations of the Study

This study was limited in its generalizability since the sample population represented a moderate range of socioeconomic backgrounds as found in a small Iowa community. The study was intensive, utilizing a small number of subjects which were selected in a non-random manner.

CHAPTER II

REVIEW OF THE LITERATURE

This review includes a review of the research on verbal reports, their use with various populations, and analysis of verbal report protocols. Finally, the issue of acceptance of verbal report data will be discussed.

Think-Aloud Protocols

Recent research has renewed the interest in cognitive processes and has used verbal reports of subjects to gather data on those processes (Garner, 1982; Marr, 1983; Olshavsky, 1976-1977; Kavale & Schreiner, 1979). Garner (1982) investigated strategy utilization of expert college readers who were given a comprehension and summarization task. She assumed the accessibility of mental events and focused on the length of time between processing and reporting on processing as a critical factor in generating data about those cognitive processes. The results supported Ericsson and Simon (1980) who emphasized that the time between processing and reporting affects the completeness of verbal reports on cognitive activity.

Olshavsky (1976-1977) used think-aloud protocols to identify reading strategies by readers and to examine differences in the application of those strategies according to reading ability. She used tenth grade readers who were asked to think aloud after reading each clause of a text. She found differences in the application of strategies according to reading ability, interest, and writing

style. Her work also supported the theory of reading as a problem solving process.

Kavale and Schreiner (1979) used think aloud protocol analysis to investigate strategy use by good and poor readers in reading comprehension. They administered a stimulus passage to sixth grade average and above average readers of high verbal ability. The subjects were instructed to think aloud about strategies used in choosing particular answers to questions which followed. This research supported the theory of reading as problem solving and protocol analysis as a viable means of investigating reading comprehension processes and strategy use. Marr (1983) used verbal reports with tenth grade students of differing levels of ability. Students were asked to think aloud and state what they were thinking or doing to comprehend a portion of text. The verbalizations were classified and analyzed to compare the effects of ability, different passages, and prior knowledge. Marr concluded that verbal reports are useful in examining processing strategies used by readers.

Meyers and Lytle (1986) drew on recent cognitive theory to suggest that individuals develop strategies which they use in learning and problem solving. They administered nonfiction reading passages to high school seniors who were asked to think aloud as they processed text. Meyers and Lytle used the results to develop a coding system for categorizing responses. In a case study using think-aloud protocol analysis with a fourth grade subject, Meyers

and Lytle developed academic interventions based on the subject's use of strategies during the verbal report process.

Howell and Morehead (1987) state that children need to become active rather than passive participants in the learning process.

> Retention of information (memory), while important, depends on things like motivation and interest that are not really synonymous with comprehension. Instead, we think that comprehension is the act of combining information in passages with prior knowledge in order to construct meaning. Comprehension, therefore, takes place as a person is reading and comprises the set of skills that lets him or her find information and understand it in terms of what is already known. It is a process that depends on the reader's prior knowledge of the content, skill at decoding, knowledge of vocabulary, language proficiency, and application of comprehension strategies. The interactive nature of comprehension requires that each of these elements combines, influences, and at times compensates for each other accurately and fluently. (Howell & Morehead, 1987, p. 166)

It becomes important to assess children's learning behaviors and processes when learning problems are apparent. In fact, most commonly used measures of psychoeducational assessment reliably predict educational achievement but do not assess learning processes and behaviors or suggest appropriate interventions. New techniques of assessment have been suggested to compensate for these deficiencies, one of which is verbal reports (Meyers, Pfeffer, & Earlbaum, 1985).

Verbal reports are descriptions of a subject's thoughts while engaged in an assigned problem solving task. The subject's use of strategy can be assessed through direct observation of overt behavior and interviews where students report the strategies they are using. Asking a student to state what he or she is doing does not guarantee

that he or she can report accurately or guarantee that he or she will do what he or she has reported. However, it does give an indication that the student is aware of the strategy and knows when and why to use it.

Retrospective verbal reports follow the experimental task and utilize the subjects' memory of their activities and thoughts. Concurrent verbal reports are given during performance of the experimental task; subjects report what they are thinking and doing as they perform the task. One form of concurrent verbal report is the think-aloud protocol.

Think-aloud protocol analysis is a specific example of a verbal report procedure designed to assess reading comprehension. Meyers and Lytle (1986) suggest that think-aloud protocol analysis is especially appropriate for assessment because it is carried out using reading which is an actual school task. The use of school tasks in assessment increases diagnostic potential for the assessment, because the adequacy of behaviors and activities required for school tasks are judged during the assessment process. Think-aloud procedures have the potential to assess strategic learning behaviors used during the actual task, and they have been used frequently for investigations of problem solving skills (Bereiter & Bird, 1985, from Meyers & Lytle, 1986).

Subjects

Most recent research using verbal reports and think-aloud protocols to investigate reading has used secondary or college

students as subjects. It is less clear whether the same procedures can be successfully applied with younger subjects.

It appears that think-aloud protocol analysis has potential for use with young subjects and applicability for diagnosis. However, relatively few studies involving a reading task have used think-aloud protocols with young subjects. Yet to be concluded is whether young children have the awareness of thinking processes to be able to verbalize what they are doing and thinking as they engage in a reading task.

Response Categorization

Studies using verbal reporting have differed in their use of categorization procedures. Some systems of categorization are less sensitive to individual differences because they require a minimum number of uses of a strategy for inclusion in the classification system, some ignore sequences and interactions of strategies, some require a high level of inference on the part of the examiner in order to select a category placement for a given strategy.

Olshavsky (1976-1977) identified 10 reading strategies which provided new information showing first, that readers use strategies and, second, that types of strategies used and identified support reading as a problem solving process. Her results indicated that frequency of use of strategies changes, while types of strategies used within a situation does not. According to Olshavsky, readers apply the most strategies when they want to comprehend, when they

are proficient readers, and when they need to because of abstract material. Strategies identified by Olshavsky were two types: problem identification and problem solving. Olshavsky stated that the types of strategies identified underlined the importance of studying strategies in reading, because it appeared a reader might adapt his behavior to achieve his goal of comprehension by first identifying his problem and then applying the problem solving strategies, a process which suggested important implications for teaching.

