DOCUMENT RESUME

ED 208 368   CS 006 315

AUTHOR   Navon, David; Shimron, Joseph
TITLE   The Distribution of Information within Letters.
              Technical Report No. 215.
INSTITUTION   Bolt, Beranek and Newman, Inc., Cambridge, Mass.;
              Illinois Univ., Urbana. Center for the Study of
              Reading.
SPONS AGENCY Ford Foundation, New York, N.Y.; National Inst. of
              Education (ED), Washington, D.C.
PUB DATE   Sep 81
CONTRACT   400-76-0116
NOTE   53p.

EDRS PRICE   MF01/PC03 Plus Postage.
DESCRIPTORS   College Students; English; Hebrew; *Identification;
              *Language Research; *Letters (Alphabet); Reading
              Research; Recognition (Psychology); *Structural
              Analysis (Linguistics); *Visual Discrimination

ABSTRACT
        Two experiments were designed to study the relative
importance of various letter segments in letter recognition. One
experiment was conducted with 24 subjects and the English alphabet,
the other with 15 subjects and the Hebrew alphabet. In each
experiment a letter was presented for identification, but was
preceded by a brief presentation of either a mutilated version of the
target letter or a neutral pattern. Mutilations were accomplished by
eliminating a specific segment, such as the lower horizontal stroke
of the letter E. It was reasoned that the more critical the
eliminated segment, the less the altered version would activate the
letter code in memory, thus the longer it would take for a subject to
name the subsequently presented target letter. This procedure was
successful in detecting significant differences consistent with
expectations. The latency data were highly correlated with the
distinctiveness of the mutilated segment, its uniqueness in the
alphabet, its impact on the letter's global shape, its topography
within the letter, and other variables. The dependency of latency on
the various factors varied considerably between alphabets. Two of the
informational variables, distinctiveness and uniqueness, were found
to have a significant effect, the first just in Hebrew and the second
in both languages. (RL)

CENTER FOR THE STUDY OF READING

Technical Report No. 215

THE DISTRIBUTION OF INFORMATION WITHIN LETTERS

David Navon
University of Illinois at Urbana-Champaign

Joseph Shimron
University of Haifa

September 1981

University of Illinois
   at Urbana-Champaign
51 Gerty Drive
Champaign, Illinois   61820

Bolt Beranek and Newman Inc.
50 Moulton Street.
Cambridge, Massachusetts   02238

3

Abstract

To study the relative importance of various letter segments for letter recognition, we presented each letter of two alphabets, English and Hebrew, preceded by a brief presentation of mutilated version of it or a neutral pattern. Mutilations were done by eliminating a specific segment. It was reasoned that the more critical the eliminated segment, the less the mutilated version activates the letter code in memory, thus the longer it takes to name the subsequently presented target letter. This procedure was successful in detecting significant differences consistent with our expectations. In further analysis it was shown that the latency data were highly correlated with the distinctiveness of the mutilated segment, its uniqueness in the alphabet, its impact on the letter global shape, its topography within the letter, and other variables. The dependency of latency on the various factors varied considerably between alphabets. Some correlational analyses were done to evaluate the roles of the various factors.

The Distribution of Information Within Letters

Information is not evenly distributed along the printed line.   Some words are more predictable from their context than others, so they may be considered as carrying less information.   Some letters in a word are more redundant than others.

In a similar vein, some elements or characteristics of a single letter might be more critical or diagnostic for its identification than others.

As early as 1879, Javal (see Huey, 1908/1968) noted that when an English text was presented in such a way that the lower half of each line was removed, readers could read it faster and more accurately than when the upper half was removed.   Huey suggested that the omitted part of the text which impaired reading probably contained less information.   He concluded, thus, that the upper part of an English text was more informative than its lower part.   In a previous study (Shimron & Navon, in press) we showed that, whereas, reading the English text was impaired by mutilating the top part of the line, the reverse was found for the Hebrew text.   This result was ascribed to the different ways in which information was distributed along the vertical axis of Roman and Hebrew letters.   Kolers (1969) used the same rationale to suggest that the right halves of Roman letters were, on the average, more informative than the left halves.

This paper reports an attempt to study in more detail the relative importance of various letter parts as well as possible sources for it.

In some cases the importance of a certain letter element is obvious. For example, the lower horizontal stroke of the letter E is necessary for distinguishing it from the letter F. In many other cases a mutilation of a certain element does not transform the letter into another one, but still makes its identification more difficult. We reasoned that one way to study the informativeness of various letter elements, i.e., their contribution to letter identification, is to eliminate them one at a time and then to test the effect of those eliminations on recognition. Our question was to what extent the mutilated letter maintains the perceptual effect of the intact one. In other words, to what extent does the mutilated version of a letter activate the internal representation of that letter in memory? To answer this question we devised the following procedure: The subject was asked to name, as fast as possible, a letter presented visually. The letter was preceded by a prime which, in most cases, was a mutilated version of the same letter and, in one case, was a standard neutral pattern. Our rationale was that the more critical the eliminated part (or the properties to which it contributes) for the recognition of the letter, the less (or the more slowly) the mutilated version activates the letter code in memory, thus the less facilitation in naming the subsequently presented intact letter is to be expected. That should be reflected in a longer naming latency.

In order to attain more generality of our conclusions we chose to investigate two alphabets. We used bold Hebrew letters and upper case English letters.

Experiment I: English Letters

Method

Apparatus. The stimuli were presented via a three-field Gerbrands Harvard type tachistoscope Model I-3B-1. Viewing distance was 16 cm. The luminance of the fields was about 11.0 cd/m^2. A crystal microphone served to transmit the onset of the subject's vocal response to a voice operated relay which terminated a digital millisecond clock, started by the onset of the target letter. Latencies were recorded by means of a printer.

Stimuli. The 26 letters of the Roman alphabet served as target stimuli. They were made by applying Letraset Futura Bold letters (sheet no. 103) on celluloid, duplicating on a white paper, and then pasting each of the duplicated letters at the center of a white tachistoscope card. They measured 15 mm (1.13° visual angle) vertically. Mutilated versions used as primes were prepared in a similar manner, except that the eliminated part was not rubbed off the Letraset sheet. Our criteria in producing the mutilated stimuli was to eliminate from each letter a fragment that consisted of either a 90° section of a curved segment, or a straight segment that measured about half of the height, or all the width of a typical English letter, and about half of the height or half of the width of a typical Hebrew letter.

All the stimuli are shown in Figure 1. A masking stimulus was prepared by cutting several letter segments and applying them haphazardly within a square with a side of 20 mm. A 19 mm. x 18 mm rectangle circumscribing a cross with bars of the same width as the bars of the letter served as a neutral prime.

Design and Procedure.   In each trial a beep was played and the masking
stimulus was shown for 800 msec simultaneously, followed after a 200 msec
interval by a prime which could be either neutral (see above) or a mutilated
version of the target letter.   The prime was shown for 300 msec and was
replaced by the masking stimulus which was presented for 150 msec, followed
by a 500 msec presentation of the target letter.   The subject had to name
the target letter as quickly as possible, and his/her response as well as
the latency from the onset of the target were recorded.   Subjects were
strictly warned not to try to respond before the target was presented by
guessing it from the prime.

Each letter was presented twice with the neutral prime and twice with
each of its mutilated versions.   The experiment started with a block of 18
practice trials in which targets were 'r ew letters and primes were some
mutilated versions of them.   Then followed a block consisting of 130 trials
in which the primes were mutilated Roman letters.   Each target-prime pair
was presented just once in a random order.   The third block consisted of a
random presentation of 52 trials with the neutral prime.   The fourth block
was a replication of the second one, only the order of trials was changed by
permuting 5 sub-blocks of 26 trials each.   The particular order used for
half of the subjects during the second block was used for the other half
during the fourth one, and vice-versa.   Subjects received with the instruc-
tions a sheet displaying all the target letters as well as the mask.   They
were instructed to look at the field as soon as the beep was played and

were encouraged to attend to the prime by its introduction in the instructions as "a clue to the identity of the subsequent letter."

Subjects. Twenty-four subjects were used. All of them were students at the University of Haifa and had been familiar with the Roman alphabet for at least 10 years. All had normal or corrected-to-normal vision.

Results

Errors were very scarce. In only two cases did both replications of a certain target-prime pair lead to errors. In those cases the data of the letters in question (Q and J) were analyzed without the data of the subject who erred. When there was an error in one replication, analysis was based on the other, correct one. Mean latencies for each prime, including the neutral one, and for each letter were calculated. The difference in msec between latency to name the target letter with a particular prime and with a neutral prime is given in Table 1 for each of the letters and each of its primes. It is called a facilitation score, but note that a negative score indicates facilitation, and a positive one indicates inhibition. The primes themselves are presented in Figure 1 in the order in which they appear in Table 1, namely, arranged from short latencies on the left to longer latencies on the right. While inspecting these data and the following analyses, one should bear in mind that each prime latency is based on just two replications per subject.

Table 1

Facilitation Scores for the Various Primes of Each English Letter

(Experiment 1)

Letter			Facilitation Scores						Significance Level
A	-120	-116	-114	-94	-14	0			.001
B	-100	-95	-79	-66	-27	-6	-4	0	.01
C	-58	-23	-3	0	+37				NS
D	-86	-63	-41	0	+5				.05
E	-109	-97	-62	-23	0	+46			.001
F	-46	-15	-4	0	+24	+37			NS
G	-151	-129	-80	-48	0	+31			.001
H	-142	-108	-54	-37	-21	0			.001
I	-62	-19	0						NS
J	-72	-15	-11	0					NS
K	-217	-157	-142	-102	0				.001
L	-7	-3	0	+73					NS
M	-154	-149	-134	-132	-110	-107	-105	-104	0	.01
N	-93	-79	-66	-57	-11	0			.01
O	-99	-85	-80	-50	0				.05
P	-123	-74	0	+14	+14	+39			.001
Q	-165	-161	-157	-119	0	+20			.001
R	-174	-122	-115	-91	-68	0	+90		.001
S	-140	-139	-127	-84	-29	0			.001
T	-70	-8	-3	0	+27				NS
U	-127	-121	-96	-37	0				.01
V	-160	-123	-51	-15	0				.001
W	-214	-204	-201	-200	-182	-165	-139	-139	0	.001
X	-64	-44	-13	0					.05
Y	-133	-99	-44	0					.05
Z	-147	-114	-109	-87	-80	-36	0		.05

