The generalizability of context effects on word recognition: A reconsideration of the roles of parafoveal priming and sentence context

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In three experiments, subjects named target words preceded by congruous, incongruous, or neutral sentence contexts. There was no evidence that the recognition of the target word was affected by the semantic characteristics of a word presented immediately to the right of it. The nature of the preceding sentence context did affect target-naming speed. However, the magnitude of the context effect was considerably smaller in these experiments, in which nonterminal target words were used, than in previous experiments in which the target word was always the final word of the sentence, was highly predictable from the context, and was often semantically related to words in the sentence. The implications of these two findings for theories of reading and context effects are discussed.

In the last decade, an increasing number of investigators have focused their attention on the problem of how the presentation of a prior context affects word recognition, a question of much potential relevance to the study of the reading process. It has been firmly established that the presentation of a single word prime can speed the recognition of a related target word (Becker & Kilborn, 1977; Fischer, 1977; Fischler & Goodman, 1978; Meyer & Schvaneveldt, 1971; Meyer, Schvaneveldt & Ruddy, 1975; Neely, 1976, 1977; Schvaneveldt & McDonald, 1981). In addition, several investigators (e.g., Fischler & Bloom, 1979, 1980; Kleinman, 1980; Schubert & Fauss, 1977; Schubert, Specht & Lane, 1981, Stanovich, 1981; Stanovich & West, 1976, 1981; West & Stanovich, 1978, 1982) have found that the processing of the last word of a sentence is faster when it is preceded by a congruous sentence context than when it is preceded by an incongruous sentence context. The purpose of the present paper is to explore the generality of the context effects that have been demonstrated in the sentence context situation.

The target word in all of the sentence context studies cited above has been the terminal word of the sentence. In this way, and in others, the situations that have been used to assess sentence context effects have been unrepresentative of average text. For example, in many experiments the target word has been deliberately chosen for its high predictability. In other experiments (e.g., Kleinman, 1980; Stanovich & West, 1976, 1981), words in the sentence context have had strong associative and semantic relationships with the target word. Gough (Note 1) has argued that perhaps in our rush to create powerful experimental designs in order to test theoretical models, we may have overloaded our stimulus materials so much that our simple estimates of context effects are not applicable to the normal reading situation. In the experiments to be reported here, we began to address this question by attempting to assess the effect of a sentence context on a nonterminal word, using a paradigm that has been shown to be sensitive to various types of context effects on the sentence-final word. Thus, we employed the pronunciation paradigm of Stanovich and West (1976, 1981) and assessed the effects of a sentence context on adjectives and nouns that modified the initial word of the sentences. The paradigm was modified only to the extent that following the sentence context, two words (a terminal noun preceded by an adjective or noun modifier) appeared.

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The subject's task was to name the first word just in they had named the terminal word in previous experi- ments. The modulators in Experiment 1 were not con- strained to be highly predictable or highly associated with words in context.

The design of Experiment 1, a modification of the Standovich and West (1979, 1981) paradigm, was one that allowed the investigation of another important issue in the area of context effects on ongoing word recog- nition. Although we usually think only of the words that precede the word currently being fixed as the context that could affect its processing, it is possible that words in the right paraspaces of a previous context could affect the processing of a word currently under fixation. In several experiments, Underwood (1976, 1977, 1980, 1981) has found that the processing of a stimulus under fixation was affected by the semantic characteristics of a word that appeared to the right of it. Thus, it is possible that context effects on ongoing word recogni- tion during reading result from words to the right of the current fixation as well as from the words preceding the target word. This issue is, at least in part, influenced by slight modifications of the design already described. Since the modulator is the target word that is named, the terminal noun can be manipulated in order to assess whether the naming of the modulator is influenced by changes in the word immediately to the right of it. Specifically, the lexical status of the terminal noun can be manipulated in order to assess whether naming modulator naming is faster in a condition in which the terminal noun is a word that is can be connected with the rest of the sentence, as opposed to a control condition in which it is not.

In summary, two separate issues can be simultaneously addressed by slightly modifying a design that has been useful in examining context effects on the recognition of the final word of a sentence. Before reporting two experiments, we briefly review the evidence concern- ing context effects on nonterminal words and pronim from words in the right paraspaces, to that the relation of these questions as general issues in the read- ing literature is clearer.