Lytle (1982, in Meyers, 1988) and Meyers and Lytle (1986) administered nonfiction reading passages to twenty-one high school subjects at an urban high school who responded by thinking aloud as they read and attempted to comprehend the passages. Using the protocols produced by the study, Lytle developed a system for coding subject responses as moves, strategies, or style.

Lytle's findings indicated that readers' responses showed a variety of patterns, but the patterns showed consistency within individuals and across situations. She found that certain features of text material caused difficulty for most readers, and readers' behavior or sequences of moves were indicative of use of a particular problem-solving approach or strategy. Lytle's results indicate that it is possible to assess reader use of comprehension strategies, and apply those findings to academic intervention.

Randall, Fairbanks, and Kennedy (1986) recorded the following protocol responses in their work with college readers:

> Student: It just depends on how you percept something and what it's gonna mean. And that goes back to the first paragraph, or I believe the second. (p. 246)
>
> Student: He's relating things back to what ordinary people do, so you can get a better understanding of it. (p. 245)
>
> Student: Well, I just read to the end of 40. (p. 244)

Using the protocols, Randall, Fairbanks, and Kennedy (1986) examined thoughts expressed during comprehension attempts. They differentiated subject responses on several levels, and categorically indicated subjects' passivity or active involvement with text use of specific strategies, and identified problems commonly encountered by readers with comprehension problems.

Classification of data collected during verbal reports is important for characterizing subjects' processing style and utilization of strategies. Researchers have differed in their choice of categories for analysis of data, depending on the needs of the particular research problem.

Acceptance of Verbal Report Data

Verbal reports have been important in reading and psychological research for many years, but renewed interest in investigating cognitive processes has increased research using verbal reports. However, acceptance of their use has been limited. Kavale and Schreiner (1979) reached the following conclusion:

> Although several studies have employed introspective and/or retrospective methods for studying the reading process and concluded they were useful techniques, the method of protocol analysis is considered an improvement over these techniques because it offers a more positive and direct method of identifying the processes used by subjects. (p. 106)

Verbal reports yield data which is language-based and qualitative in nature. Wide variability in amount and quality of responses from subject to subject and even within a given protocol demand special care in analysis but also provides unique data not available through normal testing procedures.

Verbal reports carefully gathered and interpreted can be valuable and reliable sources of information about the way a child approaches a problem-solving task.

CHAPTER III

METHODS AND PROCEDURES

The subjects in this study, the instruments used, and the procedures followed are described in this chapter.

Subjects

Twenty 5th and 6th grade students from an elementary school in an Iowa school district were selected for participation in this study. Nine students had above average reading skills ranging from 75 to 98 national percentile rank, and eleven had average or below average reading skills ranging from 27 to 55 national percentile rank determined by student performance on the Iowa Tests of Basic Skills reading subtest. Teacher judgment was used to confirm reading placement. Five poor readers had been previously placed in special programs for help in reading because of diagnosed deficiency.

The 20 students were also divided into groups according to the level at which they engaged in verbal interactions in the academic setting. Teacher judgment was used to classify students according to verbal activity level. Teachers were asked to state which of the students they would classify as highly verbal according to level of verbal interactions with peers, teachers, and in the classroom. At interest was propensity to talk rather than verbal ability. Seven students of the 20 were classified as verbal.

Thirteen were classified as less verbal and considered to interact verbally at a low to moderate level.

Instruments

Iowa Tests of Basic Skills

The Iowa Test of Basic Skills (ITBS) is a norm-referenced and criterion-referenced test designed to assess broad general functioning. Skills are measured in reading, language, work study, and mathematics.

Materials

A passage was used from the book Jonathan Livingston Seagull (Bach, 1970), which contained 14 sentences drawn from the beginning of the book. This passage was used by Lytle (Meyers, 1988) in a think-aloud protocol case study with a 4th grade girl. It presents little difficulty with decoding for 5th and 6th grade students but demands the student allocate attention to the reading task rather than reading automatically without attention. The passage presents a demanding processing task in order to encourage awareness of comprehension strategies, but one which is do-able at the upper elementary level of reading proficiency.

Procedures

All subjects were tested individually. The procedure was explained to them and modeled for them. A sample passage was administered until the student expressed comfort with the procedure and provided responses which indicated understanding of the task.

One sentence at a time was exposed to the subjects who were instructed to read it aloud and state everything they were thinking or doing to understand what they read. Instructions, from Lytle (1982, in Meyers, 1988) were as follows: Tell me what you are doing and thinking about as you try to understand the sentence. This is just like talking to yourself or thinking out loud. Testing time varied from approximately 20 minutes to 50 minutes per subject, depending on quantity and expansiveness of responses.

The subject's verbalizations were tape recorded and later transcribed. All responses were also noted verbatim by the researcher as they occurred. Both methods were used to ensure completeness of data. Subject behaviors of interest such as those confirming stated activities (i.e., rereading) were also noted. Transcriptions and notes were matched with text and classified into two categories: (a) text-restricted comments and (b) cognitive comments. Text-restricted comments indicated that the subject had rephrased information or reread material but not actively interacted with the text. For example, "He loved to fly," given as a response to "More than anything else, Jonathan Livingston Seagull loved to fly" was a rephrasing of the sentence without indication of interaction between text and reader. Cognitive responses revealed the subjects' thoughts, reflections, monitoring activities, use of strategies, and indicated deliberate interaction with text. "He must have something that he likes to do because he's practicing

it," indicated that the subject was hypothesizing and adding to the information given in the sentence, "But way off alone, out by himself beyond boat and shore, Jonathan Livingston Seagull was practicing." There were 25 unclassified responses. The unclassified responses occurred when subjects indicated either verbally or by physical behavior that they had nothing to tell the examiner at that point. These responses were unclassified because placement in one of the two categories would have required high levels of inference. Several responses were unclassified because they were ambiguous and could not be understood by the examiner. In all cases subjects were given adequate time and were encouraged to respond to the task.

Total number of responses elicited were examined for the entire subject group. The t-test comparisons were made for number of responses per reader group and category.

