THE COMPONENT MODEL OF READING: SIMPLE VIEW OF READING MADE A LITTLE MORE COMPLEX

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The “Simple View of Reading” proposes that reading comprehension could be predicted by the product of decoding and linguistic comprehension. A somewhat modified version of this model suggests that the relationship between decoding and linguistic comprehension should be additive rather than multiplicative. This research is comprised of two studies. The first study compared the efficacy of the two formulas: (a) Reading Comprehension = Decoding \times Listening Comprehension, and (b) Reading Comprehension = Decoding + Listening Comprehension. The second study reported here explored whether adding another factor, speed of processing, to the Simple View of Reading formula improves its ability to predict reading comprehension. Forty third-grade children were administered word-attack and listening comprehension subtests from the Woodcock Language Proficiency Battery; the reading comprehension subtest from the Gates-MacGinitie Reading Tests; and a list of 40 letters to measure speed of processing. The results showed that Decoding and Listening Comprehension, whether multiplied with each other or added to each other, did not significantly alter the outcome. Furthermore, while 48% of the variance for Reading Comprehension could be explained by Decoding and Listening Comprehension, speed of naming the letters added another 10%. A modified model of reading is proposed which can be expressed by the formula, \( R = D \times C + S \).

It is estimated that approximately 25 percent of elementary age school children have some type of reading problem (Stedman & Kaestle, 1987). It is not surprising, therefore, that a great deal of time and effort are invested in special education programs such as

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Title I and learning disability programs, which are aimed at improving reading skills. Since it is also recognized that early identification is essential for remediation to be effective, special education programs have invested heavily in assessment procedures. In spite of sustained efforts, the current procedures used for identification of reading disabilities are riddled with several problems which led Vinsonhaler, Weinshank, Wagner, and Polin (1983) to comment that the diagnostic instruments that are currently being used in the school systems are generally not very useful. One reason for this disappointing outcome may be the fact that the diagnostic procedures that are currently being used in the school systems are not based on valid theoretical models of reading and therefore, provide no direction as to the remedial strategies to be used. Consequently, reading specialists often come up with different diagnoses on the same case when such are presented as two different cases simply by masquerading the name (Vinsonhaler & Shermon, cited in Carr, 1982), which makes remedial instruction only a gamble. It would appear, therefore, that a sound model of reading would provide a valid focal point for assessment and remedial procedures.

A model can be defined as “a way of depicting a theory’s variables, mechanisms, constructs, and interrelationships” (Singer & Ruddell, 1985, p. 620). According to this definition, a model is a superstructure derived from a combination of theory or theories and empirical data and is more comprehensive than a theory. During the course of the past 50 years, several models relating to the reading process have been proposed by educators and researchers. Among these are: information processing models, linguistic models, an interactive activation model of context effects, an interactive model of reading, an inferential schema theory model, an affective model, a dual-route model of word recognition, etc. (Singer & Ruddell, 1985). Generally speaking, these models have sprung from specific theories and are, therefore, concerned either with a single aspect of reading such as word recognition or are global in nature and describe cognition in general. For example, the dual-route model (Coltheart, Curtis, Atkins, & Haller, 1993) is concerned with word recognition only; the linguistic model (Athey, 1985) is concerned with syntax and semantics but excludes phonology; on the other hand, the schema theory models are descriptors of cognition in general.
A pragmatic model designed to link assessment with instruction which can be helpful in the diagnosis and remediation of reading problems has been recently developed and tested (see Aaron & Joshi, 1997; Aaron, 1997; Joshi, 1999). Named the “Component Model of Reading”, it was inspired by the Simple View of Reading proposed by Gough and Tunmer (1986) and Hoover and Gough (1990). In this model, a component is defined as an independent elementary information processing system that operates upon internal representations of objects and symbols (Sternberg, 1985). According to this definition, a cognitive process such as reading can be composed of several independent components. Furthermore, one component of a cognitive process may function normally whereas other components may fail to develop to an optimal level.

Gough and Tunmer (1986) and Hoover and Gough (1990) have expressed their Simple View of Reading in the form of a formula \( R = D \times C \), where \( R \) stands for Reading Comprehension, \( D \) for Decoding and \( C \) for linguistic Comprehension. What this means is that if \( D = 0 \), then \( R = 0 \); and if \( C = 0 \), then also \( R = 0 \). It follows, then, that a student who has virtually no decoding skill will be a non-reader. Similarly, a student who has no language comprehension skill will also be a non-reader.

In the Component Model, decoding is treated as a basic requirement for word-recognition skill. Sight-word reading skill emerges as an important word aspect of word recognition at about grade 4. Because sight-word reading skill appears to be built on decoding skill and, therefore, not independent of decoding skill (Aaron, Joshi, Ayotollah et al. 1999; Ehri, 1998), it is not treated as an independent component in this model.