Note. The order within a line corresponds to the order within a respective line in Figure 1. A score is the difference in msec between naming latency to that letter with that prime and with a neutral prime. Significance level of Min F' ratios are given in the right column.
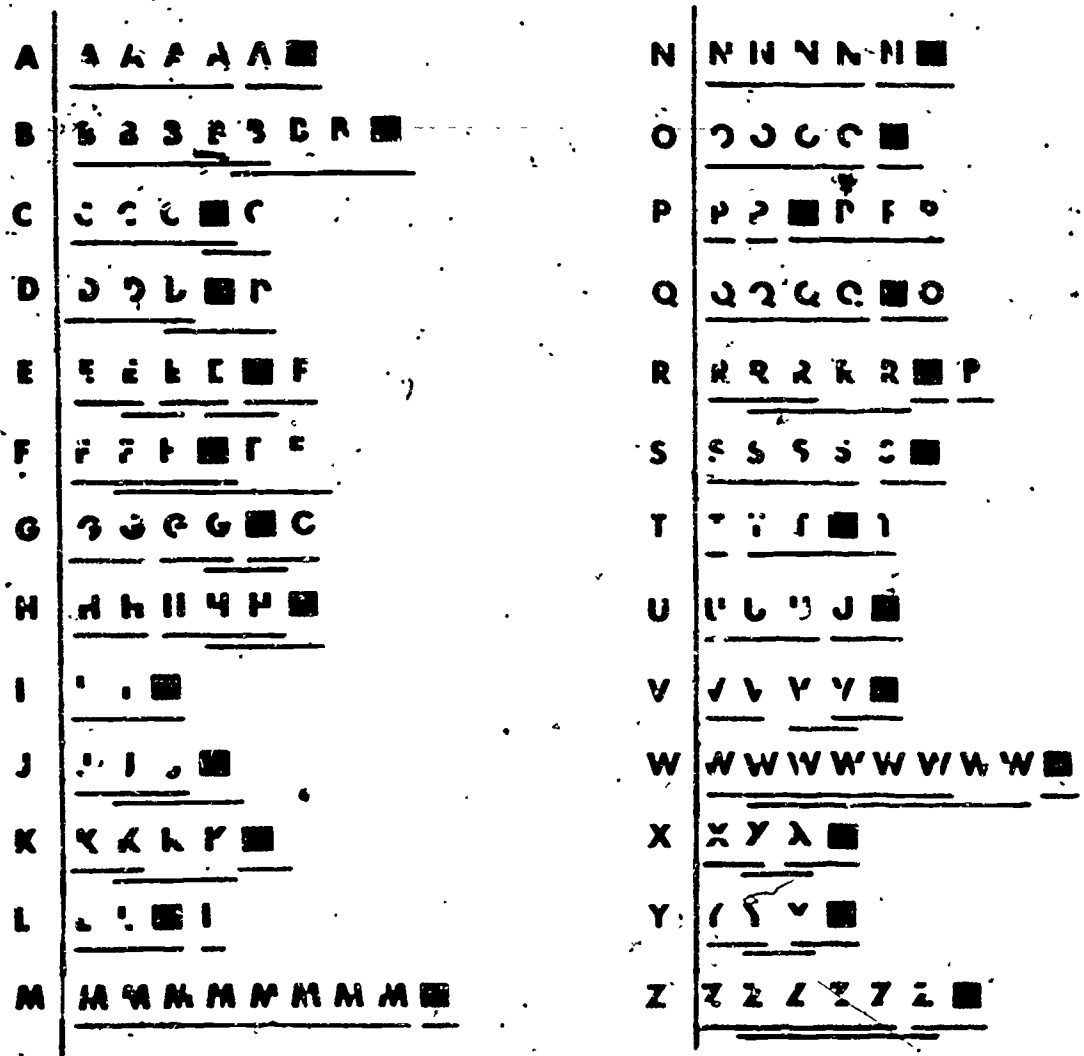
Figure 1. The English letters used in Experiment I and the various primes arranged by mean latency, shortest latency on the left. The black rectangle stands for the neutral prime (see text). Horizontal lines show the results of post hoc comparisons. Primes underscored by the same line are not significantly different from each other.

Separate analyses of variance were conducted on the data of each letter to compare the effects of the various primes. Since only two replications per a given prime were used, the results might have been considerably affected by the positions those replications occupied within the sequence of trials. Therefore, in addition to the ordinary analysis using the interaction of subjects with primes as an error term, we calculated another F term in which replications within primes within subjects served as an error term; this term presumably reflects most of the variability due to sequence effects. The rightmost column in Table 1 presents the significance of Min F' calculated on the basis of both types of F ratio (Clark, 1973). Newman-Keuls pairwise comparisons were done using as an error term only the interactions of primes with subjects. The results of those comparisons are presented in Figure 1: Primes that are underlined by a common line are not significantly different from each other at the .05 level. For example, the leftmost prime for the A is significantly more facilitative than the neutral prime, but not significantly more facilitative than the second one from the left. The results of this experiment are discussed after the presentation of the second one.

Experiment II: Hebrew Letters

Method

The same method as in Experiment I was used, only the target letters were Hebrew. Twenty-one Hebrew letters out of 22 in the alphabet were used.

One was not used, because in the type font employed (Letraset, Amit sheet No. 12367) that letter consisted of just a half of a vertical bar.

The second and fourth block of trials consisted of 119 trials in which the primes were mutilated letters. The trials were arranged in 4 subblocks of 24 each and one subblock of 23 trials. The third block consisted of 42 trials with the neutral prime. In the practice trials subjects were presented with Roman letters.

Fifteen subjects were used, all students at the University of Haifa who were very familiar with the Hebrew alphabet.

Results

As in Experiment I, errors were very scarce. One subject made errors in both replications of a certain target-prime pair. His data with regard to all appearances of that letter were not included in the analysis. When an error was made in one replication, analysis was based just on the other one.

The data are presented in Table 2 and Figure 2 which are completely analogous to Table 1 and Figure 1 respectively.

General Discussion

As can be seen in Figure 2, on the whole the primes were not equally facilitative. Some of them were, in fact, inhibitory; they delayed letter naming with respect to a neutral prime, probably because they resembled a letter which was different from the one to be named.

Table 2

Facilitation Scores for the Various Primes of Each English Letter

(Experiment II)

Letter	Facilititation Scores								Significance Level
א	-54	-50	-48	-13	0	+47			NS
ב	-86	-51	-47	-43	-37	-25	0	+33	NS
ג	-102	-51	-40	-21	0				NS
ד	-76	-70	0	+20	+30	+44			NS
ה	-105	-80	-52	0	+47	+63			.01
ו	0	+19	+37						NS
ז	0	+19	+19	+261					NS
ח	-61	-56	-41	-28	0	+11	+55		.01
ט	-70	-39	-13	-3	0	+4	+11	+56	NS
י	-78	-14	0	+13	+21	+32	+62		.05
כ	-122	-96	-53	-27	-24	0	+10		.05
ל	-81	-77	-59	-38	-19	-19	0	+24 +48	.05
מ	0	+28	+34	+159					NS
נ	-80	-54	-45	-22	0	+9	+11	+39	NS
ס	-48	-45	-13	-10	-1	0	+7	+52	NS
ע	-134	-118	-96	-70	-66	-37	0	+11	.05
פ	-170	-105	-93	-64	-27	0			.01
צ	-168	-127	-125	-124	-94	-92	-90	0	.0!
ק	-42	0	+4	+4	+58				.05
ש	-115	-98	-80	-77	-75	-63	-20	-2 0	.05
ת	-131	-128	-123	-110	-108	-108	0	+60	.001

Note. The order within a line corresponds to the order within a
respective line in Figure 2. A score is the difference in
msec between naming latency to that letter with that prime
and with a neutral prime. Significance level of Min F' ratios
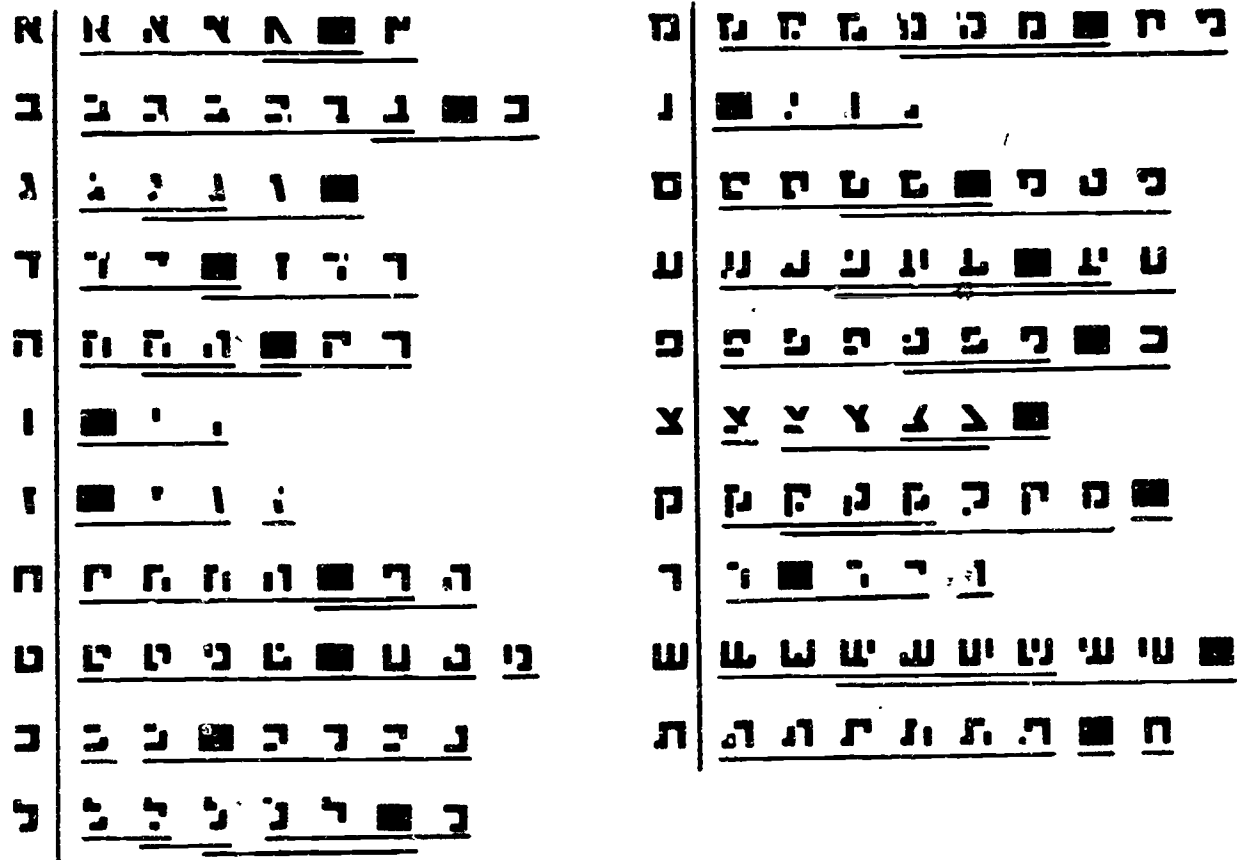are given in the right column.

Figure 2. The Hebrew letters used in Experiment II and the various primes arranged by mean
naming latency, shortest latency on the left. The black rectangle stands for the
neutral prime (see text). Horizontal lines show the results of post hoc comparisons.
Primes underscored by the same line are not significantly different from each other.

1C

17

Looking across a whole set of mutilated letters as primes of differ-
ential facilitative effects, we can attempt to evaluate some general factors
of letter discrimination. In order to simplify the analysis, we inspected
for every letter the primes that produced the shortest and the longest
latencies. We assumed that the most facilitative primes were those mutilated
letters in which the missing element contributed very little to the recognition
of that letter. By contrast, the least facilitative (or even inhibitory)
primes were those mutilated letters in which the missing element was crucial
for letter discrimination.

In analyzing the data further we shall consider three types of variables
that might have affected the process. The first type to be considered is
topographic variables. The issue is whether there is a correlation between
latency of recognition and the locus of the missing elements with regard to
the two major axes of the letter matrix (right-left, up-down). If such a
correlation exists, what is its source?

Secondly, we asked about the relationship between recognition latency
and other possible sources of element informativeness that are unrelated
with the location of the element with respect to the major axes of the
letter. Those sources have to do with the relationship of elements to other
elements within the letter which presumably affect the likeness of the
mutilated letter to its template, or with the presence of those elements in
other letters which presumably affect their informational value.

We considered two types of informational variables: distinctiveness and uniqueness. Distinctiveness of a letter element is the extent to which it defines a difference between one letter and others, which is determined by the extent to which the other non-mutilated features of the letter constitute or are subsumed in the set of features of one (or more) of the letters. For example, the lower horizontal stroke of the letter E is perfectly distinctive, because in its absence the letter would look exactly like an F. Similarly, the diagonal stroke of the letter R is perfectly distinctive, because in its absence the rest of the figure looks exactly like a P. The upper diagonal of the letter K is fairly, though not perfectly, distinctive, because the rest of the features constitute a subset of the letter R. In contrast, the upper horizontal stroke of the letter E is not distinctive at all, because even in its absence the remaining pattern is not compatible with any other letter.

