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Automatic Contextual Facilitation in Readers of Three Ages

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WEST, RICHARD F., and STANOVICH, KEITH E. *Automatic Contextual Facilitation in Readers of Three Ages*. *Child Development*, 1978, *49*, 717–727. Fourth graders, sixth graders, and adults read words preceded by either a congruous, incongruous, or no-sentence context. Congruous contexts facilitated the reading times of all 3 groups. Incongruous contexts slowed the responses of the fourth and sixth graders, but not those of the adults. The same subjects completed another task, using similar materials, in which they had to name the color of the target word. The results of this and another control task indicated that context effects are mediated, at least in part, by automatic processes. However, the relative importance of these automatic contextual processes appears to decrease with age and reading ability as automatic word-recognition processes become more dominant.

There are undoubtedly numerous factors involved in the acquisition of proficiency in reading. The factors most frequently mentioned by reading researchers are the increasing ability to use contextual information, or redundancy, to facilitate the processing of written material (e.g., Gibson & Levin 1975), and the gradual development of automatic-processing skills (e.g., LaBerge & Samuels 1974). With respect to the use of contextual information, redundancy exists both within and between words. The role of within-word redundancy in letter and word recognition has been intensively investigated. In contrast to within-word redundancy, between-word redundancy has received relatively little experimental scrutiny. The relative dearth of research on between-word redundancy exists despite the fact that between-word redundancy is assigned a central role in contemporary reading theories (e.g., Gibson & Levin 1975; Goodman 1970; Smith 1971).

Schuberth and Eimas (1977) investigated the use of context by presenting subjects with sentences that had their terminal word deleted. When a target appeared, the subject's task was to classify the target as either a word or a nonword as rapidly as possible. Sentence contexts were found to facilitate the classification of words that were predictable from the context. The lexical-decision task used by Schuberth and Eimas (1977) yielded findings that were consistent with those of tachistoscopic-recognition experiments (e.g., Tulving & Gold 1963). Recent work (e.g., Fischler 1977; Tweedy, Lapinski, & Schvaneveldt 1977) has focused on whether contextual facilitation results from conscious expectations or from involuntary priming of appropriate words. This issue is addressed in this paper.

Schvaneveldt, Ackerman, and Semlear (1977) employed a lexical-decision task in a developmental investigation of the use of semantic context in word recognition. Second- and fourth-grade children were asked to make word-nonword decisions about targets in semantically related or unrelated contexts. A context consisted of the prior display of a single word that was either a high associate or a nonassociate of the target word. Decision times were faster for target words in the semantically related as opposed to the unrelated contexts. There was a marginal (*p* < .10) interaction between age and context condition. Interestingly, this interaction was due to the fact that the younger children showed a somewhat larger context effect. There was also evidence that, within each grade, the poorer readers made relatively greater use of context. The magnitude of the context effect for

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children of both grades was correlated with the vocabulary, spelling, and reading tests of the Iowa Basic Skills Achievement Test. All six of these correlations were in the negative direction (lower test scores tended to go with larger context effects), although only two reached statistical significance.

Since the ability to use contextual information is usually assumed to increase with age and reading ability, the findings of Schvaneveldt et al. (1977) are unexpected. However, recall that both the ability to use contextual information and the ability to process information automatically are assumed to be involved in the acquisition of proficiency in reading. Perhaps the developmental findings of this study are due to word recognition taking place more automatically for the more skillful readers. A process is considered to be automatic when it can take place without attention being directed to it (LaBerge & Samuels 1974). Presumably a reader develops fluency by automating certain low-level processes such as letter and word identification so that attention can be allocated to higher-level functions such as comprehension. The Stroop effect, which has been viewed as an index of automatic word reading (Posner & Snyder 1975a), may provide a means for studying automatic processes. Color-word interference is normally explained in terms of the competition between the vocal responses to the printed word and the ink color. Since the subjects are attempting to attend only to the color of the ink, the word can be considered to have been read automatically. The Stroop effect is not restricted to the case where colored ink patterns spell the names of color words. Indeed, contextual manipulations can also increase the amount of color-word interference. For example, if the colored ink spells a word that has just been heard a few seconds earlier, interference is found (Warren 1974). It is this latter aspect of the Stroop effect that is of potential use in the study of whether contextual facilitation occurs via an automatic process. For if the color-naming task is preceded by a sentence context that automatically primes a response other than the relevant color, then color-naming time should be increased. In this way the Stroop paradigm can be extended to study automatic contextual facilitation as well as its more common use as an index of automatic word recognition.