Sight-word reading can be considered a speeded up decoding process; that is, Decoding + Speed = Sight-Word Reading. However, whether ‘reading speed’ could be considered an independent component is an issue that is yet to be resolved (see Bowers & Wolf, 1993; Carver, 1998). Nevertheless, rapid and automatic recognition of words are characteristics that mark the skilled reader, the rate at which the written word is processed should be considered as a factor to be reckoned with in reading. In the present context, comprehension is used as a generic term that refers to both reading and listening comprehension. In a study, Palmer, McCleod, Hunt, and Davidson (1985) obtained a correlation co-
efficient of 0.82 between reading comprehension and listening comprehension and concluded that listening comprehension can be predicted almost perfectly by a listening measure. A review of similar studies suggest that it matters little, as far as comprehension is concerned, whether the material is read or heard (Trabasso, 1981).

Empirical evidence in support of the validity of the Component Model comes from experimental, developmental, neuropsychological, and genetic studies. For instance, children labeled ‘hyperlexic’ can pronounce words aloud well but do not comprehend nearly as well what they read, whereas dyslexic children cannot read aloud well, but can, nevertheless, comprehend better than they can pronounce words (Frith & Snowling, 1983). Similarly, neuropsychological patients described as ‘deep dyslexics’ can comprehend the meaning of words better than they can read aloud these words accurately; an opposite pattern of behavior is observed among ‘surface dyslexics’ (Marshall & Newcombe, 1973).

Even though these studies suggest that decoding and comprehension are independent components of reading, the nature of their interaction during the reading process is not clear. Hoover and Gough (1990) propose that both decoding and comprehension interact in a multiplicative fashion \( R = D \times C \). In contrast, Dreyer and Katz (1992) propose that the relationship between these two variables is additive \( R = D + C \). Perfetti (1985) added another factor which he simply labeled as ‘X’ and proposed the following formula: Reading comprehension = decoding language comprehension + X, and noted that X is small relative to the other two factors. As noted earlier, the multiplicative formula would theoretically recognize the existence of potential ‘non-readers’ whereas the additive formula would predict the existence of poor readers whose reading skill will not be nearly as deficient. Hoover and Gough confirmed the predictive validity of their multiplicative formula by administering decoding and comprehension tasks to bilingual children in grades 1 through 4. In that study, decoding was assessed by administering 42 nonwords and reading comprehension was assessed by asking the subjects to recall as much information as they could remember from the passage they had read. Dreyer and Katz (1992), on the other hand, administered 60 low-frequency single syllable real words as a decoding test and the reading and listening comprehension subtests from the Educational
Records Bureau Comprehensive Testing Program II (Educational Testing Service, 1987). These tests were administered to 137 monolingual third graders and two years later when these children were in grade 5. Dreyer and Katz concluded that the additive formula predicts reading comprehension as well as the multiplicative formula. Thus, the interactive relationship between decoding and comprehension still remains unclear.

The present investigation was designed to answer two questions: (a) which one, the multiplicative model of Gough and Tunmer or the additive model of Dreyer and Katz, is a better predictor of reading comprehension, and (b) will adding processing speed enhance the predictive ability of the multiplicative model proposed by Gough and Tunmer.

**Study 1**

**Participants**

Forty children from two sections of grade 3 were selected for this study. No effort was made to select children on any criteria. Children from each section participated in the study. They were attending regular classrooms in an elementary school in the Southwestern part of the United States and represented the general population distribution of the region. None of the children had any reported uncorrected hearing or vision problems nor had they repeated any grade.

**Procedure**

The participants were administered the word-attack subtest and the listening comprehension subtest of the Woodcock Language Proficiency Battery–Revised (WLPB-R; Woodcock, 1991). The word-attack subtest consists of 30 nonwords which the participants were asked to read aloud as quickly and as accurately as possible. The number of items named correctly were noted. The listening comprehension subtest follows a cloze format. The examiner reads the sentence with one word missing and the subject is asked to supply the missing word. These tests were administered individually and their responses were taped for further analyses. The reading comprehension portion of the Gates-MacGinitie Test
(MacGinitie & MacGinitie, 1989) was administered to these children as a group test. This is a silent reading test that has 45 questions for which the possible answers are presented in a multiple-choice format. The number of correct answers obtained by each student was noted and the raw scores were converted to standard scores.

Results

The standard scores from the word-attack subtest and from the listening comprehension subtest were used to compute the coefficients of correlation between reading achievement and the product of decoding and listening comprehension ($D \times C$) on the one hand, and between reading achievement and sum of decoding and listening comprehension ($D + C$) on the other. The results are shown in Table 1.