More formally, if each letter j in the alphabet is conceived of as a set of elements E_j, and the perceptual contribution of elements is represented by a salience function f (see Tversky, 1977), then the distinctiveness of a certain element e for a given letter k may be defined as the maximum of the term $f(E_k-e)/f(E_j)$ over all letters of the alphabet other than k which satisfy: $(E_k-e) \cap \bar{E_j} = \phi$.

Distinctiveness, as it is defined here, may be construed as the degree to which the feature is critical for differentiating between a given letter and other letters in the alphabet.[1]

We computed distinctiveness by a method congenial with the above definition. Our measure was the ratio between the number of line segments in the mutilated letter and the number of line segments in the intact letter of which the mutilated version was a part. If the mutilated letter could not be entirely subsumed in any letter of the alphabet, the distinctiveness value of the mutilated element was zero. If the mutilated letter was identical with another letter, the distinctive value of the mutilated element was one. Our count of number of line segments was, of course, fairly arbitrary, but we believe that it must be monotonous in the measure that would have resulted, had we known the features by which letters are analyzed.

Uniqueness. The uniqueness of an element for a given letter is inversely related to the number of other letters of which it is a part. For example, if we superimpose all letters in an alphabet one upon the other, some letter parts will overlap more than others. Some letter elements may appear just in one letter. This is the case with the small diagonal of the letter Q. Thus, its uniqueness for the letter Q is very high.

The uniqueness of an element e for a given letter k may be conceived of as its diagnosticity $p(e|k)/p(e|\bar{k})$, where $\bar{k}$ is the set of all other letters in the alphabet.

To score uniqueness, the location of the mutilated element was defined within the common matrix for all upper-case letters of the type we used.

Then each one of the letters was superimposed upon that matrix and the number of times that location was covered by other letters of the alphabet was counted. Uniqueness is inversely related to this measure of line segment overlap, thus it was defined as its negative.

Likeness. So far, we conceived of the letter primes as if their only function was to differentiate one letter of the alphabet from the others. Thus, attention was given to the differences between letters. But a prime may fail to facilitate letter recognition not because it suggests other letters, but rather because it does not suggest very much the image of the target letter. For example, the pattern resulting from mutilating the upper horizontal of the letter E is uniquely different from any other letter of the alphabet, but it makes it quite dissimilar with the stored image of an E. It seems that the damage would be considerably less when the mutilation is at the vertical stroke. That still leaves this pattern quite similar to the typical E. Whereas the previous measures were functions of the other members in the stimulus ensemble (namely, the letters of the alphabet), the variables that we subsume under the heading likeness variables are to some extent independent of the range of alternative stimuli. Conceivably, even if all element combinations had existed, so that all mutilations had been equally disruptive from an informational point of view, some mutilations would still have resembled the prototype less than others.

We identified two likeness variables: one, whether the absence of the mutilated element changes the envelope of the letter; two, whether the

21

mutilated element constitutes the edge of a stroke. By relating to letter
envelope and edge as likeness variables we do not wish to convey that
mutilations of inner elements cannot destroy the gestalt of the letter.
For example, mutilating the horizontal stroke of an H may be quite harmful.
Our taxonomy is based on our intuition that the effects of mutilations of
letter envelope or edge are fairly independent of the range of alternatives.

To gain some insights about the role of the factors mentioned above on
letter recognition we correlated the latency facilitation score associated
with the primes (see Tables 1 and 2) with the following variables:

Element Variables

Topographic Variables

a. Whether the element is at the left or at the right half of
the letter;

b. Whether the element is at the lower or at the upper half of
the letter;

Informational Variables

c. The distinctiveness of the element;

d. The uniqueness of the element;

Likeness Variables

e. Whether the absence of the element changes the envelope of
the letter;

f. Whether the element constitutes the edge of a stroke;

Letter Variables

g. The number of line segments that constitute the letter.

To simplify the analyses we analyzed only primes associated with the shortest and longest latencies for a given letter. In Table 3 we present percentages or mean scores of primes with the shortest and the longest latencies, in Hebrew and English separately, according to the above variables.

We also computed Pearson product-moment correlation coefficients between every one of the above variables, including the latency facilitation scores and all other variables (see Table 4).

Finally, we ran a stepwise multiple regression with the latency facilitation scores as the dependent variable and all other variables as independent variables.

In the stepwise multiple regression in English, distinctiveness and left/right were the only significant variables ($p < .001$). They accounted for 40% and 21% of the total variance, respectively. The same analysis in Hebrew revealed a more complex picture. The uniqueness variable entered first in the equation and in itself accounted for 32% of the variance ($p < .001$). The variables distinctiveness, number of elements, and left/right entered next in this order with marginal contributions to the variance accounted for 6%, 5%, and 7% ($p < .10$, $p < .10$ and $p < .05$) respectively. However, in the equation having all four variables the beta weights were .28, .22, -.38, and -.33 respectively. A more detailed discussion of these results, and of various partial correlations we calculated, follows.

23

Table 3

Percentage of Primes Associated with Shortest and Longest

Target Naming Latencies in Hebrew and in English

that the Condition (A, B, E, F), or Mean

Scores of Variables (C, D) have for these Primes

Condition or Variable	English			Hebrew		
	Shortest	Longest	$p <$	Shortest	Longest	$p <$
a. at the right (left) half[a]	15.4 (69.2)	61.5 (23.1)	.025[b]	76.2 (14.3)	23.8 (66.7)	.01[b]
b. at the upper (lower) half[a]	50.0 (46.2)	23.1 (65.4)	.05[b]	57.1 (42.9)	47.6 (52.4)	NS[b]
c. element distinctiveness	0.16	0.44	.01[c]	0.21	0.61	.001[c]
d. element uniqueness	-4.81	-3.58	.10[c]	-8.38	-3.14	.001[c]
e. mutilation changes letter envelope	61.5	65.4	NS[b]	19.0	71.4	.025[b]
f. the element constitutes the edge of a stroke	34.6	61.5	.052[b]	19.0	76.2	.025[b]

Note. Variable g is not included in the table since the number of line segments is the same in shortest and in longest target naming latencies.

[a] Percentages do not add up to 100, because some elements could not be located at either of the sides.

[b] In a McNemar test.

[c] In a matched pairs t test.

Table 4

Correlation Coefficients Between the Variables Tested

	1	2	3	4	5	6	7	8
English Letters								
1. Facilitation score	1.00							
2. Left/right	.57	1.00						
3. Upper/lower	-.28	-.34	1.00					
4. Distinctiveness	.63	.18	-.22	1.00				
5. Uniqueness	.12	.37	-.10	-.07	1.00			
6. Change of envelope	.10	.12	-.07	.21	-.03	1.00		
7. Mutilation of edge	.31	.13	-.06	.28	-.03	.65	1.00	
8. Number of line segments	-.26	-.22	.16	-.22	-.02	-.39	-.35	1.00
Hebrew Letters								
1. Facilitation score	1.00							
2. Left/right	-.43	1.00						
3. Upper/lower	-.06	.21	1.00					
4. Distinctiveness	.27	-.37	-.16	1.00				
5. Uniqueness	.57	-.37	-.15	.07	1.00			
6. Change of envelope	.40	-.20	-.19	.30	.44	1.00		
7. Mutilation of edge	.41	-.25	-.14	.37	.49	.95	1.00	
8. Number of line segments	-.37	-.23	-.16	.23	-.41	-.22	-.18	1.00

25

Topographic Variables

Right/left part of the letter. Kolers (1969) observed that the most helpful clues in an English letter appear on its right. But to the best of our knowledge, no experimental evidence was so far presented to support this claim.

The retinal position and the angular width of the letters were such that laterality effects or reading habits which might affect scanning direction were most likely eliminated.

Our data indicate that mutilation of line segments at the left and line segments at the right of the letters do ot have the same effect on recognition. Also, it is indicated that the English alphabet is diametrically different in this sense from the Hebrew. Subjects who identified English letters (see Table 3) appear to have identified very well letters mutilated in their left part but not in their right part. The opposite was true for subjects who identified Hebrew letters, although the effect was somewhat smaller. The correlations between the horizontal position and the latency facilitation score were .57 for the English alphabet, and -.43 for the Hebrew alphabet.

The marked difference between the effects observed within the two alphabets indicates that these topographic effects cannot be attributed to any inherent advantage of one sector of the stimulus, or of the visual field, over the other. This is best illustrated by the fact that while mutilating the right portion of the English letter O was more disruptive than mutilating its left portion (Figure 1), the reverse was true of the Hebrew letter Samech (third from top in the right column of Figure 2) which is very similar to an O.

An apparent explanation for this interaction of alphabets with horizontal

position is that while most of the information of English letters resides

at the right (11 of them are right facing, and only one, J, is left facing),

the information in Hebrew letters is located mostly at their left side (14

of them are left facing, and only one is right facing). This explanation is

supported by the fact that the correlation between horizontal position and

the latency facilitation score in Hebrew letters is considerably reduced

(r = .28) and becomes just marginally significant (p < .10) once the variable

of uniqueness is partialled out. However, this does not recur in the English

alphabet. There the variable of horizontal position accounts for roughly

30% of the variance of facilitation scores, regardless of whether either, all,

or none of the other variables is partialled out. As we comment later, we

believe that this is due to the fact that, because of the versatility of

curvature in the Enlgish font used, we did not find the right way to measure

uniqueness. However, evidently our data are not incompatible with the

possibility that the greater contribution of the right side of English letters

to their identification is not just due to the concentration of unique or

distinctive features in it.

Lower/upper part of the letter. We recently found (Shimron and Navon,

in press) that mutilation of the top of a whole line of text was more harmful

than multilation of its bottom in mixed-case English, but not in Hebrew in

which the opposite was true. We attributed this mainly to the presence of

informative features at the top of mixed-case English letters and at the

bottom of Hebrew letters.

Here, however, the correlation between lower/upper and facilitation stores in English was only -.28 (p < .10) and its marginal contribution to the variance of latency facilitation as indicated by the stepwise multiple regression was negligible. Lower/upper effect in Hebrew letters was even weaker.[2] This was somehow surprising since, as mentioned above, we found the lower part of Hebrew letters to be significantly more informative in a task of reading lines of text. One reason for the difference between the two studies may have to do with the differences in the tasks and conditions in the two experiments. Mutilating a complete half or third, as we did in the other study, may have a stronger effect than mutilating a single line segment.

Informational Variables

Distinctiveness. There are not too many letters in the alphabet in which mutilation of one line segment would change the letter identity. But as could be predicted, when it happened, it was almost always associated with the longest latency in recognition. With one exception, such primes were never associated with shortest latencies. Indeed, it can be seen from Table 3 that the mean score for distinctiveness in both Hebrew and English was three times higher among primes associated with longest latencies than among those associated with shortest latencies. For the English letters, this variable accounted for the greatest percentage of the variance. For

the Hebrew letters, it entered second in the stepwise regression and accounted

for 6% of the variance.

Uniqueness. As mentioned above, it was predicted that absence of

elements that are diagnostic, in that they appear just in the target letter

or in a few more letters, would be more disruptive than absence of elements

that are present in many letters.

The correlation coefficients between the facilitation scores and

uniqueness in Hebrew letters was .57. By itself, it explained 32% of the

variance in the multiple regression and was the first factor in the equation.

We calculated partial correlations between the facilitation score and unique-

ness while holding constant, one at a time, each one of the other independent

variables. These partial correlations were never smaller than .46, which

indicates that none of the other independent variables can in itself account

for the uniqueness effect on latencies. On the other hand, no other variable

correlated significantly (p < .05) with the facilitation score when uniqueness

was held constant.