The present study investigates developmental changes in the influence of sentence context. In addition, the question of the relative influence of automatic word recognition and automatic contextual facilitation is explored. Fourth- and sixth-grade children and college students each performed three separate tasks. In task 1, the word-reading task, subjects were asked to read target words as rapidly as possible under the following three conditions: (a) with the prior display of a sentence context that was congruous with the target (e.g., "the dog ran after the" for the target "cat"), (b) with the prior display of a sentence context that was incongruous with the target (e.g., "the girl sat on the" for the target "cat"), and (c) without the prior display of a sentence context (e.g., only the word "the" preceding the target "cat"). This task will provide an indication of how the use of context, in a situation approximating actual reading, changes with age. In task 2, the word color-naming task, subjects were asked to name the color of target words as rapidly as possible under the same three context conditions described for task 1. An effect of context condition in this task would indicate that contextual facilitation is mediated, at least in part, by automatic or involuntary processes. Task 3 was included as a stronger test of the hypothesis that context effects reflect automatic processes. In task 3, the nonword color-naming task, subjects were asked to name the color of target nonwords as rapidly as possible under conditions with and without the prior display of a sentence context. Context effects in this task cannot be due simply to a general tendency to read the terminal word of a sentence, since no word is presented. Tasks 2 and 3 will allow for inferences regarding the relative influence of automatic word recognition and automatic contextual facilitation at three age levels. Automatic word recognition is responsible for the general Stroop effect. Thus, response time in the no-context condition of task 2 should be longer than that in the same condition of task 3. More important, if evidence for automatic contextual facilitation is obtained, the results from these two tasks will suggest whether these processes act with a speed comparable to automatic word recognition. In addition, it might be possible to make inferences regarding the relative dominance of these two types of automatic processes at different age levels.
Method

Subjects

The subjects were 48 fourth graders (24 males and 24 females), 48 sixth graders (24 males and 24 females), and 48 college students (22 males and 26 females). The children were recruited from three predominantly middle-class elementary schools. The fourth graders had a mean age of 9-9 (range 8-8 to 10-6), and their mean reading ability was at the 5-5 grade level as tested by the reading subtest level 1 of the Wide Range Achievement Test (WRAT) (Jastak, Bijou, & Jastak 1985). The sixth graders had a mean age of 11-6 (range 10-4 to 12-3), and their mean reading ability was at the 7-5 grade level as tested by the WRAT. Three additional children were dropped from the study because of their inability to perform the experimental tasks properly. The college students were enrolled in an introductory psychology course and received credit toward course requirements for participating in this study. The mean age of the college students was 20-5 (range 18-0 to 32-0). Not surprisingly, their reading performance on the level 1 portion of the WRAT was generally at or near ceiling level (their mean score was 98 out of a possible 100 points). All subjects were able to identify the colors used in the study.

Stimuli and Apparatus

Sixty-eight sentences were constructed so that their last two words were the words “the” and a noun that was highly predictable from the words that preceded it in the sentence (e.g., “The dog ran after the cat”). Secondand third-grade primers, Dolch words, and simple, high-frequency words (Kučera & Francis 1967) were used in formulating the sentences. After the 68 sentences were constructed, they were organized into 34 sentence pairs (e.g., “the dog ran after the cat” was paired with “the girl sat on the chair”). The terminal word of each sentence was then deleted, and the resulting pairs of incomplete sentences were used as sentence contexts. The deleted nouns were used as word targets; from four to six letter X’s were used as nonword targets. A sentence context and a target word were considered to be congruous when they had been derived from the same original sentence (e.g., “the dog ran after the” was congruous with the target “cat”). A sentence context and a target word were considered to be incongruous when they had been derived from opposite members of the original sentence pairs (e.g., “the girl sat on the” was incongruous with the target “cat”). Three of the original sentence pairs were used in deriving the stimuli for the practice trials, 27 for the experimental trials of tasks 1 and 2, and four for the trials of task 3.

