Assessing semantic context effects in good and poor readers using a moving window paradigm.

Lina. Murdaca

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Assessing Semantic Context Effects In Good and Poor Readers Using A Moving Window Paradigm

by

Lina Murdaca

B. A. Concordia University, 1989

A Thesis
Submitted to the Faculty of Graduate Studies through the Department of Psychology in Partial Fulfilment of the Requirements for the Degree of Master of Arts at the University of Windsor
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1991
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The present research project was concerned with the study of sentence context effects on the reading behavior of good and poor readers. Using a moving window paradigm, sixth graders read sentences containing target words varying in context congruity (congruous, incongruous, neutral), and difficulty (easy, difficult). Mean word reading times across the varying conditions were recorded for target words, words immediately following the target word (target+1 word), and the last word of sentences. The resulting means were subjected to three separate 2 x 3 x 2 (Ability x Context condition x Target word difficulty) analyses of variance. With regards to the target word, it was hypothesized that as compared to good readers, poor readers would exhibit larger context effects due to their greater reliance on controlled processes. Moreover, it was expected that difficult target words would yield greater facilitation effects (i.e., shorter reading times for the congruous condition as compared to the neutral condition) than easy target words. As it was assumed that reading times are reflective of both word level and sentence level processing, it was expected that target word difficulty and context effects would be carried over to target+1 words. Moreover, for last words it was hypothesized that context would affect sentence integration processing, yielding both facilitation and
inhibition effects. Contrary to expectations, the findings failed to yield any differences in good and poor readers' use of context. The only significant difference between good and poor readers was noted on last word reading times. Poor readers were found to read last words significantly faster than good readers. Possible explanations for this anomalous finding are discussed. As was hypothesized, target word difficulty was found to affect the reading times of target words and target+1 words. Words in the easy condition were read significantly faster than words in the difficult condition. Moreover, support was obtained for the hypothesis that difficult target words would present greater facilitation effects than the easy target words. For last words, a significant inhibition effect was noted for the incongruous-easy condition as compared to the neutral condition.
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CHAPTER 1

INTRODUCTION

Reading may be defined as the ability to abstract textual information from a page and comprehend its meaning (Rayner & Pollatsek, 1989, p. 23). For the skilled reader many of the mental processes involved in reading appear to occur automatically and seem effortless. The beginning reader, however, will find reading a very time-consuming and effortful activity. Research has repeatedly demonstrated that the reading process can be facilitated and/or hindered by the semantic context in which words are presented (e.g., Neely, 1977; Schuberth & Eimas, 1977; Stanovich & West, 1983; West & Stanovich, 1978). Over the last twenty years, theorists have proposed contrasting reading models to explain how cognitive processes are affected by semantic context (e.g., Gough, 1972; LaBerge & Samuels, 1974; Rumelhart, 1977; Stanovich, 1980; 1986). A central issue which has caused disputes among theorists has been the observance of differential effects of context on the reading processes of good and poor readers. It is unclear how reading ability is interacting with reading processes to produce context effects of varying direction and magnitude.

The focus of this project was to study the differential effects of semantic context on the reading behavior of good
and poor readers using an experimental paradigm that more closely approximates a natural reading situation than has been typical of most previous research. Contrary to previous research, the present study attempted to distinguish between context effects occurring at a word recognition level and those occurring at a sentence integration level.

The sections to follow will present a theory of reading development along with models currently being proposed to outline the processes involved in reading behavior. A review of studies focusing on the effects of context on the reading processes will then be presented. After noting the significance and limitations of previous research findings, the rationale for the present study will be presented.

READING DEVELOPMENT

Before becoming a proficient reader, a beginner proceeds through various stages of reading development. A number of researchers have proposed different theories of reading development (e.g., Chall, 1983; Gough & Hillinger, 1980; Mason, 1980; Marsh, Friedman, Welch & Desberg, 1981), all presenting a sequence of increasingly complex cognitive skills which must be mastered. Marsh et al. (1981) proposed that reading development occurs over four stages. In the first stage, linguistic guessing, the child is believed to
approach the reading task by associating a visual stimulus (the printed word) with an oral response. The child is seen as taking one aspect of the word (e.g., the first letter) and forming an association with the oral response. This reading stage is analogous to the whole word reading approach (i.e., associating the visual word as a whole to specific sound formations).

In the second stage, discrimination net guessing, the child's guessing is seen as being more sophisticated. Whereas in the linguistic guessing approach the child relied on one feature of the word, he/she now makes word discriminations on additional cues such as the word length, word shape or other graphemic cues.

In sequential decoding, the third reading stage, the child has realized that certain letters appearing together form a certain sound. Marsh et al. have suggested that this shift from a graphemic approach (i.e., word shape) to a more phonetic approach (i.e., sounds) occurs as a result of an increased vocabulary size. As the child is exposed to a larger sample of words, a solely graphemic approach becomes inefficient as more words will begin to be visually similar. Hence the child progresses to a stage at which words are decoded into their phonetic components.

In the final stage of reading, hierarchical decoding, the child becomes very sophisticated in his/her use of decoding skills. He/she realizes that a letter's sound is
context specific. For example, the letter "c" sounds like "ess" when followed by an "i", but is pronounced "kay" if placed before an "o". When decoding words, the child now makes use of analogies, thus being able to read words he/she has never seen before. Essentially, by this stage the child's reading process is identical to that of an adult. Experience is likely to increase the child's efficiency, but the reading process will remain the same.

Models of Reading

A number of different information processing models have been proposed to explain the cognitive processes involved in skilled reading. All of these can be subdivided into the following three categories: (1) bottom-up models, (2) top-down models, and (3) interactive models.

Bottom-up models (e.g., Gough, 1972; LaBerge & Samuels, 1974; Massaro, 1975) argue that the cognitive processes underlying reading are very fast and must proceed in a serial fashion. Processing proceeds from the printed text to increasingly higher levels of encoding. In the initial stage, a visual representation of the printed word is maintained in an iconic buffer. This representation is used to extract features of the word for purposes of word pattern recognition. As processing proceeds to increasingly higher levels, the resulting pattern would then be used to find a
match within the lexicon (i.e., mental dictionary). According to Gough's model (1972), the lexicon contains both a visual and phonemic (i.e., sound) representation of the word. Once a match has been found between the visual pattern and an entry in the lexicon, processing proceeds to a syntactic and semantic level. Hence, according to bottom-up models the reading process receives no influence from semantic rules or any other higher order processing strategy, as reading must proceed serially from lower to higher processes (Rayner & Pollatsek, 1989).