Research Hypotheses

1. There is no difference in number of responses to a think-aloud procedure generated by good and poor readers.

2. There is no difference in the number of text-restricted responses to a think-aloud procedure generated by good and poor readers.

3. There is no difference in the number of cognitive responses to a think-aloud procedure generated by good and poor readers.

4. There is no difference in number of responses to a think-aloud procedure generated by readers who are verbal or less verbal.

Data Analysis

Means and standard deviations were computed for responses in each classification, text-restricted and cognitive, by each subject group. In some instances, the assumption of homogeneity of variance was untenable, and a non-parametric test, the Mann-Whitney, was computed to compare means. In all other instances, the t-test was computed.

Qualitative analysis of responses and differences between groups of subjects was made to determine the character of predominant comments and types of strategy use for reader groups.

CHAPTER IV

RESULTS AND DISCUSSION

The verbal report data for good and poor readers were compared. In the text-restricted and cognitive categories a comparison of responses per reader group was made. Responses of verbal and less verbal readers were also compared.

An inter-rater reliability check on categories found agreement on 80% of the responses when the original categories of metacognitive (thoughts, reflections and monitoring) and cognitive responses (strategies) were combined into a cognitive category. These subjects at the elementary level were less specific and elaborate in their responses when compared with older subjects in other studies. As a result it was sometimes difficult to agree on which specific activity had taken place. Inter-rater agreement existed that given responses were either metacognitive or cognitive rather than text-restricted, but disagreement existed as to whether a response reflected use of strategy which is cognitive, or a reflecting or monitoring activity which is metacognitive. Since reflecting and monitoring can also be considered strategies, it was reasonable to collapse the cognitive and metacognitive categories into one. Many subject responses were in the form of questions which indicated the subject was actively participating in the task. It was more difficult to determine from the subjects' responses the actual extent and exact form of participation.

Verbal Reports

It was assumed that elementary students are able to give verbal reports related to text in response to a think-aloud request during a reading task. Students did respond verbally to the task, supporting this assumption.

Verbal Response Differences Between Good and Poor Reader Groups and Verbal and Less Verbal Groups

Variation in number and type of responses given by groups of subjects classified according to reading proficiency and verbal activity are examined. Hypothesis 1 states that there is no difference in the number of responses to a think-aloud procedure given by good and poor readers. Means and standard deviations for high and low ability readers are presented in Table 1. The Fmax statistic indicated homogeneity of variance could not be assumed (Fmax = 20.81, $p < .05$) for the good and poor reader groups. The high standard deviation was partially a result of one subject in the good reader group who gave a high number of responses. The data were reanalyzed leaving out the outlying score of this subject with the following result. The standard deviation was reduced from 16.01 to 9.27, but the difference between good and poor readers remained significant. There was wide variation among good readers in number of responses given. The Mann-Whitney test indicated that good readers gave significantly more responses than poor readers ($Z(9,11) = 1.78$, $p < .05$). Therefore, the second null hypothesis is rejected.

Table 1

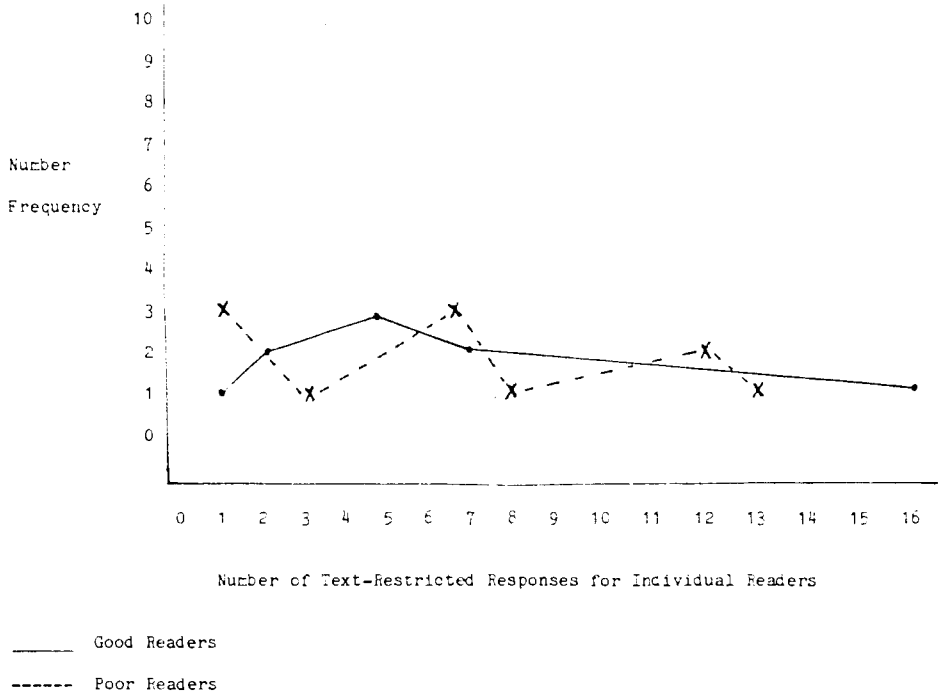
Mean Number of Responses and Standard Deviations for Groups of Subjects and Categories

Group	n	Average Total Responses	SD	Average Text-Restricted Responses	%	SD	Average Cognitive Responses	%	SD
Good Readers	9	28.16	16.01	5.56	19.0	4.48	22.60	80.0	15.68
Verbal	4	32.00	21.90	4.00	12.5		28.00	87.5	
Less Verbal	5	25.00	11.20	6.80	27.0		18.20	72.0	
Poor Readers	11	13.91	3.51	6.55	47	4.57	7.36	52	4.52
Verbal	3	12.33	4.04	3.67	30	3.06	8.67	70	5.50
Less Verbal	8	14.50	3.38	7.63	62	4.71	6.87	47	4.42

