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ABSTRACT

Recent reading research has identified three reader variables involved in fluent reading: automatic word identification, contextual word identification, and text phrasing. To confirm the validity of these variables in the reading process, to test reading models employing them in an integrated and interactive manner, and to identify developmental changes in the models, a study was undertaken involving 77 third grade and 65 fifth grade students. The students read orally a social studies passage and identified within-sentence breaks in the passage. After a buffer task, they were asked to retell all they could remember from the passage, then completed a multiple choice comprehension measure and a standardized reading achievement test. A model using the variables was then hypothesized, fitted to the study data, and tested using structural equation modeling. The findings suggest that the variables are valid surface level factors involved in fluent reading, that they interact in leading to comprehension, and that the nature of their interrelationship was not static, since developmental changes occurred. (FL)

DEVELOPING MODELS OF READING FLUENCY

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ABSTRACT

DEVELOPING MODELS OF READING FLUENCY

Recent research into the reading process has identified three reader factors involved in fluent reading. These are automatic and contextual word identification, and text phrasing. The purpose of the present study was to verify the validity of the three factors in the reading process, to test reading models employing the factors in an integrated and interactive manner, and to identify developmental changes in the models. The third- and fifth-grade subjects were administered multiple measures of all factors under study, including comprehension. A model using the factors was hypothesized, fitted to the data, and tested using covariance structure analysis. In the model the effects of the word identification factors were mediated through phrasing. The results of the analysis supported the validity of the three factors. Moreover, the hypothesized model of reading displayed good fit to the data. Developmental effects included an increase in the relative importance of contextual word identification.

DEVELOPING MODELS OF READING FLUENCY

How is it that a child becomes a fluent reader? What factors are involved in fluent reading and how are these factors related? These research questions formed the basic conceptual framework that guided the present study.

Previous fluency-related research has identified three factors that appear to be involved in fluent oral reading. These are contextual word identification, automatic word identification, and text phrasing.

Each of the three factors are distinct and enjoy a certain amount of prominence in the reading field. A good deal of the research in support of the context-dependent word identification factor comes from the work of K. Goodman. Goodman (1965) used his study of contextual versus isolated word reading to support the position that context facilitates word recognition. In the study readers could read words in context that they were unable to identify in isolation. He thus posited that word identification, to a large extent, involves the use of contextual cues embedded within the textual environment.

According to the context-dependent word identification hypothesis reading is seen primarily as a process of extracting meaning from texts. The ability to abstract meaning is reflected in the reader's use of the redundancy of language and the semantic and syntactic cues embedded within the text. Thus, according to this perspective, the proficient reader will rely heavily upon semantic and syntactic cue strategies over grapho-phonic based strategies in identifying of words. The less proficient reader, on the other hand, is characterized by a bottom-up, graphic array oriented approach to word recognition (Y. Goodman, 1970). These strategies will be apparent in the deviations from expected responses that the readers make in their oral reading. The reader is seen as going through a process of prediction based upon ongoing textual meaning and sampling of minimal perceptual features from the text in order to confirm the prediction. This is

generally thought of as a top-down, concept driven process in which the semantic and syntactic knowledge that the reader possesses guides the word recognition process.

The second factor involves the automatic identification of words (LaBerge and Samuels, 1974) . According to this hypothesis, proficiency in reading occurs when the reader achieves a level of automaticity in reading. Automaticity is defined in terms of the reader's instantaneous and attention-free decoding of words. This occurs when the reader decodes a target word quickly and without error. Of the two characteristics, speed and accuracy, speed is the most important (Samuels, 1979; Stanovich, 1980). The process is primarily bottom-up in that the reader tends to use, without employing attentional resources, the perceptual information embedded in the text to guide the word identification process.

Samuels (1979) used the theory of automaticity in reading to explain the success of his method of repeated readings and C. Chomsky's (1979) work with remedial readers in developing reading fluency. In both methods repeated practice in reading single texts resulted in increases in reading speed, accuracy and comprehension of those passages and new ones. Samuels claimed that the techniques helped the students achieve fluency by bringing their word recognition skills to an automatic level. Comprehension improved commensurately as the students were able to devote a greater portion of their attentional resources to the understanding of the text.

The third factor maintains that reading proficiency is a function of the ability of the reader to phrase or chunk text into syntactically appropriate and meaningful units of multiple words. Proficient reading is exhibited in oral reading by proper phrasing that generally coincides with syntactic boundaries. The proficient reader orally reads text in such a way that his/her pause behavior

follows those established by convention and/or syntactic rule.

According to Schreiber (1980), oral language has embedded within it a set of prosodic cues that help the listener segment utterances into syntactic units for processing. Written texts, however, do not provide the same clear cues for phrasing that oral speech provides. "The child must learn to compensate somehow for the lack of overt marking of many syntactic units" (Schreiber, 1980, p. 181).

