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This study investigated fourth-grade children's ability to identify and retrieve tachistoscopically presented words in relation to their rated ability on both reading speed and comprehension. No significant difference was found between fast and slow readers in either recognition or retrieval. High comprehension children had significantly lower recognition thresholds and retrieval times than the low comprehenders. In all analyses, high-frequency words had lower recognition thresholds and retrieval times than low-frequency words. Length of word had a significant effect only on retrieval time; the longer words took more time to retrieve. A significant interaction between word length and reading ability on the retrieval task suggests an important locus of difficulty for poor readers in the processing of long words. (Author)

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ABSTRACT

This study investigated fourth grade children's ability to identify and retrieve tachistoscopically presented words in relation to their rated ability on both reading speed and comprehension. No significant difference was found between fast and slow readers in either recognition or retrieval. High comprehension children had significantly lower recognition thresholds and retrieval times than the low comprehenders. In all analyses, high-frequency words had lower recognition thresholds and retrieval times than low-frequency words. Length of word had a significant effect only on retrieval time, the longer words took more time to retrieve. A significant interaction between word length and reading ability on the retrieval task suggests an important locus of difficulty for poor readers in the processing of long words.

CHILDREN'S WORD RECOGNITION AND RETRIEVAL AS A FUNCTION OF READING ABILITY[1]

It is hypothesized that the presence of a relatively large repertoire of sight words might be an important factor distinguishing good from poor readers. In order to test this hypothesis experimentally, a task was sought which would make an estimate of this repertoire.

On the basis of Sperling's (1970) model of information processing it was decided that a tachistoscopic word recognition threshold task may be a useful measure of sight word vocabulary. By presenting words for subliminal durations and increasing exposure by the method of ascending limits, recognition thresholds could be estimated for a number of words. It is assumed that for any given child, words with very low thresholds are sight words while those with higher thresholds are those that require processing of smaller units within the word. If the presence of a relatively large proportion of sight words is an important factor in reading ability, good readers should be found to have average lower recognition threshold scores across all words presented.

A further hypothesis involves the distinction between word recognition and retrieval. Retrieval refers to the actual vocalization of the stimulus word following recognition. The total amount of time required for recognition plus retrieval is termed verbal reaction time (Fraisse, 1969; 1967) and latency of response initiation (Seymore, 1970). By subtracting average word recognition time for a given person from his average verbal reaction time we would have an approximation of the delay of overt vocalization following word recognition.

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[1]Thanks to Gary Verna for assistance in data collection.

Method

All 34 members of a fourth grade class at a local elementary school served as subjects in a larger study of component skills of reading of which the present study is only a part. At the beginning of the study, their ages ranged from 9 years and 3 months to 11 years, with a mean of 9 years and 11 months. The California Test of Mental Maturity scores provided by the school ranged from 75 to 126 with a mean of 104. There were an equal number of boys and girls.

The Gates-MacGinitie Reading Tests, Survey D (1965) were used to divide the children into groups of fast and slow using speed of reading subscores and into groups of high and low comprehenders using their scores on the reading comprehension test. The Gates-MacGinitie Reading Tests, Survey D (1965) are group administered and meet the current standards for an adequate test as specified in the *Standards for Educational and Psychological Tests and Manuals* (1966).

The five minute timed speed test consists of 36 items of the following type:

> The huge animals walked slowly, swinging their trunks from side to side. They had big floppy ears and long white tusks. The animals were
>
> tigers deer lions elephants

All items are of approximately equal difficulty.

The Comprehension test consists of 21 paragraphs containing 52 blanks to be filled in as follows:

> We have a playroom in our_____1_____. It is down in the basement, so we need to turn on the electric_____2_____even on sunny days.
>
> 1. stove house bed car lake
> 2. storm friend ladder room light

The items increase progressively in length and difficulty. The 25 minutes provided for the test was sufficient for all children to complete the test.

Two forms of each of the tests were used. Form 1 of both tests was administered by the experimenter and an aide in a single classroom session at the beginning of the study and Form 2 after the experimental tasks were completed. Two forms were used to obtain more reliable measures than could be made on the basis of one form. One speed score and one comprehension score was obtained for each child by adding his respective scores on each form of the two subtests.

Two experimenters were required to administer the recognition and retrieval tasks to each child individually in a trailer on the school grounds. The stimulus materials were centered on 4 x 6 inch white cards in 16 point Helvetica lower case type. The cards were exposed at a distance of 30 inches from the eyepiece of a three-field tachistoscope (Gerbrands: Model T-3B-1). The intensity of the light in the tachistoscope was set and maintained at a comfortable level for reading (0.13 footcandles of illumination as measured by a Gossen Luna Pro Light Meter at the eyepiece). A button below the eyepiece enabled the subject to control the presentation of the stimulus after a ready signal was given by the experimenter.