However, in English the correlation coefficient between uniqueness and

latency was non-significant. We believe that this difference has something

to do with the difference in the variety of segment types in English and in

Hebrew. Most Hebrew letters fit a design of a square block. There are

fewer curves and diagonals in Hebrew compared with English letters, at least

in the type font we used. Also, the measure of uniqueness we used was

positively related to the diversity of segment types. If letters do not

overlap much, as it happens in English, many segments may be judged as unique, although in fact they are functionally equivalent. Also, perhaps diversity makes the relation of the segment with the rest of the character more crucial than its mere presence. It may be that for that reason our method of rating uniqueness failed to capture the psychological variable that was so compellingly captured in the Hebrew alphabet.

A strong effect of uniqueness supports models of letter recognition in which features are not just counted but rather weighted by their diagnosticity across the alphabet (e.g., Rumelhart & Siple, 1974).

Likeness Variables

Change of letter envelope. Bouma (1971) defined letter envelope as the "smallest enclosing polygon without indentations." The concept is particularly helpful in understanding why most letter confusions occur within groups which are easily characterized by the common envelope of the group members. For example, more or less the same envelope characterizes the lower case letters a, s, z, and x; e, o, and c; y, v, and w (cf. Lupker, 1979).

The correlation coefficients between change of envelope and latency facilitation scores was .10 in English and .40 in Hebrew. In the multiple regression, none of them was found to have a significant contribution. The main reason is probably the high correlation of envelope change with the variable of edge mutilation. At least one of these variables might not have any independent causal role in recognition.

Mutilation of an edge of a stroke. We made a distinction here between
mutilations of an unconnected edge of stroke and others that are either
applied to the middle of a line or to an edge connected with some other
stroke.

Mutilation of an edge of a stroke was significantly more harmful in
both English and Hebrew.

Does this factor have any independent contribution? The multiple
regressions suggest that it does not. This variable, for obvious reasons,
correlated very highly with the envelope change variable (.65 and .95 in
English and Hebrew respectively). Its correlation with latency facilitation
became small (.12) and non-significant once the envelope change variable
was partialled out, for the English but not for the Hebrew letters. So,
it is not completely clear without further experimental investigation which
variable assumes a more important causative role here.

Furthermore, the effect of this variable may be due not to the signif-
icance of edges or envelopes but rather to an artifact of the distribution
of informativeness over the letter space. That this might be the case is
suggested by the fact that the correlation of the edge mutilation variable
with the facilitation scores for Hebrew letters decreased from .41 to .19
(p <.25) when uniqueness was partialled out. This was not the case for
English letters, but that might be because, as conjectured above, the
uniqueness variable was poorly defined with respect to English letters.

31

Letter Variables

Number of line segments. We predicted that the number of line segments in a letter will be negatively correlated with the latency facilitation scores. It was reasoned that, other things being equal, the more line segments in a letter, the less its recognition will be affected by mutilation of a single element. The expected correlations were found in both English and Hebrew although the former did not quite reach significance. It should be pointed out, however, that those correlations became smaller and non-significant when some other variables were partialled out. In Hebrew that occurred when uniqueness was held constant $(-.19; \underline{p} < .25)$, and in English it occurs when each of the other variables, except for uniqueness, was held constant. In Hebrew, the number of line segments did contribute considerably to the prediction of facilitation scores as indicated by the multiple regression analysis. However, the contribution of this variable was non-significant $(\underline{p} = .087)$ when it was added on top of uniqueness and distinctiveness which were already in the equations as th first two variables.

Summary

The paradigm of priming letters with a mutilated version of themselves for the purpose of evaluating the diagnostic value of each line feature was found sensitive to a number of variables expected to play a role in letter recognition.

Some of the variables studied played their role differently in the two alphabets investigated. This may serve as a reminder that studies of letter recognition should not be excessively Angiocentric.

A more substantive lesson is that letter recognition depends on the variety of alternatives in each language. Two of the informational variables (uniqueness and distinctiveness) were found to have a significant effect, the first just in Hebrew and the second in both languages. Together, they represent the only group that had a salient effect in both alphabets.

Likeness, as defined in this study, was not found to have a significant independent effect in either alphabet. Our findings lead us to suspect that some of its effect might be mediated by its covariation with informational variables.

We expected the topographic variables to have an effect but we also expected informational or likeness variables to account for topographic effects. However, the strong effect of horizontal position in the English alphabet appears to indicate that the topography of features is important in its own right. However, as we pointed out above, we believe that a better operational definition of informational variables might be able to show that the topographical effect is reducible to an informational account.

In summary, we managed to map out the relative importance of various letter segments in two alphabets, and to show with a considerable degree of certainty that it is greatly mediated by informativeness of the segments, namely by their value for distinguishing between the target letter and other letters in the alphabet. A more conclusive statement about the sources of the differential criticality of the various segments will have to await an experimental study with carefully designed stimulus material rather than natural alphabets.

References

Bouma, H. Visual recognition of isolated lower-case letters. Vision Research, 1971, 11, 459-474.

Clark, H. B. The language-as fixed-effect fallacy: A critique of language statistics in psychological research. Journal of Verbal Learning and Verbal Behavior, 1973, 12, 335-359.

Huey, E. B. The Psychology and Pedagogy of Reading. Cambridge, Mass.: MIT Press, 1968 (originally published, 1908).

Kolers, P. A. Clues to a letter's recognition: Implications for the design of character. The Journal of Typographic Research, 1969, 3, 145-167.

Lupker, S. J. On the nature of perceptual information during letter perception. Perception and Psychophysics, 1979, 25, 303-312.

Rumelhart, D. E., & Siple, P. Processes of recognizing tachistoscopically presented words. Psychological Review, 1974, 81, 99-118.

Shimron, J., & Navon, D. The distribution of visual information in the vertical dimension of Roman and Hebrew letters. Visible Language, in press.

Tversky, A. Features of similarity. Psychological Review, 1977, 84, 327-352.

Footnotes

This work was supported by grants from the Ford Foundation received through the Israel Foundations Trustees and from the Israel Commission of Basic Research. Preparation of the manuscript was done while the first author visited at the Center for the Study of Reading of the University of Illinois at Urbana-Champaign. This report represents equal and shared contributions of both authors.

[1]Note that one may try to define distinctiveness as well in terms of diagnosticity. It may be considered as inversely related to the diagnosticity of the rest of the features of the given letter, namely of E_k-c. We did not pursue this definition further, since for intuitive reasons we preferred our own.

[2]Nevertheless, we counted 8 letters, the naming of which was most facilitated by a prime mutilated at the top and least facilitated (or inhibited) by a mutilation at the bottom, and only 4 letters in which the reverse was true.

Adams, M. J., Anderson, R. C., & Durkin, D. Beginning Reading: Theory and Practice (No. 3), November 1977. (ERIC Document Reproduction Service No. ED 151 722, 15p., PC-$2.00, MF-$.91)

Adams, M., & Bruce, B. Background Knowledge and Reading Comprehension (No. 13), January 1980. (ERIC Document Reproduction Service No. ED 181 431, 48p., PC-$3.65, MF-$.91)

Anderson, R. C., & Freebody, P. Vocabulary Knowledge and Reading (No. 11), August 1979. (ERIC Document Reproduction Service No. ED 177 470, 52p., PC-$5.30, MF-$.91)

Anderson, T. H. Another Look at the Self-Questioning Study Technique (No. 6), September 1978. (ERIC Document Reproduction Service No. ED 163 441, 19p., PC-$2.00, MF-$.91)

Anderson, T. H., Armbruster, B. B., & Kantor, R. N. How Clearly Written are Children's Textbooks? Or, Of Bladderworts and Alfa (includes a response by M. Kane, Senior Editor, Ginn and Company) (No. 16) August 1980. (ERIC Document Reproduction Service No. ED 192 275, 63p., PC-$5.30, MF-$.91)

Armbruster, B. B., & Anderson, T. H. Content Area Textbooks (No. 23), July 1981.

Asher, S. R. Sex Differences in Reading Achievement (No. 2), October 1977. (ERIC Document Reproduction Service No. ED 146 567, 30p., PC-$3.65, MF-$.91)

Baker, L. Do I Understand or Do I not Understand: That is the Question (No. 10), July 1979. (ERIC Document Reproduction Service No. ED 174 948, 27p., PC-$3.65, MF-$.91)

Bruce, B. What Makes a Good Story? (No. 5), June 1978. (ERIC Document Reproduction Service No. ED 158 222, 16p., PC-$2.00, MF-$.91)

Bruce, B. A New Point of View on Children's Stories (No. 25), July 1981.

Bruce, B. Stories within Stories (No. 29), August 1981.

Bruce, B., & Rubin, A. Strategies for Controlling Hypothesis Formation in Reading (No. 22), June 1981.

Bruce, B., Rubin, A., & Starr, K. Why Readability Formulas Fail (No. 28), August 1981.

Collins, A., & Haviland, S. E. Children's Reading Problems (No. 8), June 1979. (ERIC Document Reproduction Service No. ED 172 188, 19p., PC-$2.00, MF-$.91)

Davison, A. Readability--Appraising Text Difficulty (No. 24), July 1981.

Durkin, D. Comprehension Instruction--Where are You? (No. 1), October 1977. (ERIC Document Reproduction Service No. ED 146 566, 14p., PC-$2.00, MF-$.91)

Durkin, D. What is the Value of the New Interest in Reading Comprehension? (No. 19), November 1980. (ERIC Document Reproduction Service No. ED 198 499, 51p., PC-$5.30, MF-$.91)

Durkin, D. Reading Comprehension Instruction in Five Basal Reader Series (No. 26), July 1981.

Jenkins, J. R., & Pany, D. Teaching Reading Comprehension in the Middle Grades (No. 4), January 1978. (ERIC Document Reproduction Service No. ED 151 756, 36p., PC-$3.65, MF-$.91)

Joag-dev, C., & Steffensen, M. S. Studies of the Bicultural Reader: Implications for Teachers and Librarians (No. 12), January 1980. (ERIC Document Reproduction Service No. ED 181 430, 28p., PC-$3.65, MF-$.91)

McCormick, C., & Mason, J. What Happens to Kindergarten Children's Knowledge about Reading after a Summer Vacation? (No. 21), June 1981.

Osborn, J. The Purposes, Uses, and Contents of Workbooks and Some Guidelines for Teachers and Publishers (No. 27), August 1981.

Pearson, P. D., & Kamil, M. L. Basic Processes and Instructional Practices in Teaching Reading (No. 7), December 1978. (ERIC Document Reproduction Service No. ED 165 118, 29p., PC-$3.65, MF-$.91)

Rubin, A. Making Stories, Making Sense (includes a response by T. Raphael and J. LaZansky) (No. 14), January 1980. (ERIC Document Reproduction Service No. ED 181 432, 42p., PC-$3.65, MF-$.91)

Schallert, D. L., & Kleiman, G. M. Some Reasons Why Teachers are Easier to Understand than Textbooks (No. 9), June 1979. (ERIC Document Reproduction Service No. ED 172 189, 17p., PC-$2.00, MF-$.91)

Steinberg, C., & Bruce, B. Higher-Level Features in Children's Stories: Rhetorical Structure and Conflict (No. 18), October 1980. (ERIC Document Reproduction Service No. ED 198 474, 27p., PC-$3.65, MF-$.91)

Taylor, M., & Ortony, A. Figurative Devices in Black Language: Some Socio-Psycholinguistic Observations (No. 20), May 1981.

