DOCUMENT RESUME

ED 263 526 CS 008 196

AUTHOR	Grabe, Mark
TITLE	Reading Ability, Processing Load and the Detection of Intersentence Inconsistencies.
PUB DATE	85
NOTE	17p.; Paper presented at the Annual Meeting of the American Educational Research Association (69th, Chicago, IL, March 31-April 4, 1985).
PUB TYPE	Reports - Research/Technical (143) -- Speeches/Conference Papers (150)
EDRS PRICE	MF01/PC01 Plus Postage.
DESCRIPTORS	Academic Aptitude; Cognitive Processes; *Coherence; Grade 4; Grade 6; Higher Education; Intermediate Grades; Reading Achievement; *Reading Comprehension; Reading Processes; *Reading Research; *Sentence Structure
IDENTIFIERS	*Comprehension Monitoring; Error Detection; *Inconsistency

ABSTRACT

A study was conducted to determine the relationship between processing load and ability to locate text segments containing intersentence contradictions. It was hypothesized that less able readers fail to exhibit comprehension monitoring skills because most tasks overload their processing capacity. Subjects were 87 fourth and sixth grade students and 28 college students, differentiated by reading ability. Processing load was controlled by manipulating the number of sentences in which contradictory sentences were embedded. Data were acquired from computer controlled reading activities in which students played the role of detectives attempting to solve a particular crime. Each game required the student to read 10 statements, five of which contained inconsistencies. The statements were two, three, and six sentences long. The computer recorded whether the subject judged each statement to be consistent or inconsistent and the time spent on each statement. The results indicated that processing load had a strong impact on monitoring performance. Even the addition of a single neutral sentence produced a decrement in performance, although the two-sentence statements were processed more slowly than the longer statements. However, processing did not interact with reading ability. Less able readers performed poorly on all monitoring tasks. This poor performance was attributed to a passive reading style in which sentences were not integrated. (HTH)

Reading Ability, Processing Load and the Detection of Intersentence Incons ncies

Mark Grabe

University of North Dakota

Running Head: Load and Monitoring

Paper presented at the 1985 American Educational Research Association Convention

Reading Ability, Processing Load and the Detection of Intersentence Inconsistencies

Abstract

College students and groups of upper-elementary students differentiated by reading ability attempted to locate text segments containing intersentence contradictions. The processing load imposed by the comprehension monitoring task was varied in order to assess the hypothesis that less able readers fail to exhibit comprehension monitoring skills because most tasks overload their processing capacity. Processing load was controlled by manipulating the number of sentences in which contradictory sentences were embedded. Processing load had a strong impact on monitoring performance. However, processing load did not interact with reading ability. Less able readers performed poorly on all monitoring tasks. Poor performance was attributed to a passive reading style in which sentences were not integrated.

Reading Ability, Processing Load and the Detection of Intersentence Inconsistencies

The search for meaning in written material sometimes results in failure. Authors may write in such a way that text is difficult to understand and readers may also misinterpret what has been written. Comprehension monitoring involves the ability to detect when failures of understanding have occurred. This skill is considered important and has been receiving the attention of reading researchers because of the role detection of comprehension failures plays in the subsequent control of remedial processing activities. Monitoring skill is also the object of a number of researcher's attention because it represents a well defined example of an executive or metacognitive process.