The stimuli were typed in Courier 72 font with an IBM Selectric II typewriter. Only the lowercase was used. The stimuli were then photographed with Kodak High Contrast film. The negatives of some of the target items were then colored either red, yellow, blue, or green with transparent pigments (all non-colored words appeared to be white). Finally, all of the negatives were mounted in 2 x 2-inch double-glass slide mounts. Considerable care was taken to insure that the last word of each sentence context (“the”) was positioned in precisely the same place on every context slide. Additional negatives that contained only the word “the” (used in the no-context condition) were mounted likewise. The same care was taken to insure that the first letter of each target item was positioned in precisely the same place on every target slide.

The slides were back projected onto a translucent screen by two Kodak Carousel 760H slide projectors. One projector contained the context slides; the other contained the target slides. The images of the two projectors were aligned so that when a sentence context and a target word were simultaneously projected, the subject seated in front of the screen saw what looked like a single complete sentence. The size of the image projected onto the screen by a single five-letter word was approximately 0.5 cm high and 2.2 cm wide. Since the subjects sat approximately 60 cm from the screen, the five-letter words subtended a visual angle of approximately 0.5 x 2.0 degrees.

Target onset was controlled by a Vincent Associates Uniblitz shutter that was positioned over the lens of the projector that contained the target slides. When the experimenter pushed a control button, the shutter was electronically opened, and the projected image of the target item appeared. Simultaneously, a National Electronic Systems Cristal stopwatch was started by the same push of the control button. When the subject verbally responded
to the target, a voice-activated relay stopped the stopwatch and closed the shutter. The microphone that led to the voice-activated relay was held by the subject.

**Procedure**

Subjects were individually tested in a session that lasted between 20 and 30 min. First, the reading subtest level 1 of the WRAT (Jastak et al. 1965) was given to the subjects. Next, the subjects were handed a microphone and told to hold it approximately 10 cm from their mouth. For every subject, task 1 was performed prior to task 2, and task 3 was performed last.

**Task 1 (word-reading task).**—In the word-reading task, subjects were asked to read aloud contexts that appeared on the screen in front of them. Approximately 0.5 sec after the subjects pronounced the last word of the context, which was always “the,” a target word appeared. Subjects were instructed to read a target word as rapidly as possible when it appeared. In addition, the subjects were told that only the reading of the target word was timed, so they were free to read the contexts at a comfortable pace. Targets were read under the following three conditions: (a) with the prior display of a congruous-sentence context, (b) with the prior display of an incongruous-sentence context, and (c) without the prior display of a sentence context (only the word “the”).

Two practice trials were given under each of the three context conditions. The practice trials were followed by nine experimental trials given under each of the three context conditions. The ordering of the three context conditions within the 27 experimental trials was random, with the constraint that each context condition occurred three times in every block of nine trials. A total of six different random orderings of the conditions were used across subjects. For the experimental trials of both tasks 1 and 2, all subjects saw the same set of 54 target words, but the assignment of these words to the two tasks and to the three context conditions was counterbalanced across subjects. In addition, each of the 54 sentence contexts was equally often congruous and incongruous with the target words across subjects. No subject saw the same target word or sentence context more than once in the course of the experiment.

**Task 2 (word color-naming task).**—The procedures, number of trials, and conditions used in the word color-naming task were identical to those used in task 1, with the exception that the subjects were asked, not to read the target words, but to name the color in which the target words were printed as rapidly as possible. In this task, the target words were colored either red, yellow, blue, or green. In all other respects, the stimuli were as described in task 1.