Tierney, R. J., & LaZansky, J. The Rights and Responsibilities of Readers and Writers: A Contractual Agreement (includes responses by R. N. Kantor and B. B. Armbruster) (No. 15), January 1980. (ERIC Document Reproduction Service No. ED 181 447, 32p., PC-$3.65, MF-$.91)

Tierney, R. J., Mosenthal, J., & Kantor, R. N. Some Classroom Applications of Text Analysis: Toward Improving Text Selection and Use (No. 17), August 1980. (ERIC Document Reproduction Service No. ED 192 251, 43p., PC-$3.65, MF-$.91)

Tierney, R. J., & Pearson, P. D. Learning to Learn from Text: A Framework for Improving Classroom Practice (No. 30), August 1981.

CENTER FOR THE STUDY OF READING

TECHNICAL REPORTS

Adams, M. J. Failures to Comprehend and Levels of Processing in Reading
(No. 37), April 1977. (ERIC Document Reproduction Service No.
ED 145 410, 51p., PC-$5.30, MF-$.91)

Adams, M. J. Models of Word Recognition (No. 107), October 1978. (ERIC
Document Reproduction Service No. ED 163 431, 93p., PC-$6.95, MF-$.91)

Adams, M. J. What Good is Orthographic Redundancy? (No. 192), December
1980. (ERIC Document Reproduction Service No. ED 199 663, 74p.,
PC-$5.30, MF-$.91)

Adams, M. J., & Collins, A. A Schema-Theoretic View of Reading
Comprehension (No. 32), April 1977. (ERIC Document Reproduction
Service No. ED 142 971, 49p., PC-$3.65, MF-$.91)

Alessi, S. M., Anderson, T. H., & Biddle, W. B. Hardware and Software
Considerations in Computer Based Course Management (No. 4), November
1975. (ERIC Document Reproduction Service No. ED 134 928, 21p.,
PC-$2.00, MF-$.91)

Alessi, S. M., Anderson, T. H., & Goetz, E. T. An Investigation of
Lookbacks During Studying (No. 140), September 1979. (ERIC Document
Reproduction Service No. ED 177 494, 40p., PC-$3.65, MF-$.91)

Anderson, R. C. Schema-Directed Processes in Language Comprehension
(No. 50), July 1977. (ERIC Document Reproduction Service No.
ED 142 977, 33p., PC-$3.65, MF-$.91)

Anderson, R. C., & Freebody, P. Vocabulary Knowledge (No. 136), August
1979. (ERIC Document Reproduction Service No. ED 177 480, 71p.,
PC-$5.30, MF-$.91)

Anderson, R. C., Goetz, E. T., Pichert, J. W., & Halff, H. M. Two Faces of
the Conceptual Peg Hypothesis (No. 6), January 1976. (ERIC Document
Reproduction Service No. ED 134 930, 29p., PC-$3.65, MF-$.91)

Anderson, R. C., & Pichert, J. W. Recall of Previously Unrecallable
Information Following a Shift in Perspective (No. 41), April 1977.
(ERIC Document Reproduction Service No. ED 142 974, 37p., PC-$3.65,
MF-$.91)

Anderson, R. C., Pichert, J. W., Goetz, E. T., Schallert, D. L.,
Stevens, K. C., & Trollip, S. R. Instantiation of General Terms
(No. 10), March 1976. (ERIC Document Reproduction Service No.
ED 134 933, 30p., PC-$3.65, MF-$.91)

Anderson, R. C., Pichert, J. W., & Shirey, L. L. Effects of the Reader's
Schema at Different Points in Time (No. 119), April 1979. (ERIC
Document Reproduction Service No. ED 169 523, 36p., PC-$3.65, MF-$.91)

38

Anderson, R. C., Reynolds, R. E., Schallert, D. L., & Goetz, E. T.
Frameworks for Comprehending Discourse (No. 12), July 1976. (ERIC
Document Reproduction Service No. ED 134 935, 33p., PC-$3.65, MF-$.91)

Anderson, R. C., Spiro, R. J., & Anderson, M. C. Schemata as Scaffolding
for the Representation of Information in Connected Discourse (No. 24),
March 1977. (ERIC Document Reproduction Service No. ED 136 236, 18p.,
PC-$2.00, MF-$.91)

Anderson, R. C., Stevens, K. C., Shifrin, Z., & Osborn, J. Instantiation
of Word Meanings in Children (No. 46), May 1977. (ERIC Document
Reproduction Service No. ED 142 976, 22p., PC-$2.00, MF-$.91)

Anderson, T. H. Study Skills and Learning Strategies (No. 104), September
1978. (ERIC Document Reproduction Service No. ED 161 000, 41p.,
PC-$3.65, MF-$.91)

Anderson, T. H., & Armbruster, B. B. Studying (No. 155), January 1980.
(ERIC Document Reproduction Service No. ED 181 427, 48p., PC-$3.65,
MF-$.91)

Anderson, T. H., Standiford, S. N., & Alessi, S. M. Computer Assisted
Problem Solving in an Introductory Statistics Course (No. 56), August
1977. (ERIC Document Reproduction Service No. ED 146 563, 26p.,
PC-$3.65, MF-$.91)

Anderson, T. H., Wardrop, J. L., Hively, W., Muller, K. E., Anderson, R. I.,
Hastings, C. N., & Fredericksen, J. Development and Trial of a Model
for Developing Domain Referenced Tests of Reading Comprehension
(No. 86), May 1978. (ERIC Document Reproduction Service No.
ED 157 036, 69p., PC-$5.30, MF-$.91)

Andre, M. E. D. A., & Anderson, T. H. The Development and Evaluation of a
Self-Questioning Study Technique (No. 87), June 1978. (ERIC Document
Reproduction Service No. ED 157 037, 37p., PC-$3.65, MF-$.91)

Antos, S. J. Processing Facilitation in a Lexical Decision Task (No. 113),
January 1979. (ERIC Document Reproduction Service No. ED 165 129,
84p., PC-$6.95, MF-$.91)

Armbruster, B. B. Learning Principles from Prose: A Cognitive Approach
Based on Schema Theory (No. 11), July 1976. (ERIC Document
Reproduction Service No. ED 134 934, 48p., PC-$3.65, MF-$.91)

Armbruster, B. B., & Anderson, T. H. The Effect of Mapping on the Free
Recall of Expository Text (No. 160), February 1980. (ERIC Document
Reproduction Service No. ED 182 735, 49p., PC-$3.65, MF-$.91)

Armbruster, B. B., Stevens, R. J., & Rosenshine, B. Analyzing Content
Coverage and Emphasis: A Study of Three Curricula and Two Tests
(No. 26), March 1977. (ERIC Document Reproduction Service No.
ED 136 238, 22p., PC-$2.00, MF-$.91)

Arter, J. A., & Jenkins, J. R. Differential Diagnosis-Prescriptive
Teaching: A Critical Appraisal (No. 80), January 1978. (ERIC Document
Reproduction Service No. ED 150 578, 104p., PC-$8.60, MF-$.91)

Asher, S. R. Referential Communication (No. 90), June 1978. (ERIC Document Reproduction Service No. ED 159 597, 71p., PC-$5.30, MF-$.91)

Asher, S. R. Influence of Topic Interest on Black Children and White Children's Reading Comprehension (No. 99), July 1978. (ERIC Document Rep)duction Service No. ED 159 661, 35p., PC-$3.65, MF-$.91)

Asher, S. R., Hymel, S., & Wigfield, A. Children's Comprehension of High- and Low-Interest Material and a Comparison of Two Cloze Scoring Methods (No. 17), November 1976. (ERIC Document Reproduction Service No. ED 134 939, 32p., PC-$3.65, MF-$.91)

Asher, S. R., & Wigfield, A. Influence of Comparison Training on Children's Referential Communication (No. 139), August 1979. (ERIC Document Reproduction Service No. ED 177 493, 42p., PC-$3.65, MF-$.91)

Asher, S. R., & Wigfield, A. Training Referential Communication Skills (No. 175), July 1980. (ERIC Document Reproduction Service No. ED 191 014, 54p., PC-$5.30, MF-$.91)

Baker, L. Processing Temporal Relationships in Simple Stories: Effects of Input Sequence (No. 84), April 1978. (ERIC Document Reproduction Service No. ED 157 016, 54p., PC-$5.30, MF-$.91)

Baker, L. Comprehension Monitoring: Identifying and Coping with Text Confusions (No. 145), September 1979. (ERIC Document Reproduction Service No. ED 177 525, 62p., PC-$5.30, MF-$.91)

Baker, L., & Anderson, R. I. Effects of Inconsistent Information on Text Processing: Evidence for Comprehension Monitoring (No. 203), May 1981.

Baker, L., & Brown, A. L. Metacognitive Skills and Reading (No. 188), November 1980. (ERIC Document Reproduction Service No. ED 195 932, 74p., PC-$5.30, MF-$.91)

Baker, L., & Stein, N. L. The Development of Prose Comprehension Skills (No. 102), September 1978. (ERIC Document Reproduction Service No. ED 159 663, 69p., PC-$5.30, MF-$.91)

Barnitz, J. Interrelationship of Orthography and Phonological Structure in Learning to Read (No. 57), August 1977. (ERIC Document Reproduction Service No. ED 150 546, 62p., PC-$5.30, MF-$.91)

Barnitz, J. G. Reading Comprehension of Pronoun-Referent Structures by Children in Grades Two, Four, and Six (No. 117), March 1979. (ERIC Document Reproduction Service No. ED 170 731, 51p., PC-$5.30, MF-$.91)

Brewer, W. F. Memory for the Pragmatic Implications of Sentences (No. 65), October 1977. (ERIC Document Reproduction Service No. ED 146 564, 27p., PC-$3.65, MF-$.91)

Brewer, W. F., & Lichtenstein, E. H. Event Schemas, Story Schemas, and Story Grammars (No. 197), December 1980. (ERIC Document Reproduction Service No. ED 199 668, 46p., PC-$3.65, MF-$.91)

Brown, A. L. Knowing When, Where, and How to Remember: A Problem of Metacognition (No. 47), June 1977. (ERIC Document Reproduction Service No. ED 146 562. 152p., PC-$11.90, MF-$.91)

Brown, A. L. Theories of Memory and the Problems of Development: Activity, Growth, and Knowledge (No. 51), July 1977. (ERIC Document Reproduction Service No. ED 144 041, 59p., PC-$5.30, MF-$.91)

Brown, A. L. Learning and Development: The Problems of Compatibility, Access, and Induction (No. 165), March 1980. (ERIC Document Reproduction Service No. ED 184 093, 76p., PC-$6.95, MF-$.91)

Brown, A. L., & Campione, J. C. Memory Strategies in Learning: Training Children to Study Strategically (No. 22), March 1977. (ERIC Document Reproduction Service No. ED 136 234, 54p., PC-$5.30, MF-$.91)

Brown, A. L., & Campione, J. C. Permissible Inferences from the Outcome of Training Studies in Cognitive Development Research (No. 127), May 1979. (ERIC Document Reproduction Service No. ED 170 736, 34p., PC-$3.65, MF-$.91)

Brown, A. L., & Campione, J. C. Inducing Flexible Thinking: The Problem of Access (No. 156), January 1980. (ERIC Document Reproduction Service No. ED 181 428, 44p., PC-$3.65, MF-$.91)

Brown, A. L., Campione, J. C., & Barclay, C. R. Training Self-Checking Routines for Estimating Test Readiness: Generalization from List Learning to Prose Recall (No. 94), July 1978. (ERIC Document Reproduction Service No. ED 158 226, 41p., PC-$3.65, MF-$.91)

Brown, A. L., Campione, J. C., & Day, J. D. Learning to Learn: On Training Students to Learn from Texts (No. 189), November 1980.