In an alternative explanation of Samuels' (1979) repeated readings, Schreiber (1980) argues that the reader, after numerous exposures to the same text, begins to recognize or infer the syntactic phrasing that is necessary in order to make sense out of the passage. This recognition takes place as the reader discovers and utilizes the semantic, syntactic, morphological, and contextual cues which are found in the written text and which correspond to oral prosodic cues. Thus:

> The explanation for the success of the method of repeated readings therefore probably...arises from the observation that what one must do in order to attain fluency in reading is to compensate for the absence of prosodic marking in identifying syntactic phrases (Schreiber, 1980, p. 182).

Although previous research has identified these factors, the studies have tended to treat each of the factors in isolation, thus making the tacit assumption that each factor alone was responsible for fluent reading. However, as Golinkoff (1975-1976) pointed out in her review of factors associated with proficient reading:

> "The way in which these individual components come together during reading comprehension, how one influences the other, and how deficiency in one affects the others is still not known" (p. 656).

The present study attempted to extend the line of reading fluency research by hypothesizing an integrated model of reading which incorporated the three

factors in an interactive manner. The viability of the model was tested using covariance structure analysis techniques. Moreover, alternative models, employing the same factors in different configurations, were also posited, fitted to the accumulated data, and tested.

Figure 1 presents a causal diagram of the hypothesized model of reading fluency. Since automatic word identification and contextual word identification are word level factors, and phrasing involves multiple word units, the model hypothesized that the effects of automatic and contextual word identification on comprehension are mediated through phrasing. Clearly, proficiency in single word analyses would seem to be a prerequisite for proficient multi-word analyses. Additionally, a correlational path between the two word-level factors represents the hypothesized interaction between them (Stanovich, 1980).

Insert Figure 1 About Here

METHOD

Subjects

The subjects for the study came from two elementary schools, representing both upper-middle and lower-middle SES neighborhoods. Normal achieving students from the third-grade (N = 77) and fifth-grade (N = 65) of both schools participated in the study.

Variables

The variables chosen follow the conventions of covariance structure analysis (Joreskog and Sorbom, 1984). In this paradigm latent variables and measured variables are posited. Latent variables are underlying, abstract factors that are not amenable to direct observation or measurement. Measured variables are imperfect but observable indicators of the latent variables or factors. In the

present study, four latent variables and ten corresponding measured variables were identified (see Table 1).

The use of multiple measures for the comprehension latent variable accords with recent work in the area of comprehension evaluation (Johnston, 1983).

Materials

Social Studies Passages . The subjects were asked to orally read and parse a passage of approximately 500 words taken from a social studies textbook. The passages were chosen from an existing elementary textbook series. In accord with criteria established by miscue analysis procedures (Y. Goodman and Burke, 1972) the calculated readability levels were approximately one grade level above grade placement.

Glod Passage . Subjects were asked to parse (i.e., identify the within-sentence breaks) a passage specifically designed for such a purpose (Kleiman, Winograd and Humphrey, 1979).

Multiple Choice Comprehension Test . A ten-point, multiple-choice comprehension test was developed for each social studies passage.

Standardized Reading Achievement Test . The appropriate level of the Gates-MacGinitie Reading Test (MacGinitie, 1978) was administered to all subjects.

Data Collection

The students orally read the appropriate social studies passage. Following a buffer task they were asked to retell all that they could remember from their oral reading following the established criteria for retelling (Y. Goodman and Burke, 1972). Retellings were audio recorded. The subjects were then asked to complete the multiple choice test on the social studies passage.

In measuring phrasing ability the subjects were asked to parse or divide each sentence of the social studies and Glod passages at its natural pause break(s), if any, by placing a slash at the identified break. They were instructed that most

sentences have points at which they break. These breaks tend to be signalled by the within-sentence pauses that occur in oral reading. Several novel sentences were presented for practice under the direction of the researcher. Finally, all subjects were administered the Gates-MacGinitie Test.

Scoring

Speed of Reading . Each subject's reading speed was determined. Reading speed was calculated on the oral reading of the social studies text. Rechecks of the original reading speed calculations did not vary by more than one percent.

Miscue Ratio Score . The miscue ratio score was based on a reading miscue inventory (RMI) (Y. Goodman and Burke, 1972) performed on all miscues observed in the oral readings of the social studies text. The procedure outlined by Y. Goodman and Burke was used to code questions 6 through 9 on the RMI for each miscue. This procedural information was then used to determine the loss potential of each miscue (i.e., "loss," "no loss," or "partial loss"). The miscue ratio score is the percentage of all miscues that result in "no loss" of comprehension. The value of "partial loss" miscues was divided in half and assigned equally to the "loss" and "no loss" categories.

The resulting score reflected the proportion of meaning- or context-based word identification strategies used in reading over more text-driven strategies. Inter-rater reliability in the miscue scoring stood at .87.

