Published as a separate and in *The Journal of Psychology*, 1980, **106**, 179-192.

THE EFFECTS OF CONTEXT ON WORD IDENTIFICATION IN GOOD AND POOR READERS*[1]

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SUMMARY

A semantic priming procedure was employed to test the hypothesis that children differing in word-decoding skill differentially use context to facilitate word identification. *S*s (14 good and 14 poor readers) were shown pairs of stimuli, a prime followed by a target, with instructions to read the target as rapidly as possible. Primes were either semantically related or unrelated to the targets. For both single-word and incomplete-sentence primes, targets in related pairs were read faster than those in unrelated pairs, with larger facilitation effects being obtained with the incomplete-sentence primes. However, the magnitude of these context effects did not vary as a function of word-decoding skill. In contrast to previous data obtained by other procedures, our findings suggest that differences between good and poor readers in word-decoding skill are not necessarily related to differences in the ability to extract and utilize the semantic content of written material.

A. INTRODUCTION

Most current models of the reading process include an account of the role of contextual information in facilitating word identification (4, 6, 18). According to these models, a skilled reader is able to use the context in which a word is presented to reduce the number of visual cues necessary for accurate word identification and to reduce the amount of attention

* Received in the Editorial Office on August 11, 1980, and published immediately at Provincetown, Massachusetts.

1 This research was supported by Grants No. HD-00973, HD-04510, and HD-07045 from the National Institute of Child Health and Human Development. The authors gratefully acknowledge the active cooperation of Robert Cantrell and the teachers of Fairview Elementary School who generously donated their time in support of our research efforts. Requests for reprints can be addressed to the first author at the address shown at the end of this article.

required for processing the word. By implication, an inability to utilize context would be assumed to result in a decrease in reading efficiency.

While it has indeed been suggested that a failure to use context efficiently may be a contributing factor to reading difficulty (7), the results of studies designed to examine this relationship are equivocal. Some data have been reported which demonstrate more efficient use of context by good readers (8, 11, 21), while other data suggest that poor readers use contextual information at least as efficiently as do good readers (1, 15).

One possible explanation for these discrepant findings involves critical differences in the methodologies and dependent measures employed in the various studies. Studies in which the differential use of context by good and poor readers has been reported all seem to involve procedures that allow *S*s to consider and choose from a number of potential response alternatives, and/or to evaluate task demands for the purpose of ascertaining the most efficient response strategy; in addition, the dependent measure in each of these studies is something other than word identification *per se*. For example, performance differences between good and poor readers have been reported on the Cloze Test (12), an exercise in which successful performance depends upon conscious inference and hypotheses-testing strategies (11), and context is assumed to influence word production, rather than word identification. Similarly, Klein *et al.* (8) reported differences as a function of reading ability on a word-boundary task in which *S*s divided strings of letters into words. But, again, there are clearly a number of potential strategies that *S*s might devise, which would be more or less successful, for accurately locating word boundaries in this task.

In contrast to these findings, under conditions in which the opportunity to consider and choose from a set of potential response strategies is at least greatly minimized, and word identification is the dependent measure, Schvaneveldt *et al.* (18) and Allington and Strange (1) found no advantage for good readers in the use of semantic context. Thus, while differences between good and poor readers have indeed been obtained in several studies designed to assess the use of semantic context, the possibility remains that these performance differences result from corresponding group differences in the efficiency of selecting and executing task-specific response strategies that are not directly related to the reading process *per se*. [See (2) for a more thorough consideration of the strategic-nonstrategic distinction as it applies to determining the locus of obtained group differences.]