Brown, A. L., & DeLoache, J. S. Skills, Plans, and Self-Regulation (No. 48), July 1977. (ERIC Document Reproduction Service No. ED 144 040, 66p., PC-$5.30, MF-$.91)

Brown, A. L., & French, L. A. The Zone of Potential Development: Implications for Intelligence Testing in the Year 2000 (No. 128), May 1979. (ERIC Document Reproduction Service No. ED 170 737, 46p., PC-$3.65, MF-$.91)

Brown, A. L., & Smiley, S. S. The Development of Strategies for Studying Prose Passages (No. 66), October 1977. (ERIC Document Reproduction Service No. ED 145 371, 59p., PC-$5.30, MF-$.91)

Brown, A. L., Smiley, S. S., Day, J. D., Townsend, M. A. R., & Lawton, S. C. Intrusion of a Thematic Idea in Children's Comprehension and Retention of Stories (No. 18), December 1976. (ERIC Document Reproduction Service No. ED 136 189, 39p., PC-$3.65, MF-$.91)

Brown, A. L., Smiley, S. S., & Lawton, S. C. The Effects of Experience on the Selection of Suitable Retrieval Cues for Studying from Prose Passages (No. 53), July 1977. (ERIC Document Reproduction Service No. ED 144 042, 30p., PC-$3.65, MF-$.91)

Bruce, B. C. Plans and Social Actions (No. 34), April 1977. (ERIC
    Document Reproduction Service No. ED 149 328, 45p., PC-$3.65, MF-$.91)

Bruce, B. Analysis of Interacting Plans as a Guide to the Understanding of
    Story Structure (No. 130), June 1979. (ERIC Document Reproduction
    Service No. ED 174 951, 43p., PC-$3.65, MF-$.91)

Bruce, B. C., Collins, A., Rubin, A. D., & Gentner, D. A Cognitive Science
    Approach to Writing (No. 89), June 1978. (ERIC Document Reproduction
    Service No. ED 157 039, 57p., PC-$5.30, MF-$.91)

Bruce, B. C., & Newman, D. Interacting Plans (No. 88), June 1978. (ERIC
    Document Reproduction Service No. ED 157 038, 100p., PC-$6.95, MF-$.91)

Campione, J. C., Nitsch, K., Bray, N., & Brown, A. L. Improving Memory
    Skills in Mentally Retarded Children: Empirical Research and
    Strategies for Intervention (No. 196), December 1980. (ERIC Document
    Reproduction Service No. ED 199 667, 67p., PC-$5.30, MF-$.91)

Canney, G., & Winograd, P. Schemata for Reading and Reading Comprehension
    Performance (No. 120), April 1979. (ERIC Document Reproduction Service
    No. ED 169 520, 99p., PC-$6.95, MF-$.91)

Cohen, P. R., & Perrault, C. R. Elements of a Plan-Based Theory of Speech
    Acts (No. 141), September 1979. (ERIC Document Reproduction Service
    No. ED 177 497, 76p., PC-$6.95, MF-$.91)

Collins, A., Brown, A. L., Morgan, J. L., & Brewer, W. F. The Analysis of
    Reading Tasks and Texts (No. 43), April 1977. (ERIC Document
    Reproduction Service No. ED 145 404, 96p., PC-$6.95, MF-$.91)

Collins, A., Brown, J. S., & Larkin, K. M. Inference in Text Understanding
    (No. 40), December 1977. (ERIC Document Reproduction Service No.
    ED 150 547, 48p., PC-$3.65, MF-$.91)

Collins, A., & Smith, E. E. Teaching the Process of Reading Comprehension
    (No. 182), September 1980. (ERIC Document Reproduction Service No.
    ED 193 616, 43p., PC-$3.65, MF-$.91)

Davison, A. Linguistics and the Measurement of Syntactic Complexity: The
    Case of Raising (No. 173), May 1980. (ERIC Document Reproduction
    Service No. ED 186 848, 60p., PC-$5.30, MF-$.91)

Davison, A., Kantor, R. N., Hannah, J., Hermon, G., Lutz, R., & Salzillo, R.
    Limitations of Readability Formulas in Guiding Adaptations of Texts
    (No. 162), March 1980. (ERIC Document Reproduction Service No.
    ED 184 090, 157p., PC-$11.90, MF-$.91)

Davison, A., Lutz, R., & Roalef, A. Text Readability: Proceedings of the
    March 1980 Conference (No. 213), August 1981.

Dunn, B. R., Gould, J. E., & Singer, M. Cognitive Style Differences in
    Expository Prose Recall (No. 210), July 1981.

Dunn, B. R., Mathews, S. R., II, & Bieger, G. Individual Differences in the Recall of Lower-Level Textual Information (No. 150), December 1979. (ERIC Document Reproduction Service No. ED 181 448, 37p., PC-$3.65, MF-$.91)

Durkin, D. What Classroom Observations Reveal about Reading Comprehension Instruction (No. 106), October 1978. (ERIC Document Reproduction Service No. ED 162 259, 94p., PC-$6.95, MF-$.91)

Fleisher, L. S., & Jenkins, J. R. Effects of Contextualized and Decontextualized Practice Conditions on Word Recognition (No. 54), July 1977. (ERIC Document Reproduction Service No. ED 144 043, 37p., PC-$3.65, MF-$.91)

Fleisher, L. S., Jenkins, J. R., & Pany, D. Effects on Poor Readers' Comprehension of Training in Rapid Decoding (No. 103), September 1978. (ERIC Document Reproduction Service No. ED 159 664, 39p., PC-$3.65, MF-$.91)

Freebody, P., & Anderson, R. C. Effects of Differing Proportions and Locations of Difficult Vocabulary on Text Comprehension (No. 202), May 1981.

Gearhart, M., & Hall, W. S. Internal State Words: Cultural and Situational Variation in Vocabulary Usage (No. 115), February 1979. (ERIC Document Reproduction Service No. ED 165 131, 66p., PC-$5.30, MF-$.91)

Gentner, D. On Relational Meaning: The Acquisition of Verb Meaning (No. 78), December 1977. (ERIC Document Reproduction Service No. ED 149 325, 46p., PC-$3.65, MF-$.91)

Gentner, D. Semantic Integration at the Level of Verb Meaning (No. 114), February 1979. (ERIC Document Reproduction Service No. ED 165 130, 39p., PC-$3.65, MF-$.91)

Gentner, D. Verb Semantic Structures in Memory for Sentences: Evidence for Componential Representation (No. 151), December 1979. (ERIC Document Reproduction Service No. ED 181 424, 75p., PC-$5.30, MF-$.91)

Geva, E. Facilitating Reading Comprehension through Flowcharting (No. 211), July 1981.

Goetz, E. T. Sentences in Lists and in Connected Discourse (No. 3), November 1975. (ERIC Document Reproduction Service No. ED 134 927, 75p., PC-$5.30, MF-$.91)

Goetz, E. T. Inferences in the Comprehension of and Memory for Text (No. 49), July 1977. (ERIC Document Reproduction Service No. ED 150 548, 97p., PC-$6.95, MF-$.91)

Goetz, E. T., Anderson, R. C., & Schallert, D. L. The Representation of Sentences in Memory (No. 144), September 1979. (ERIC Document Reproduction Service No. ED 177 527, 71p., PC-$5.30, MF-$.91)

Goetz, E. T., & Osborn, J. Procedures for Sampling Texts and Tasks in Kindergarten through Eighth Grade (No. 30), April 1977. (ERIC Document Reproduction Service No. ED 146 565, 80p., PC-$6.95, MF-$.91)

Green, G. M. Discourse Functions of Inversion Construction (No. 98), July 1978. (ERIC Document Reproduction Service No. ED 160 998, 42p., PC-$3.65, MF-$.91)

Green, G. M. Organization, Goals, and Comprehensibility in Narratives: Newswriting, a Case Study (No. 132), July 1979. (ERIC Document Reproduction Service No. ED 174 949, 66p., PC-$5.30, MF-$.91)

Green, G. M. Linguistics and the Pragmatics of Language Use: What You Know When You Know a Language . . . and What Else You Know (No. 179), August 1980. (ERIC Document Reproduction Service No. ED 193 666, 73p., PC-$5.30, MF-$.91)

Green, G. M., Kantor, R. N., Morgan, J. L., Stein, N. L., Hermon, G., Salzillo, R., & Sellner, M. B. Analysis of "Babar Loses His Crown" (No. 169), April 1980. (ERIC Document Reproduction Service No. ED 185 514, 89p., PC-$6.95, MF-$.91)

Green, G. M., Kantor, R. N., Morgan, J. L., Stein, N. L., Hermon, G., Salzillo, R., & Sellner, M. B. Analysis of "The Wonderful Desert" (No. 170), April 1980. (ERIC Document Reproduction Service No. ED 185 515, 47p., PC-$3.65, MF-$.91)

Green, G. M., Kantor, R. N., Morgan, J. L., Stein, N. L., Hermon, G., Salzillo, R., Sellner, M. B., Bruce, B. C., Gentner, D., & Webber, B. L. Problems and Techniques of Text Analysis (No. 168), April 1980. (ERIC Document-Reproduction Service No. ED 185 513, 173p., PC-$11.90, MF-$.91)

Green, G. M., & Laff, M. O. Five-Year-Olds' Recognition of Authorship by Literary Style (No. 181), September 1980. (ERIC Document Reproduction Service No. ED 193 615, 44p., PC-$3.65, MF-$.91)

Grueneich, R., & Trabasso, T. The Story as Social Environment: Children's Comprehension and Evaluation of Intentions and Consequences (No. 142), September 1979. (ERIC Document Reproduction Service No. ED 177 496, 56p., PC-$5.30, MF-$.91)

Halff, H. M. Graphical Evaluation of Hierarchical Clustering Schemes (No. 1), October 1975. (ERIC Document Reproduction Service No. ED 134 926, 11p., PC-$2.00, MF-$.91)

Hall, W. S., & Dore, J. Lexical Sharing in Mother-Child Interaction (No. 161), March 1980. (ERIC Document Reproduction Service No. ED 184 066, 39p., PC-$3.65, MF-$.91)

Hall, W. S., & Guthrie, L. F. On the Dialect Question and Reading (No. 121), May 1979. (ERIC Document Reproduction Service No. ED 169 522, 32p., PC-$3.65, MF-$.91)

Hall, W. S., & Guthrie, L. F. Cultural and Situational Variation in Language Function and Use: Methods and Procedures for Research (No. 148), October 1979. (ERIC Document Reproduction Service No. ED 179 944, 49p., PC-$3.65, MF-$.91)

Hall, W. S., Linn, R. L., & Nagy, W. E. Spoken Words (No. 177), August 1980.

Hall, W. S., & Nagy, W. E. Theoretical Issues in the Investigation of Words of Internal Report (No. 146), October 1979. (ERIC Document Reproduction Service No. ED 177 526, 108p., PC-$8.60, MF-$.91)

Hall, W. S., Nagy, W. E., & Nottenburg, G. Situational Variation in the Use of Internal State Words (No. 212), August 1981.

Hall, W. S., & Tirre, W. C. The Communicative Environment of Young Children: Social Class, Ethnic, and Situational Differences (No. 125), May 1979. (ERIC Document Reproduction Service No. ED 170 788, 30p., PC-$3.65, MF-$.91)

Hansen, J., & Pearson, P. D. The Effects of Inference Training and Practice on Young Children's Comprehension (No. 166), April 1980. (ERIC Document Reproduction Service No. ED 186 839, 53p., PC-$5.30, MF-$.91)

Hayes, D. A., & Tierney, R. J. Increasing Background Knowledge through Analogy: Its Effects upon Comprehension and Learning (No. 186), October 1980. (ERIC Document Reproduction Service No. ED 195 953, 81p., PC-$6.95, MF-$.91)

Hermon, G. On the Discourse Structure of Direct Quotation (No. 143), September 1979. (ERIC Document Reproduction Service No. ED 177 495, 46p., PC-$3.65, MF-$.91)

Hogaboam, T. W., & McConkie, G. W. The Rocky Road from Eye Fixations to Comprehension (No. 207), May 1981.