Effects of Preceding Context on Word Recognition

A strong position on how context affects word recogniti on is taken by the so-called top-down models of the reading process (e.g., Goodman, 1976; Hochberg, 1970; Levin & Kaplan, 1970; Smith, 1978). In these models, reading is con- ceptualized as a process of hypothesis generation and confirmation. Readers supposedly predict upcoming text and only minimally sample visual information in order to confirm predictions. According to these models, it is this minimal sampling of visual information that accounts for the rapid reading of the fluent reader.

At first glance, the experimental literature on single- word pruning and sentence context effects would suggest to provide strong support for the account of ongoing word recognition given by the top-down models. In both paradigms, large context effects have been demon- strated. However, as mentioned in the introduction, the results in the single-word studies have been either strongly related to or predictive of the target words. These are also a few problems with the sentence con- text literature. As previously mentioned, the targets employed by most investigations have been nouns that were always the final word of the sentence. Thus, there was never any uncertainty about the position of nouns after the sentence. More important, Fischer and Bloom (1979) found that contextual facilitation of word pro- cessing occurred only when the mean predictability of the target word was greater than 90%. Word processing was facilitated only when the target word was much more predictable than the average word in most texts (see below). Standovich and West (1981) have found contextual facilitation effects for target words that were much less predictable than the Fischer and Bloom (1979) stimuli. However, the target words in their studies had an atypically high number of semantic and associative relationships with words in the sentence context (see also Kleinman, 1980).

In summary, an analysis of existing sentence context experiments suggests that the large context effects observed vary have resulted from the overloading of the stimuli with highly predictable sentence-final nouns and/or targets that were strongly related to context words. There is some limited empirical evidence that supports this conjecture. Using a continuous lexical decision task and a self-paced reading task (admittedly, an experimental situation quite different from the pronunciation and lexical decision paradigms from the bulk of the literature), Mitchell and Green (1978, Note 2) found no contextual effects on words occurring in the interior of sentences. The materials came from published books stories and novels, Alford (Note 3) used a pronunciation task to test for contextual effects on the fifth word of sentences that were drawn from books and newspapers. He observed a context effect of only 1.9%, much smaller than that observed in previous studies that employed predictable terminal nouns as targets (although the use of only a four-word context without the previous sentence may have biased Alford's study toward obtaining a smaller effect than usual).

From the writings of the top-down theorists, one gets the impression that predicting upcoming words in sent- ences is a relatively easy, natural, and highly accurate activity. However, several different empirical studies of the issue (Alcorn, Reutenauer, & Steigler, 1959; Miller & Coleman, 1967; Perfetti, Goldman, & Hogaboam, 1979; Rubenstein & Aborn, 1958; Gough, Note 1; Alford, Note 4; Gough, Alford, & Foley, 1978; Note 5) have all indicated that upcoming words in text are not very predictable. Across a variety of subject popula-
Can Words to the Right of Fixation Affect the Processing of the Currently Fixed Word?

To begin, this question must be differentiated from a very similar and related issue that has received some investigation. Several studies (e.g., McClelland & O'Regan, 1981; Paap & Newcombe, 1981; Rayner, McConkie, & Zola, 1980) have addressed the question of whether various types of information are extracted from a word in the parafovea so that the processing of that word is facilitated when it is brought into the fovea on the next fixation. In contrast, in this paper, we are concerned with the question of whether aspects (in particular, semantic aspects) of a word to the right of fixation can affect the processing of the word currently being fixated. The available evidence relevant to the latter question is indeed ambiguous. While there are theoretical reasons for expecting such effects, and while such effects have been demonstrated in experimental paradigms that bear similarities to the reading situation, other experiments have failed to reveal an effect.

Certain facts about attentional and unattended processing must be true in order for the parafoveal priming of a currently fixated word to be even a theoretical possibility. Since most of a reader's attention is focused on the fovea, rather than the parafovea, for parafoveal priming to take place, it must be possible for an unattended word to prime an attended one (or, at the very least, for a word receiving little attentional allocation to prime one toward which the bulk of attention is directed). There is now some evidence on this point. Several studies have been reported (e.g., Fischler & Goodman, 1978; Fowler, Wolford, Shade, & Taninami, 1981; Marcel, 1978; McCuskey, Peremee, Spreber, & Carr, 1980; Philpott & Wilding, 1979) in which it has been shown that a stimulus that is presented under visual conditions so degraded that it cannot be reported
a storable target benefit. There is a precedent for such a finding in a study by McCloud and O’Regan (1981). It is thus not inconceivable that there could be an interaction between the effect of a sentence context and that of a word to the right of fixation.