As seen in Table 1, about 48% of the variance in reading comprehension can be explained by the product of decoding and listening comprehension and about 46% of the variance in reading comprehension can be explained by summing up decoding and listening comprehension scores. Even though the percentages of variances are slightly higher than those found in the Hoover and Gough, and Dreyer and Katz studies, the product ($D \times C$) index is slightly better than the summation ($D + C$) index. Nevertheless, the Simple View of Reading model, as proposed by Gough and Tunmer (1986), is as applicable to monolingual children as it is to bilingual children when nonwords are used as a test of decoding ability.

**TABLE 1. Coefficients of Correlation Between Reading Comprehension and Other Variables Tested in the Study**

<table>
<thead>
<tr>
<th>Correlation Coefficient Between Reading Comprehension and</th>
<th>Variance in Reading Comprehension Accounted For</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Word Attack ($D$)</td>
<td>0.59*</td>
</tr>
<tr>
<td>2. Listing Comprehension ($C$)</td>
<td>0.50*</td>
</tr>
<tr>
<td>3. $D \times C$</td>
<td>0.69*</td>
</tr>
<tr>
<td>4. $D + C$</td>
<td>0.68*</td>
</tr>
</tbody>
</table>

*significant at 0.0001 level
Study II

According to the recent report of the National Research Council of the National Academy of Sciences (Snow, Burns, & Griffin, 1998), a good reader should possess three skills: decoding, comprehension, and fluency. The models proposed by Gough and Tunmer and by Dreyer and Katz take into consideration decoding and comprehension but not the speed of processing. The present study attempted to see if adding processing speed would enhance the formula’s predictive ability. As noted earlier, the status of speed of processing as an independent component of reading remains a contentious issue (Bowers & Wolf, 1993; Carver, 1998). We wanted to see whether prediction of reading comprehension could be enhanced by adding speed of processing as a factor to decoding and linguistic comprehension.

The speed factor was not used as a multiplier of the product of decoding and listening comprehension for predicting reading achievement, but was added to the product of decoding and listening comprehension because we are uncertain about the status of speed of processing as an independent component of reading. Studies show that in the first three grades of elementary school decoding is more closely associated with reading skill than speed of processing information. From then on, speed emerges as an important factor. At this point, children are said to be able to read many words by “sight” without relying entirely on to the relatively slow decoding process.

A criterion for sight word reading is that the reader be able to name a word as quickly as he can name a letter of the alphabet. That is, when a word is named as rapidly as a letter, it is assumed that the word is read by sight. The fact that common monosyllabic words can be named as fast as a letter indicates that the letters that make up a word are processed simultaneously, in parallel. This means, that an ability to name a word by sight will tantamount to an ability to decode all the letters in the word simultaneously. For this reason, sight word reading skill (or speed of processing) can be considered an accretion to decoding skill. A number of studies support this view of speed of processing in reading (Aaron, Joshi, Ayotollah et al., 1999; Ehri, 1992, 1998).
Participants

The same group of 40 children from the third grade participated in the study.

Procedure

The scores of word-attack subtest, the listening comprehension subtest, and the reading comprehension subtest, from the original sample were used for the present study. Additionally, the subjects were asked to name aloud, as quickly and accurately as possible, 40 letters of the alphabet printed one below the other in lower case, in 14-point bold type. Letters of the alphabet are the simplest units of linguistic information that could be processed without resorting to complex grapheme-to-phoneme conversion (GPC). In addition to minimizing the skills needed for grapheme-to-phoneme conversion, letter naming also controls for factors such as word-frequency and regularity. The responses of the children were taped and the time taken to read the list of letters was computed by playing the tape back. Since most of the subjects named almost all of the letters accurately, the error factor was not considered important. A speed index for each subject was computed by dividing 40 (the total number of words in the list) by the time taken to read the list. This score was multiplied by 100 to remove the decimals. This was done because a child with a faster reading skill is likely to take less time in naming letters and the child with low reading skill is likely to take more time to name letters. This will result in a lower index score for good readers and a higher index score for poor readers. For example, if a poor reader takes 80 seconds to name the list, her index score would be $0.5 \times 100 = 50$ (the total number of letters, which is 40, divided by the time taken to read the list, which is 80, and then multiplied by 100). In contrast, if a good reader takes 20 seconds to name the list, then her score would be $2.0 \times 100 = 200$ (the total number of letters, which is 40, divided by the time taken to read the list, which is 20 and then multiplied by 100). Use of the unconverted index score can distort the figures when they are added to or multiplied by decoding and listening comprehension scores. Yet another adjustment was necessary since it is also known that letter and word naming speed reaches a ceiling effect by about the 5th grade (Aaron, Joshi,
Ayotollah et al., 1999; Biemiller, 1977/78). If this ceiling effect is not controlled, the formula will become inapplicable beyond grade 5. In order to eliminate the ceiling effect and make the trend linear, these scores were converted into log scores. Thus, the formula used in the present study for computing speed index was:

\[
\text{Speed Index} = \frac{40}{\text{time taken to read the list}} \times 100
\]

**Results**

The coefficients of correlation between reading comprehension and speed, and the product of decoding and listening comprehension with speed added to the product was computed. The results are shown in Table 2.