Huggins, A. W. F. Syntactic Aspects of Reading Comprehension (No. 33), April 1977. (ERIC Document Reproduction Service No. ED 142 972, 68p., PC-$5.30, MF-$.91)

Iran-Nejad, A. The Schema: A Structural or a Functional Pattern (No. 159), February 1980. (ERIC Document Reproduction Service No. ED 181 449, 46p., PC-$3.65, MF-$.91)

Iran-Nejad, A., Ortony, A., & Rittenhouse, R. K. The Comprehension of Metaphorical Uses of English by Deaf Children (No. 184), October 1980. (ERIC Document Reproduction Service No. ED 193 618, 34p., PC-$3.65, MF-$.91)

Jenkins, J. R., & Larson, K. Evaluating Error Correction Procedures for Oral Reading (No. 55), June 1978. (ERIC Document Reproduction Service No. ED 158 224, 34p., PC-$3.65, MF-$.91)

Jenkins, J. R., & Pany, D. Curriculum Biases in Reading Achievement Tests (No. 16), November 1976. (ERIC Document Reproduction Service No. ED 134 938, 24p., PC-$2.00, MF-$.91)

Jenkins, J. R., Pany, D., & Schreck, J. Vocabulary and Reading Comprehension: Instructional Effects (No. 100), August 1978. (ERIC Document Reproduction Service No. ED 160 999, 50p., PC-$3.65, MF-$.91)

Johnston, P. Implications of Basic Research for the Assessment of Reading Comprehension (No. 206), May 1981.

Kane, J. H., & Anderson, R. C. Depth of Processing and Interference Effects in the Learning and Remembering of Sentences (No. 21), February 1977. (ERIC Document Reproduction Service No. ED 134 942, 29p., PC-$3.65, MF-$.91)

Kleiman, G. M. The Effect of Previous Context on Reading Individual Words (No. 20), February 1977. (ERIC Document Reproduction Service No. ED 134 941, 76p., PC-$6.95, MF-$.91)

Kleiman, G. M. The Prelinguistic Cognitive Basis of Children's Communicative Intentions (No. 19), February 1977. (ERIC Document Reproduction Service No. ED 134 940, 51p., PC-$5.30, MF-$.91)

Kleiman, G. M. The Scope of Facilitation of Word Recognition from Single Word and Sentence Frame Contexts (No. 133), July 1979. (ERIC Document Reproduction Service No. ED 174 947, 61p., PC-$5.30, MF-$.91)

Kleiman, G. M., Winograd, P. N., & Humphrey, M. M. Prosody and Children's Parsing of Sentences (No. 123), May 1979. (ERIC Document Reproduction Service No. ED 170 733, 28p., PC-$3.65, MF-$.91)

Linn, R. L., Levine, M. V., Hastings, C. N., & Wardrop, J. L. An Investigation of Item Bias in a Test of Reading Comprehension (No. 163), March 1980. (ERIC Document Reproduction Service No. ED 184 091, 97p., PC-$6.95, MF-$.91)

Mason, J. M. Questioning the Notion of Independent Processing Stages in Reading (No. 8), February 1976. (Journal of Educational Psychology, 1977, 69, 288-297.

Mason, J. M. Reading Readiness: A Definition and Skills Hierarchy from Preschoolers' Developing Conceptions of Print (No. 59), September 1977. (ERIC Document Reproduction Service No. ED 145 403, 57p., PC-$5.30, MF-$.91)

Mason, J. M. The Role of Strategy in Reading in the Mentally Retarded (No. 58), September 1977. (ERIC Document Reproduction Service No. ED 145 406, 28p., PC-$3.65, MF-$.91)

Mason, J. M. Prereading: A Developmental Perspective (No. 198), February 1981. (ERIC Document Reproduction Service No. ED 199 659, 96p., PC-$6.95, MF-$.91)

Mason, J. M., & Au, K. H. Learning Social Context Characteristics in Prereading Lessons (No. 205), May 1981.

Mason, J. M., & Kendall, J. R. Facilitating Reading Comprehension Through Text Structure Manipulation (No. 92), June 1978. (ERIC Document Reproduction Service No. ED 157 041, 36p., PC-$3.65, MF-$.91)

Mason, J. M., Knisely, E., & Kendall, J. Effects of Polysemous Words on Sentence Comprehension (No. 85), May 1978. (ERIC Document Reproduction Service No. ED 157 015, 34p., PC-$3.65, MF-$.91)

Mason, J., & McCormick, C. Testing the Development of Reading and Linguistic Awareness (No. 126), May 1979. (ERIC Document Reproduction Service No. ED 170 735, 50p., PC-$3.65, MF-$.91)

Mason, J., Osborn, J., & Rosenshine, B. A Consideration of Skill Hierarchy Approaches to the Teaching of Reading (No. 42), December 1977. (ERIC Document Reproduction Service No. ED 150 549, 176p., PC-$13.55, MF-$.91)

McClure, E. Aspects of Code-Switching in the Discourse of Bilingual Mexican-American Children (No. 44), April 1977. (ERIC Document Reproduction Service No. ED 142 975, 38p., PC-$3.65, MF-$.91)

McClure, E., Mason, J., & Barnitz, J. Story Structure and Age Effects on Children's Ability to Sequence Stories (No. 122), May 1979. (ERIC Document Reproduction Service No. ED 170 732, 75p., PC-$5.30, MF-$.91)

McClure, E., Mason, J., & Williams, J. Sociocultural Variables in Children's Sequencing of Stories (No. 209), July 1981.

McClure, E., & Steffensen, M. S. A Study of the Use of Conjunctions across Grades and Ethnic Groups (No. 158), January 1980. (ERIC Document Reproduction Service No. ED 182 688, 43p., PC-$3.65, MF-$.91)

McConkie, G. W. Evaluating and Reporting Data Quality in Eye Movement Research (No. 193), December 1980. (ERIC Document Reproduction Service No. ED 199 664, 50p., PC-$3.65, MF-$.91)

McConkie, G. W., Hogaboam, T. W., Wolverton, G. S., Zola, D., & Lucas, P. A. Toward the Use of Eye Movements in the Study of Language Processing (No. 134), August 1979. (ERIC Document Reproduction Service No. ED 174 968, 48p., PC-$3.65, MF-$.91)

McConkie, G. W., & Zola, D. Language Constraints and the Functional Stimulus in Reading (No. 194), December 1980. (ERIC Document Reproduction Service No. ED 199 665, 51p., PC-$5.30, MF-$.91)

Morgan, J. L. Two Types of Convention in Indirect Speech Acts (No. 52), July 1977. (ERIC Document Reproduction Service No. ED 145 405, 40p., PC-$3.65, MF-$.91)

Nash-Webber, B. Anaphora: A Cross-Disciplinary Survey (No. 31), April 1977. (ERIC Document Reproduction Service No. ED 144 039, 43p., PC-$3.65, MF-$.91)

Nash-Webber, B. L. Inferences in an Approach to Discourse Anaphora (No. 77), January 1978. (ERIC Document Reproduction Service No. ED 150 552, 30p., PC-$3.65, MF-$.91)

Nash-Webber, B., & Reiter, R. Anaphora and Logical Form: On Formal Meaning Representation for Natural Language (No. 36), April 1977. (ERIC Document Reproduction Service No. ED 142 973, 42p., PC-$3.65, MF-$.91)

Navon, D., & Shimron, J. The Distribution of Information within Letters (No. 215), September 1981.

Nezworski, T., Stein, N. L., & Trabasso, T. Story Structure Versus Content Effects on Children's Recall and Evaluative Inferences (No. 129), June 1979. (ERIC Document Reproduction Service No. ED 172 187, 49p., PC-$3.65, MF-$.91)

Nicholson, T., Pearson, P. D., & Dykstra, R. Effects of Embedded Anomalies and Oral Reading Errors on Children's Understanding of Stories (No. 118), March 1979. (ERIC Document Reproduction Service No. ED 169 524, 43p., PC-$3.65, MF-$.91)

Nolan, S. D., Tanenhaus, M. K., & Seidenberg, M. S. Multiple Code Activation in Word Recognition: Evidence from Rhyme Monitoring (No. 204), May 1981.

Ortony, A. Names, Descriptions, and Pragmatics (No. 7), February 1976. (ERIC Document Reproduction Service No. ED 134 931, 25p., PC-$2.00, MF-$.91)

Ortony, A. Remembering and Understanding Jabberwocky and Small-Talk (No. 28), March 1977. (ERIC Document Reproduction Service No. ED 137 753, 36p., PC-$3.65, MF-$.91)

Ortony, A. Beyond Literal Similarity (No. 105), October 1978. (ERIC Document Reproduction Service No. ED 166 635, 58p., PC-$5.30, MF-$.91)

Ortony, A. Some Psycholinguistic Aspects of Metaphor (No. 112), January 1979. (ERIC Document Reproduction Service No. ED 165 115, 38p., PC-$3.65, MF-$.91)

Ortony, A. Understanding Metaphors (No. 154), January 1980. (ERIC Document Reproduction Service No. ED 181 426, 52p., PC-$5.30, MF-$.91)

Ortony, A., Reynolds, R. E., & Arter, J. A. Metaphor: Theoretical and Empirical Research (No. 27), March 1977. (ERIC Document Reproduction Service No. ED 137 752, 63p., PC-$5.30, MF-$.91)

Ortony, A., Schallert, D. L., Reynolds, R. E., & Antos, S. J. Interpreting Metaphors and Idioms: Some Effects of Context on Comprehension (No. 93), July 1978. (ERIC Document Reproduction Service No. ED 157 042, 41p., PC-$3.65, MF-$.91)

Pany, D., & Jenkins, J. R. Learning Word Meanings: A Comparison of Instructional Procedures and Effects on Measures of Reading Comprehension with Learning Disabled Students (No. 25), March 1977. (ERIC Document Reproduction Service No. ED 136 237, 34p., PC-$3.65, MF-$.91)

Pearson, P. D., Hansen, J., & Gordon, C. The Effect of Background Knowledge on Young Children's Comprehension of Explicit and Implicit Information (No. 116), March 1979. (ERIC Document Reproduction Service No. ED 169 521, 26p., PC-$3.65, MF-$.91)

Pearson, P. D., Raphael, T., TePaske, N., & Hyser, C. The Function of Metaphor in Children's Recall of Expository Passages (No. 131), July 1979. (ERIC Document Reproduction Service No. ED 174 950, 41p., PC-$3.65, MF-$.91)

Pichert, J. W. Sensitivity to What is Important in Prose (No. 149), November 1979. (ERIC Document Reproduction Service No. ED 179 946, 64p., PC-$5.30, MF-$.91)

Pichert, J. W., & Anderson, R. C. Taking Different Perspectives on a Story (No. 14), November 1976. (ERIC Document Reproduction Service No. ED 134 936, 30p., PC-$3.65, MF-$.91)

Raphael, T. E., Myers, A. C., Freebody, P., Tirre, W. C., & Fritz, M. Contrasting the Effects of Some Text Variables on Comprehension and Ratings of Comprehensibility (No. 190), December 1980. (ERIC Document Reproduction Service No. ED 199 661, 58p., PC-$5.30, MF-$.91)

Reder, L. M. Comprehension and Retention of Prose: A Literature Review (No. 108), November 1978. (ERIC Document Reproduction Service No. ED 165 114, 116p., PC-$8.60, MF-$.91)

Reichman, R. Conversational Coherency (No. 95), July 1978. (ERIC Document Reproduction Service No. ED 159 658, 86p., PC-$6.95, MF-$.91)

Reynolds, R. E., & Anderson, R. C. Influence of Questions on the Allocation of Attention during Reading (No. 183), October 1980. (ERIC Document Reproduction Service No. ED 193 617, 44p., PC-$3.65, MF-$.91)

Reynolds, R. E., & Ortony, A. Some Issues in the Measurement of Children's Comprehension of Metaphorical Language (No. 172), May 1980. (ERIC Document Reproduction Service No. ED 185 542, 42p., PC-$3.65, MF-$.91)

Reynolds, R. E., Standiford, S. N., & Anderson, R. C. Distribution of Reading Time When Questions are Asked about a Restricted Category of Text Information (No. 83), April 1978. (ERIC Document Reproduction Service No. ED 153 206, 34p., PC-$3.65, MF-$.91)

Reynolds, R. E., Taylor, M. A., Steffensen, M. S., Shirey, L. L., & Anderson, R. C. Cultural Schemata and Reading Comprehension (No. 201), April 1981.