Gibson and Levin (4) have concluded that rules of redundancy (i.e.,

context clues) operate automatically during skilled reading [see also (9)]. Therefore, it would appear that results obtained using tasks which assess the automatic (as opposed to strategic) use of contextual information have the most generality to normal reading. As noted above, Schvaneveldt *et al.* (15) and Allington and Strange (1) found no advantage in the use of context by good readers under relatively automatic conditions. However, conclusions as to the role of context in actual reading based on the results of these studies must remain somewhat tentative. Schvaneveldt *et al.* employed a lexical-decision task in which *S*s were required to determine whether or not a given string of letters was a word. Theios and Muise (22) have argued that the lexical-decision task may have little to do with normal reading in that word/nonword decisions involve the use of more complicated memory processes. In the Allington and Strange (1) study, *S*s were in fact required to read, but the use of context was measured by the number of times in a given passage an *S* misread words that were contextually inappropriate but graphemically similar to words that fitted the context. During normal reading, however, one rarely encounters text in which inappropriate, but graphemically confusable, words appear. Therefore, the two studies reported to date on the nonstrategic use of context by good and poor readers may suffer from some limitations in generality.

Our interest in the present studies was in assessing the effects of context on *word identification* under relatively nonstrategic conditions in which the problems noted above were eliminated. Good and poor readers were shown pairs of stimuli (a prime and a target) and were instructed simply to identify each stimulus as rapidly as possible. In this paradigm, the comparison of response times to targets that are preceded by a semantically related stimulus with those that are preceded by an unrelated stimulus yields a measure of automatic facilitation due to context (10, 19). Experiment 1 was designed to examine differences between good and poor readers in the effects of a single-word semantic context on subsequent word processing. The purpose of the second experiment was to extend the findings of Experiment 1 to include an assessment of the effects of sentence contexts on word identification.

B. Experiment 1

As mentioned above, the purpose of the first experiment was to assess the relationship between reading ability and the degree to which single-word contexts facilitate word identification. To the extent that individual differences in overall reading ability are at least partially attributable to

differences in the nonstrategic use of context, then larger facilitation (priming) effects should obtain for good than for poor readers under present task conditions.

One additional variable was manipulated in this experiment in order to eliminate a possible confounding of reading ability and conceptual knowledge. It is possible that any differences between groups that might be elicited in this semantic-priming task would simply reflect group differences in knowledge about semantic relationships. Therefore, to assess conceptual knowledge independent of reading skill, picture pairs, as well as word pairs, were employed (19). If group differences are found in the effects of context with word stimuli and not with picture stimuli, then these differences would be attributable to variations in reading skill *per se* and not to differences in semantic knowledge. In addition, the inclusion of the picture/word manipulation also served as a partial control for possible group differences in general intellectual functioning. If our good and our poor readers did differ in general intellectual ability, then group differences in overall response time should obtain with picture stimuli as well as with word stimuli (20).

1. *Method*

a. Subjects. *S*s were 14 good and 14 poor readers selected from fifth grade classes at a rural public school. All students were Caucasian and were from middle-income families. Group assignment was made on the basis of *S*s' scores on both the vocabulary and comprehension subtests of the Stanford Achievement Test. Poor readers were defined as those students who had achieved grade equivalent scores of 4.5 or lower on both tests, and good readers were defined as those who had achieved scores of 5.0 or higher on both tests. Mean grade equivalent scores in vocabulary were 6.3 (SD = .9; range = 5.1 to 7.3) for the good readers and 3.7 (SD = .5; range = 3.0 to 4.4) for the poor readers. For comprehension, scores were 5.8 (SD = .7; range 5.0 to 7.4 and 3.5 (SD = .7; range = 2.5 to 4.5) for good and poor readers, respectively. In an effort to better classify the particular readers used in the experiment, scores were also obtained for the spelling, word study, and language subtests. Mean grade equivalents on these subtests were 5.7 and 3.7 in spelling, 5.7 and 3.1 in word study, and 5.7 and 3.3 in language, for good and poor readers, respectively.

b. Materials. Picture stimuli were photographs of black and white line drawings, most taken from the Peabody Picture Vocabulary Test and the remainder drawn by an artist. Twenty of the pictures were selected from

the stimulus pool and designated as target pictures. The selection criterion was that each target picture (the second picture in each pair) could be paired intuitively with one other picture (the prime) to form an associatively related pair (e.g., bone-dog, bullet-gun). Each of the target pictures was then paired again with a different picture to form a set of 20 unrelated pairs (e.g., bullet-dog, bone-gun). This procedure yielded a set of 40 pairs, half related and half unrelated, for use on experimental trials. An additional set of 15 unrelated pairs was formed from the remaining pictures in the stimulus pool for use on practice trials.