The ascending method of limits was used for the Recognition threshold task. The initial exposure duration for each subject was determined by his performance on the warm-up trials and was always below the recognition threshold. Subsequent exposures were incremented by 10 milliseconds until a correct identification of the stimulus was made. Pre- and post-field were exposed immediately before and after each stimulus presentation for 200 milliseconds and with an illumination equal to that of the stimulus field. A fixation area was outlined on the white pre-field card by penciled lines above and below the position where the stimulus would appear. The post-field contained a blank white card.

In order to counterbalance for practice effects over the three types of items, the letters, words, and phrases were combined and presented in four different random orders with eight or nine subjects using each order. Extensive practice on items similar to the test items was given to familiarize subjects with the procedure and to minimize practice effects during the session. Warm-up items were given prior to the beginning of each of the three sessions required to complete the task. Subjects were told before the initial presentation of each item whether to expect a letter, a word, or a phrase.

The letter recognition stimuli included all the letters of the alphabet in lower case. The scores were based on the mean of the recognition thresholds for all 26 letters.

The word recognition stimuli included 48 words selected on the basis of frequency and length from those listed by Thorndike and Lorge (1944) as well as Finsland's (1945) frequency count for fourth graders. High-frequency words included those with ratings over 100

occurences per million by Thorndike and Lorge and listed in the first thousand words of the Rinsland count for fourth graders. Medium-frequency words were rated 30-50 per million and listed in the second or third thousand. Low-frequency words were rated 10-20 per million and listed in the fifth or sixth thousand. An equal number of three, four, five, and six letter words were chosen from each frequency level (see Appendix A).

Word recognition scores were based on the recognition thresholds for the words which the child pronounced. The lowest number of words upon which any child's score was based was 33. Most of the scores were based on the complete set of 48 words.

Since the distribution of scores was positively skewed and variances tended to be correlated with means, the scores were transformed to logarithms. Winer (1962) suggests that

> ...the logarithmic transformation is particularly effective in normalizing distributions which have positive skewness. Such distributions occur in psychological research when the criterion is in terms of a time scale.

The retrieval time task stimuli were 32 words from three to six letters in length and selected using the same high- and medium-frequency criteria as those used in the recognition task, however, different words were used in each task (see Appendix B). The child initiated tachistoscopic exposure of the word by pressing the button below the eyepiece which also activated a timer. The timer was stopped when the child responded by a voice key, the microphone for which was placed below the eyepiece at mouth level. The word remained in view until the child responded. Retrieval time scores were converted to logarithms. The lowest number of words upon which any subject's score was based was 23 since no score was obtained when the child did not know the word.

Results

Children with the 17 highest total scores on the two forms of the Speed test were grouped together as "fast" readers and the lowest 17 were grouped together as "slow" readers. Analyses was carried out on the basis on this division. There was no difference between the two groups in letter recognition thresholds ($t<1$). The results of the analysis of variance for the recognition task is presented in Table 1, and for the retrieval task, in Table 2.

The children with the 17 highest total scores on the two forms of the Comprehension test were grouped together as "high-comprehenders" and the lowest 17 were grouped together as "low-comprehenders". This regrouping resulted in the crossing over of just three fast readers into the low-comprehension group, and three slow readers into the high-comprehension group. Analyses of the same data used in the previous analysis were carried out on the basis of the divisions. There was no difference between the two groups in letter recognition thresholds ($t<1$). The results of the analysis of variance for the recognition task is presented in Table 3, and for the retrieval task in Table 4. Since the retrieval time scores turned out to be approximately ten times larger than the recognition scores, the analysis of retrieval minus recognition turned out essentially the same as the analysis of retrieval alone and is therefore not reported.

TABLE 1

ANALYSIS OF RECOGNITION THRESHOLD AS A FUNCTION OF READING SPEED, WORD FREQUENCY AND LENGTH

Source	df	Mean Square	F
Between subjects	33		
Speed (S)	1	0.2950	2.33
Subj. within groups	32	0.1267	
Within subjects	170		
Frequency (F)	2	0.4676	79.25[a]
S x F	2	0.0065	1.10
F x subj. within groups	64	0.0059	
Length (L)	1	0.0063	1.05
S x L	1	0.0020	0.33
L x subj. within groups	32	0.0060	
F x L	2	0.0169	4.33[b]
S x F x L	2	0.0015	0.38
F x L x subj. within groups	64		