**Task 3 (nonword color-naming task).**—In the nonword color-naming task, the stimuli were presented just as they were in tasks 1 and 2. As in task 2, subjects were instructed to name the colors of the targets as rapidly as possible. However, this time the targets were nonwords (X’s). The subjects were informed of this prior to the first trial of this task. The colors of the target nonwords were named under conditions with and without the prior display of a sentence context. Four trials were presented under each of these two context conditions.

**Results**

Of the 62 experimental trials presented to each subject, 2.3% were dropped from the data analysis because the voice-activated relay either failed to trigger (e.g., the relay was improperly adjusted, the vocal response was too quiet) or was triggered by irrelevant factors (the subject handled the microphone, coughing, etc.). The following types of responses were scored as errors: a response that took longer than 2,000 msec, an incorrect reading of a word in task 1, and a reading of a word instead of a naming of a color in task 2. Across all trials the mean error rate was 4.1% for the fourth graders, 3.0% for the sixth graders, and 0.04% for the college students. Trials on which errors were made were dropped from the reaction-time analyses.

**Task 1 (word-reading task).**—The mean reading times for the target words for each of the age groups and context conditions are displayed in figure 1. The mean percentage of errors is indicated in parentheses. A two-way analysis of variance was performed on the reaction-time data with age as a between-subject factor and context condition as a within-subject factor. The analysis indicated a highly significant effect of age, \( F(2,141) = 54.56, p < .001; \) context condition, \( F(2,282) = 49.90, \)
p < .001; and age × context condition interaction, $F(4.282) = 4.62$, $p < .001$. Virtually identical results were obtained when an analysis of covariance was carried out on the reaction times with the percentage of errors as a covariate. As can be seen in figure 1, the speed of reading target words increased steadily from fourth grade to college. Scheffé post hoc comparisons indicated that within each context condition, the mean length of reading time was significantly larger in the younger of every pairwise comparison of a younger and older group. In addition, large negative correlations were found between the WRAT scores and reading times within each condition (all subjects pooled: $r = -.73$ to $-.80$, $p < .001$; all children pooled: $r = -.63$ to $-.76$, $p < .001$).

From figure 1 it is apparent that the context condition had an influence on word-reading times. The mean length of time required to read target words was significantly shorter in the congruous-context condition than in the no-context condition for the fourth graders ($p < .001$), sixth graders ($p < .005$), and college students ($p < .05$). The measure of the extent to which word reading was facilitated by a congruous context was the magnitude of the difference between the congruous context and no-context conditions. The size of the facilitation score (congruous-context minus no-context condition reaction time [RT]) did not significantly differ between any groups of subjects. However, a significant negative correlation was found between the WRAT score and the facilitation score (all subjects pooled: $r = -.35$, $p < .001$; all children pooled: $r = -.23$, $p < .025$). This negative correlation is analogous to that reported by Schvaneveldt et al. (1977). Better readers (as indicated by a standardized test) make less use of context.

As predicted, word reading was facilitated by congruous-sentence contexts. However, contrary to expectations, there was no evidence that the use of sentence context increased with age and reading ability. Indeed, the correlational data suggests that word-reading latencies were less influenced by the congruous context for the skillful, as compared to less skillful, readers.
The mean length of time required to read the target words was significantly longer in the incongruous-context condition than in the no-context condition for the fourth graders ($p < .001$) and sixth graders ($p < .05$), but not for the college students. The magnitude of the difference between the incongruous-context and no-context conditions was used in this study as the measure of the extent to which incongruous contexts interfered with word reading. None of the pairwise comparisons of interference scores (incongruous-context minus no-context condition RT) was significant. However, the comparison between fourth graders and college students did approach significance ($p < .06$). A significant negative correlation was found between the WRAT score and the interference score (all subjects pooled: $r = -.19$, $p < .05$; all children pooled: $r = -.29$, $p < .005$).

The prediction that the incongruous-sentence contexts would interfere with word reading was met for the two groups of children, but not for the adults. The expectation that the extent of this interference would increase with age and reading ability was not met. In fact, the post hoc analyses and the correlational data suggest that the less skilled readers were somewhat more influenced by the incongruous contexts than the more skilled readers.