Bottom-up theorists (e.g., Gough, 1972) would argue that semantic context can have a facilitative effect on reading through an automatic spread of activation to semantically related memory locations. Previously read material is believed to partially activate related words in memory, thus facilitating their later recognition. Based on the spread of activation theory, however, context cannot have an inhibitive effect on reading. It is for this reason that bottom-up models have failed to receive much support. Bottom-up models cannot account for the results of reading studies which have found that higher-level processes can affect lower level processes (e.g., Rumelhart, 1977; Stanovich, 1980).

Top-down models (e.g., Goodman, 1970; Smith, 1971) also argue that information is processed serially. Contrary to bottom-up models, however, top-down models view reading as
proceeding from higher level processes to the lower levels. Hence the lower levels of processing (e.g., feature extraction and pattern recognition) are influenced and directed by the higher levels (e.g., semantic and syntactic rules). The reader is seen as sampling textual information so as to test hypotheses generated by the higher level processes.

Top-down models have received much criticism for the implausible demands they place on reading processes. The exclusive use of top-down processes during reading implies that the generation of hypotheses requires less time than recognizing words purely on their visual basis. Several researchers (e.g., Rayner & Pollatsek, 1989; Stanovich, 1980) have argued that it is very unlikely that complex syntactic and semantic analyses could be performed in less time than it takes fluent readers to recognize most words. Furthermore, several studies have obtained results indicating that fluent readers do not make use of conscious expectancies to facilitate word recognition (see Rayner & Pollatsek, 1989; Stanovich, 1980).

As a result of the difficulties experienced by the bottom-up and top-down models, new theories have emerged which fall under the category of interactive models (e.g., Just & Carpenter, 1980; Rumelhart, 1977; Smith, 1988; Stanovich, 1980; Stanovich, West, & Feeman, 1981). As the name would imply, interactive models view reading as
involving an interaction between both bottom-up and top-down information. The various processing levels are believed to be operating simultaneously and not sequentially as in the bottom-up or top-down models.

Interactive models can accommodate much of the reading research findings obtained over the last few decades (Rayner & Pollatsek, 1989). If it is assumed that higher level processes do not require the completion of lower ones, then the interactive models can also accommodate for what Stanovich (1980; 1990) has referred to as the compensatory hypothesis. According to this hypothesis, higher level processes are seen as compensating for some potentially weaker lower level processes. Thus, a reader with poor word recognition skills (low level process) will likely rely more heavily on additional sources of information such as contextual cues (high level process). Neither the bottom-up nor top-down models can accommodate a compensatory assumption.

FACTORS AFFECTING THE READING PROCESS

Regardless of which reading model is adopted, a number of factors have been shown to affect the reading process. One factor is the visual form of the word itself (i.e., orthographic structure) (Juel, 1983; Schvaneveldt, Ackerman, & Semlereal, 1977). Theorists have argued that the written
language is orthographically structured (e.g., the letter q is usually followed by the letter u) and that readers can use this information to speed word recognition processes (Goodman, 1970; Juel, 1983; Smith, 1971). Smith (1971) proposed that the ability to use orthographic redundancy was what distinguished good from poor readers. He predicted that good readers would be more likely to make use of orthographic redundancy to speed word recognition.

Smith's prediction is in accordance with the top-down theories which would stress the importance of higher level processes (e.g., intraword redundancy) over lower level processes (e.g., feature extraction). Although studies have shown that good readers tend to have greater knowledge of orthographic structure as compared to poor readers (Allington, 1978; Lott & Smith, 1970), orthographic knowledge is not believed to be the cause of differing reading abilities. Researchers have found that the use of orthographic redundancy could only distinguish good and poor readers at the initial stages of reading acquisition (Krueger, Keen, & Rublevich, 1974; Stanovich, 1980; Stanovich, Purcell, & West, 1979).

In a more recent edition of his book, Smith (1988) has taken a view of reading which is more in line with interactive models. He argues that "reading depends on what the reader already knows" (p. 64). In his view, good readers read more quickly because their larger knowledge
base requires them to sample less of the written text. To support his argument, Smith points out that readers will take longer to read information about which they have no previous knowledge as compared to familiar material.

A second factor which has been shown to affect the word-recognition process is the contextual information which accompanies the word (e.g., Neely, 1977; Rayner & Pollatsek, 1989; Schvaneveldt et al., 1977; Stanovich, 1980). According to top-down theorists (Goodman, 1970; Smith, 1971), superior readers are better able to make use of context to facilitate word recognition. Smith (1971; 1988) stated that because of their sensitivity to syntactic and semantic redundancy within sentences, superior readers are generating hypotheses about upcoming words and thus extract fewer features from upcoming words. Hence, good readers are reading more quickly because their use of contextual redundancy places fewer demands on the stimulus-analysis processes. The limited use of contextual redundancy by the poorer readers forces them to process more visual features of the word thus slowing down word recognition.

Support for Smith's view has been obtained from the work of Bohannon (1976) who found that children experience a dramatic development in their understanding of syntactic structures over the age range of 5 to 8 years of age. As the understanding of syntactic rules expands, word-
recognition processes are more likely to be facilitated by the semantic context of a given sentence (Bohannon, 1976; Goodman, 1970).

Similarly, bottom-up theorists (e.g., Gough, 1972; LaBerge & Samuels, 1974) suggested that the facilitative effects of context on reading should increase as a function of reading experience. LaBerge and Samuels (1974) argued that as readers become more proficient, some processes become automatic. That is, the reader can process the printed text without using any controlled (i.e., attentional and effortful) processing capacity. Because controlled processing capacity is limited by the person's attentional span (Posner & Snyder, 1975), automatizing some reading processes frees up processing capacity for other functions, such as text integration and comprehension. Thus, LaBerge and Samuels asserted that the greater automaticity in good readers allows for an increased probability that context will affect word recognition processing.

Semantic Context Effects:

An Empirical Overview

Although a number of studies in the 1970s supported the view that semantic context effects increase with reading fluency (e.g., Klein, Klein, & Bertino, 1974; Steiner, Wiener & Cromer, 1971), many later studies challenged this
view. Schvaneveldt et al. (1977) argued that the semantic context effects of younger readers should be as strong as those of older readers, because contextual information is present even before the child can read. Although young children cannot read words they are aware of the meaning of some words. Schvaneveldt et al. claimed that unskilled readers should rely on contextual information to the same extent as skilled readers if the semantic organization of memory is independent of the graphemic properties of words.