Word stimuli were made by typing the name of each pictured object in the center of a transparent slide. All words were typed in lower case elite type. The same related and unrelated pairs that were formed for picture stimuli were used with word stimuli. All words had a relatively high occurrence frequency in the combined third and fourth grade corpus of The American Heritage Word Frequency Book (3), with 15 of the 20 target words having an occurrence frequency of 50+ per million.

c. Apparatus. The apparatus consisted of a Kodak Carousel (Model C) slide projector equipped with a tachistoscope lens for presenting stimuli, a voice-operated relay wired to a Hunter Mfg. Co. Model 120-C Klockounter for recording response times to target stimuli, and supportive electromechanical equipment. The Klockounter was interfaced with the voice operated relay and tachistoscopic lens such that the appearance of the target slide started the timing cycle, and the *S*'s response to the target stopped the cycle.

d. Design. Three variables were included in the experiment: groups (good readers *vs.* poor readers), stimulus type (picture *vs.* word), and relatedness (related *vs.* unrelated). For each *S*, picture stimuli and word stimuli were presented on separate blocks. Half of the *S*s in each group received pictures first and half received words first. Within each block, the order of experimental pairs was randomized with the restrictions that an equal number of related and unrelated pairs appeared in each half of the block and that no more than three related or unrelated pairs appeared in sequence. Each target concept appeared once in a related and once in an unrelated pair in each block. All *S*s received the entire set of 80 experimental trials, 20 trials in each condition resulting from the factoral combination of stimulus type and relatedness.

e. Procedure. *S*s were tested individually. Prior to the beginning of the experimental trials *S*s were shown all test pictures in a random order and were asked to name each. This was done to ensure that names given to the

pictured objects would correspond to the word stimuli used. Any discrepancies were corrected by the *E* (no more than one for any given *S*). After the picture-naming phase, *S*s were given 15 practice trials with all pairs being of the stimulus type that the particular *S* had been assigned to receive first. All practice pairs contained unrelated primes and targets to ensure that any "set" or response bias that might be established during practice would work against obtaining the predicted relatedness effect. *S*s were instructed simply to identify each picture or word as quickly as possible without making any errors. The sequence of events within each practice trial was as follows. The prime stimulus appeared on the screen and was removed immediately after the *S* named it. One second later the target stimulus appeared and the timing cycle was initiated. The *S*'s response to the target stopped the timing cycle and ended the trial. Response times were recorded to the nearest msec. Intertrial intervals were approximately 10 seconds.

Experimental trials were initiated following practice. The test procedure and instructions were identical to those used in practice, and no mention was ever made about potential relationships between stimuli. Upon completion of the first block of experimental trials, *S*s were given 15 practice trials on the stimulus type designated to be received second, followed by the second block of experimental trials.

2. *Results and Discussion*

For each *S*, median response times (excluding errors) were tabulated and analyzed in a mixed analysis of variance. Errors were extremely rare, being less than 2% for both groups of *S*s. Since preliminary analyses had indicated that response times did not differ as a function of the presentation order of blocks, this variable was not included in the main analysis.

The analysis revealed that words (634 msec) were identified faster than pictures (728 msec) by both groups, F (1, 26) = 45.35, $p < .001$. This difference is consistent with the results of previous studies with adults (19) and supports the view that phonemic codes are more easily accessed from graphemic stimuli than from pictorial stimuli (14, 16). The main effect of groups was also significant, F (1, 26) = 4.66, $p < .05$, with overall response times for good readers (654) being faster than those for poor readers (708 msec). However, both main effects were qualified by their interaction, F (1, 26) = 4.99, $p < .05$. Subsequent analyses revealed that group differences were localized in response times to word stimuli. Groups did not differ significantly on response times to picture stimuli, $F < 1.0$, but differed