A number of studies (Garner, 1980, 1981; Grabe & Mann, 1984; Harris, Kruitof, Terwogt & Visser, 1981; Johnson & Smith, 1981; Markman, 1979; Winograd and Johnston, 1980) have demonstrated either age or reading ability differences in elementary-aged readers' monitoring skills. The younger or less able readers in these studies appeared in some way to be less aware of inconsistencies purposefully placed in the texts they had been asked to read. Explanations for these group differences, when advanced, have been rather speculative and have focused on various processing activities. Given the attentional limits of the information processing system (LaBerge & Samuels, 1974), some have claimed that less able readers may be fully occupied with the requirements of decoding, lexical access, idea unit comprehension, and other tasks that must be accomplished before the monitoring of idea unit compatilibity would be possible. This explanation of general comprehension problems has been preferred by some (Curtis, 1980; Perfetti & Lesgold, 1977) and has been specifically mentioned in reference to monitoring failures (Daneman & Carpenter, 1983). A second planation centers more directly on the strategic behavior of the reader. Less able students may fail to interrelate ideas as they read or listen (Brodzinsky, Feuer & Owens, 1977; Garner, 1981; Harris et al., 1981; Kimmel & MacGinitie, 1984; Markman, 1979) and thus could not determine when ideas were contradictory. It would seem useful to attempt to empirically investigate the two general explanations of monitoring failures. This effort would provide both a clearer theoretical explanation of monitoring failures and a clearer direction to those interested in teaching monitoring skills.

Shatz (1978) argues that researchers should be careful not to assume that a skill is missing because a study or several studies fail to demonstrate evidence that the skill is being utilized. Because of competing cognitive demands and the additional degree of effort required when a skill is not well mastered, the skill may only evidence itself when other processing demands are low. In a general way, this can be said to be true of comprehension monitoring. Certain kinds of comprehension dificulties and certain kinds of task requirements appear to be associated with a higher likelihood of error detection. For example, difficulties appear more likely to be detected if the problem is a difficult vocabulary word rather than an intersentence contradiction (Garner, 1981), an intra- rather than intersentence contradiction (Daneman & Carpenter, 1983; Garner & Kraus, 1981-82), a contradiction with facts already learned rather than among facts simultaneously presented in text (Reis & Spekman, 1983), a contradiction presented at the end of a single paragraph rather than after three paragraphs (Glenberg, Wilkinson & Epstein, 1982) or a contradiction prefaced by syntactic structures indicating a sentence should be related to what has already been read rather than syntactic structures indicating the presentation of new information (Glenberg, Wilkinson & Epstein, 1982). Collectively, these studies indicate that monitoring skill is more likely to be evident in some circumstances than others. It might also be argued that the situations resulting in successful monitoring could be characterized as the easier of each task pair. Two difficulties prevent drawing conclusions about the monitoring skills of poor elementary-aged readers from this research. First, the research fails to statistically compare the performance of good and poor readers across the easier and more difficult monitoring tasks (Daneman & Carpenter, 1983, represent an exception). Secondly, the monitoring tasks are in many cases very different and may involve the utilization of different cognitive skills. While at a very general level it may be of some value to know that a form of comprehension monitoring is possible, researchers are more likely to be interested in whether a particular monitoring skill is functioning (e.g., intersentence comprehension).

This research followed Shatz's (1978) suggestion of comparing subjects of different ability levels on tasks of different difficulty levels. However, in contrast to most existing research, this study focused on a single type of monitoring task. The task used in this research was the ability to combine information from several different sentences (i.e., intersentence integration). Certainly, the ability to actively integrate what has been read is a necessity for adequate comprehension. Processing load was controlled by varying the number of sentences that the reader had to deal with in searching for intersentence contradictions. Only Glenberg, Wilkinson and Epstein (1982) have varied the amount of material in a monitoring experiment and then in a study using college subjects who were not differentiated by level of ability. In the present study, load varied from the minimum context for sentence inconsistencies (2 sentences) up to six sentences. Johnson and Smith (1981) have used a very similar technique to demonstrate how processing load differentially influenced younger and older children's capacity to draw inferences from written material. The task used here simply foll[illegible] the reading process one step further; the products of integrative activity must also be evaluated for logical consistency. An ability by processing load interaction in the accuracy of monitoring proficiency was anticipated.

METHOD

Subjects

A total of 87 elementary-grade students (fourth and sixth graders) and 28 college students served as subjects. The college students participated in order to earn extra-credit toward their final grade in introductory psychology.