Schvaneveldt et al. tested their hypothesis by presenting second and fourth grade readers with a lexical decision task. In a lexical decision task, subjects are asked to determine whether a presented letter string forms a word or a nonword. In Schvaneveldt et al.'s study, subjects made lexical decisions for target letter strings preceded by semantically related or unrelated words (e.g., Bread - Butter versus Nurse - Butter). Results revealed that decision time was shorter when the target words had been preceded by a related context as opposed to an unrelated context. Although no significant interaction was noted between grade and context effects, a trend toward greater context effects was noted for younger children as compared to older children (i.e., greater effect for second graders as compared to fourth graders). Also, using the Iowa Basic Skills Achievement Test as a measure of reading ability, it was
noted that within each grade poorer readers tended to make greater use of context than did better readers.

The results obtained by Schvaneveldt et al. contradicted the view that semantic context effects increase as a function of age and reading ability. Since their results were published, many other studies have emerged with similar results obtained under different experimental manipulations (e.g., Goldsmith-Phillips, 1989; Perfetti, Goldman, & Hogaboam, 1979; Pring & Snowling, 1986; West & Stanovich, 1978).

West and Stanovich (1978) noted that perhaps the observed developmental decrease in context effects resulted from the greater automaticity of word recognition in skilled readers. That is, the slower word recognition processes of the unskilled reader provide more time for the facilitative effects of semantic context to affect reading. The already quick word recognition processes of the skilled readers place a ceiling (or upper limit) on the benefits which could accrue through semantic context. The superior reader has most likely recognized the printed word before the semantic context can have any facilitative effects.

To study developmental changes in semantic context effects, West and Stanovich (1978) presented fourth graders, sixth graders and college students with an oral reading task. Subjects were asked to read target words in three different conditions: (1) preceded by a congruous context
(e.g., "The dog ran after the" when the target word was "cat"), (2) preceded by an incongruous context (e.g., "The girl sat on the" for the target word "cat"), and (3) without a previous sentence context (e.g., preceding the target word "cat" only by "the"). The voice onset time to read the target words served as a dependent measure.

The results revealed that as compared to the no-context condition, the congruous context condition facilitated reading for all ages (i.e., shorter voice onset times for the target words in the congruous condition as compared to target words in the no-context condition). Using scores on the Wide Range Achievement Test (Jastak, Bijou, & Jastak, 1965) as a measure of reading ability, West and Stanovich noted that facilitation effects were greatest for the poorer readers.

Comparisons of the voice onset times for the incongruous condition and the no-context condition revealed an inhibition effect (i.e., longer voice onset times for target words in the incongruous condition as compared to target words in the no-context condition) for the fourth and sixth graders only. The college readers appeared unaffected by the incongruous contexts. West and Stanovich interpreted this finding as evidence that in the skilled reader word recognition occurs automatically. Although a congruous context will facilitate word recognition, an incongruous context will not affect the automatic nature of this process.
in the skilled reader. The presence of inhibition effects in the younger readers is taken as evidence of the less automatized nature of the word recognition process in these less skilled readers. Thus, West and Stanovich concluded that facilitative effects of context can occur automatically or through processing capacity, whereas inhibitive effects are only observed when processing capacity (i.e., effortful capacity) is required.

If context effects are dependent on reading automaticity, it then becomes important to study the development of automatic processing as a function of age and reading ability. In a study by Guttentag and Haith (1978), automaticity was studied using a Stroop-like task. Subjects were presented with pictures of common items across six different conditions: (1) alone (control condition), (2) with visual noise i.e., non-letter symbols (e.g., #?%) appearing within the item, (3) with a nonpronounceable letter string (e.g., lbch), (4) with a pronounceable letter string (e.g., lart), (5) with an extracategory word (e.g., the word "dog" appearing with the picture of a chair), and (6) with an intracategory word (e.g., the word dog appearing with the picture of a pig). The subjects' task was to name the item in the picture as quickly as possible, ignoring any other information. Guttentag and Haith argued that if the subjects could not ignore the printed information (i.e., longer reaction times as compared to the control condition),
then automaticity in processing of print would be inferred. To study automaticity as a function of age and reading ability, five different subject groups were used: (1) early first grade (i.e., second month), (2) late first grade (i.e., ninth month), (3) third grade poor readers, (4) third grade good readers, and (5) adults.

The analyses revealed four different sources of picture-naming interference: (1) interference attributable to visual noise (i.e., #?%) was noted for the early first grade group and both third grade groups; (2) letter interference was observed for all groups; (3) interference attributable to word meaning was noted for all groups except for the early first grade; (4) interference from pronounceability was noted only for the third grade good readers and the adults.

From these findings, Guttentag and Haith concluded that as early as two months into the first grade, children are processing letters automatically, as evidenced by the letter interference. Interference attributable to word meaning developed sometime between the second and ninth month of schooling. Hence, it would seem that some degree of word recognition becomes automatized soon after reading ability is acquired. With regards to reading ability, the findings revealed that both good and poor readers possess automatic word-processing skills. However, the findings suggest that poor readers are less skilled at automatically processing

Schwantes (1981) argued that the larger context effects observed in children as opposed to adults are the result of slower decoding processes in the unskilled reader. These slower processes allow for context to influence the conscious-expectancy mechanism, thus explaining why children are more likely to show both facilitative and inhibitory effects from context.

Schwantes hypothesized that adults would show context effects similar to those of children if their word-recognition processes could be slowed down. This aim was accomplished by visually degrading the stimuli to be read. Schwantes required third grade and college subjects to perform a lexical decision task with and without context, as well as under normal and degraded conditions. As hypothesized, the younger readers showed greater context effects in the normal condition, but this developmental difference in context was attenuated when the words were visually degraded (see also Pring, 1984; Simpson, Lorsbach, & Whitehouse, 1983). Schwantes concluded that the age differences observed in the effects of semantic context are the result of differences in visual decoding processes. That is, as compared to younger readers, the older readers
were better able to transform the features of printed text into their equivalent mental codes.

Similarly, Raduege and Schwantes (1987) hypothesized that improving the word recognition skills of poorer readers should lead to a use of sentence context similar to that observed in skilled readers. Using third and sixth graders, they noted that practice with a list of words did increase the speed with which younger readers recognized the same words in context. Moreover, they observed that the context effects in poor readers decreased, thus resembling the reading of more proficient readers. Similar results were obtained by Stanovich, West, and Freeman (1981) who found a decrease in context effects for second graders given word recognition practice.