TABLE 1
MEAN RESPONSE TIMES TO TARGETS (IN MSEC) FOR GOOD AND POOR READERS AS A FUNCTION OF STIMULUS TYPE AND RELATEDNESS
(Priming Effects in Parentheses)

	Pictures		Words	
Readers	Related	Unrelated	Related	Unrelated
Good	696	740 (44)	580	602 (22)
Poor	715	765 (50)	666	687 (21)

significantly on response times to words, F (1, 26) = 8.46, $p < .01$, (591 msec for good readers *vs.* 677 msec for poor readers). These results, then, are consistent with studies that have found decoding differences between good and poor readers on familiar words (13), and the data suggest that these decoding differences do not extend to picture processing. As discussed earlier, this latter finding provides indirect support for our assumption that the present good and poor readers did not differ significantly in general intellectual ability.

As expected, target stimuli in related pairs were identified faster than those in unrelated pairs (664 *vs.* 698 msec), F (1, 26) = 38.36, $p < .001$. Further, an interaction of relatedness × stimulus type was obtained, F (1, 26) = 4.10, $p = .05$, which resulted from differences in the magnitude of the relatedness effect obtained for pictures (47 msec) relative to words (21 msec). This finding replicates results reported and discussed by Sperber *et al.* (19) with adult *S*s.

Of major importance, the groups × stimulus type × relatedness interaction did not even approach significance, $F = 1.0$, with the magnitude of the relatedness effect on word processing being almost identical for the two groups (22 msec for good readers and 21 msec for poor readers). This result provides confirmation in a reading task for the conclusion reached by Golinkoff and Rosinski (5) in an experiment using a modified Stroop procedure; despite differences in decoding skill, good and poor readers appear able to extract equivalent meaning from the presentation of familiar single words. However, while the Golinkoff and Rosinski results indicate equal interference from words in a picture-naming task for good and for poor readers, the present data suggest equal facilitation effects under more normal reading conditions in which the context precedes the to-be-identified word. Thus, the tentative indication is that readers differing in decoding skill not only extract equivalent meaning from single-word contexts, but, further, that they are also able to use that information to facilitate subsequent word processing to the same degree.

C. Experiment 2

The data from the first experiment provide no evidence for a relationship between reading ability and the extent to which context is used to facilitate subsequent word identification. However, normal reading typically requires the extraction of contextual information from sentences. Therefore in this experiment, the general design of which was similar to that of Experiment 1, we investigated the facilitative effects of an incomplete-sentence prime as compared to those of a single-word prime. Although type of context (sentence *vs.* word) was varied orthogonally with semantic relatedness, only data obtained in the two related conditions were used to assess the facilitative effects of sentence primes in this experiment. Since the processing of an unrelated (i.e., inappropriate) sentence context could potentially *interfere* with the identification of a subsequent target word, the unrelated-sentence condition was considered to be an inappropriate control against which the facilitative effects of a related-sentence context could be assessed; i.e., such a comparison might provide artifactual overestimates of the magnitude of the facilitation effect. The unrelated-sentence primes were included in this study primarily to eliminate the possibility of *S*s attempting to anticipate the identity of targets following related-sentence primes.

In a lexical-decision task, Shuberth and Eimas (17) have previously reported context effects resulting from the presentation of an incomplete sentence. On the basis of their results, we expected that incomplete-sentence priming would be evident under present task conditions. Indeed, the additional semantic and syntactic constraints imposed by a sentence context, relative to single-word context, were expected to result in an even greater facilitation in the time required for target word identification. However, the extent to which a sentence context facilitates word identification would be expected to vary with the ability of the reader to integrate the semantic information accessed during the processing of the individual words in the sentence. Assuming that poor readers tend to process written material in a word-by-word fashion (11, 21), good readers would be expected to benefit more from sentence contexts than would poor readers. In the present experiment, direct support for this hypothesis would obtain if the facilitation resulting from related sentence contexts, relative to that obtained with related single-word contexts, were greater for good than for poor readers.