In general, the results displayed in figure 1 indicated that the ease with which target words were read increased with their predictability from the context. No developmental trend toward increased use of context was evident in the data. Fourth and sixth graders did not differ significantly in their use of context. In fact, when the data from the adults were taken into account, age $\times$ condition interactions indicated less use of context by the older subjects. The correlational results were also indicative of this pattern. The correlation between the WRAT scores and the facilitation and interference scores suggested that the less skilled readers relied more on context than the more skilled readers. These and other similar results (Schvaneveldt et al. 1977) can be explained by recourse to the concept of automatic processing. It is possible that the word-recognition processes of poorer readers are not so automated and are slow enough so that there is time for context to have a facilitating effect.

**Task 2 (word color-naming task).**—Task 2 was designed to investigate whether the contextual facilitation effect displayed in task 1 was due to conscious prediction or to involuntary priming of appropriate words. If involuntary priming is involved, inferences will be possible regarding the dominance of these processes relative to automatic word recognition at different age levels. The mean color-naming times for the target words for each of the age groups and context conditions are displayed in figure 2. The mean percentage of errors is indicated in parentheses. A two-way analysis of variance was performed on the reaction-time data with age as a between-subject factor and context condition as a within-subject factor. The analysis indicated a highly significant effect of age, $F(2,141) = 93.20$, $p < .001$; context condition $F(2,282) = 30.07$, $p < .001$; and age $\times$ context condition interaction, $F(4,282) = 8.99$, $p < .001$. When an analysis of covariance was carried out on the reaction times with the percentage of errors as a covariate, virtually identical results were obtained.

As is apparent in figure 2, the speed of naming colors increased steadily from the fourth grade to college. The correlations between WRAT scores and color-naming times were negative and significant within each condition (all subjects pooled: $r = -.61$ to $-.66$, $p < .001$; all children pooled: $r = -.25$ to $-.34$, $p < .05$ to .001).

It is apparent from figure 2 that the context conditions had a large influence on the color-naming times for the fourth and sixth graders but not for the college students. However, there was a tendency for contextual influence to decrease with age even when only the data from the children were considered. A significant age $\times$ context condition interaction still obtains, $F(2,184) = 3.30$, $p < .05$, when the adult sample is excluded from the analysis. Scheffé post hoc comparisons indicated that the mean length of time required to name the colored words was significantly longer in the congruous-context condition than in the no-context condition for the fourth and sixth graders ($p < .001$), but not for the college students. The measure of the extent to which the congruous-context condition interfered with (slowed) color naming was the magnitude of the difference between the congruous-context and no-context conditions. The size of this interference score (congruous-context minus no-context condition RT) was significantly larger for the fourth graders than for
the college students \((p < .001)\). The size of the congruous-interference score did not significantly differ between the fourth and sixth graders and the sixth graders and college students. The correlations between the WRAT scores and the congruous-interference scores were significant only when all subjects were pooled \((all \text{ subjects pooled: } r = -.38, p < .001; \text{ all children pooled: } r = -.15, \text{ N.S.})\).

The mean length of time required to name the colors of the word targets was significantly longer in the incongruous-context condition than in the no-context condition for the fourth graders and sixth graders \((p < .001)\), but not for the college students. The measure of the extent to which incongruous contexts interfered with color naming was determined by the magnitude of the difference between the incongruous-context and the no-context condition. While the size of this interference score (incongruence-context minus no-context condition RT) was significantly larger for the fourth graders than for the college students \((p < .001)\), it did not significantly differ between the fourth and sixth graders, and the sixth graders and college students.

The correlation between the WRAT score and the incongruous-interference score remained significant only when all subjects were pooled \((all \text{ subjects pooled: } r = -.30, p < .001; \text{ all children pooled: } r = -.04, \text{ N.S.})\).

**Task 3 (nonword color-naming task).**—The mean color-naming times for the target nonwords for each of the age groups and context conditions are displayed in figure 3. The mean percentage of errors is indicated in parentheses. A two-way analysis of variance was performed on the reaction-time data with age as a between-subject factor and context condition as a within-subject factor. The analysis indicated a highly significant effect of age, \(F(2,141) = 48.00, p < .001\); context condition, \(F(1,141) = 26.94, p < .001\); and age \(\times\) context-condition interaction, \(F(2,141) = 5.68, p < .005\). Virtually identical results were obtained when an analysis of covariance was carried out on the reaction times with the percentage of errors as a covariate.