In accordance with the aforementioned studies, a number of other researchers have argued that the difference between good and poor readers lies in their decoding abilities (e.g., Perfetti, 1984; Perfetti & McCutchen, 1982; Nicholson, Lillas & Rzoska, 1988). Perfetti (1984) stated that decoding ability plays a central role in reading ability and disability. However, Perfetti was quick to stress that very little is known about these linguistic abilities and thus conclusions should be drawn with caution.
LIMITATIONS OF READING STUDIES

Due to the covert nature of the processes involved in reading, researchers are frequently forced to make inferences about the reading process based on experimental manipulations. Problems arise, however, when the experimental task deviates substantially from typical naturalistic reading behavior. Ultimately the behavior of interest is silent reading, yet very few studies have actually required subjects to engage in this behavior.

A common manipulation used to study reading has been the lexical decision task (e.g., Meyer & Schvaneveldt, 1971; Schuberth & Eimas, 1977; Schvaneveldt et al., 1977). Using this approach, it has been repeatedly demonstrated that a congruous context can facilitate a lexical decision. However, it is not unreasonable to question the validity of this approach to studying reading. Hupet and Elousa (1986) have pointed out that the lexical decision task cannot be considered a semantic task. When a subject is presented with a letter string, he/she is likely accessing a memory location within the lexicon (i.e., mental dictionary) to verify if the letter string constitutes a word. This decision, however, need not await a semantic (i.e., meaning) check of the letter string. Hence the lexical decision task could only be used to study context effects at the lexical
access stage (Norris, 1987). Any further inference would be unfounded.

Another common approach to the study of reading has been the oral reading task. Subjects are typically required to orally read information which has been preceded by a related or unrelated prime. However, as noted by Goldsmith-Phillips (1989), the oral task may not be an adequate reflection of silent reading. Reading orally places demands on the reader which may not be present in more natural situations. For instance, greater attention may be placed on phrasing and enunciation, leaving less processing capacity for comprehension.

Furthermore, the technique of oral reading places a limit on the generalizations which can be made. Gibson and Levin (1975) have stated that when reading orally, subjects' performance may be affected by an eye-voice span factor. That is, the eye may be fixating and grasping the meaning of an information unit some time before it is vocalized. In other words, it would seem that the vocalization of information lags behind the eye. Thus, the voice onset time for a given word within a sentence may not be an adequate measure of the word processing time (at a word level and/or sentence level).

Another factor which is frequently overlooked in reading research is what has been termed the sentence wrap-up effect (Just & Carpenter, 1980). Using eye-fixation
data, Just and Carpenter have observed that the gaze duration is longest for words which occur at the end of sentences. They concluded that this longer fixation duration is due to a sentence integration process. That is, when fixating the last word, the reader is not only taking time to recognize and process the word, but is also processing the sentence meaning as a whole. Most studies looking at the effect of context on word reading times have consistently placed their target words at the end of sentences (e.g., Juel, 1983; Schwantes, 1981; Stanovich & West, 1981; 1983; West and Stanovich, 1978). Hence, it becomes difficult to determine if the observed effects are the result of context effects on target word recognition and/or on sentence integration.

RATIONALE FOR THE PRESENT STUDY

The present study attempted to observe the effects of sentence context on word reading times of good and poor sixth grade readers using a more natural reading situation than has been used by previous studies. Of interest were the differential effects of context as a function of word difficulty and reading ability. An attempt was made to distinguish between effects on word recognition processes and effects on sentence integration processes.
To avoid many of the confounding variables inherent in other experimental techniques (e.g. lexical decision task, voice onset time), a moving window paradigm was adopted (Just, Carpenter, & Wooley, 1982). The moving window paradigm provides subjects with information about sentence layout, word length, and punctuation prior to presenting the words to be read. This preparation of subjects is accomplished by replacing words with series of dashes, each dash representing a letter, thus preserving spacing and punctuation (e.g., presenting "--- --- -----" for the sentence "The boy fell."). Words are then successively presented, one at a time, following button presses initiated by the reader.

The dependent measure of interest was the exposure duration of each word. It is assumed that the exposure duration of each word can be taken as a measure of individual word processing time. This assumption is in accordance with the eye-mind assumption proposed by Just and Carpenter (1980). The eye-mind assumption stipulates that readers will fixate a word for as long as it takes to process it. That is, the fixation will last until the word is recognized and processed for comprehension, often with the help of previously read material. Thus, if the eye-mind assumption is valid, the moving window paradigm would seem to be an appropriate technique for studying the reading process.
Presently, it is unclear to what extent word reading times are reflective of word level processes as well as sentence level processes. Word level processes refer to processes underlying word recognition (i.e., decoding, lexical access), whereas sentence level processes involve the integration of information so as to abstract the sentence meaning (Haberlandt & Graesser, 1985).

Based on the eye-mind assumption, Just and Carpenter (1980) have argued that sentence level processes are mostly postponed until the last word of the sentence (i.e., sentence wrap-up). However, using a moving window paradigm Murdaca and Komoda (1991) have demonstrated that some sentence level processing is occurring before the last word. Data revealed that readers' word reading times were increased if an incongruity was present in a sentence. The increase in word reading time was found to carry over to words following the incongruity, thus suggesting that word reading times are reflective of an ongoing sentence integration along with word level processing.

The present study attempted to verify the occurrence of sentence level processing by analyzing the word reading times for three words in each sentence. Analyses of target word reading times were conducted to reveal any effects of context and word difficulty on word reading time, but could not be used to determine the extent of word and sentence level processes. By additionally analyzing the word
following the target word (target+1), it was possible to verify for the occurrence of sentence level processing. It was argued that if target word congruity and difficulty were found to affect the target+1 word reading times, then ongoing sentence integration would have been demonstrated. Additionally, the reading times for last words were analyzed to study the differential effects of context on sentence wrap-up.

Hypothesis I

In accordance with findings predicted by the interactive-compensatory model, it was expected that for the target words, poor readers would demonstrate greater context effects than good readers. If the word recognition skills of poor readers are more reliant on controlled processes (Stanovich, 1980), then it was expected that both facilitation (i.e., shorter reading times for words in a congruous context as compared to a neutral context) and inhibition effects (i.e., longer reading times for words in an incongruous context as compared to a neutral context) of context would be noted, with a tendency toward inhibition dominance (i.e., pronounced inhibition effects with modest facilitation effects). A pattern of facilitation dominance for target words was expected for the good readers if greater word automaticity was to be inferred.
Hypothesis II

Based on previous research findings (e.g., Murdaca & Komoda, 1991; Stanovich & West, 1983), it was expected that greater facilitation effects would be observed for difficult target words as compared to easy target words (with difficulty assessed by word frequency and word length). Because easy words are recognized very quickly, facilitative effects of context are limited in the benefits they can provide (i.e., ceiling effect). The longer word recognition times of difficult words, however, provide more time for semantic context (i.e., higher level process) to have a facilitative effect on the identification process.