1. *Method*

a. Subjects. *S*s were the same as those used in Experiment 1.

b. Materials. Thirty related word pairs and 30 unrelated word pairs (different from those used in Experiment 1) were constructed for use in the word-context condition. All words again had a high occurrence frequency (3). For each word-word pair, a corresponding sentence-word pair was constructed such that the prime word in each word-word pair served as the subject of the sentence and the target word served as the direct object of that sentence. For example, from the related word pairs "baker-cake" and "boat-river" the corresponding related sentences "The baker made a—cake" and "The boat sailed on the—river" were formed. From the unrelated word pairs "boat-cake" and "baker-river", the unrelated sentences "The boat sailed on the—cake" and "The baker made a—river" were generated. Each sentence was typed on two slides so as to form a prime and a target stimulus as follows. The incomplete sentence context (e.g., The baker made a) was typed on the first slide. The object noun (e.g., cake) was placed on a second slide such that, when presented, the object noun appeared in its normal spatial position. An additional set of 15 word-word and sentence-word pairs were constructed for use on practice trials.

c. Design and procedure. The factors in the experiment were groups, relatedness, and type of context (sentence *vs.* word). Each *S* received half of the 30 target words in the word-context condition and the remaining targets in the sentence-context condition. Each target word appeared twice, once in a related and once in an unrelated pair. Assignment of particular targets to sentence- *vs.* word-context conditions was counterbalanced over *S*s such that across the *S*s within each group, each target appeared an equal number of times in each context condition. Sentence-word pairs and word-word pairs were presented in separate blocks, with the presentation order of blocks appropriately counterbalanced. The order of experimental trials within blocks was randomized as in Experiment 1. Thus, each *S* received a total of 60 experimental trials, 15 trials in each of the four conditions resulting from the factoral combination of type of context and relatedness.

The general procedure was the same as Experiment 1 except that for the sentence-context condition *S*s were informed that they would see an incomplete sentence on the screen in front of them and were instructed to read the sentence at their normal reading rate. As soon as the *S* read the

last word, the prime was removed and one second later the target word that completed the sentence appeared. *S*s were instructed to read the target work as rapidly and as accurately as possible. They were informed that guessing would not be beneficial since the completed sentences would not always make sense.

2. *Results*

Median response times to target stimuli were tabulated for each *S* and analyzed in a mixed analysis of variance. Errors were again infrequent (less than 1% for both groups.) Preliminary analyses revealed that response times did not differ as a function of either assignment of targets to context conditions or presentation order of blocks. Therefore, these factors were omitted from the main analysis.

Good readers were again faster than poor readers at reading target words (587 *vs.* 693 msec), F (1, 26) = 19.54, $p < .001$, and target words preceded by a related context were read faster than those preceded by an unrelated context (616 *vs.* 664 msec), F (1, 26) = 70.59, $p < .0001$.

The predicted interaction of relatedness × type of context was also significant, F (1, 26) = 48.02, $p < .001$, with the magnitude of the relatedness effect being greater with sentence contexts (76 msec) than with single-word contexts (21 msec). This finding, however, was qualified by the significant three-way interaction of groups × type of context × relatedness, F (1, 26) = 6.37, $p < .02$. It can be noted from the data in Table 2 that group differences were restricted entirely to the sentence-context condition. (Indeed, with single-word primes response times to related *vs.* unrelated targets differed in the expected direction by 20 msec for poor readers and 21 msec for good readers, a result virtually identical to that of Experiment 1.) To assess the relationship between reading ability and the additional facilitation resulting from sentence contexts, the three-way interaction was broken down by analyzing the effects of groups and type of context sepa-

TABLE 2
MEAN RESPONSE TIMES TO TARGETS (IN MSEC) FOR GOOD AND POOR READERS AS A FUNCTION OF RELATEDNESS AND TYPE OF CONTEXT
(Word/Sentence Differences in Parentheses)

	Related		Unrelated	
Readers	Word context	Sentence context	Word context	Sentence context
Good	586	551 (35)	607	607 (0)
Poor	684	645 (39)	704	740 (−36)

rately for related and unrelated targets. For related targets, the presence of a sentence context facilitated word identification over and above the facilitation from a single-word context by 37 msec, F (1, 26) = 12.33, $p < .01$. This finding clearly indicates that sentence primes served to increase the amount of contextual information available, thereby further reducing the time required to process related targets. Of major importance was the finding that for related targets, the extent to which sentence primes were superior to single-word primes did not differ for good and poor readers (35 and 39 msec, respectively; $F < 1.0$ for the groups × type of context interaction). Thus, despite differences in the amount of time required to process individual words, good and poor readers apparently benefited equally from the enriched context provided by a related sentence prime.