The elementary students were divided into three ability groups using the reading subtest from the Iowa Tests of Basic Skills (Hieronymus, Lindquist & Hoover, 1978) (cutoffs were grade equivalent scores of 6.1 and 7.8). The mean grade equivalent scores in the three ability groups were 5.0, 7.0 and 8.8.

Materials and Procedure

All data were acquired within the context of computer-controlled reading activities that were described to students as Master Detective games. Each game placed the student in the role of a detective attempting to solve a particular crime. The crime was described in the brief preface to each game. This introductory information was made available only to increase the interest value of the game and was not necessary for performing the required comprehension monitoring task. Each game required the student to read 10 statements produced by characters from the crime scenario. Five of the statements contained inconsistencies (sentence to sentence contradictions). The following examples are the consistent and inconsistent alternatives produced by the clown in a game focused on a circus scenario.

Consistent Statement

Circus people lead simple lives so we don't need much money.
If you don't need fancy things you can be happy here.

Inconsistent Statement

Circus people lead simple lives so we don't need much money.
I am planning to buy a new sports car soon.

Before the student played the first game, the following instructions were provided to explain the purpose of Master Detective games and to inform the student of the kinds of statements that they should label as inconsistent. Some parts of these instructions were taken from instructions used by Markman and Gorin (198).

> Now that you know how to use the computer, we are going to play a game on it. This game is called Master Detective because the person playing the game is trying to find the person who committed the crime. To find the criminal you will have to find people who say things that sound mixed up or confused. Criminals say things that are mixed up so you won't find out the truth about them - they try to fool or mislead you.
>
> Knowing when people say something that is mixed up or confused is something I think you will be able to do. For example, suppose you heard "John loves to ski" then later you heard "John hates to ski." These two sentences do not make sense together - they are confusing. Suppose one part of a story said "Suzie is a tiny baby" then another part said "Suzie is big enough to walk to school." It would be confusing to have sentences like this together - Suzie cannot be a little baby and be big enough to walk to school. Some of the people in the game you are going to play will say things that are confusing. You must try to find which people say things like this.

Three different game settings were prepared for this research. Statements from each game were prepared in two, three and six sentence lengths. The three and six sentence versions were constructed by padding the two sentence statements with sentences which fit the general context, but which were assumed not to modify whatever consistent or inconsistent relationship already existed. The readability levels of the three versions of each game were calculated using the computerized program developed by Schuyler (1982). The Dale-Chall scores for the statements encountered in all games were in the 5-6 grade range. Schuyler's (1982) program also indicated that the two, three and six sentence statements averaged 32, 44 and 78 syllables in length respectively. Each subject played a two, three and six sentence game. The length of statements associated with a particular game and the order of the games were balanced across subjects. The computer recorded whether the player judged each statement to be consistent or inconsistent and the time spent on each statement.

RESULTS

Both speed and accuracy data were analyzed in two ways. In the most straightforward approach, the raw accuracy and viewing time data were used. A second approach was included to potentially differentiate student potential from actual student performance. It was felt certain students may have responded in a careless or impulsive fashion on some trials and that these responses may have given a false impression of true capability. Such a situation could arise if subjects became frustrated with a difficult task. This situation would prove misleading if students prone to this behavior were disproportionally represented in a particular group or if a particular group (e.g., lowest ability students) responded in an impulsive fashion to statements of a particular length. To eliminate some of the misleading raw data, separate analyses were conducted based on viewing time data within one and a half standard deviations of each subject's mean. Viewing time data falling outside this range were eliminated in the second set of analyses. Accuracy data corresponding to overly rapid responses were also not used. For this set of analyses, the accuracy data were expressed as the proportion of valid responses that were correctly labelled.

Both speed and accuracy data were analyzed using a 4 x 3 x 2 mixed model analysis of variance. Factors in this model were Ability (low, middle, upper elementary and college students), Statement Length (2,3,6 sentences) and Statement Type (consistent, inconsistent). Statement Length and Statement Type were within-subjects factors. Dependent variables were viewing times (average syllables per minute) and accuracy (number correct or proportion correct).