As can be seen in figure 3, the speed of naming colors increased steadily from the fourth grade to college. Significant negative correlations were obtained in the sentence-

![Fig. 2.—Mean word color-naming times as a function of grade level and context condition for task 2. Mean percentage of errors indicated in parentheses.](image-url)
context condition between the WRAT scores and the color-naming times (all subjects pooled: $r = -.57$, $p < .001$; all children pooled: $r = -.25$, $p < .025$). However, in the no-context condition the negative correlations found between the WRAT scores and the color-naming times were significant only when all subjects were pooled (all subjects pooled: $r = -.42$, $p < .001$; all children pooled: $r = -.07$, N.S.).

From figure 3 it is apparent that the context conditions had a large influence on the color-naming times for the fourth and sixth graders, but not for the college students. The mean length of time required to name the colored nonwords was significantly larger in the sentence-context condition than in the no-context condition for the fourth and the sixth graders ($p < .001$) but not for the college students. In this task the measure of the extent to which the sentence-context condition interfered with (slowed) color naming was the magnitude of the differences between the sentence-context and no-context conditions. The size of this interference score (sentence-context − no-context condition RT) was significantly larger for the fourth and sixth graders than for the college students ($p < .001$). The size of this interference score did not significantly differ between the fourth and sixth graders. However, the correlation between the WRAT scores and the interference scores was significant when all subjects were pooled ($r = -.35$, $p < .001$), and when all children were pooled ($r = -.24$, $p < .025$).

Discussion

The comparison of the congruous-context and no-context conditions of task 1 indicated that subjects of all three ages utilized sentence context to speed processing of the target word. However, there was no increase in contextual facilitation with age. In fact, the correlations involving WRAT scores suggested that the poorer readers made greater use of context. This conjecture was supported by the comparison of the no-context and incongruous-context conditions. Incongruous context slowed processing of the target word for children but had no effect on the reaction times of adults. It should be noted that when the results from the adult sample are interpreted within the context of the distinction between automatic path-
way activation and conscious attention drawn by Posner and Snyder (1975a, 1975b), strong support is given for the notion that contextual facilitation in these subjects is due to automatic activation. Specifically, the benefit of a congruous context occurred without a corresponding cost in the incongruous-context condition.

Turning to the other tasks, the general interference effect due to automatic word recognition can be seen by comparing the times to name the color in the no-context conditions of tasks 2 and 3 (see figs. 2 and 3). More important for present purposes is the effect of sentence context on performance under Stroop color-naming conditions. The results of task 2 indicated that context had no effect on the performance of adults. This result is supportive of the idea that contextual facilitation does not interact with the automatic word-recognition processes of adults. It is possible that the adults' automatic processing leads to word recognition that is fast enough to interfere with color naming but that the cognitive processes mediating context effects are too slow to cause any additional interference. This would be particularly likely given the simple words used in this experiment. In contrast, both groups of children displayed highly significant effects of context in task 2. These results indicate that contextual effects may be due to automatic processes. In task 2 the subjects were attempting, not to read the target words, but to name the colors in which the target words were printed. Since the subjects were presumably not intending to use the sentence contexts to facilitate the reading of the targets, the interference effects displayed by the children in task 2 must be the result of involuntary contextual priming.