For unrelated targets, however, the relative effects of sentence *vs.* word contexts did differ for good and poor readers, F (1, 26) = 4.57, $p < .05$. For poor readers, the processing of an incomplete sentence significantly *increased* response times relative to those obtained following the processing of a single-word context (740 *vs.* 704 msec, respectively; F (1, 13) = 5.96, $p < .02$). This effect was not found with good readers, who responded to targets following either type of context at exactly the same rate (607 msec). Thus, while good and poor readers did not differ to the extent to which word and sentence contexts facilitated the processing of related words, the presence of an inappropriate sentence context differentially affected the two groups.

3. *Discussion*

Consistent with the results of Experiment 1, the present data offer no support for the hypothesis that readers differing in word-decoding skill differentially utilize semantic context to facilitate word processing. As in Experiment 1, both groups of readers identified targets preceded by a related word approximately 20 msec faster than those preceded by an unrelated word. More importantly, the additional facilitation resulting from the processing of a related-sentence context, relative to that obtained with a related-word context, was also equivalent for the two groups. Taken together, these results suggest that: (*a*) the mechanisms which underlie the nonstrategic use of semantic context function similarly in these good and poor readers, and (*b*) differences between good and poor readers in word-decoding skill are not necessarily related to differences in the ability to extract the semantic content of written material. These conclusions are quite consistent with the results of previous studies designed to assess the

use of semantic context under relatively nonstrategic conditions (1, 15), and as such, are consistent with our suggestion that differences between good and poor readers that have been obtained in other context-usage studies may be attributable primarily to group differences in the use of task-specific response strategies.

On the surface, the equivalent sentence-context effects obtained for the good and poor readers in this study appear to contradict the view that poor readers process text in a word-by-word fashion (11, 21), since this type of processing should logically limit the reader's ability to integrate the semantic information accessed during the processing of individual words in a sentence. However, despite their limited ability to decode words, the poor readers used in the present study may have been sufficiently skilled at graphemic decoding so as to minimize the necessity to process words as isolate units. In light of this possibility, the data obtained with sentence contexts may not be generalizeable to poor readers whose decoding skills differ substantially from those tested here.

Nevertheless, the present results remain inconsistent with models of reading (6, 18) which suggest that poorer readers, by virtue of their need to allocate more attention to the processing of graphemic features of words, should be less able to access the semantic representations of those words and/or less able to use the information that is extracted to facilitate subsequent word processing. It is important to note that while predictions derived from these models may in fact hold when *S*s are placed under reading-time constraints not imposed here, normal reading ordinarily involves reading at one's own pace. Our data suggest that under such conditions, differences in decoding skill may not be directly related to the reader's ability to extract information from prose and use that information to facilitate subsequent word identification.

Finally, although our major interest was in the extent to which an appropriate context facilitates the identification of familiar words, the data indicated that for the poor readers an inappropriate sentence context actually interfered with the processing of target words. There is probably no direct correlate in normal reading to our unrelated-sentence context condition since familiar words whose meanings are known to the reader do not ordinarily occur in the inappropriate context. However, the results may have implications for potential group differences in the way in which new words and word meanings are acquired. A situation somewhat analogous to our inappropriate context condition may arise when the reader encounters an uncommon usage, or previously unknown usage of an otherwise

familiar word. From the reader's perspective, that particular word would not be semantically congruous with the preceding context. Our data invite the speculation that under these conditions, the semantic information extracted from the context might actually interfere with the poor reader's processing of the word and the learning of the new meaning.

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