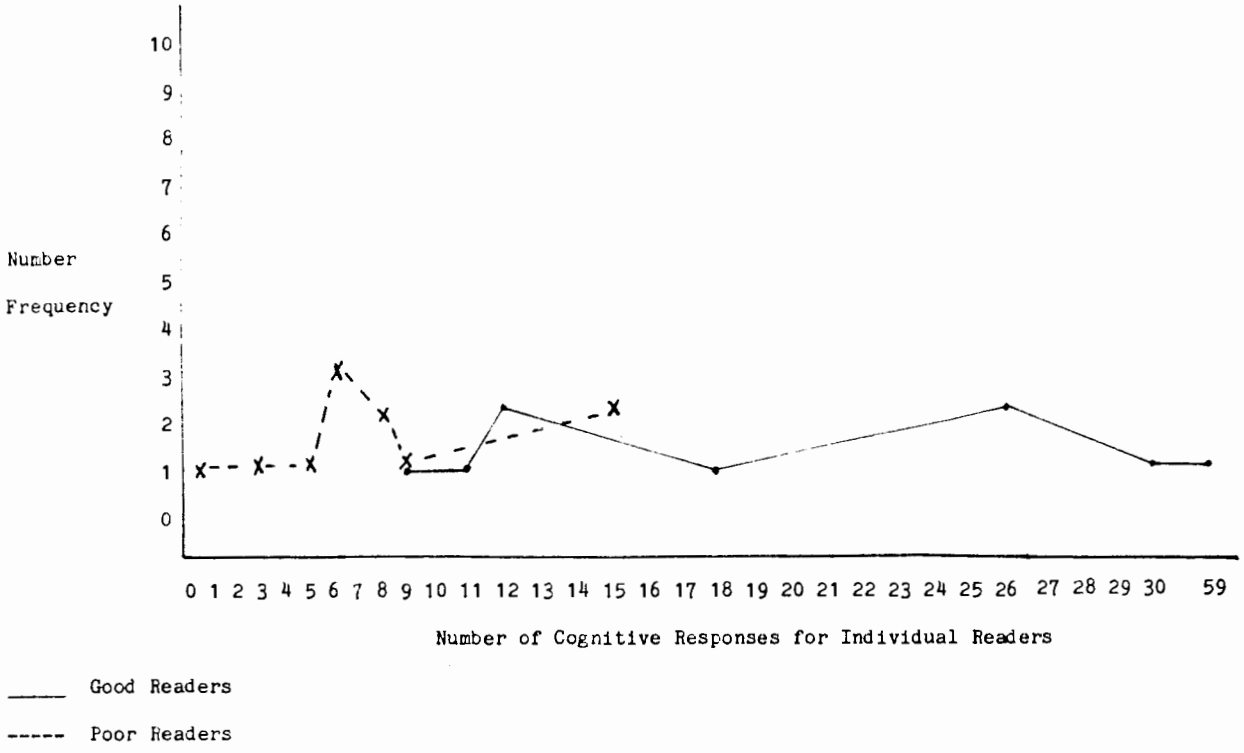
Hypothesis 2 states that there is no difference in number of responses allocated to the test-restricted classification of responses to a think-aloud procedure by good and poor readers. (See Graph 1.) A t-test indicated no significant difference between good and poor readers at $p < .05$. Means and standard deviations are given in Table 1. The third null hypothesis is not rejected.

Hypothesis 3 states that there is no difference in the number of responses allocated to the cognitive classification of responses to a think-aloud procedure by good and poor readers. (See Graph 2.) The Fmax statistic indicated homogeneity of variance could not be assumed (Fmax = 12.03, $p < .05$). The high standard deviation was partially a result of one subject in the good reader group who gave a high number of responses. The data were reanalyzed leaving out the outlying score of this subject with the following result. The standard deviation was reduced from 15.68 to 7.69. However, the difference between groups remained significant. There was wide variation between good readers in number of responses given. The Mann-Whitney test indicated that good readers gave significantly more cognitive responses than poor readers ($Z(9, 11) = 1.35$, $p < .01$). Therefore, the third null hypothesis is rejected. Means and standard deviations are given in Table 1.

Hypothesis 4 states that there is no difference in number of responses given to a think-aloud procedure by verbal and less verbal readers. Means and standard deviations for verbal and less verbal



Graph 1. Text-restricted response frequency for good and poor readers.



Graph 2. Cognitive response frequency for good and poor readers.

readers are given in Table 1. A t-test indicated no significant difference between groups at $p < .05$. Therefore, the fourth null hypothesis was not rejected. The number of total responses generated by verbal and less verbal groups was not significantly different.

Discussion

Results of this study indicated that there are differences in the think-aloud protocols produced by young subjects of different levels of reading ability. In comparing groups, significant differences were found between good and poor readers in quantity and variety of strategies evidenced in the think-aloud protocol. For example, in the first example given in the appendix, the good reader gives evidence of using visualization, and connecting information given in the sentence with prior knowledge and previous experience. The second response by a poor reader adds no new information to what is given in the text, and tends to be a rewording of a portion of the sentence, resulting in a response which is text-restricted.

Good readers asked interactive questions in their responses to the reading task at a higher rate than poor readers. Good readers asked questions and then attempted to answer their questions by using various strategies such as making connections between sentences, relating to prior knowledge, elaborating on text, visualizing, or hypothesizing. For example, a good reader stated, "Why put it that it wasn't eating that mattered but flight? You gotta eat to have strong healthy bones so you can fly better."

Another good reader questioned, "Is this gull supposed to be Jonathan Livingston Seagull? Why is he different than other gulls? Oh, it's him because they've been talking about him--in that one they said he was practicing. Yeah, right here it's supposed to be Jonathan." These readers elaborated on text, hypothesized, questioned, and made connections. One good reader questioned, "Why do they call it Jonathan Livingston Seagull? Is he a seagull or what? They don't give you very much information. Go back up to that first one that says it. Can all these sentences be about him or not? They must--all these sentences must be talking about that one bird or one person." Another good reader gave verbal evidence of hypothesizing and visualizing when he said, "It makes me think like when I'm riding a bike and I can feel the wind against my face. That's probably how he feels. Yeah." These good readers were effectively using a variety of strategies and interacting with the text in their efforts to understand what they were reading. Poor readers also questioned extensively, "Wonder why . . . ?" "Wonder what . . . ?," but often did not actually attempt to answer the questions they asked. Poor readers failed to draw inferences, form hypotheses, make elaborations and use other strategies to the same degree or as effectively as good readers. For example, the examples in the appendix show variation in use of strategies and interaction with text when the first and second responses are compared. The first response in each case is a good

reader; the second is a poor reader who rarely appears to interact or use strategies to understand text.