Hypothesis III

Given the assumption that word reading times are reflective of both word level and sentence level processing, it was expected that context effects would carry over to the target+1 word. Consistent with findings obtained by Murdaca and Komoda (1991), it was expected that target word difficulty would differentially affect target+1 reading times. Greater reading times were expected for target+1 words preceded by difficult target words as compared to easy target words.
Hypothesis IV

Inasmuch as the sentence wrap-up effect is reflective of sentence integration processes, both facilitation and inhibition effects of context were expected for last word reading times. No effects of target word difficulty were expected on the last word reading time due to the physical distance (i.e., three words) between these stimuli.
CHAPTER II

METHOD

Subjects

Thirty-two sixth grade children from elementary schools in the Essex County area (Ontario, Canada) were selected to participate in this study. Prior to participating in the study subjects were administered the Speed and Accuracy subtest of the Gates-MacGinitie Reading Tests (Gates & MacGinitie, 1965). Sixteen subjects (eight males and eight females) scoring between the 58th and 99th percentile on the Speed and Accuracy subtest comprised the good readers group. Sixteen subjects (eight males and eight females) scoring between the 24th and the 38th percentile on the Speed and Accuracy subtest comprised the poor readers group. The mean percentiles on the Speed and Accuracy subtest were 71.69 for the good readers group and 29.56 for the poor readers group. The first language of all subjects was English, as determined by the language of their schooling. Moreover, all subjects were required to have normal or corrected to normal vision.

Materials

Ninety-six sentence frames and 128 target words from Murdaca and Komoda (1991) were used. The target words
selected had a cumulative sixth grade frequency (i.e., 3rd + 4th + 5th + 6th grade; Carroll, Davies & Richman, 1971) of at least one. Of the 96 sentence frames, 64 were context sentence frames (e.g., "The cat drank from the ____ on the floor") and 32 were neutral sentence frames (e.g., "It could have been the ____ that we sold"). Each context sentence frame had two congruent target words, one easy and one difficult, as assessed by word frequency and word length (Carroll et al., 1971). The 64 easy target words had a mean cumulative word frequency of 686.23 (SD = 994.39) and a mean word length of 4.72 letters (SD = 1.16). The 64 difficult target words had a mean cumulative word frequency of 16.17 (SD = 22.52) and a mean word length of 7.25 letters (SD = 1.95).

Inasmuch as analyses were performed on the word reading times of the last word in each sentence as well as the word following the target word (target+1), the characteristics of these words were also assessed. In the context sentence frames, for the last words the mean cumulative word frequency was 1051.80 (SD = 1479.85) with a mean word length of 5.28 letters (SD = 1.69). In the neutral sentence frames the last words had a mean cumulative word frequency of 865.09 (SD = 1590.19) with a mean word length of 6.09 letters (SD = 2.08).

For the target+1 word in the context sentence frames, the mean cumulative word frequency was 28352.62 (SD =
33776.41), with a mean word length of 3.33 letters (SD = 1.47). In the neutral sentence frames, the target+1 words had a mean cumulative word frequency of 22541.34 (SD = 17267.11), with a mean word length of 3.38 letters (SD = 1.18).

The 96 sentence frames were divided into 32 triads each containing two context sentence frames and one neutral sentence frame (Appendix A). Within each triad the four target words (two for each of the two context sentence frames) were paired with each of the three sentence frames. Thus, each target word appeared in a congruous, incongruous, and neutral sentence frame.

The 384 sentences resulting from the pairings (i.e., 96 sentence frames x 4 target words) were then subdivided into four separate sets observing the following limitations: (1) each sentence frame appeared once in each set; (2) a target word appeared no more than once per set; (3) each set contained an equal number of congruous, incongruous, and neutral sentences; (4) each set contained an equal number of easy and difficult target words across congruous, incongruous, and neutral sentences. Figure 1 illustrates the counterbalancing procedure adopted.

Each of the four sets were then permuted to form two different sequences of presentation. The following constraints were observed for each sequence: (1) no more than 2 sentences of the same type (i.e., congruous,
<table>
<thead>
<tr>
<th>Sentence Frames</th>
<th>Target Words</th>
</tr>
</thead>
<tbody>
<tr>
<td>The preacher spread the ___ in the town.</td>
<td>word, gospel</td>
</tr>
<tr>
<td>The cat drank from the ___ on the floor.</td>
<td>bowl, saucer</td>
</tr>
<tr>
<td>It could have been the ___ that we overlooked.</td>
<td></td>
</tr>
</tbody>
</table>