Glod Passage Phrasing Scores . The students' phrase marking of the Glod passage was scored by comparing each student's performance against the combined performance of a set of proficient adult readers who had earlier completed the same task. The results of the adult performance identified required breaks (marked by 50% or more of the norming sample) and indeterminate breaks (marked by 13 to 49% of the sample). Matches between students and the adult-generated key in identification of required breaks resulted in no loss of points. Failure to mark

a required break resulted in a loss of one point per occurrence. One point was also lost for each break marked by the student which was not marked as required by the key. At points of indeterminancy students could have either marked or failed to mark breaks without the loss of points. Inter-rater reliability for this scoring was calculated to be .99.

Sentential Phrasing Score . The students' phrase marking of the social studies passage was used as the basis for the sentential phrasing score. The students' marking of the social studies passage was scored by comparing each student's performance against the combined performance of a set of proficient adult readers who had earlier completed the same task. Sentences that were phrase marked identically by 50% or more of the norming sample were given a value of two points for that particular configuration. Sentences marked identically by 11 to 49% were given a value of one point. Points were allotted, then, according to the scale. Inter-rater reliability for the scoring of the sentential phrasing task was found to be .99 for grade three and .93 for grade five.

Retelling Score . The retelling score for each reading of the social studies passage was determined using procedures developed by Y. Goodman and Burke (1972) for informational material. Prior to the actual scoring of the retelling outlines were developed for each passage, incorporating Y. Goodman and Burke's categories of "specific content", "generalizations", and "major concepts". Points were then distributed among the various elements of the outlines which reflected the ratio of point distribution suggested by Y. Goodman and Burke. An independent rater then scored the retellings by listening to the taped retellings of the students and assigning points as indicated by the scoring keys. Inter-rater reliability in the scoring of the retellings was found to be .94 for the total retelling scores.

Multiple Choice Comprehension Score . Each student reading a social

studies passage was given the appropriate ten-point multiple choice test. The scoring of the tests was rechecked by a second observer. No errors were detected.

Gates-MacGinitie Reading Test Comprehension Score . Each student was administered the appropriate level of the comprehension subtest from the Gates MacGinitie (MacGinitie, 1978). Standardized scores were determined. The scores were rechecked by a second observer who found no errors.

RESULTS

Descriptive Analyses

The variables examined in this study are presented with their abbreviations in Table 1. Means and standard deviations for scores on the measured variables by grade levels were calculated (See Tables 2 and 3). In addition correlation matrices for the measured variables by grade levels were calculated (see Tables 4 and 5). All correlations, except for two at each grade level were found to be significant at the .05 level.

Insert Tables 1 Through 5 About Here

Factor Analysis

In order to verify the existence of the three independent factors and a comprehension factor a factor analysis with oblique rotation of axes was run on all test scores for each grade level. The resultant loadings are displayed in Tables 6 and 7. The results of the analysis tend to confirm the existence of these factors.

Insert Tables 6 and 7 About Here

Testing and Fitting the Hypothesized Model

The plausability of the hypothesized model (see Figure 1) was tested by fitting the data to the model and assessing fit. The LISREL V' (Joreskog and Sorbom, 1984) version of covariance structure analysis was employed. Parameters were estimated using the maximum likelihood method.

Covariance structure analysis or structural equation modeli.g attempts to explain the relationships among a set of observed or measured variables in terms of a smaller set of unobserved cr latent variables (i.e. factors). It allows for inferences of causation to be ma'e from non-experimental data (Joreskog and Sorbom, 1984) (c.f. Bentler, 1980).

The first model tested for grade three (Grade Three, Model One) was the hypothesized model (see Figure 2 for the standardized solution). The overall fit of the model was deemed marginal (see Table 8) and the modification indices indicated that conceptually meaningful paths could be added to the model. Thus, a specification search yielded the final fitted model for grade three (Grade Three, Model Three). This model incorporated conceptual.y justifiable correlation paths between the GLOD and SENT measured variables and between the RETL and MULT measures (see Figure 3). Overall fit information (Table 8) indicated that the fit of the model improved considerably.

Insert Figures 2 and 3 About Here

Insert Table 8 About Here

The hypothesized model for grade five (Grade Five, Model One) fitted the data well enough to require no further modification (Figure 4). All goodness of fit indices (Table 8) indicated that the model displayed good fit to the data.

Insert Figure About Here

As shown in Table 9, the amount of variance in comprehension accounted for by the three independent factors ranged from 77 to 96.5%. Thus the inference that the three factors, Automatic Word Identification, Contextual Word Identification, and Phrasing, acting together, are important contributors to comprehension ability in the population is substantiated.

Insert Table 9 About Here

The major difference in the fitted models for grades three and five lies in the change in relative influence of the Contextual and Automatic Word Identification factors on Phrasing directly, and reading comprehension indirectly. It appears that with increased reading maturity the reader relies in increasingly larger measures on contextual cues in word identification.

Testing and Fitting Alternative Models

Although the hypothesized model resulted in a reasonably good fit to the data the possibility remained that other models, using the same latent and measured variables, could produce even better and more parsimonious fits to the data. In order to explore such possibilities a series of alternative models were

proposed.