A poor reader questioned, "How could a sun be new?" "How did they know there was a crowd of 1000 sea gulls?" and "I'm wondering what he was practicing?," without reaching any conclusions about his questions or giving evidence of strategy use or actual interaction with text. One poor reader responded to various sentences with, "If there's people around and how they thought of the sea. How they liked watching the sea. How many sea gulls were there? How long was the fishing boat on the water? I don't really understand. I don't have anything on that." Little or no evidence of effective strategy use and appropriate interaction with text is evident in the reader's response. This reader monitored his reading well enough to be aware of his lack of understanding, but did not seem to know what to do to remedy the situation. Poor readers frequently asked questions but failed to answer the questions they did ask, and failed to discern whether the questions they were asking were actually helpful in aiding comprehension.

According to Howell and Morehead (1987), active readers approach text with questions and modify their understanding by actively attempting to answer those questions. Poorer readers seem to be less aware of the relationship between questions and sources of answers, a conclusion which appears to be supported by this research. Poor readers ask questions about what they read, but fail to answer them adequately to enlarge their understanding. In terms of

intervention, they benefit from being taught to recognize sources of answers to their questions and the importance of answering them.

Some poor readers used the same strategies as good readers, but tended to use one or two strategies ineffectively throughout the passage. For example, one poor reader repeatedly attempted to form hypotheses, "probably wants money," "probably hoping no one saw him," but failed to interact successfully with the text and find enough information to test his hypotheses. In addition, the reader seemed to be unaware of the importance of testing his hypothesis and using the results to enlarge his understanding of text. Consequently, his use of strategy appeared limited to generating a hypothesis which was not further investigated. These results are consistent with those of Randall, Fairbanks, and Kennedy (1986) and Olshavsky (1976-1977) who found in their studies with college and high school subjects that similar strategies are used by more proficient and less proficient readers, but that they are used more or less effectively and efficiently by readers of different levels of ability.

Comparisons between the two reader groups on total number of verbal responses elicited by passages revealed a significant difference. The two reader groups differed significantly in number of cognitive responses with the good reader group reporting three times as many total cognitive responses as the poor reader group. The two reader groups differed significantly as to the percentage of their own responses which were cognitive. Good readers gave

cognitive responses approximately 80% of the time compared to 50% of the time for the poor reader group. In addition, the poor readers gave less than one-half as many total responses as the good readers. (See Table 1.) The cognitive classification for this study may be indicative of strategy use. These results are thus consistent with those of Olshavsky (1976-1977) who found that good readers use strategies more often than poor readers, and Kavale and Schreiner (1979) who found significant differences between average and above average readers in application of strategies.

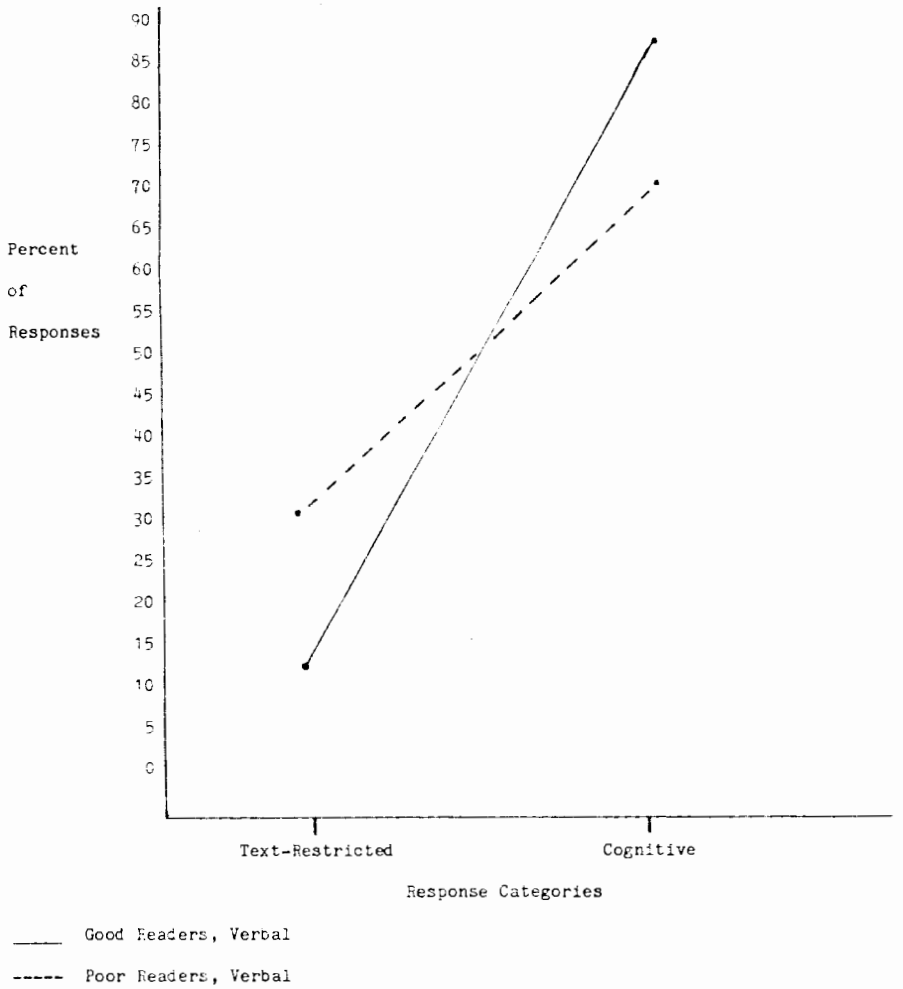
Good reader and poor reader groups responded with similar levels of text-restricted comments. Although the average number of text-restricted comments for both groups was similar, the poor reader group actually gave text-restricted comments about 50% of the time compared to 20% of the time for the good reader group. (See Table 1.) These results again indicate that strategy use as indicated by cognitive responses differs according to level of reading ability, with good readers utilizing strategies to a greater degree.