The analysis of the raw accuracy data produced significant main effects for Ability, $F(3,111)=35.02$, $p < .01$, $MSe = 1.54$, Statement Length, $F(2,222)=4.99$, $p < .01$, $MSe = 1.03$, and Statement Type, $F(1,111)=21.83$, $p < .01$, $MSe = 1.47$. The interaction of Statement Length and Statement Type was also significant, $F(2,222)=$ [illegible]98, $p < .01$, $MSe = .83$. Consistent statements were labelled more accurately than inconsistent statements. Post hoc tests (Newman-Kuels) indicated that all groups with the exception of the best elementary readers and the college students differred significantly and that the three sentence and six sentence statements were more difficult to correctly label than the two sentence statements. The interaction could be explained by the finding that consistent statements were labelled more accurately than inconsistent statements for the two longer statement categories, but not for the two sentence statements. The analyses conducted using the more restricted data set produced exactly the same pattern of results. In this analysis, significant effects were found for Ability, F (3,111)=32.74, $p<$ .01, MSe =.07, Statement Length, F (2,222)=4.77, $p<$ .01, MSe =.04, Statement Type, F (1,111)=19.93, $p<$ .01, MSe =.06, and the Statement Length by Statement Type interaction, F (2,222)=7.89, $p<$ .01, MSe =.04. Means for both sets of analyses are presented in the top panel of Table 1.

****

Insert Table 1 about here

****

The analysis of raw viewing times produced significant main effects for Ability, F (3,111)=11.42, $p<$ .01, MSe =6818, and Statement Length, F (2,222)=14.32, $p<$ .01, MSe =3974. Post hoc comparisons indicated that all groups but the better elementary readers and college students were significantly different. As would be expected, better readers read faster. The data also indicated that the two sentence statements were processed more slowly than the longer statements. The more restricted data set produced the same significant main effects; Ability, F (3,111)=5.92, $p<$ .01, MSe =7431 and Statement Length, F (2,222)=25.26, $p<$ .01, MSe =2899. Post hoc tests revealed one slight difference from the analysis conducted on the raw viewing time data. Significant group differences existed only between the least able readers and the two most able groups. Means for both data sets are provided in the bottom panel of Table 1.

DISCUSSION

The technique employed here represents a unique methodological variation of the error detection paradigm. The microcomputer game format was employed because of its appeal to the you . students participating in this research and because the game format creates a believable setting for asking young readers to search for errors. Winograd and Johnston (1980) suggest that the error detection task may underestimate the comprehension monitoring skill of younger subjects because children may believe that adults do not say things that do not make sense. In the game format, it would be logical that suspects would try to say things to confuse the "Master Detective" and children should not have been hesitant to report statements that did not make sense. As in several earlier studies, more able readers were more adept at locating logical inconsistencies in text. It was a little surprising that the best elementary readers were able to perform at a level equal to that of adult subjects. Because readers in these groups were able to correctly label over 85% of the statements, it is possible that performance in these groups was approaching the practical ceiling for the material utilized.

The study time data did not appear to support the findings of the limited research available utilizing reading speed as a dependent variable. Previous research (Baker & Anderson, 1982; Harris et al., 1981) found that readers spent more time on the sentence presenting an inconsistency. It is possible that this finding does not generalize to experiments which present a multi-sentence statement as a single display. It was also anticipated that six sentence statements would be the most difficult and would thus be processed at a slower rate. While the accuracy data did demonstrate that the longer statements were more difficult, these statements were actually studied at a faster rate.

The present study successf'lly replicates the few existing studies demonstrating a relationship between the difficulty of the monitoring task and task performance. The unique feature of this research was the manner in which task difficulty was varied. With the possible exception of Gl_nberg, Wilkenson and Epstein (1982), difficulty has not been defined in terms of the amount of information readers must process. Even the addition of a single neutral sentence produced a decrement in performance. This trend was evidenced in all ability groups. Glenberg et al. (1980) explained their results by speculating that additional information provided opportunities for the reader to draw inferences that might explain awav existing inconsistencies. While this may have been possible with the larger amounts of text they employed, this suggestion would seem less likely to explain the difficulty produced by adding a single sentence to a two sentence statement. A second possibility is that the increase in amount of material considered stressed the available processing resources and impaired performance.