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<table>
<thead>
<tr>
<th>Set 1</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>The preacher ... word</td>
</tr>
<tr>
<td>2</td>
<td>The cat ... gospel</td>
</tr>
<tr>
<td>3</td>
<td>It could have ... bowl</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Set 2</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>The preacher ... gospel</td>
</tr>
<tr>
<td>2</td>
<td>The cat ... word</td>
</tr>
<tr>
<td>3</td>
<td>It could have ... saucer</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Set 3</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>The preacher ... bowl</td>
</tr>
<tr>
<td>2</td>
<td>The cat ... saucer</td>
</tr>
<tr>
<td>3</td>
<td>It could have ... word</td>
</tr>
</tbody>
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<table>
<thead>
<tr>
<th>Set 4</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
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</tr>
<tr>
<td>2</td>
<td>The cat ... bowl</td>
</tr>
<tr>
<td>3</td>
<td>It could have ... gospel</td>
</tr>
</tbody>
</table>
```

Figure 1. Counterbalancing approach used to form 4 sets of 96 sentences.
incongruous, neutral) followed each other; (2) no more than 3 target words of the same type (i.e., easy, difficult) followed each other.

Along with the 8 sets (i.e., 4 sets x 2 sequences of presentation), 10 practice sentences (Appendix B) and 24 filler sentences (Appendix C) were used. Moreover, 26 True-False statements (2 for the practice trials) were created for a recognition task. The inclusion of a recognition task was necessary to verify for the active reading participation of the subjects. Of the 26 True-False statements, thirteen contained nouns and verbs from a previously presented sentence (e.g., using the statement "The flood broke over the dam" for the sentence "The flood waters broke over the dam during the storm"). The remaining thirteen statements contained a noun and/or verb which were not in any previously presented sentences (e.g., "The flood came to the party").

Apparatus

A 286-AT IBM compatible computer was used to generate the stimulus material on a monochrome (amber) monitor. The viewing distance was set at approximately 50 cm. The character size was set at 5 mm vertically and 3 mm horizontally. A mouse connected to an input port was used to allow subjects to control the rate of presentation of
words. A software clock measured word reading times (i.e., the exposure duration of each word).

Procedure

All subjects were individually tested over one session. In the first phase of the session, subjects were individually administered the Speed and Accuracy subtest. For the second phase, subjects were instructed that for 26 trials (including two practice trials), they would be presented with a screen containing five lines of dashes with each line representing one sentence. For each line, groups of dashes represented words, with each dash representing one letter. Although the sentence layout was displayed on the screen, words only appeared following mouse clicks initiated by the subject. Each click converted one group of dashes into its corresponding word. At the next click the following word was presented as the previous word converted back to dashes. Hence, words were presented one at a time successively without the possibility of returning to previously presented words. The computer recorded the amount of time each word was displayed on the screen (i.e., the word reading time).

A click following the exposure of the last word on the screen initiated a recognition task. The screen displayed a statement concerning the last five sentences presented. The
subjects' task was to determine whether the statement was true or false using the mouse to make their responses. The answers provided were recorded by the computer. This procedure was repeated for 26 trials, with only the data from the last 24 trials being recorded. To ensure the active participation of subjects in the reading task, all subjects were required to have performed above chance in the recognition task (i.e., 17 correct answers out of a possible 24).

Moreover, subjects were unaware that for each screen of five sentences, the fifth sentence was not included in any data analyses. The rationale for discarding the fifth sentence is that subjects may have likely read the last sentence differently in anticipation of the recognition task to follow. Hence, to minimize this confound, only the first four sentences of each trial were test stimuli, with the fifth sentence being a filler. For each subject, data for 96 test sentences (i.e., 24 trials x 4 sentences per trial) were recorded and analyzed.

With rest periods available following every fourth trial, testing sessions lasted from 45 to 60 minutes, depending on each child's reading speed.
CHAPTER III

RESULTS

The results of interest were the mean word reading times for target words, target+1 words, and last words as a function of context condition and target word difficulty. Reading ability was completely crossed with the two factors, resulting in a $2 \times 3 \times 2$ design (Ability x Context condition x Target word difficulty), with repeated measures on the last two factors.

Of the 32 subjects who participated in the moving window experiment, all obtained a score on the recognition test which exceeded the critical score of 17 out of 24 required to be included in the sample. The recognition scores ranged from 19 to 24, with a mean of 21.72. Thus, the data from all 32 subjects figured in the subsequent analyses.

Prior to undertaking analyses of variance on subjects' mean word reading times for each condition and word type, outlying scores were identified. For each subject, means and standard deviations were calculated for each context condition and level of difficulty. Scores falling three standard deviations above or below the mean for each condition were considered outliers. Based on a procedure recommended by Tabachnick and Fidell (1989), to minimize the
effects of extreme scores each outlier was replaced by a score one unit larger or smaller (depending on the direction of the outlier) than the highest or lowest score which fell within three standard deviations of the mean. This procedure was repeated until all outliers were replaced. For example, in a situation in which a score of 564 is the highest score within three standard deviations from the mean, outlying scores of 723 and 876 would be replaced by 565 and 566 (i.e., 564 + 1, and 565 +1). The reading times for all three word positions (i.e., target, target+1, and last) underwent this procedure.

Following the substitution of outliers, means were calculated for each subjects' word reading times. For each word position six means (i.e., 3 context conditions x 2 levels of difficulty) were obtained for each subject. These resulting means were then subjected to three separate 2 x 3 x 2 (Ability x Context condition x Target word difficulty) analyses of variance (ANOVAs) for target words, target+1 words, and last words (see Appendix D for all the ANOVA summary tables). Tukey's honestly significant difference (HSD) test was used for all necessary post-hoc analyses (alpha = .05). The subsections to follow will describe the results of these analyses.
Target word

The ANOVA on mean target word reading times yielded a main effect of target word difficulty ($F(1, 30) = 37.38$, $p < .00$). As was expected, easy target words were read significantly faster than difficult target words, with mean reading times of 825.771 ms and 1096.934 ms, respectively (see Figure 2).

Although no main effect of context condition was present ($F(2, 60) = 2.53$, $p < .09$), an interaction between context condition and target word difficulty was noted ($F(2, 60) = 6.06$, $p < .00$). As the factors of interest were the occurrence of facilitation and inhibition effects, the only comparisons of interest were the differences between the neutral conditions and the equivalent congruous and incongruous conditions. Thus, the mean reading times for the neutral conditions (easy, difficult) were subtracted from the congruous (easy, difficult) and incongruous (easy, difficult) conditions. Positive scores were interpreted as implying inhibitive effects for the given factors, whereas negative scores were interpreted as facilitative effects.

Figure 3 presents the interaction between context condition and target word difficulty. It was expected that difficult target words would experience greater facilitation effects than easy target words. Consistent with this hypothesis, a Tukey test ($HSD = 88.66$ ms) revealed that a significant facilitation effect was present for congruous-
Figure 2. Mean reading times for easy and difficult target words.
Figure 3. Mean differences from the neutral conditions for easy and difficult target words as a function of congruity.