An analysis of results showed that level of verbal activity does not affect subjects' willingness to make comments and respond verbally to a reading task. Number of total responses given by verbal and less verbal readers was not significantly different but verbal readers showed greater variation in number of responses from reader to reader than the less verbal group. However, when the outlying results from a verbal/good reader subject were removed,

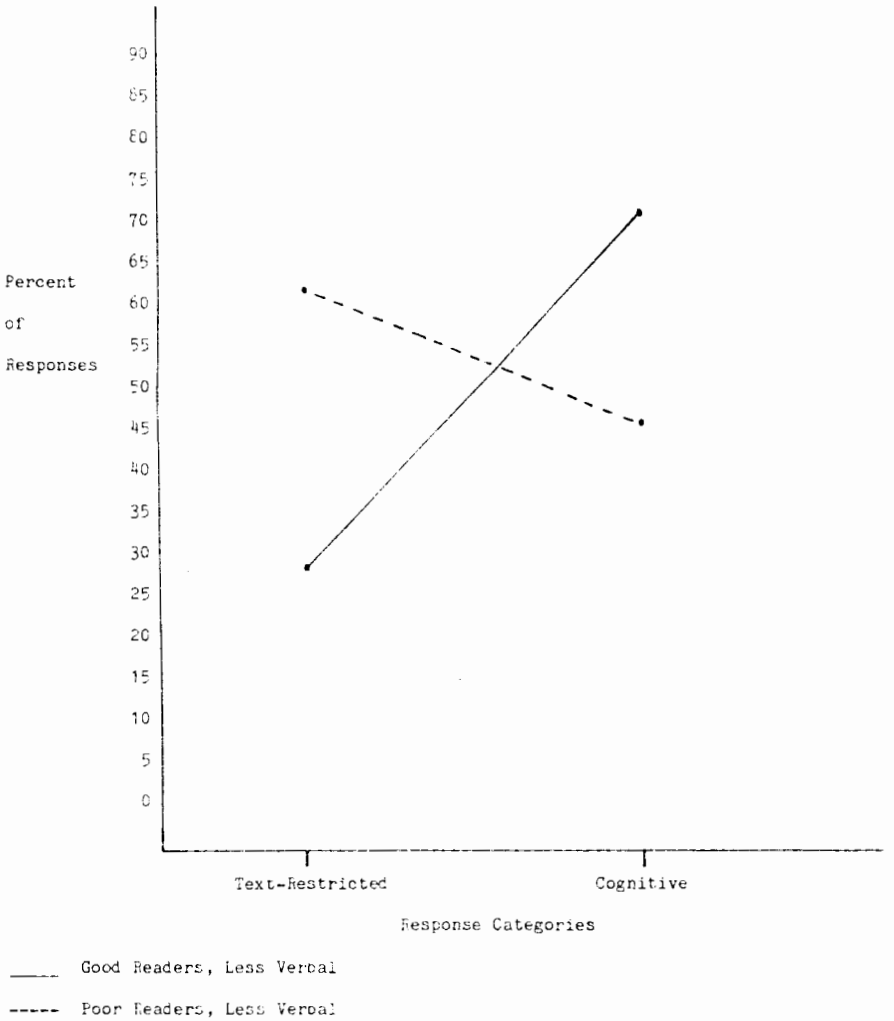
the variation in number of responses for verbal and less verbal subjects was reduced. Subjects who were both verbal and good readers gave slightly more responses to the reading task and demonstrated greater variability in number of responses. Responses for good reader/verbal subjects were predominantly cognitive. Responses for good reader/less verbal subjects were also predominantly cognitive, but with more text-restricted comments.

Poor reader/less verbal subjects gave more responses than poor reader/verbal subjects, but the difference was due to increased text-restricted responses. (See graphs 3 and 4.) The difference in type of responses may indicate a greater willingness by verbal readers to move beyond general comments about text and to express their thoughts about the text and their interactions with it. In general, it was difficult for the examiner to recognize from their responses whether subjects were categorized verbal or less verbal, because of the variability in responses, both in quantity and quality. The good readers were more easily distinguished from poor readers. See appendix responses 1 and 2 for each sentence. Their responses generally were more expansive and interactive. There were, however, good readers who responded to the task with brief responses evidencing passivity and who gave little overt evidence of strategy use and high ability.

Responses of good readers indicated a higher level of monitoring activity as shown by responses including thoughts, reflections and self-monitoring for understanding. For example, "Who is Jonathan



Graph 3. Percent of responses by category for verbal readers.



Graph 4. Percent of responses by category for less verbal readers.

Livingston Seagull? What was he practicing? Oh, . . . Now who is it talking about?" The reader then indicates he is engaging in the strategy of rereading, which results in a response of "That's it!" indicating understanding has occurred. These subjects moved to problem-solving techniques or strategies such as rereading, referring to reference materials, questioning and criticizing, relating to previous experience, linking prior knowledge, and visualizing, and expressed these strategies as cognitive responses.

Another good reader responded to a sentence by verbalizing, "Well, it makes me sort of think that I don't really understand the sentence." She reread the material and continued, "Well, I guess it reminds me of . . . I don't know . . . a bird diving for food. I'm not sure. I think I should go on and see if then I start to understand it," indicating that she was effectively monitoring her understanding and engaging in strategies which she felt would help her understand. The subject later responded, "I'm sort of picturing it as a person in its place cause I'm person and I know how it would feel to me." "It's trying to fly and his feathers ruffling . . . ." "It makes me feel like it's a person so I was confused at first whether it was a person or a sea gull." This good reader was adept at engaging in the metacognitive strategies of monitoring and reflecting and actively involving herself with the text and verbally reporting those activities. One good reader gave evidence of using the strategy of drawing on prior knowledge and experience when he stated, "Chummed. It means

water is going away from the boat. I already know cause we got a boat." Good readers frequently criticized and/or questioned the text or the author. For example, a good reader asked, "Why did he hold his breath? The sentence doesn't tell you very much what he did," "Why'd they put 'as you know' cause some people don't know that." Poor readers frequently made statements which indicated that they knew they were experiencing difficulty, "Doesn't tell me a whole lot," "Nothing about that sentence," "I'm not sure what the sentence more or less means," "Doesn't make a whole lot of sense to me," but they moved to problem-solving and strategy use much less frequently than good readers. Poor readers often expressed their frustration and lack of understanding, but either seemed to feel their responsibility ended there, or it appeared they had no knowledge of how to proceed further.