In the Stanovich and West (1979, 1981) experiments, subjects named terminal nouns that were preceded by sentence contexts that were congruous, incongruous, or neutral with respect to the target sentence. This design was altered in order to investigate the two issues previously discussed. The data from these experiments of Stanovich and West (1981) formed the basis for the stimuli of Experiment 1. Modifiers were inserted before the final noun of each sentence and the modifier-noun pair became the target stimuli. These pairs were presented as targets following congruous, incongruous, and neutral sentences, as before. However, subjects had to name only the modifier. The lexical status of the terminal noun was manipulated in order to investigate the issue of parafoveal priming. On one-half of the trials, the stimulus appearing to the right of the modifier was a nonword anagram of the noun that should have appeared. The lexical status of the stimulus to the right of the target was varied orthographically with sentence congruity.

Method

Subjects. The subjects were 24 undergraduate psychology students recruited through a subject pool at James Madison University.

Stimuli and Apparatus. The 96 sentence contexts presented in Appendix A of the Stanovich and West (1981) paper were used in stimuli, along with the difficult set of nonword nouns from that appendix. A word, either a noun (e.g., church aisle) or an adjective or a noun (e.g., bags, tonnage), that was orthographically identical to the terminal noun was inserted into each sentence. The elicited "the side was injured by the horses" became "the side was injured by the horse’s horn." Thus, the last three words of the sentences were the word "the," a noun that modified the sentence's last word, and a sentence cue.

The 96 sentence contexts were presented to 17 college students who did not participate in the experiment as a distractor task as well. Their task was to read through the sentences and report the context of each sentence. Across all contexts, the target modifier appeared approximately 8.5% of the time as the modifier in the subject's best completion. An additional 24 subjects were presented with the 96 contexts followed by a blank and the terminal noun and were asked to supply a word for the blank thus best completed the sentence. Across all contexts, the target modifier appeared at the subject's best completion 18% of the time. An effort was made to assess the strength of the relationship between the target modifier and the terminal noun and between the target modifier and words in the context. Two pairs of words for each sentence were constructed (the context word most strongly related with the target modifier was paired with the modifier, and the modifier was paired with the terminal noun) and randomly assigned to two lists. Thus, no word appeared more than once in a list and the two types of relationships (context-modifier and modifier-noun) were mixed within a list. A separate group of 22 subjects produced relational ratings for each list. Subjects made a judgment as to how related the words of each pair were on a 1-5 scale, with 5 indicating a high degree of relationship, 3 indicating a moderate degree of relation, and 1 indicating no relationship. Across all pairs, the mean relational ratings for context word/target modifier pairs was 2.81, and the first relational ratings using target modifier/terminal noun pairs was 3.11. The difference between the two types of word pairs was statistically significant (p < .01).

The stimuli were organized into pairs (e.g., "the game won by the dirt picker" was paired with "the goal was on fire""). The goal was on fire""). The goal was on fire""). A sentence context and an MW target were considered to be congruous when they had been defined from the same oriented sentence context. A sentence context and an MW target were considered to be incongruous when they had been defined from opposite members of the original sentence pair (e.g., "the game won by the dirt picker" was incongruous with the MW of "the goal was on fire""). A neutral context and an MW target were deemed to be incongruous when they had been defined from opposite members of the original sentence pair (e.g., "the game won by the dirt picker" was incongruous with the MW of "the goal was on fire""). The neutral context was formed by presenting the incongruous context "they said it was the" before an MW target. Across all MW targets, the mean number of letters in the modifier was 6.2 and the mean number of letters in the terminal noun was 7.4. In addition to the MW targets, a set of modifier-plus-nonword (MN) targets was created by replacing the terminal noun in the MW targets with a nonword anagram (e.g., "deer seeker"").