The alternative models employed the same latent and measured variables used in the previous analyses but in different schemes. In the Alternative Model Set A the Phrasing, Contextual Word Identification, and Automatic Word Identification latent variables were developed with direct causal paths for each to comprehension. None of the effects of the three independent latent variables were mediated through another variable set prior to impacting on comprehension. The models in Alternative Model Set B were the same in structure as the earlier hypothesized models. However, in Alternative Model Set B1 the Automatic Word Identification latent variable was posed as the mediating variable, with the effects of Phrasing and Contextual Word Identification being passed through it. In the Alternative Model Set B2 Contextual Word Identification played the role of mediating variable. All alternative models were fitted to the data using the same rule-governed procedures employed in fitting the hypothesized models and which were described previously.

In general, the analysis of fit information for the alternative models revealed that: (1) the alternative models did not fit as well as the fitted hypothesized models; (2) they did not account for as much variance in comprehension as the fitted hypothesized models; and/or (3) they were less parsimonious models of the reading process than the hypothesized models. The fitted alternative models were significantly more complex, less easy to interpret, and far less parsimonious explanations of the comprehension process than the hypothesized models. Although a few alternative models approximated the level of fit of the hypothesized models, these models were also burdened with excessive complexity in specification and decreased levels of variance accounted for in comprehension.

DISCUSSION

The fitted forms of the hypothesized models displayed good fit to the data, especially in light of the testing of alternative models. Each model accounted for a very significant amount of variance in comprehension. These models suggest, then, that reading is an interactive process between the two modes of word identification. This is consistent with previous models of reading and language processing (e.g. Dell and Newman, 1980; Rumelhart, 1977).

Both final fitted models developed in this study are in agreement with Stanovich's (1980) contention that reading is an interactive process among the word identification factors. However, as reading proficiency increased from third-grade to fifth the relative importance of the Contextual Word Identification factor (as measured by the standardized Gamma coefficients on the paths between the word identification factors and Phrasing) also increased. Although Automatic Word Identification continues to play the primary role at both grade levels, the relative importance of context increases to the point where it is nearly equal to Automatic Word Identification by grade five. This particular effect is not consistent with the Stanovich model which suggests that with increased reading proficiency the Automatic Word Identification processes should become progressively dominant over Contextual Word Identification.

One possible explanation for these results in terms of Stanovich's model may lie in the relative reading abilities of the subjects used in the study. The fifth-grade subjects were, as a group, less proficient readers relative to their grade placement than the third-graders. Thus, given texts of equal difficulty relative to grade placement, the fifth-graders were actually less proficient readers.

Conclusions

Several tentative conclusions emerge from this study:

1. The three identified independent latent variables, Automatic Word Identification, Contextual Word Identification, and Phrasing are indeed valid surface-level reader factors involved in fluent reading. Each factor accounted for a substantial and significant amount of variance in comprehension.

2. The identified factors appear to act in an interactive manner in leading to comprehension. These factors are not isolated contributors to comprehension but act in such a way that they are influenced by other variables. Specifically, the Phrasing factor appears to mediate the effects of the two word identification factors at both grades three and five.

3. The nature of the interrelationship of these factors is not static. Developmental changes were observed. The major developmental effect was a relative increase in the importance of Contextual Word Identification over Automatic Word Identification from third- to fifth-grades.

Instructional Implications

The results of the present study offer several general implications for classroom practice. First, the study suggests that reading is made up of multiple, interrelated, and dynamic factors. Accordingly, teaching strategies that emphasize only one factor may not be optimal. For example, a strategy to develop automatic word recognition through isolated word practice (Reid, 1980) will do little to develop children's use of context in word identification and their abilities to phrase texts. A more sensible teaching strategy may include the wide use of activities and materials that allow students to simultaneously develop proficiency in contextual as well as automatic word recognition, and in the ability to phrase texts.

Second, this study suggests that among the factors studied the Phrasing

factor is dependent upon the word recognition factors. If that is truly the case, then in order for children to mature in the ability to phrase texts they mu. given materials which do not cause profound difficulties in word identification. Thus, the use of reading materials that are not difficult in terms of word recognition or conceptual understanding is recommended.

Third, Schreiber and Read (1980) suggest that the ability to phrase in reading is due, in large part, to a developmental leap from phrasing in oral language to phrasing in written language. If so, then it is suggested that the written texts that children are exposed to at an early age reflect the natural language that they hear in oral speech. The use of language experience activities (Stauffer, 1980) and children' literature (Huck, 1976), is recommended.

Fourth, in bridging the gap from phrasing in oral language to phrasing in written language the use of modeling by teachers and others in such a way that written language is expressed orally with correct use of prosodic features cannot be underestimated. Thus, such activities as reading aloud to children (Huck, 1976), imitative reading (C. Chomsky, 1978), dramatic plays and readers the.ter (Moffett and Wagner, 1983), etc. are very appropriate. Reading aloud to children is a particularly good way to introduce them to the language and conventions of written texts.

Directions for Future Research

Future research efforts may wish to consider models emerging from different age subjects and different classroom contexts. Such studies may contribute to an understanding of the developmental and school-related environmental factors affecting reading fluency.