Royer, J. M. Theories of Learning Transfer (No. 79), January 1978. (ERIC Document Reproduction Service No. ED 149 326, 55p., PC-$5.30, MF-$.91)

Royer, J. M., & Cunningham, D. J. On the Theory and Measurement of Reading Comprehension (No. 91), June 1978. (ERIC Document Reproduction Service No. ED 157 040, 63p., PC-$5.30, MF-$.91)

Royer, J. M., Hastings, C. N., & Hook, C. A Sentence Verification Technique for Measuring Reading Comprehension (No. 137), August 1979. (ERIC Document Reproduction Service No. ED 176 234, 34p., PC-$3.65, MF-$.91)

Rubin, A. D. A Theoretical Taxonomy of the Differences between Oral and Written Language (No. 35), January 1978. (ERIC Document Reproduction Service No. ED 150 550, 61p., PC-$5.30, MF-$.91)

Rubin, A. D., Bruce, B. C., & Brown, J. S. A Process-Oriented Language for Describing Aspects of Reading Comprehension (No. 13), November 1976. (ERIC Document Reproduction Service No. ED 136 188, 41p., PC-$3.65, MF-$.91)

Schallert, D. L. Improving Memory for Prose: The Relationship between Depth of Processing and Context (No. 5), November 1975. (ERIC Document Reproduction Service No. ED 134 929, 37p., PC-$3.65, MF-$.91)

Schallert, D. L., Kleiman, G. M., & Rubin, A. D. Analyses of Differences between Written and Oral Language (No. 29), April 1977. (ERIC Document Reproduction Service No. ED 144 038, 33p., PC-$3.65, MF-$.91)

Schwartz, R. M. Strategic Processes in Beginning Reading (No. 15), November 1976. (ERIC Document Reproduction Service No. ED 134 937, 19p., PC-$2.00, MF-$.91)

Schwartz, R. M. Relation of Context Utilization and Orthographic Automaticity in Word Identification (No. 45), May 1977. (ERIC Document Reproduction Service No. ED 137 762, 27p., PC-$3.65, MF-$.91).

Schwartz, R. M. Levels of Processing: The Strategic Demands of Reading Comprehension (No. 135), August 1979. (ERIC Document Reproduction Service No. ED 177 471, 45p., PC-$3.65, MF-$.91)

Seidenberg, M. S., Tanenhaus, M. K., & Leiman, J. M. The Time Course of Lexical Ambiguity Resolution in Context (No. 164), March 1980. (ERIC Document Reproduction Service No. ED 184 092, 58p., PC-$5.30, MF-$.91)

Shatz, M. Learning the Rules of the Game: Four Views of the Relation between Social Interaction and Syntax Acquisition (No. 214), September 1981.

Shimron, J., & Navon, D. The Dependence on Graphemes and on Their Translation to Phonemes in Reading: A Developmental Perspective (No. 208), June 1981.

Shoben, E. J. Choosing a Model of Sentence Picture Comparisons: A Reply to Catlin and Jones (No. 61), February 1978. (ERIC Document Reproduction Service No. ED 150 577, 30p., PC-$3.65, MF-$.91)

Shoben, E. J., Rips, L. J., & Smith, E. E. Issues in Semantic Memory: A Response to Glass and Holyoak (No. 101), August 1978. (ERIC Document Reproduction Service No. ED 159 662, 85p., PC-$6.95, MF-$.91)

Siegel, M. A. Teacher Behaviors and Curriculum Packages: Implications for Research and Teacher Education (No. 9), April 1976. (ERIC Document Reproduction Service No. ED 134 932, 42p., PC-$3.65, MF-$.91)

Smiley, S. S., Oakley, D. D., Worthen, D., Campione, J. C., & Brown, A. L. Recall of Thematically Relevant Material by Adolescent Good and Poor Readers as a Function of Written Versus Oral Presentation (No. 23), March 1977. (ERIC Document Reproduction Service No. ED 136 235, 23p., PC-$2.00, MF-$.91)

Smith, E. E. Organization of Factual Knowledge (No. 185), October 1980.
    (ERIC Document Reproduction Service No. ED 195 954, 109p., PC-$8.60,
    MF-$.91)

Spiro, R. J. Inferential Reconstruction in Memory for Connected Discourse
    (No. 2), October 1975. (ERIC Document Reproduction Service No.
    ED 136 187, 81p., PC-$6.95, MF-$.91)

Spiro, R. J. Etiology of Reading Comprehension Style (No. 124), May 1979.
    (ERIC Document Reproduction Service No. ED 170 734, 21p., PC-$2.00,
    MF-$.91)

Spiro, R. J. Prior Knowledge and Story Processing: Integration,
    Selection, and Variation (No. 138), August 1979. (ERIC Document
    Reproduction Service No. ED 176 235, 41p., PC-3.32, MF-$.91)

Spiro, R. J. Schema Theory and Reading Comprehension: New Directions
    (No. 191), December 1980. (ERIC Document Reproduction Service No.
    ED 199 662, 49p., PC-$3.65, MF-$.91)

Spiro, R. J., & Esposito, J. J. Superficial Processing of Explicit
    Inferences in Text (No. 60), December 1977. (ERIC Document
    Reproduction Service No. ED 150 545, 27p., PC-$3.65, MF-$.91)

Spiro, R. J., & Taylor, B. M. On Investigating Children's Transition from
    Narrative to Expository Discourse: The Multidimensional Nature of
    Psychological Text Classification (No. 195), December 1980. (ERIC
    Document Reproduction Service No. ED 199 666, 43p., PC-$3.65, MF-$.91)

Spiro, R. J., & Tirre, W. C. Individual Differences in Schema Utilization
    During Discourse Processing (No. 111), January 1979. (ERIC Document
    Reproduction Service No. ED 166 651, 29p., PC-$3.65, MF-$.91)

Steffensen, M. S. Bereiter and Engelmann Reconsidered: The Evidence from
    Children Acquiring Black English Vernacular (No. 82), March 1978.
    (ERIC Document Reproduction Service No. ED 153 204, 31p., PC-$3.65,
    MF-$.91)

Steffensen, M. S., & Guthrie, L. F. Effect of Situation on the
    Verbalization of Black Inner-City Children (No. 180), September 1980.
    (ERIC Document Reproduction Service No. ED 193 614, 37p., PC-$3.65,
    MF-$.91)

Steffensen, M. S., Jogdeo, C., & Anderson, R. C. A Cross-Cultural
    Perspective on Reading Comprehension (No. 97), July 1978. (ERIC
    Document Reproduction Service No. ED 159 660, 41p., PC-$3.65, MF-$.91)

Steffensen, M. S., Reynolds, R. E., McClure, E., & Guthrie, L. F. Black
    English Vernacular and Reading Comprehension: A Cloze Study of Third,
    Sixth, and Ninth Graders (No. 199), February 1981. (ERIC Document
    Reproduction Service No. ED 199 660, 44p., PC-$3.65, MF-$.91)

Stein, N. L. How Children Understand Stories: A Developmental Analysis
    (No. 69), March 1978. (ERIC Document Reproduction Service No.
    ED 153 205, 68p., PC-$5.30, MF-$.91)

Stein, N. L., & Goldman, S. Children's Knowledge about Social Situations: From Causes to Consequences (No. 147), October 1979. (ERIC Document Reproduction Service No. ED 177 524, 54p., PC-$5.30, MF-$.91)

Stein, N. L., & Nezworski, T. The Effects of Organization and Instructional Set on Story Memory (No. 68), January 1978. (ERIC Document Reproduction Service No. ED 149 327, 41p., PC-$3.65, MF-$.91)

Stein, N. L., & Trabasso, T. What's in a Story: An Approach to Comprehension and Instruction (No. 200), April 1981.

Straker, D. Y. Situational Variables in Language Use (No. 167), April 1980. (ERIC Document Reproduction Service No. ED 185 619, 49p., PC-$3.65, MF-$.91)

Tanenhaus, M. K., Flanigan, H., & Seidenberg, M. S. Orthographic and Phonological Activation in Auditory and Visual Word Recognition (No. 178), August 1980. (ERIC Document Reproduction Service No. ED 193 620, 46p., PC-$3.65, MF-$.91)

Tanenhaus, M. K., & Seidenberg, M. S. Discourse Context and Sentence Perception (No. 176), July 1980. (ERIC Document Reproduction Service No. ED 191 015, 45p., PC-$3.65, MF-$.91)

Thieman, T. J., & Brown, A. L. The Effects of Semantic and Formal Similarity on Recognition Memory for Sentences in Children (No. 76), November 1977. (ERIC Document Reproduction Service No. ED 150 551, 26p., PC-$3.65, MF-$.91)

Tierney, R. J., & Cunningham, J. W. Research on Teaching Reading Comprehension (No. 187), November 1980. (ERIC Document Reproduction Service No. ED 195 946, 125p., PC-$8.60, MF-$.91)

Tierney, R. J., & Mosenthal, J. Discourse Comprehension and Production: Analyzing Text Structure and Cohesion (No. 152), January 1980. (ERIC Document Reproduction Service No. ED 179 945, 84p., PC-$6.95, MF-$.91)

Tirre, W. C., Freebody, P., & Kaufman, K. Achievement Outcomes of Two Reading Programs: An Instance of Aptitude-Treatment Interaction (No. 174), June 1980. (ERIC Document Reproduction Service No. ED 193 619, 34p., PC-$3.65, MF-$.91)

Tirre, W. C., Manelis, L., & Leicht, K. L. The Effects of Imaginal and Verbal Strategies on Prose Comprehension in Adults (No. 110), December 1978. (ERIC Document Reproduction Service No. ED 165 116, 27p., PC-$3.65, MF-$.91)

Trabasso, T. On the Making of Inferences During Reading and Their Assessment (No. 157), January 1980. (ERIC Document Reproduction Service No. ED 181 429, 38p., PC-$3.65, MF-$.91)

Wardrop, J. L., Anderson, T. H., Hively, W., Anderson, R. I., Hastings, C. N., & Muller, K. E. A Framework for Analyzing Reading Test Characteristics (No. 109), December 1978. (ERIC Document Reproduction Service No. ED 165 117, 65p., PC-$5.30, MF-$.91)

Wigfield, A., & Asher, S. R. Age Differences in Children's Referential
    Communication Performance: An Investigation of Task Effects (No. 96),
    July 1978. (ERIC Document Reproduction Service No. ED 159 659, 31p.,
    PC-$3.65, MF-$.91)

Winograd, P., & Johnston, P. Comprehension Monitoring and the Error
    Detection Paradigm (No. 153), January 1980. (ERIC Document
    Reproduction Service No. ED 181 425, 57p., PC-$5.30, MF-$.91)

Woods, W. A. Multiple Theory Formation in High-Level Perception (No. 38),
    April 1977. (ERIC Document Reproduction Service No. ED 144 020, 58p.,
    PC-$5.30, MF-$.91)

Zehler, A. M., & Brewer, W. F. Acquisition of the Article System in
    English (No. 171), May 1980. (ERIC Document Reproduction Service No.
    ED 186 907, 51p., PC-$5.30, MF-$.91)