The stimuli were typed on 10.2 x 12.7 cm cards in Lowercase Gothic font with an IBM Selectric II typewriter. One set of cards contained the sentence contexts, and another set contained the targets. Approximately 70% of the contexts required two lines. In these cases, the final letter in the last word of the top line was always a space directly above the first letter of the sentence context. The stimuli were presented via a Scientific Prototype tachograph at a viewing distance of approximately 76 cm. 20-letter words subtended a horizontal visual angle of approximately .32 deg, and the space between words subtended a horizontal visual angle of approximately .15 deg. The contexts and the targets were presented in separate fields of the tachograph and were aligned so that if both were presented simultaneously the stimuli looked like a complete sentence. There was normal spacing between the modifiers and terminal letter string. On all experimental trials, sentence context (offset) was simultaneous with target onset. Target onset was defined as the time at which the auditory button pressed by the experimenter that immediately preceded the target to be displayed and the nonword anagram. The auditory stimulus was a "pick-up" sound and was accompanied by a visual cue indicating to the subject that a target was to be presented.

Prior to the collection of the data, the experimenter was given extensive practice in synchronizing the pushing of the control button with the articulation of the "hit" (the context word that always immediately preceded the target). Of course, some time invariably elapsed between the subject's articulation and the experimenter's button press. However, the experimenter tried to minimize this time by attempting, on all trials, to initiate his button press with the articulation of the "hit" such that his button press was synchronized with the subject's articulation of the "hit." The examiner was instructed to position himself approximately 20 ft in front of the subject, to raise his hand in raising the button during the articulation of "hit," thus further minimizing the time between the subject's articulation and the button press. This instruction was stressed repeatedly. On a few occasions, a "pick-up" sound was also heard in his raising the button during the articulation of "hit," thus further minimizing the time between the subject's articulation and the button press. This instruction was stressed repeatedly.

The subjects were randomly tested in a session that lasted approximately 40 min. Subjects were told to look into the tachograph and read aloud the sentence contexts that appeared. In addition, they were instructed to verbally report the target as rapidly as possible when they appeared. Although a target consisted of both a modifier and a terminal noun in most words, the subjects were asked to name only the modifier. In addition, the subjects were told that only the vocal report to the modifier was timed, so they were free to read the contexts at a comfortable pace.
Each subject received a random ordering of 12 practice trials consisting of two trials given under each of the six conditions formed by the factorial combination of context (congruent, incongruent, neutral) and target type (NW, MN). Following the practice trials, each subject received a random ordering of 32 experimental trials consisting of 16 trials for each of the above six conditions. In the experimental trials, each subject was shown a subset of 32 of the total population of 192 possible NW and MN targets. The assignment of targets from the total population was counterbalanced across subjects so that each target was used equally often under each type of context condition and target type. The subject saw the same target on neutral context trials more than once in the course of the experiment, and no subject saw more than one subset of MN or NW pair. When neutral context trials were used as incongruent context trials, the decked terminal words from the original sentences were next sent to the subject.

Results and Discussion

Trials on which some type of experimental malfunction occurred (e.g., the vocal response was too soft for the relay setting, the experimenter aborted the trial by pushing the button too early) were dropped from the data analysis. Trials on which the subject articulated the wrong word, had a response time longer than 2.5 standard deviations above the mean for that condition, were scored as subject errors and were also dropped from the analysis. The mean reaction times and the mean percentage of subject errors for all of the experimental conditions are displayed in Table 1. Also contained in Table 1 are the magnitudes of the overall context effect (the difference between the congruous and incongruous conditions), the facilitation effect (the difference between the congruous and neutral context conditions), and the inhibition effect (the difference between the neutral and incongruous conditions). All of the analyses that follow are based on the subject’s mean reaction time in each condition.

An analysis of variance on the reaction times indicated that the effect of context condition was significant [F(2,46) = 4.17, p < .05], but neither the main effect of target type nor the Context Condition by Target Type interaction approached significance (F < 1 in both cases). Planned comparisons indicated that the inhibition effect in the word condition was significant (p < .025), but the inhibition effect in the nonword condition did not attain significance. Neither facilitation effect was significant.