difficult target words as compared to the neutral-difficult condition. Although the incongruous-easy condition did not significantly differ from the neutral-easy condition (difference = 88 ms), Figure 3 reveals that there was a strong tendency towards inhibition for this condition. It should also be noted that although the reading times for incongruous-difficult target words did not significantly differ from those of neutral-difficult target words, the direction of the results was contrary to expectations. As can be seen from Figure 3, the mean reading time for incongruous-difficult target words was 77 ms faster than its equivalent neutral condition, thus implying a tendency toward a facilitative effect.

Although it was hypothesized that poor readers would demonstrate greater context effects than good readers, the target word analysis failed to yield an interaction between reading ability and context condition ($F(2, 60) = 0.84, p<.44$).

**Target+1 word**

As was the case with the target word analysis, the ANOVA on mean reading times for target+1 words revealed a main effect of target word difficulty ($F(1, 30) = 7.33, p<.01$). That is, when target words were difficult, the mean reading time for target+1 words was 27.45 ms longer than when preceded by easy target words (see Figure 4). This
Figure 4. Mean reading times for target+1 words preceded by easy and difficult target words.
finding is consistent with the hypothesis that word reading times for target+1 words would be affected by attributes of the previous words.

Moreover, it was also hypothesized that target+1 word reading times would be differentially affected by target word congruity. Consistent with this view, the target+1 analysis yielded a main effect of context condition ($F(2, 60) = 4.294, p<.02$). A Tukey test ($HSD = 32.73$ ms) revealed that the only significant difference was between the congruous and incongruous conditions (difference = 36.84 ms). As illustrated in Figure 5, there is a tendency towards inhibition effects, though the difference between the incongruous and neutral condition (31.71 ms) was not statistically significant.

The interaction between context condition and target word difficulty was found to be marginally nonsignificant ($F(2, 60) = 2.77, p<.07$). Figure 6 demonstrates that although most conditions do not seem to vary greatly from their neutral counterparts, a tendency towards inhibition was present for the reading of target+1 words preceded by incongruous-easy target words.

Last words

The ANOVA on mean last word reading times revealed a main effect of ability ($F(1, 30) = 6.37, p<0.02$). Contrary to expectations, the mean reading times for last words were
Figure 5. Mean differences from the neutral condition for target+1 words in the congruous and incongruous conditions.
Figure 6. Mean differences from the neutral conditions for target+1 words preceded by easy and difficult target words as a function of congruity.
longer for good readers (1488.51 ms) as compared to the poor readers (1020.44 ms) (see Figure 7). As last word reading times are believed to reflect sentence integration processing (i.e., wrap-up effect), the difference in reading times between good and poor readers raised the issue of potential differences in the comprehension scores of the two groups. A t test performed on subjects' scores on the comprehension test demonstrated that as compared to good readers, poor readers performed significantly poorer on the recognition test (t(30) = -5.33). The mean recognition test scores were 22.63 (SD = .89) and 20.81 (SD = 1.05) for the good and poor readers, respectively.

Although a main effect of difficulty was marginally nonsignificant (F(1, 30) = 3.644, p<.07), it is interesting to note that contrary to observations made on target and target+1 words, difficult target words tended to lead to shorter reading times for last words as compared to easy target words (see Figure 8). Mean reading times for last words were 1275.15 ms for the easy target word condition and 1233.8 ms for the difficult word condition.

Although it was hypothesized that facilitation and inhibition effects would be observed for the last word reading times, no main effect of context was noted (F(2, 60) = 1.15, p<.32). However, a significant interaction was observed between context condition and target word
Figure 7. Mean reading times for last words as a function of reading ability.
Figure 8. Mean reading times for last words as a function of target word difficulty.
difficulty ($F(2, 60) = 7.59, p<.00$) (see Figure 9). A Tukey test (HSD = 125.03 ms) revealed that the significance resulted from the longer mean reading time (i.e., inhibition) for the incongruous-easy condition as compared to the neutral-easy condition (difference = 143.93 ms). As was noted with target word and target+1 word analyses, a tendency toward a facilitation effect was noted for last words in the incongruous-difficult condition as compared to the neutral-difficult condition (difference = -108.61 ms).
Figure 9. Mean differences from the neutral conditions for last words as a function of congruity and target word difficulty.
CHAPTER IV

DISCUSSION

Using a moving window paradigm, the present study has failed to support the hypothesis that poor readers would demonstrate greater context effects than good readers. Across all three words analyzed (i.e., target, target+1, and last), no interaction was noted between context condition and reading ability. As was predicted, greater facilitation effects were observed for difficult target words as compared to easy target words. Furthermore, target word difficulty was also found to carry over to target+1 words. This carry over effect suggests that word reading times reflect word recognition processes as well as some ongoing sentence integration processes. As hypothesized, context effects were observed on last word reading times. Sentence wrap-up time was increased when the sentence was in the incongruous-easy condition as compared to the neutral-easy condition.

Contrary to findings obtained by previous studies (e.g., Schvaneveldt et al., 1977; Schwantes, 1981; Underwood & Briggs, 1984; West & Stanovich, 1978), the present study did not observe differences in good and poor readers' use of semantic context. Moreover, it is of interest to note that for the target word and target+1 word, the analyses failed to yield main effects of reading ability. With the
assignment of good and poor reading ability being based on reading speed on the screening test (i.e., Speed and Accuracy subtest), it was expected that for the moving window experiment good readers would read more quickly than their less skilled counterparts. Quite to the contrary, last word analyses revealed that the mean reading times for last words were significantly shorter for poor readers as compared to good readers.

The discrepancy between the reading speed on the Speed and Accuracy subtest and the reading speed for last words would appear to be the result of differences in the demand characteristics of the reading tasks. For the Speed and Accuracy subtest, readers were instructed to read as fast as they could while ensuring that they could correctly answer the comprehension questions which followed each short paragraph. In spite of a time limit, the readers were free to reread any parts of the paragraph prior to answering the questions. It is evident, however, that if readers were frequently rereading portions of the text, their overall reading speed would be lowered. Thus, it is possible that subjects scored as poor readers when the deficiency was the result of slower comprehension skills.

In the moving window experiment readers were not provided with the opportunity to make any regressive eye movements. With words being presented one at a time successively, readers were not permitted to return to
previously presented words. Hence it is possible that the shorter wrap-up times observed in poor readers are reflective of a difficulty in fully integrating sentences when previous words may not have been fully processed for meaning.

Although the present study does not allow for this hypothesis to be tested, some support is obtained by examining the scores obtained on the recognition task. Poor readers were found to obtain a significantly lower score on the recognition task as compared to good readers. This discrepancy is taken as evidence of a limited amount of sentence integration processing by the poor readers which in turn led to shorter sentence wrap-up times.

The present study does not allow for any conclusions to be drawn concerning the potential differences in good and poor readers' use of context. The moving window paradigm was adopted for this study because it was believed to more closely approximate a natural reading situation as compared to lexical decision tasks or oral reading. However, the present study's inability to allow for regressive reading may have sufficiently departed from natural reading so as to limit the study of differences between good and poor readers. The potentially different strategies used by good and poor readers may have been altered by restricting regressive eye movements as well as presenting words individually.