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Table 1

Variables

Abbreviations		
Latent	Measured	Variable
AUTO		Automatic Word Identification
	RATE	Speed of Reading
CNTX		Contextual Word Identification
	MSCR	Miscue Ratio Score
PHRS		Phrasing
	GLOD	Parsing score on GLOD Story
	SENT	Parsing score on Social Studies Passage
COMP		Comprehension
	RETL	Retelling Score
	MULC	Multiple Choice Test Score
	GCMP	Gates-MacGinitie Reading Test Comprehension Score

Table 2

Means and Standard Deviations for Grade 3

Measured Variable	N	Mean	Standard Deviation
RATE	74	79.86	30.01
MSCR	77	52.91	16.90
GLOD	76	79.47	11.10
SENT	75	17.31	6.24
RETL	76	32.35	13.48
MULC	76	6.41	2.11
GCMP	75	473.93	60.92

Table 3

Means and Standard Deviations for Grade 5

Measured Variable	N	Mean	Standard Deviation
RATE	65	113.27	28.20
MSCR	65	64.18	14.63
GLOD	65	87.89	6.05
SENT	63	17.00	7.05
RETL	64	59.51	22.35
MULC	65	5.49	2.14
GCMP	63	512.73	72.80

Table 4

Correlation Matrix for Grade 3

	RATE	MSCR	GLOD	SENT	RETL	MULC	GCMP
RATE	1.0						
MSCR	.688*	1.0					
GLOD	.540*	.495*	1.0				
SENT	.389*	.441*	.456*	1.0			
RETL	.366*	.386*	.217	.105	1.0		
MULC	.447*	.610*	.422*	.362*	.499*	1.0	
GCMP	.791*	.668*	.493*	.350*	.393*	.632*	1.0

* $p < .01$

Table 5

Correlation Matrix for Grade 5

	RATE	MSCR	GLOD	SENT	RETL	MULC	GCMP
RATE	1.0						
MSCR	.605*	1.0					
GLOD	.418*	.369*	1.0				
SENT	.336*	.503*	.302**	1.0			
RETL	.377*	.517*	.128	.285	1.0		
MULC	.527*	.602*	.294**	.393**	.467*	1.0	
GCMP	.753*	.723*	.464*	.568*	.570*	.722*	1.0

* $p < .01$

** $p < .05$

Table 6

Grade 3 Factor Loadings for Measured Variables with ACCR and HOLS Deleted and Using Oblique Rotation of Axes

Measured Variable	Factor			
	I COMP	II AUTO	III PHRS	IV CNTX
RATE		.83		
MSCR				.34
GLOD			.51	
SENT			.61	
RETL	.64			
MULC	.67			
GCMP	.26			

Table 7

Grade 5 Factor Loadings for Measured Variables with ACCR and HOLS Deleted and Using Oblique Rotation of Axes

Measured Variable	Factor			
	I COMP	II AUTO	III CNTX	IV PHRS
RATE		.58		
MSCR			.60	
GLOD				.13
SENT				.45
RETL	.72			
MULC	.63			
GCMP	.56			

Table 8

Overall Goodness of Fit Information

Model	Chi Sq.*	DF	Prob	ML** GFI	LS** GFI	Rho **	RMR**
Grade 3 Model 1	31.16	12	.002	.895	.989	.852	.062
Grade 3 Model 3	19.83	10	.031	.929	.995	.909	.046
Grade 5 Model 1	13.46	12	.336	.944	.995	.987	.048

* In LISREL the chi-square is a test of the null hypothesis which states that the model fits in the population. Thus, a non-significant chi-square is desirable as it leads to a failure to reject the null hypothesis.

** ML GFI = Maximum Likelihood Goodness of Fit Index

LS GFI = Unweighted Least Squares Goodness of Fit Index

Rho = (See Bentler & Bonett, 1980)

RMR = Root Mean Square Residual

Table 9

Amount of Variance in Dependent Latent Variables Accounted for by the Structural Equation Model

Model	Latent Variables	
	Phrasing	Comprehension
Grade 3 Model 1	89.2*	83.1
Grade 3 Model 3	92.9	77.2
Grade 5 Model 1	72.2	96.5