Given that target type did not interact with context condition and that when collapsed across context conditions, the times in the word and nonword conditions were virtually identical, it appears that there is no evidence that the lexical status of the terminal noun affected the speed of word naming. The results regarding the effect of the preceding sentence context are easily summarized. The significant effect of context condition indicates that a prior sentence context can affect the processing of a nonterminal word that was not chosen for its high predictability of relatedness. However, the overall context effect averaged only 18 msec. Although significant, the magnitude of this effect is well below that observed in similar experiments that have assessed the effect of a prior context on the final word of the sentence (although the 7-msec overall context effect in the nonword condition may be somewhat of an underestimate due to the presence of a small context effect in the error rate). Depending on the difficulty of the target word, contextual effects in these experiments have varied between 40 and 129 msec. Thus, the results do reinforce the conjecture discussed in the introduction, that previous experimental designs have produced estimates of contextual effects that are not representative of the values that might be obtained from a wider sampling of materials and word positions. One aspect of the results that was puzzling was that the contextual effects that were obtained in Experiment 1 were manifested almost entirely as inhibition. In previous experiments with this paradigm (Stevens & West, 1979, 1981), a pervasive pattern of facilitation dominance had been found. Experiment 2, designed as a stronger test of whether parafocal priming effects could be obtained in this paradigm, also provided an opportunity to see if this discrepancy with past results could be replicated.

<table>
<thead>
<tr>
<th>Table 1</th>
<th>Mean Reaction Times (in msec) and Mean Percentage of Errors (PE)</th>
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<tr>
<td>Context Condition</td>
<td>Neutral</td>
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<tr>
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<td>RT</td>
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<tr>
<td>Word</td>
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<tr>
<td>Nonword</td>
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<tr>
<td>Word</td>
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<tr>
<td>Nonword</td>
<td>557</td>
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<tr>
<td>Word</td>
<td>578</td>
</tr>
<tr>
<td>Nonword</td>
<td>577</td>
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Experiment 2

It is possible that Experiment 1 provided only a weak test of whether parafocal priming effects during ongoing reading can be obtained. Although the stimulus sentences were constructed so that the terminal noun was always congruous with the preceding sentence and several sentences contained nouns that were semantically related to or associated with their modifiers (e.g., "The predications are the holy grail"), many semantically related modifiers and final words that were only weakly related (e.g., "The house was destroyed by the powerful sun") were used. If a word in the right parafocal zone can prime a word under fixation, such an effect would probably be due to some type of automatic spreading activation in semantic memory. Thus, it could be argued that parafoveal priming was precluded in Experiment 1 because, across stimuli, the average semantic relationship between modifier and noun was simply too low. In Experiment 2, we attempted a stronger test of the effect of a parafocal zone by replicating Experiment 1 with a different set of materials that were "loaded" with semantic relationships.

Method

The subjects were 32 undergraduate students recruited through a subject pool at Oakland University. Approximately 25% of the sentences used in Experiment 1 were judged by the experimenters to have strong modifier-noun relationships and were retained in Experiment 2. The remaining sentences were altered to increase the semantic and/or associative relationship between the modifier and noun. Sometimes this was done by changing a modifier. The relationship in other sentences was strengthened by using the easy, rather than the difficult, terminal noun from Appendix A of Stanovich and West (1981). In some cases, both the modifier and the noun were changed (e.g., "The house was destroyed by the powerful tempest" was changed to "The house was destroyed by the hot sun"). Approximately 30% of the preceding contexts were also changed so as to maintain congruity with the target word pair. Across all of the MN stimuli, the mean number of letters in the modifiers word and the mean number of letters in the terminal noun was 5.7. The MN targets and the neutral context were constructed as in Experiment 1.

The 96 sentence contexts were presented to 22 students (who did not participate in the experiment) as a dark task in which they were to write down the two words that best completed the sentence. Across all contexts, the target modifier appeared 5.8% of the time as the modifier in the subject's first completion. An additional 22 subjects were presented with the 96 contexts followed by a blank and the terminal noun and were asked to supply a word for the blank that best completed the sentence. Across all contexts, the target modifier appeared in the subject's best completion 11.9% of the time. Two groups of subjects (N = 26 and 22, respectively) made rehabilitation judgments, as described in Experiment 1. Across all pairs, the mean original mean rating for context word/target modifier pairs was 2.93 and the mean rehabilitation rating for target modifier/terminal noun pairs was 3.15. The difference between the two types of word pairs was statistically significant (p < .001). The mean rating of the modifier-noun pairs was only slightly higher than that obtained for pairs with neutral contexts. Even though these in Experiment 2 were chosen to be more highly related. This was probably the result of the fact that the pairs from each experiment were not mixed together but, instead, were given to separate groups of subjects who then may have adopted different subjective weighting points in order to keep their average rating around 3.