The results suggest several hypotheses: (a) poor readers may not be actively interacting with text material during comprehension efforts. If it can be determined through further assessment that these subjects are passive readers who fail to interact at appropriate levels, steps can be taken to plan appropriate interventions; (b) poor readers may reflect on and monitor their cognitive activities during reading at a productive level but be unable to choose and engage in effective strategies. These readers can be taught appropriate strategies and how to apply them productively. Poor readers may feel less confident in expressing their use of strategies, choosing instead to echo text. These

readers may be using strategies during a think-aloud procedure but be unable or unwilling to express them. A test of comprehension following the think-aloud process would help to determine if successful strategy use existed. If subjects appear to echo text because they do not strategize, interventions can be suggested to teach strategies and their use; and (c) poor readers may use strategies only when they are not overwhelmed by the text. It may be that poor readers give fewer cognitive responses because they do not understand what they are reading. Readers who appeared deficient or inefficient in strategy use could be reassessed using different texts at different levels to determine where and at what level strategy use was effective.

These hypotheses have implications for intervention. Missing or unused comprehension strategies such as active reading, comprehension monitoring, problem solving, and skills can be taught to children who need to develop effective problem solving strategies or who need to develop confidence in their use. Think-aloud protocol analysis can help identify some students with ineffective processing or strategy use. However, the procedure cannot accurately identify all problem areas for all readers. Some readers may verbalize more than they are doing; others may verbalize less. A test of comprehension may help verify readers' efficient approach to and interaction with text as expressed by the think-alouds. Protocol responses were less complete than those recorded by Randall, Fairbanks, and Kennedy (1986) in their investigation using college

students. The subjects in this study indicated that they experienced some difficulty producing verbal reports of their thoughts while engaging in the reading task. The protocols lacked the specificity found in protocols of older subjects, such as, "He's relating things back to what ordinary people do, so you can get a better understanding of it." Younger subjects usually did not verbalize fully and precisely their activities, reasons for activities or explanations. The protocols, while less detailed than those of older subjects, did indicate successful attempts to use strategies. Unsuccessful attempts were also apparent, such as when subjects attended too closely to details and ignored main ideas. The protocols are informative indicators in agreement with Ericsson and Simon (1980) who found that verbal protocols are not useless simply because some information is unreported.

CHAPTER V

SUMMARY AND CONCLUSIONS

Summary

This study examined 5th and 6th grade reader responses to a think-aloud protocol procedure. It examined the ability of elementary school subjects to respond verbally to a think-aloud procedure in reading and the differences in responses between groups of good and poor readers and verbal and less verbal readers.

The subjects were 20 5th and 6th grade students in an Iowa school district in the 1988-89 school year. Academic achievement information was obtained from the Iowa Tests of Basic Skills. Teacher judgment was used to define students as high or low verbal.

Data were analyzed to determine if young children generate responses which can be examined by think-aloud protocol analysis for evidence of strategy use and processing information useful for diagnosis of specific reading comprehension problems or specific intervention recommendations.

Results indicated that elementary students of varying ability levels generate verbal responses at a level which allows for analysis and categorization of responses. Good and poor reader groups responded with significantly different types of comments. Good readers gave significantly more cognitive responses to the think-aloud task than did the poor readers.

Conclusions

Results of this study indicated that think-aloud protocols can provide information about the reading process when used with young subjects. They can provide valuable information about specific processes and strategies utilized by students of varying abilities as they process text. However, think-aloud protocols can not be assumed to yield specific processing and strategy information on all subjects because some subjects provide little in the way of responses.

Better readers appear to use processes and strategies differently than poorer readers. While reports of good readers appeared more complete, the protocols of poor readers also provided data for analysis of reading comprehension processes and strategy use.

Think-aloud protocol analysis has important implications for diagnosis and intervention design, and potential for use with young children of elementary age. A think-aloud protocol does not, however, provide a complete picture. Cognitive processes are difficult to trace and verify, but think-aloud protocol analysis can be a useful tool in examining process rather than product in reading comprehension, especially when used in conjunction with other assessment devices.

When children experience difficulties in learning, it becomes necessary for specialists in various areas to use their collective expertise to arrive at an adequate diagnosis of the problem,

prescribe appropriate interventions, and implement programming. The school psychologist is in the unique position of being able to coordinate the efforts of diverse personnel. Classroom teachers and specialists often look to the school psychologist for information on ability, learning modalities, behavioral and emotional disorders, neurological impairment, and processing deficiencies. Since reading difficulties are common referral problems encountered by school psychologists, the school psychologist who is knowledgeable about the reading process and who can convey specific information to teachers and specialists about a particular child's reading processing and use of strategies will be better able to serve that child and provide important contributions to intervention and program planning. Think-aloud protocol analysis can be useful in helping to convey specific information to teachers and specialists about a particular child's reading processing and use of strategies, resulting in knowledgeable personnel better able to serve the child and provide specific interventions and program planning options.

References

Afflerbach, P., & Johnston, P. (1984). Research methodology on the use of verbal reports in reading research. Journal of Reading Behavior, 16(4), 307-322.

Bach, R. (1970). Jonathan Livingston Seagull. New York, N.Y.: Macmillan Publishing Company, Inc.

Bergen, J. R. (1988). Diagnosis of diagnosis diagnosed. Professional School Psychology, 3(2), 135-140.

Christopherson, S. L., Schultz, C. B., & Waern, Y. (1981). The effect of two contextual conditions on recall of a reading passage and on thought processes in reading. Journal of Reading, April, 573-578.

Ericsson, K. A., & Simon, H. A. (1980). Verbal reports as data. Psychological Review, 87(3), 215-251.

Fareed, A. A. (1971). Interpretive responses in reading history and biology: An exploratory study. Reading Research Quarterly, 6(4), 493-532.

Garner, R. (1982). Verbal-report data on reading strategies. Journal of Reading Behavior, 14(2), 159-167.