*Values represent percentages

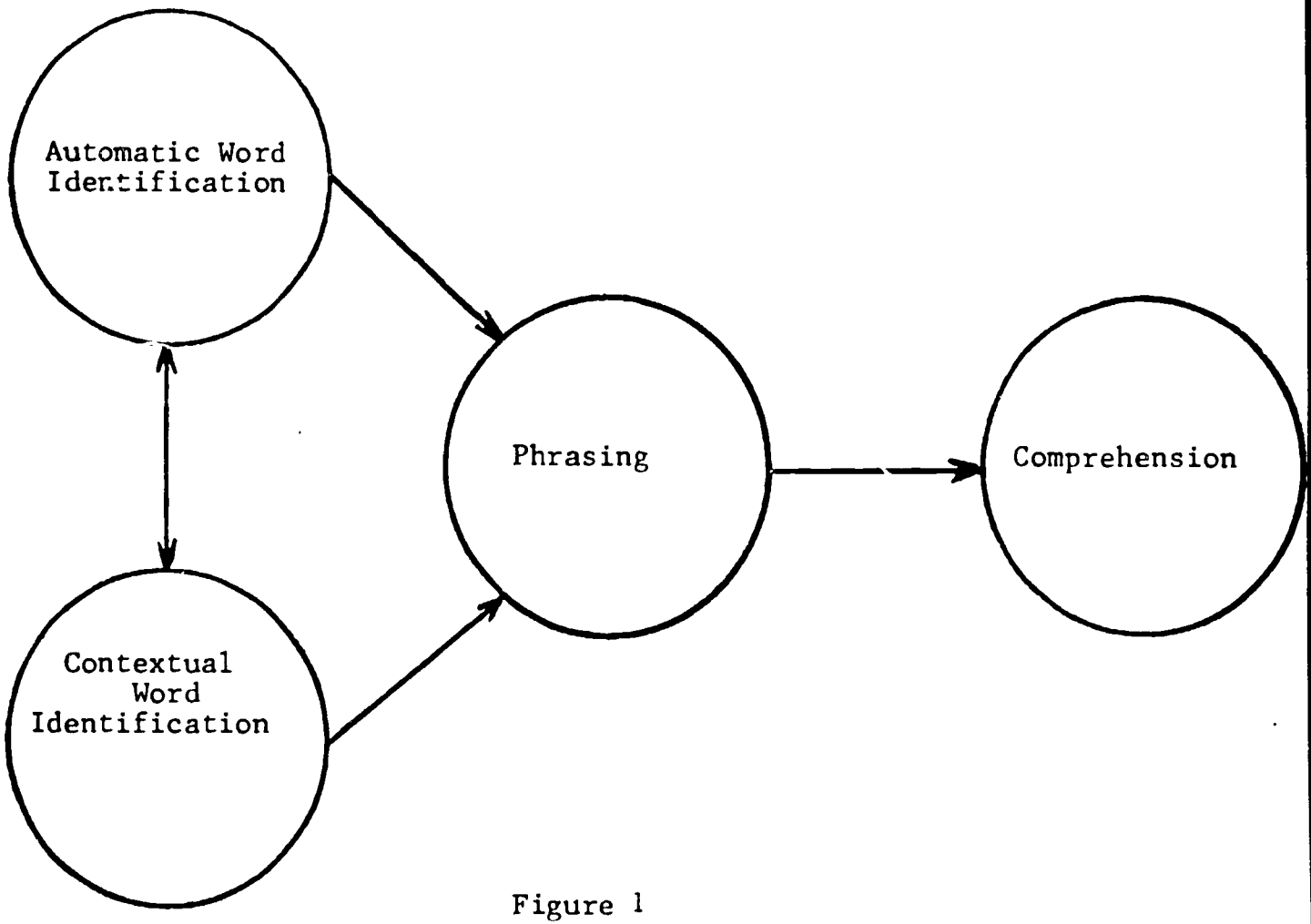

Figure 1

Causal Model of the Hypothesized Interrelationship of Factors