The data show that even though approximately 48% of the variance in reading achievement could be explained by the product of decoding and listening comprehension, adding letter naming speed would explain nearly an additional 10% of the variance. Fisher’s Z test was applied to find out whether the two correlation, \(D \times C (0.69)\) and \(D \times C + S (0.76)\) were significantly different. The Z value of -2.78 was significant at the 0.0027 level indicating that adding the speed factor to the Simple View of Reading significantly improves the ability to predict reading achievement.

**Discussion**

The results of the first study showed that approximately 50% of the variance in reading comprehension could be explained by two

<table>
<thead>
<tr>
<th>Correlation Coefficient Between Reading Comprehension and Decoding × Listing Comprehension + Speed</th>
<th>Variance in Reading Comprehension Accounted For</th>
</tr>
</thead>
<tbody>
<tr>
<td>Speed (S)</td>
<td>0.32*</td>
</tr>
<tr>
<td>10.24%</td>
<td></td>
</tr>
<tr>
<td>Decoding (D) × Listening Comprehension (C)</td>
<td>0.69**</td>
</tr>
<tr>
<td>47.61%</td>
<td></td>
</tr>
<tr>
<td>D × C + S</td>
<td>0.76**</td>
</tr>
<tr>
<td>57.76%</td>
<td></td>
</tr>
</tbody>
</table>

* significant at 0.05 level, ** significant at 0.0001 level
factors: decoding and listening comprehension. It was also found
that the amount of variance seen in reading comprehension was
similar irrespective of whether the two components were added
or multiplied. However, the multiplicative model, as proposed in
the Simple View (Hoover & Gough, 1990), was recommended as
it is applicable to a wide range of reading skills. Assume that there
is an extreme case of hyperlexic child with very good decoding
skills but virtually no comprehension skill (zero comprehension)
because the child could not answer any question from the test.
According to the multiplicative model, the reading achievement
of this child will be zero. Similarly, in the extreme case of deep
dyslexics, Decoding might be zero, even though Comprehension
might be at an acceptable level. Then, according to the simple
view:

\[ R = 0 \times C = \text{Zero Reading Achievement, and} \]
\[ R = D \times 0 = \text{Zero Reading Achievement} \]

However, according to the additive formula, it would be

\[ R = 0 + C = \text{Some Reading Achievement} \]
\[ R = D + 0 = \text{Some Reading Achievement} \]

Thus, even though the product and additive indices predict read-
ing achievement to the same degree, the product index is a better
formula because it makes allowances for nonreaders. Such non-
readers are encountered often, particularly in early elementary
grades.

The purpose of the second study was to find out whether add-
ing the factor of Speed of processing letters to the simple view
model would explain more variance in reading comprehension.
It was found that the speed factor adds another 10\% to the vari-
ance. Fisher’s Z test showed that adding speed factor to the pro-
duct of Decoding and Listening Comprehension significantly adds
to the formula’s ability to predict reading comprehension. \( D \times C + S \) is recommended for componental model rather than \( D \times C \times S \) because sight-word reading, which contributes much to the speed
of precessing, appears to be built on decoding skills. In one of our
previous studies (Aaron, Joshi, & Williams, 1999), Speed emerged
as an important factor at about grade 4. So, it is reasonable to
expect that the processing speed would explain even more vari-
ance at grade 4 and beyond than what is obtained here. In order to distinguish the new and improved model from the classical Simple View of Reading Model, we call the revised one the “Componental Model.”

Conclusion

The Simple View of Reading proposes that reading comprehension could be well predicted by the relationship between Decoding and Linguistic Comprehension (Gough & Tunmer, 1986; Hoover & Gough 1990). However, whether the relationship is multiplicative or additive has not been satisfactorily resolved. The first study explored this relationship based on the performance of 40 third graders on tests of word-attack, listening comprehension, and reading comprehension. Even though the product and additive indices predict reading achievement to a similar extent, the product index appears to be a better formula, because it can successfully deal with a wider range of reading abilities than the additive formula. Further, it was shown that adding speed of processing to the simple view formula significantly improves prediction of reading comprehension. A revised model of reading, \( R = D \times C + S \), named the “Componental model” is proposed. While this model seems to produce satisfactory results, its predictive validity remains to be tested at levels other than grade 3. We expect that at grade 4 and beyond, its predictive ability will increase.

References

Biemiller, A. (1977/78). Relationship between oral reading rates for letters,