Results

Experiment 1 and subject errors were scored as in Experiment 1. The mean reaction times and mean percentage of subject errors for all of the experimental conditions are displayed in Table 1. An analysis of variance on the reaction times indicated that the effect of context condition was significant [F(2,62) = 8.38, p < .001], but neither the main effect of target type [F(1,31) = 3.09] nor the Context Condition by Target Type interaction [F(1,31) = 7.59] attained statistical significance. Averaged across target type, the overall context effect was approximately 20 msec; (small overall context effects were also present in the error rates), a value very similar to that obtained in Experiment 1. Unlike Experiment 1, the contextual effects in Experiment 2 was transcribed exclusively as facilitation. Planned comparisons indicated that the 28-msec facilitation effect in both the word and nonword conditions was significant (p < .01). The facilitation dominance of Experiment 2 was thus consistent with previous experiments that have employed this paradigm (Stanovich & West, 1979, 1981).

Experiment 3

In order to assess the generality of the results obtained in Experiments 1 and 2, an additional experiment that employed completely different methods of target initiation and context processing was carried out. In the previous experiments, the subject read the context aloud and the experimenter controlled target presentation. In Experiment 3, the subject read the context silently and the target onset occurred at a fixed interval after context onset.

Method

The subjects were 36 undergraduate students recruited through a subject pool at Oakland University. The stimuli and procedures used in Experiment 1 were employed in Experiment 2. The designs and counterbalancing were also the same as those in Experiment 2. Experiment 3 differed from the previous experiments in that subjects were told to read the contexts silently before naming the target modifiers. The targets were always
The mean reaction times and mean percentage of errors for all of the experimental conditions are displayed in Table 1. An analysis of variance on the reaction times indicated that the effect of context condition was significant (F(2,30) = 7.09, p < .001), but neither the main effect of target type (F < 1) nor the Context Condition by Target Type interaction (F < 1) attained statistical significance. Collapsed across context conditions, the word and nonword target types had equal reaction times that were very similar. Consistent with the findings of the first two experiments, the lexical status of the terminal word did not affect target naming.

As in Experiment 2, the significant effect of context condition was manifested entirely as contextual facilitation. Planned comparisons indicated that the 36-msec and the 34-msec facilitation effects were both significant at the .05 level. The nonword condition showed an unexpected 22-msec advantage for incongruous contexts over neutral contexts. However, this 22-msec effect did not reach statistical significance (t(24) = 1.60, p > .15). More important, the higher error rate displayed by the incongruous condition probably accounts for its reaction time advantage.

GENERAL DISCUSSION

All three experiments produced consistent, evocative evidence for the presence of paralexical priming during reading. The results indicated that the semantic characteristics of the word immediately to the right of the word being fixated do not influence the processing of the fixated word. This finding considerably simplifies the problem faced by researchers investigating the effects of context on on-line word recognition during reading. At least in regards to the effect of semantic context, it appears that researchers need be concerned only with contextual information that occurs before the fixated word.

The results reported contradict Underwood's (1981) conjecture that the semantic characteristics of words in the right parafield can affect ongoing processing during reading. However, we are left with the problem of trying to reconcile the present results with Underwood's (1976, 1977, 1980) finding that strength of recognition was influenced by the semantic characteristics of words presented to the right of fixation. One obvious methodological difference was that Underwood's experiments did not include the presentation of a sentence context. The processing of the target in his experiments was not embedded in ongoing sentence processing. Instead, subjects had to respond only to a single target presented on every trial. Also, the stimuli used by Underwood (category naming, picture rating, paired associate response time) were quite different from those employed in the present experiments, and whether a parafield phrase facilitated or inhibited the response to the focal stimulus in his experiments depended on the task employed (compare Underwood, 1980, and Underwood, 1981).