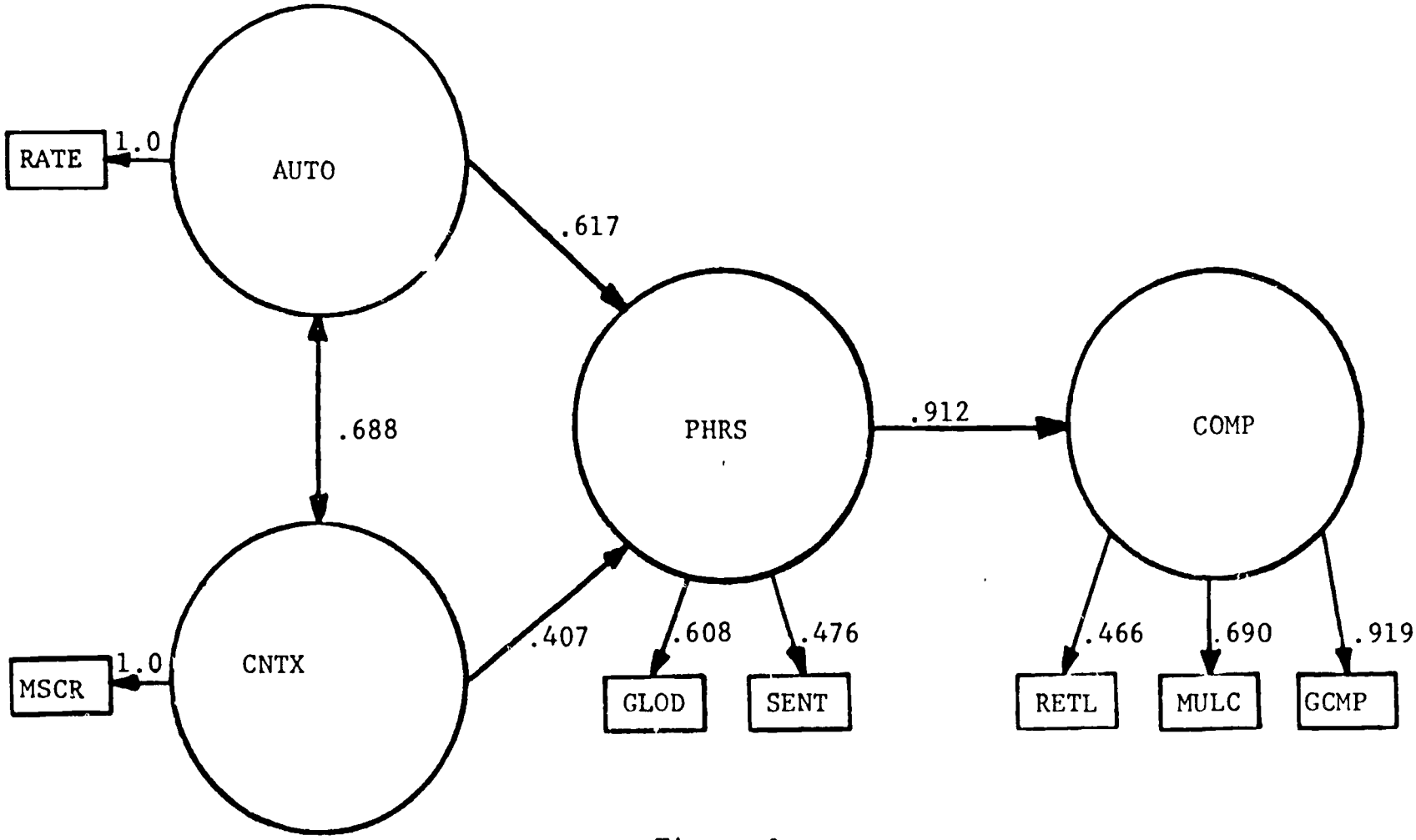

Figure 2
Standardized Solution for Grade Three, Model One

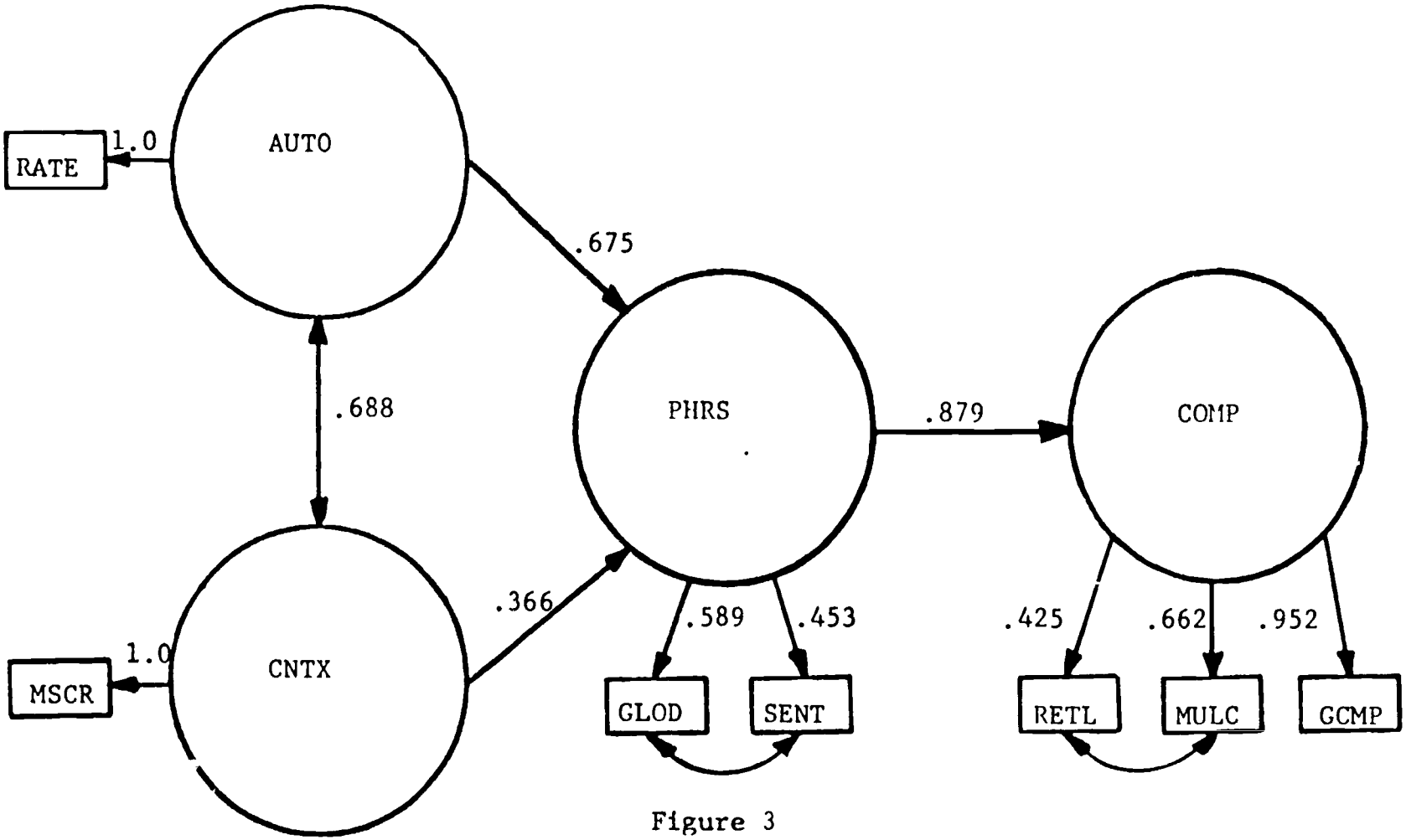

Figure 3