[a] $p < .01$

[b] $p < .05$

TABLE 2

ANALYSIS OF RETRIEVAL TIME SCORES AS A FUNCTION OF READING SPEED, WORD FREQUENCY AND LENGTH

Source	df	Mean Square	F
Between subjects	33		
Speed (S)	1	0.0911	3.44
Subj. within groups	32	0.0265	
Within subjects	102		
Frequency (F)	1	0.0771	42.83[a]
S x F	1	0.0000	0.00
F x subj. within groups	32	0.0018	
Length (L)	1	0.1089	99.00[a]
S x L	1	0.0148	13.45
L x subj. within groups	32	0.0011	
F x L	1	0.0094	13.43[a]
S x F x L	1	0.0005	0.71
F x L x subj. within groups	32	0.0007	

[a] $p < .01$

TABLE 3

ANALYSIS OF RECOGNITION THRESHOLD AS A FUNCTION OF READING COMPREHENSION, WORD FREQUENCY AND LENGTH

Source	df	Mean Square	F
Between subjects	33		
Speed (S)	1	0.9080	8.45[a]
Subj. within groups	32	0.1074	
Within subjects	170		
Frequency (F)	2	0.4676	79.25[a]
S x F	2	0.0087	1.47
F x subj. within groups	64	0.0059	
Length (L)	1	0.0063	1.05
S x L	1	0.0023	0.38
L x subj. within groups	32	0.0060	
F x L	2	0.0169	4.45[b]
S x F x L	2	0.0030	0.79
F x L x subj. within groups	64	0.0038	

[a] $p < .01$

[b] $p < .05$

TABLE 4

ANALYSIS OF RETRIEVAL TIME SCORES AS A FUNCTION OF READING COMPREHENSION, WORD FREQUENCY AND LENGTH

Source	df	Mean Square	F
Between subjects	33		
Speed (S)	1	0.1440	5.78[b]
Subj. within groups	32	0.0249	
Within subjects	102		
Frequency (F)	1	0.0771	42.83[a]
S x F	1	0.0003	0.17
F x subj. within groups	32	0.0018	
Length (L)	1	0.1089	83.77[a]
S x L	1	0.0109	8.38[a]
L x subj. within groups	32	0.0013	
F x L	1	0.0094	13.43[a]
S x F x L	1	0.0010	1.43
F x L x subj. within groups	32	0.0007	

[a] $p < .01$

[b] $p < .05$

Discussion

The recognition and retrieval tasks serve only to distinguish between good and poor comprehenders, the good comprehenders having significantly lower recognition thresholds and retrieval times. The difference between fast and slow readers was in the same direction yet not significant. In order to interpret this finding it is necessary to consider in greater detail what the two tests of reading ab measuring. The Gates-MacGinitie technical manual offers no distinctions, however, analysis of the Speed test items reveals that it consists of several two or three sentence paragraphs each ending in a simple question or unfinished sentence requiring selection of a single word answer from four relatively short high-frequency alternatives. Approximately 30% of the items could be answered on the basis of information contained in the final sentence alone. All paragraphs contain either the answer itself or a form of it. The test appears to require a minimum amount of word knowledge and sentence comprehension as is typical of Speed tests.

In contrast, the Comprehension test is constructed of paragraphs containing from two to five sentences with two to three blank spaces to be filled in from five alternatives which in the more difficult items are relatively long, low-frequency words (for example, millennium and conspicuous). Only 29% of the answers are of the more obvious type included in the Speed test. The remaining 71% require knowledge and use of context as well as definition of the alternatives Since there are two or three responses per paragraph, one error influences subsequent

interpretation. It is also often necessary to read past the blank in order to determine the correct response. Hence, the Comprehension test measures a far broader range of word knowledge than the Speed test as wel as phrase, sentence and intersentence comprehension.

storage pr Since the child knows that in the retrieval comprehenders scored poorly on medium- and low-frequency long words. This suggests that they have fewer sight words in these categories. The significant interaction between reading ability (speed and comprehension) length, poor readers may have a tendency to subject long words to this

Consistent with our hypothesis it was found that the low- task the word remains in view until he responds, he might produce the word subvocally to make its auditory representation assessible to the short-term recognition store where a match can be made with the visual image. In this manner he can be virtually certain that his response is correct prior to committing himself with an overt verbal response. Since no difference was found in recognition time as a function of and word length on the retrieval task is interpretable from short-term conscious rehearsal analysi even when it is not required.

The tendency to subject long words to detailed analysis even after the words have been "recognized" might be related to unnecessary regressive eye movements in reading. In both cases, poor readers would be delaying their progress until a verbal-auditory memory and visual match can be made. This phemomenon might also account for the effectiveness of forced pacing without loss in comprehension (Spache, 1957; Wedeen, 1954; Wilson & Leavell, 1956).