The data do not support the hypothesis that less able readers have a unique difficulty detecting ambiguities because they are overburdened with more basic processing requirements. Asserting the null hypothesis can be questionable, but given the large sample of subjects and the lack of any hint of an interaction, the conclusion would appear well founded. Futhermore, the fact that the accuracy with which inconsistencies were detected differed with the amount of information the subjects were asked to process would suggest that the method employed was clearly sensitive to differences in processing de[illegible] What of the somewhat related notion that if the task is easy enough poorer readers will be able to perform it? The data do not support this hypothesis either. Even at the two sentence level, the most elementary level for intersentence comparisons, ambiguities were detected at less than a 60 percent rate. Random guessing would allow the reader to identify half of the inconsistencies. The argument is not [illegible]ing made that less able or younger readers are incapable of any form of comprehension monitoring. These readers may be quite capable of pointing out words they do not understand or facts that defy their real world experiences. However, when the detection of inconsistencies requires that inferences be made to link information across sentence boundaries, it appears that less able readers are very limited.

It is possible that less mature or less able readers respond to some higher level processing requirements in a passive manner. Garner (1981) contends poor readers compartmentalize their reading so much that they do not notice inconsistencies. If idea units are not purposefully integrated, there is little chance a lack of compatibility would be detected. If this description is an accurate portrayal of the processing of less able readers, it is unclear what criteria passive readers would be using for making their decisions on the error detection task. In the present study it is possible that some readers responded in a random manner. A more likely possibility is that some readers may be responding in a global manner when the task requires analytical processing (Pratt & Wickens, 1983). Such readers may respond on the basis of a general gestalt or impression and not actively make idea unit comparisons. An interesting sidelight to this claim is that a similar explanation has been used to account for the behavior of subjects with an impulsive cognitive style (Egeland, 1974). Differences in cognitive style have been related to differences in monitoring performance (Brodzinsky, Feuer & Owens, 1977; Kimmel & Macginitie, 1984; Pratt & Wickens, 1983). Because the general comprehension performance of less able readers has been improved by teaching them to slow down and engage in purposeful strategic behavior (Learner & Richman, 1984), one might speculate that a similar approach would prove successful in developing monitoring skills.

REFERENCES

Baker, L. & Anderson, R. (1982). Effects of inconsistent information on text processing: Evidence for comprehension monitoring. Reading Research Quarterly, 17, 281-293.

Brodzinsky, D., Feuer, V. & Owens, J. (1977). Detection of linguistic ambiguity by reflective, impulsive, fast/accurate and slow/inaccurate children. Journal of Educational Psychology, 69, 237-243.

Curtis, M. (1980). Development of components of components of reading skill. Journal of Educational Psychology, 72, 656-669.

Daneman, M. & Carpenter, P. (1983). Individual differences in integrating information between and within sentences. Journal of Experimental Psychology: Learning, Memory and Cognition, 9, 561-584.

Egeland, B. (1974). Training impulsive children in the use of more efficient scanning techniques. Child Development, 45, 165-171.

Garner, R. (1980). Monitoring of understanding: An investigation of good and poor readers awareness of induced miscomprehension of text. Journal of Reading Behavior, 12, 55-63.

Garner, R. (1981). Monitoring of passage inconsistency among poor comprehenders: A preliminary test of the "Piecemeal Processing" explanation. Journal of Educational Research, 74, 159-162.

Garner, R. & Anderson, J. (1981-82). Monitoring of understanding research: Inquiry direcions, methodological dilemmas. Journal of Experimental Education, 50, 70-76.

Garner, R. & Kraus, C. (1981-82). Good and poor comprehenders differences in knowing and regulating behavior. Educational Research Quarterly, 6, 5-12.