Standardized Solution for Grade Three, Model Three

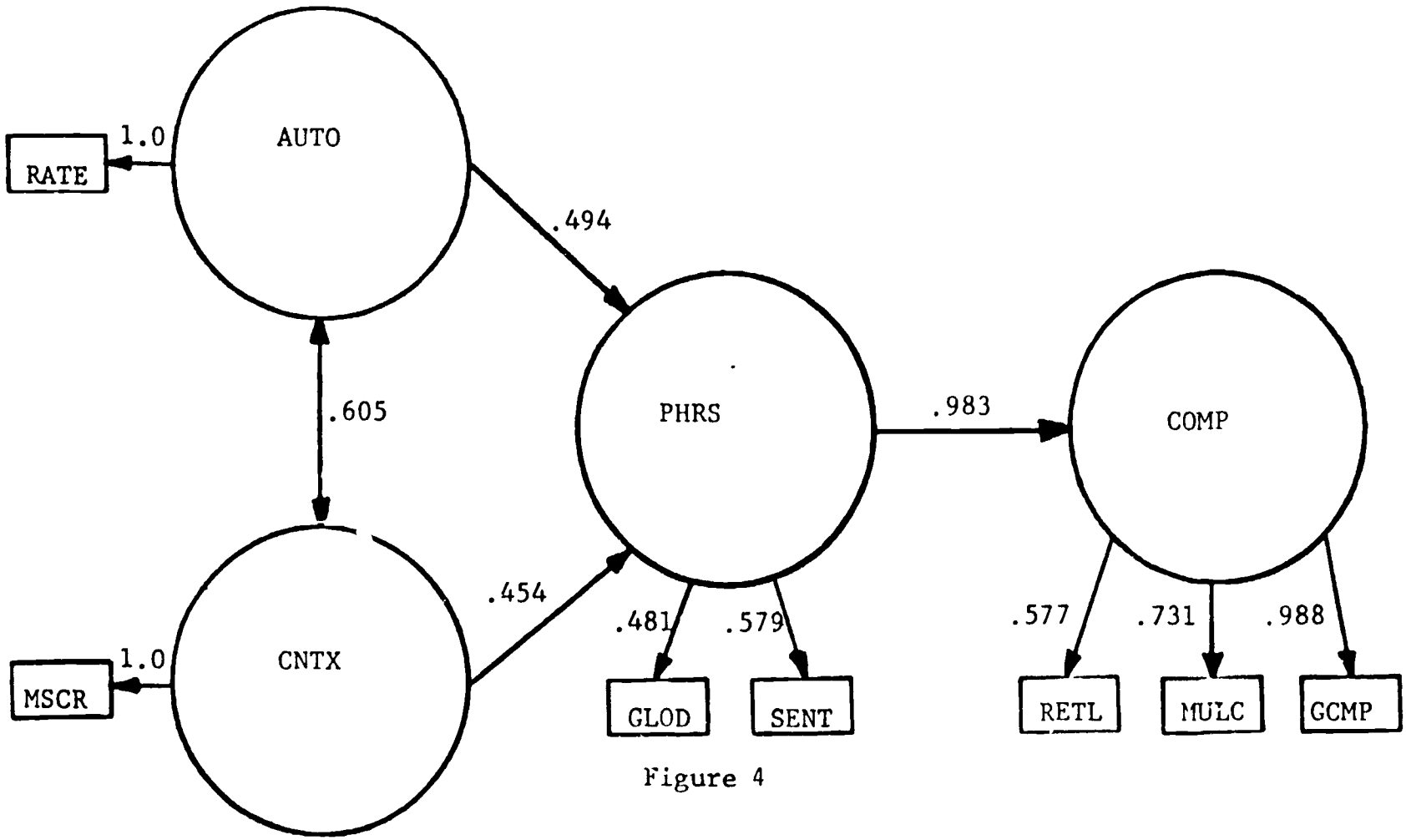

Figure 4

Standardized Solution for Grade Five, Model One