While the overall effect of frequency and frequency-length interaction was found in all analyses, the effect of word length on recognition was confounded to a greater degree than on retrieval by the interaction. While high-frequency short words had lower recognition thresholds than high-frequency long words, the reverse was found for the low-frequency words--the long words having lower recognition thresholds. Considering that short- and low-frequency words used in the recognition task are encountered just as often in children's reading experience as the long-low-frequency words, the relative difficulty in recognizing short words was most likely a function of the number of similiar words in each child's reading vocabulary.

APPENDIX A

WORDS FOR TACHISTOSCOPIC RECOGNITION TASK

	Length 6			5			4			3		
HiF	people	AA	(1a2)	water	AA	(1a2)	baby	AA	(1a2)	bed	AA	(1a2)
	dinner	AA	(1a2)	house	AA	(1a2)	door	AA	(1a2)	way	AA	(1a2)
	winter	AA	(1a3)	party	AA	(1a3)	fire	AA	(1a3)	car	AA	(1a3)
	street	AA	(1a4)	money	AA	(1a4)	bird	AA	(1a4)	top	AA	(1a4)
MdF	driver	40	(3a)	chest	41	(3a)	drum	40	(3a)	rug	40	(3a)
	statue	36	(3b)	magic	39	(3b)	fork	31	(3b)	fan	38	(3b)
	marble	38	(2b)	bunch	32	(2b)	soup	36	(2b)	tin	36	(2b)
	museum	38	(2b)	spear	40	(2b)	palm	37	(2b)	toe	35	(2b)
LoF	winner	10	(5b)	dough	11	(5b)	pier	11	(5b)	arc	9	(5b)
	sample	15	(6)	cigar	16	(6)	beak	15	(6)	cot	15	(6)
	dancer	10	(6)	skull	12	(6)	dusk	14	(6)	gap	7	(6)
	cereal	10	(5b)	liver	10	(5b)	dove	19	(5b)	elm	16	(5b)

APPENDIX B

WORDS FOR RETRIEVED TASK

	6			5			4			3		
HiF	sister	AA	(1a2)	night	AA	(1a2)	tree	AA	(1a2)	eat	AA	(1a2)
	church	AA	(1a5)	world	AA	(1a5)	meat	AA	(1a5)	air	AA	(1a5)
	bridge	AA	(1a5)	green	AA	(1a5)	city	AA	(1a5)	sun	AA	(1a5)
	garden	AA	(1b2)	music	AA	(1b2)	skin	AA	(1b2)	bag	AA	(1b2)
MdF	candle	43	(2b)	goose	45	(2b)	lamb	45	(2b)	pin	43	(2b)
	mirror	46	(3b)	angel	47	(3b)	bean	43	(3b)	ant	38	(3b)
	cellar	32	(2a)	tooth	47	(3a)	joke	37	(3a)	hut	32	(3a)
	autumn	49	(2a)	trunk	48	(2a)	duck	49	(2a)	hen	49	(2a)

References

American Psychological Association. *Standards for educational tests and manuals.* Washington: American Psychological Association, 1966.

Fraisse, P. Latency of different responses to the same stimulus. *Quarterly Journal of Experimental Psychology*, 1967, 19, 353-355.

Fraisse, P. Le temps de réaction verbale: I. Dénomination et lecture. *Année Psychologie*, 1964, 21-46.

Gates, A. I., & MacGinitie, W. H. *Gates-MacGinitie reading tests (Survey D).* New York: Columbia University, 1965.

Rinsland, H. D. *A basic vocabulary of elementary school children.* New York: MacMillan, 1945.

Seymore, P. H. K. Representational processes in comprehension of printed words. *British Journal of Psychology*, 1970, 61, 207-218.

Spache, G. D. A rationale of mechanical methods of improving reading. In Causey, O. S. (Ed) *Techniques and procedures in college and adult reading improvement*, 6th Yearbook, Southwest Reading Conference for Colleges and Universities, 1957, Pp. 115-132.

Sperling, G. Short-term memory, long-term memory, and scanning in the processing of visual information. In Young, F. A., & Lindsley, D. B. (Eds.). *Early experience and visual information processing in perceptual and reading disorders.* Washington: National Acadamy of Sciences, 1970.

Thorndike, E. L., & Lorge, I. *The teacher's word book of 30,000 words.* New York: Bureau of Publications, Teacher's College, Columbia University, 1944.

Wedeen, S. U. Mechanical vs. non-mechanical reading techniques for college freshmen. *School and Society*, 1954, 79, 121-123.

Wilson, G. E., & Leavell, U. W. An experiment with accelerator training. *Peabody Journal of Education*, 1956, 34, 9-18.

Winer, B. J. *Statistical principles in experimental design.* New York: McGraw, 1962.

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