The involuntary processes that mediate contextual effects for the children must occur at a speed comparable to that of the automatic word recognition since both sources (the terminal word and the context) interfere with color naming. Context effects in task 2 were greater for the fourth graders than for the sixth graders. This result, in addition to the lack of a context effect for adults, indicated that the relative speeds of contextual-facilitation processes and automatic word-recognition processes change with age. The recognition speed of older and better readers is so fast that the influence of contextual factors is attenuated. Word-recognition speed of poorer readers is slower relative to the speed at which contextual factors operate and, thus, these latter processes have a greater effect on the performance of these readers. This conjecture was supported by the results of task 3. Here, context had an effect on the color-naming times of fourth and sixth graders even when no interfering word was present. One possible explanation of the involuntary contextual priming displayed by the children in task 2 is that the sentence contexts may have set the subject to read the target words rather than to name the colors. The results obtained in task 3 cast doubt on the adequacy of this explanation, since sentence contexts were found to slow color naming even when the target items were nonwords. In light of the findings of task 3, a more reasonable explanation of the context effects displayed by the children in task 2 is that the sentence contexts automatically primed an inappropriate response. As in task 2, the adults showed no effect of context condition in task 3. In addition, WRAT scores correlated negatively with the magnitude of the context effect, another indication that poorer readers made greater use of context.

The results from tasks 2 and 3 support the contention that the greater use of context by younger and poorer readers in task 1 was due to the relative speed of automatic visual-recognition processes as opposed to the automatic processes that mediate syntactic and semantic redundancy. With increasing reading fluency, automatic word-recognition processes dominate performance, and recognition is so fast that the effect of contextual factors is mitigated. This notion contrasts with the conventional wisdom that reliance on context increases with age and reading ability. However, it is consistent with some other empirical results and at least one popular model of word recognition. The Schvaneveldt et al. (1977) study, mentioned earlier, found the semantic-context effect in a lexical-decision task to be greater for second graders than for fourth graders. Furthermore, correlations between the context effect and three subtests of the Iowa Basic Skills Test were all negative for both grades (although all were not significant). Samuels, Begy, and Chen (1975–1976), using a tachistoscopic-recognition task, reported data suggesting that single-word context had a greater effect on the performance of fourth graders who were poor readers than on the performance of good readers of the same age. In a tachistoscopic-recognition study of adults,
Jackson and McClelland (1975) found that even with nonredundant materials good readers identified more words and letters. If use of redundancy were the only thing differentiating good from poor readers, no differences in performance would be observed on such tasks.

Seymour (1976) has discussed how Morton's (1969, 1970) logogen model of word recognition predicts that when sensory processes are relatively slow, nonsensory factors will have a greater effect on recognition time. Studies using adult subjects have tended to support this prediction. Meyer, Schvaneveldt, and Ruddy (1975) found that the semantic-context effect in the lexical-decision task is greater when the stimuli are degraded by visual noise. Degradation slows the feature-extraction process, allowing nonsensory processes to have a relatively greater influence. Similar results obtain when feature extraction is slowed by intensity reduction (Becker & Killion 1977). Sanford, Garrod, and Boyle (1977) found that the association frequency of a previously displayed semantic category had a greater effect on naming words when the words were degraded. Finally, presentation probability has been shown to have a larger effect on naming numerals when the stimuli are degraded (Stanovich & Pachella 1977). These results all support the logogen model's prediction that nonsensory factors will have a greater influence on performance when feature extraction (i.e., sensory processing) is slowed. It would not seem unreasonable to consider the developmental implications of this particular model. If the rate of sensory processing is slower in children, then the logogen model would predict that nonsensory factors would have a greater effect at younger age levels. Another prediction of the logogen model that is supported by the data is that the incongruous- and congruous-context conditions should have equal effects on color-naming time in task 2. This follows from the logogen model's assumption that sensory and nonsensory information sources contribute to word recognition in an additive rather than an interactive manner. The data from task 2 clearly support this prediction.

In summary, the present study has led to some important conclusions regarding the operation of automatic recognition processes and interword redundancy in reading. First of all, it appears that sentence context can automatically facilitate reading performance. However, the performance of more fluent readers seems to be dominated by rapid, probably automatic (in the sense of LaBerge & Samuels [1974]), word recognition. These recognition processes occur so fast that effects due to slower-acting contextual factors are reduced. In less fluent readers these two sources of information are mediated by processes of a similar speed and both contribute to performance. It should be noted, however, that the relatively simple words used in the study would serve to exaggerate the influence of automatic word-recognition processes. Adults' use of context is probably greater when they read more difficult material.

References