Howell, K. W., & Morehead, M. (1987). Curriculum-based evaluation for special and remedial education. Columbus, OH: Merrill Publishing Company.

Kavale, K., & Schreiner, R. (1979). The reading processes of above average and average readers: A comparison of the use of reasoning strategies in responding to standardized comprehension measures. Reading Research Quarterly, 15(1), 102-128.

Marr, M. B. (1983). Verbal reports: How readers process unfamiliar text. Paper presented at the Annual Meeting of the American Educational Research Association, Montreal, Canada.

Mercer, C. B. (1987). Students with learning disabilities. Columbus, OH: Merrill Publishing Company.

Meyers, J. (1988). Diagnosis diagnosed: Twenty years after. Professional School Psychology, 3(2), 123-134.

Meyers, J., & Lytle, S. (1986). Assessment of the learning process. Exceptional Children, 53(2), 138-144.

Meyers, J. M., Pfeffer, J., & Earlbaum, V. (1985). Process Assessment: A model for broadening assessment. The Journal of Special Education, 19(1), 73-89.

Olshavsky, J. E. (1976-1977). Reading as problem solving: An investigation of strategies. Reading Research Quarterly, 12(4), 654-674.

Randall, A., Fairbanks, M. M., & Kennedy, M. L. (1986). Using think-aloud protocols diagnostically with college readers. Reading Research and Instruction, 25(4), 240-253.

Spear, L. C., & Sternberg, R. J. (1986). Cognitive assessment with disabled readers. Special Services in the Schools, 2(2), 71-84.

APPENDIX A

Sentences Used for the Reading Task and Response Examples

1. It was morning, and the new sun sparkled gold across the ripples of a gentle sea.

Response: It makes me think of when we went to the ocean it was in the evening and it was real nice and I sort of picture it in my head like I see the sparkling and the ripples. (Good reader, cognitive response)

Response: The sun was beautiful. (Poor reader, text-restricted response)

2. A mile from shore a fishing boat chummed the water, and a crowd of a thousand sea gulls came to dodge and fight for bits of food.

Response: It makes me think of like somebody like feeding birds and then the birds come down to get like...or the seeds that are being thrown out but here it's just fish or little things by the sea. (Good reader, cognitive response)

Response: That the sea gulls were hungry. (Poor reader, text-restricted response)

3. But way off alone, out by himself beyond boat and shore. Jonathan Livingston Seagull was practicing.

Response: Well it makes me sort of think that I don't really understand the sentence. (Rereading) Well I guess it reminds me of I don't know...a bird diving for food...I'm not sure. I'm thinking I should go on and see if then I begin to understand it or... (Good reader, cognitive response)

Response: That he was far away. (Poor reader, text-restricted response)

4. A hundred feet in the sky he lowered his webbed feet, lifted his beak, and strained to hold a painful hard twisting curve through his wings.

Response: Well the sentence makes me think of just a bird sort of getting ready to take off and start flying...something of the sort. (Good reader, cognitive response)

Response: That the bird was very strange. (Poor reader, cognitive response)

5. The curve meant that he would fly slowly, and now he slowed until the wind was a whisper in his face, until the ocean stood still beneath him.

Response: It makes me think like when I'm riding a bike and I can feel the wind against my face...that's probably how he feels. (Good reader, cognitive response)

Response: That the ocean stood still beneath him. (Poor reader, text-restricted response)

6. He narrowed his eyes in fierce concentration, held his breath, forced one...single...more...inch...of...curve...

Response: Well it makes me think of like you're in gymnastics and you're trying to do something real hard but you just don't think you can do it but you try and find out. (Good reader, cognitive response)

Response: Why did they put them dots in the sentence (Poor reader, text-restricted response)

7. Then his feathers ruffled, he stalled and fell.

Response: The next sentence...um...if it were me I'd feel a little disappointed or something. (Good reader, cognitive response)

Response: He fell. (Poor reader, text-restricted response)

8. Sea gulls, as you know, never falter, never stall.

Response: It would make me feel like I was the only one ever to do this...to fall or whatever. (Good reader, cognitive response)

Response: That the sea gull never stalls. (Poor reader, text-restricted response)

9. To stall in the air is for them disgrace and it is dishonor.

Response: It would make the bird or person (pause, hesitate) feel like they're the only one and nobody will ever like them cause they were a disgrace. I'm sort of picturing it as a person in it's place cause I'm a person and I know how it would feel to me. Because it's trying to fly and his feathers ruffling. It makes me feel yeah...like it's a person and I was confused at first whether it was a person or a sea gull. (Good reader, cognitive response)

Response: That the bird is a very disgraceful bird. (Poor reader, text-restricted response)

10. But Jonathan Livingston Seagull, unashamed, stretching his wings again in that trembling hard curve - slowing, slowing, and stalling once more - was no ordinary bird.

Response: It reminds me of somebody or something with a lot of courage. It doesn't give up; it keeps trying. It doesn't just say, oh I couldn't do it once I'll just give it up. (Good reader, cognitive response)

Response: That he was not an ordinary bird. (Poor reader, text-restrictive response)

11. Most gulls don't bother to learn more than the simplest facts of flight - how to get from shore to food and back again.

Response: Next sentence um...probably makes him feel special because he's going to get more facts than the others, he usually did. (Good reader, cognitive response)

Response: That they never learn more than the simplest facts. (Poor reader, text-restricted response)

12. For most gulls, it is not flying that matters, but eating.

Response: This bird must have more interest in flying than in eating cause he really wants to find out more about it and he's not worried not that worried as the other about getting his food. (Good reader, cognitive response)

Response: They don't care about any other things except eating. (Poor reader, text-restricted response)

13. For this gull, though, it was not eating that mattered, but flight.

Response: I know this gull is different cause he would rather fly than eat and most would rather eat than fly. (Good reader, cognitive response)

Response: He'd rather be able to fly a long distance than eat a lot. (Poor reader, text-restricted response)

14. More than anything else, Jonathan Livingston Seagull loved to fly.

Response: It tells me that he really wanted to learn to fly and he didn't want to be different or it wasn't just the eating that mattered. He enjoyed the flying. (Good reader, cognitive response)

Response: He loved to fly. (Poor reader, text-restrictive response)