Glenberg, A., Wilkinson, A. & Epstein, W. (1982). The illusion of knowing: Failure in the self-assessment of comprehension. Memory and Cognition, 10, 597-602.

Grabe, M. & Mann, S. (1984). A technique for the assessment and training of comprehension monitoring skills. Journal of Reading Behavior, 16, 131-144.

Harris, P., Kruitof, A., Terwogt, B. & Visser, T. (1981). Children's detection and awareness of textual anomaly. Journal of Experimental Child Psychology, 31, 212-230.

Hieronymus, A., Lindquist, E. & Hoover, H. (1978). Iowa Test of Basic Skills - Form 7. Iowa City, IA: Houghton Mifflin.

Johnson, H. & Smith, L. (1981). Children's inferential abilities in the context of reading to understand. Child Development, 52, 1216-1223.

Kimmel, S. & MacGinitie, W. (1984). Identifying children who use a perseverative text processing strategy, Reading Research Quarterly, 19, 162-172.

LaBerge, D. & Samuels, S. (1974). Toward a theory of automatic information processing in reading. Cognitive Psychology, 6, 293-323.

Learner, K. & Richman, C. (1984). The effect of modifying the cognitive tempo of reading disabled children on reading comprehension. Contemporary Educational Psychology, 9, 122-134.

Markman, E. (1979). Realizing that you don't understand: Elementary school children's awareness of inconsistencies. Child Development, 50, 643-655.

Markman, E. & Gorin, L. (1981). Children's ability to adjust their standards for evaluating comprehension. Journal of Educational Psychology, 73, 320-325.

Perfetti, C. & Lesgold, A. (1977). Discourse comprehension and sources of individual differences. In M. Just and P. Carpenter (eds.) Cognitive processes in comprehension. New York:Erlbaum, 141-183.

Pratt, M. & Wickens, G. (1983). Checking it out: Cognitive style, context, and problem type in children's monitoring of text comprehension. Journal of Educational Psychology, 75, 716-726.

Reis, R. & Spekman, . (198. The detection of reader-based versus text based inconsistencies and the effects of direct training of comprehension monitoring among upper-grade poor comprehenders. Journal of Reading Behavior, 15, 49-60.

Schatz, M. (1978). The relationship between cognitive processes and the development of communication skills. In B. Keasey (Ed.), 1977 Nebraska Symposium on Motivation (pp. 1-42). Lincoln: University of Nebraska Press.

Schuyler, M. (1982). A readability formula program for use on microcomputers, Journal of Reading, 25, 560-591.

Winograd, P. & Johnston, P. (1980). Comprehension monitoring and the error detection paradigm (Tech. Rep. #153). Champaign, IL.:University of Illinois, Center for the Study of Reading.

Table 1: Mean Accuracy and Viewing Speed Data for Ability Groups on Consistent and Inconsistent Statements

	Group							
	Low Elementary		Middle Elementary		Upper Elementary		College	
Statement Length	Con.	Incon.	Con.	Incon.	Con.	Incon.	Con.	Incon.
	Raw Accuracy Data							
2	3.50	2.87	4.07	3.90	4.45	4.38	4.57	4.68
3	3.64	2.86	3.90	3.13	4.21	4.31	4.18	4.25
6	3.50	2.54	4.00	3.43	4.52	3.69	4.61	3.93
	Restricted Accuracy Data							
2	.70	.58	.82	.79	.88	.88	.91	.94
3	.73	.58	.78	.66	.86	.86	.84	.86
6	.71	.51	.78	.66	.94	.76	.92	.76
	Raw Rate Data							
2	146	101	129	121	144	149	155	155
3	123	115	148	139	159	160	161	169
6	143	119	163	161	184	185	195	196
	Restricted Rate Data							
2	116	107	131	128	148	149	150	159
3	121	125	148	148	154	162	163	157
6	160	160	165	162	176	186	176	188