Perhaps a more important difference concerns the relationship between the targets and parafield primes. Underwood purposely chose his stimulus pairs (which were nonword pairs rather than modifiable word pairs) to be highly related. In his 1976 paper, the examples of stimulus pairs given in the Methods section were chair/table, brush/wood, and lemon-juice. In the 1981 paper, in which a category-naming task was employed, the stimuli were the most popular responses (taken from the Breug & Mottagge, 1969, normal from five highly overlearned categories; colors, animals, clothing, bodily parts, and methods of transport). Even though the stimuli used in Experiments 2 and 3 of the present paper were constructed to have stronger relationships than those used in Experiment 1, they were probably still well below Underwood's stimuli in terms of semantic relatedness. This is simply because of the constraints imposed by the fact that the last two words had to make the sentence grammatical and also be meaningful complements of the stimulus and West (1981) sentences. Thus, it might be conjectured that semantic priming from parafield words can occur if the prime and target are strong associates, but that such priming does not normally occur for the more moderate relationships found in natural text. To avoid any misunderstanding regarding this hypothesis, it should be pointed out that we are not arguing that the sentences used in Experiments 2 and 3 were representative of the average text that is read by fluent adults. They were most definitely unrepresentative in a number of ways, the most relevant being that the last two words had an unusually high degree of semantic association. The point is that the materials used in the experiments were biased in favor of observing parafield priming effects. If such effects do not occur with the materials of Experiments 2 and 3, it is highly unlikely that they are much of a factor in normal reading.

The results of the three experiments also lead to several conclusions regarding the effect of a sentence context on the recognition of a nonterminal word. The findings indicated that sentence congruity can affect the processing of a nonterminal word that was not chosen for its high probability. There are, however, some important caveats to this general conclusion. First, the size of the context effect (averaging 19-msec across experiments) was smaller than that observed in previous experiments that, using similar methodologies, have investigated the effect of a sentence context on the processing of terminal nouns that were either highly
related to words in the context. The hypothesis discussed earlier, that the size of the effect was previously observed would not generalize to other sentence positions, appears to have borne some support. A second and related point is that the particular paradigm employed serves to, if anything, overestimate the magnitude of context effects. Mitchell (1982; Mitchell & Green, 1978) has argued that the paradigm used by Fischer and Beloff (1979). Schorhoff and Kinum (1977), and Stanovich and West (1983) all introduce an unusually long interval between the reading of the sentence context and the target word (see also McConkie & Zola, 1981). This extra time may allow the subject to employ conscious prediction strategies that would be precluded in normal reading due to the speed of ongoing word recognition. Thus, the 19-suce figure obtained probably represents an upper bound on the magnitude of the context effect on the type of target word sampled in these experiments. In short, while our results should not be interpreted as questioning the theoretical utility of previous sentence context experiments (for example, regardless of various models of word recognition, perceptual identification, and acoustic memory), they do suggest caution in extrapolating the magnitude of observed experimental effects to the actual reading situation.

Specifying the mechanism that was responsible for the contextual effects that were observed requires some discussion of the inconsistencies in the pattern of the effects across the three experiments. Experiment 1 showed a pattern of inhibition dominance, whereas Experiments 2 and 3 showed a pattern of facilitation dominance. According to the traditional interpretation of these patterns in terms of the Feuer-Snyder (1974a, 1975b) two-process theory of memory (Nelson, 1977; Stanovich & West, 1979, 1981) facilitation dominance is indicative of a context effect that is caused by the automatic spread of activation in semantic memory. Inhibition is caused by an attentional expectancy strategy. However, according to this framework, inhibition should be accompanied by facilitation. Thus, given this framework, the results of Experiment 1 are inexplicable. The results are also anomalous when viewed in the context of the rest of the empirical literature. In over a dozen sentence context experiments employing the naming paradigm (Stanovich, 1981; Stanovich & West, 1979, 1981; Note 7; Note & Stanovich, West, & Freeman, 1981; West & Stanovich, 1978, 1982), we have never observed a pattern of inhibition dominance. Thus, due to the theoretical and empirical consistency of the results of Experiments 2 and 3 and the theoretical and empirical inconsistency of the results of Experiment 1, we feel reasonably safe in putting greater reliance on the former when searching for a theoretical mechanism to explain the small context effect that was obtained. Not surprisingly, we are drawn to automatic spreading activation as a likely mechanism. No previous experiments with this paradigm (e.g., Stanovich & West, 1979, 1981; West & Stanovich, 1983) have yielded evidence suggesting that an intentional prediction process was responsible for the context effects produced when adults read unadorned material. Instead, investigators who have used quite different methodologies to attack the same issue have also argued against conscious prediction as the mechanism responsible for the context effects observed in their paradigms (e.g., Fischler & Bloch, 1979; Fischler, Note 9).

The results of the three experiments, in conjunction with the findings of Mitchell and Green (1978), Gough (Note 1), and Afford (Note 3), question the view of the fluent reader provided by the top-down models. These models see the fluent reader as minimally sampling visual features in order to constrain hypotheses on the choice among a limited set of alternative consistents with the previous context. It is this minimal sampling of visual features based on contextual redundancy that accounts in large part for the good reader's fluency. However, the average magnitude of contextual effects on ongoing word recognition do not appear to be large enough to allow this mechanism to be a major determinant of reading fluency. In addition, the mechanism involved does not seem to be one of word prediction but, instead, appears to be a passive process of spreading activation. This may help to explain why there is motivating evidence that top-down models do not give an accurate account of individual differences in reading ability (Stanovich, 1980) or the performance pattern of fluent readers (Ehlich & Rayner, 1981; McConkie & Zola, 1981; Mitchell, 1982; Mitchell & Green, 1978; Rayner & Stauweeck, 1981; Gough, Note 1; Gough et al., Note 5).

In no case, however, is it true, to the contrary. The most prevalent approach to context, however, is that effects on lexical access are conceptual. Thus, if a fact is taken, it means that the context effects that top-down theorists are concerned with are postlexical, that is, effects on comprehension processes that occur after a word has been recognized (the existence of this type of effect is not disputed by any theorist that we know of). We would mean giving up the all-stated claims for "hypothetical-driven" feature extraction and lexical access during reading (e.g., Goodman, 1976; Smith, 1978).
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NOTES

1. Of course, part of the contextual information may be
different visual features of the fixed word that were picked up par-
allelly on the previous fixation. As mentioned in the introduc-
tion, there may exist some useful data on this issue (e.g., Rayner,
McColo& Zola, 1980).

2. Also, the fact that the sentence frame was not under experi-
mental control would also tend to bias the results in favor of ob-
serveing partial effects. If the sentence sometimes occurred in
the central mean before the lexical access of the modifier was com-
plete (see, given present partial results, this should have affected
modeller naming).

3. A more specific statement is in order regarding the magni-
tude of the context effects to be expected for the modifier stimu-
s, based on previous results from this paradigm with sentence-final stimulus words. Previous work has established that the magnitude of the overall context effect is directly related to the
difficulty (i.e., naming latency) of the target word (Perfetti,
Goldman, & Holum, 1979; Stanovich, 1981; Stanovich & West,
1981; Stanovich, West, & Feiman, 1981; West & Stanovich, 1982).
Since in naming tasks word length has the most potent
influence on response time (Corky, 1976; Frederiksen & Kroh,
1976; Rayner, 1976), it will be useful to examine this vari-
able. The modeller in Experiments 2 and 3 had a mean length of 6.4 letters and an average naming times of approximately
600 ms in the neutral condition. The word used by Stanovich and West (1981) had a mean length of 5.5 letters, and the
difficult words had a mean length of 7.4 letters. Across a series of experiments employing the same apparatus and
stimuli conditions in Experiments 2 and 3 (West & Stanovich, 1982; Stanovich & West, Note 7, Note 8), the mean naming
time for the easy words was approximately 550 ms and the mean
time for the difficult words was approximately 710 ms in the neutral condition. Thus, both in terms of word length and in actual naming latency, the difficulty of the modifiers is interrelated to the ease and difficult words in the appendix of Stanovich and West (1981).
The latter two acts, which used as sentence-final target in the Stanovich and West (1981) sentences, focused on average overall context effects of approximately 30 ms and 35 ms, respectively
(West & Stanovich, 1981; Stanovich & West, Note 7, Note 8). The effect observed for the modifiers (approximately 19 ms) is not a reliable interaction for each of these cases. Insofar as far, it is
out of the range altogether.

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