Studies (e.g., Haberlandt, Graesser, & Schneider, 1989; Rayner, 1975) have demonstrated that proficient readers do not always fixate every word in a given text. As the reader progresses through a given text, he/she is believed to be generating hypotheses about words to follow (e.g., Smith, 1988). Hence he/she only needs to minimally sample the printed words to confirm his/her hypothesis.

Smith (1988) has argued that good readers require fewer fixations to read a given text, thus allowing them to read quicker (see also Hochberg & Brooks, 1976). Good readers are believed to have a greater knowledge base which they can use in the generation of hypotheses about information to follow.

If differences in reading speed are the result of the number of required eye fixations, then the moving window paradigm is limited in its capacity to study differences in reading ability. The moving window paradigm forces readers to read one word at a time. Although good readers may be generating hypotheses about words to follow before they are presented, they are nonetheless required to fixate them, albeit for a self-determined duration.

These aforementioned shortcomings of the moving window paradigm can be overcome with some modifications. The paradigm can be altered to allow readers the possibility to make regressive eye movements. Furthermore, the size of the window could be increased to reveal two or three words at a
time. This alteration, however, would limit the investigators' ability to study the reading behavior on each word independently. Nonetheless, studies using windows of varying sizes may prove informative to the study of different reading abilities.

The analysis on target words revealed a significant interaction between context condition and target word difficulty. The source of the significance was found to be a facilitation effect for difficult-congruous words as compared to difficult-neutral words. This pattern of facilitation dominance is consistent with previous research findings (e.g., Murdaca & Komoda, 1991; Stanovich & West, 1983). At first glance these results would appear to provide support for bottom-up models of reading, which argue for only facilitative effects of context (e.g., Gough, 1972; LaBerge & Samuels, 1974). Easy words are believed to be recognized quickly and automatically, thus remaining unaffected by context effects. The slower recognition processes for difficult words, however, can benefit from an automatic spread of activation to context related material in the lexicon (Murdaca & Komoda, 1991; Smith, 1988; Stanovich & West, 1983).

However, a closer look at the interaction between context condition and target word difficulty reveals that reading times for easy-incongruous words narrowly missed presenting a significant inhibition effect. Hence, taken
together these results actually provide more support for the top down (e.g., Goodman, 1970) or interactive models (e.g., Stanovich, 1980), and less support for bottom-up models. Both top-down and interactive models can accommodate for facilitative and inhibitive effects of context. As they read, readers are believed to be generating hypotheses about upcoming words. When the hypotheses are correct, shorter reading times (i.e., facilitation effects) are the result. Conversely, when the hypotheses entertained are not confirmed, longer reading times (i.e., inhibition effects) are observed.

The analysis on mean target word reading times also yielded a significant effect of target word difficulty. As expected, difficult target words had longer reading times than easy target words. Due to their lower frequency and/or greater word length, difficult words have consistently been found to take longer to read (Haberlandt et al., 1989; Murdaca & Komoda, 1991; Smith, 1988; Stanovich & West, 1983).

Consistent with findings obtained by Murdaca and Komoda (1991), the analysis on mean target+1 word reading times revealed that the effects of target word difficulty carried over to the following word. Mean reading times for target+1 words were larger when preceded by a difficult word as compared to an easy word. Moreover, a significant main effect of context condition on target+1 words revealed a
trend towards greater inhibition effects as compared to facilitation effects.

The effects observed on target+1 word reading times are believed to be reflective of some ongoing sentence level processing. Hence word reading times are believed to be reflective of both word level and sentence level processing. These findings are contrary to Just and Carpenter's (1980) assertion that sentence integration processes are postponed until the last word in the sentence is fixated.

Moreover, the effects observed on target+1 word reading time are a violation of Just and Carpenter's (1980) eye mind assumption. Just and Carpenter would argue that prior to fixating the target+1 word, readers should have fully processed the target word. Results, however, revealed that readers are still being affected by target word difficulty and congruity when fixating target+1 words. Hence, it would seem plausible to argue that readers move their fixations after having recognized words, but may not have fully processed them for meaning (Haberlandt et al. 1989; Murdaca & Komoda, 1991).

A study conducted by Haberlandt et al. (1989) obtained results which also contradict the eye-mind assumption. Using a moving window paradigm, they noted that word reading times were affected by preceding words. Moreover, they noted that good readers were more greatly affected by previous words than were poor readers. Haberlandt et al.
argue that good readers are attempting to group adjacent words. This grouping is believed to facilitate the reading process when a difficulty is encountered.

The analysis on last word reading times did not yield significant main effects of context condition or target word difficulty. Due to the physical distance between the target word and the last word, it was not expected that target word difficulty would affect the reading of last words. Nonetheless, the mean reading times for last words suggest that last words are read quicker if they are in the difficult condition as compared to the easy condition.

Moreover, a significant interaction between context and difficulty presents a tendency toward facilitation effects for last words in the incongruous-difficult condition. The direction of the results is contrary to the significant inhibition noted for last words in the incongruous-easy condition. Readers appear to have difficulties integrating incongruous sentences containing easy target words, but have shorter reading times when the target word is difficult. The same pattern of results was noted for target words and target+1 words.

As a facilitation effect for the incongruous-difficult condition is counter-intuitive, it would seem reasonable to conclude that readers did not attempt to integrate sentences in this condition. The additive effect of incongruity and
target word difficulty may have proved too overwhelming a task for the sixth grade readers.

Using adult readers, Murdaca & Komoda (1991) noted that sentence incongruity significantly delayed sentence integration processes. No tendency toward facilitation effects was noted for last words in the incongruous-difficult condition.

With younger readers, it may prove informative to include target words of moderate difficulty so as to determine at which point sentence integration becomes too difficult. It may also be interesting to observe the differences in reading time when readers are forced to engage in greater sentence integration processing. This can be accomplished by requiring readers to answer recognition questions which demand more in depth processing (e.g., changing recognition sentences from the active to the passive; Khodaverdi, 1991).

In summary, the present study did not observe any differences in good and poor readers' use of sentence context. It is hypothesized that limitations of the moving window paradigm may have minimized the observance of potential differences in good and poor readers' use of context. Nonetheless, overall context effects were observed on the sixth graders' reading times. Context was found to have both a facilitative and inhibitive effect on reading. These effects were found to carry over to words following
target words as well as to last words. The effects observed on target+1 disconfirm Just and Carpenter's (1980) eye-mind assumption, as sentence integration is believed to be ongoing prior to last word fixations.
Appendix A

Test sentence frames and target words
(1) The preacher spread the ___ in the town.
word gospel

The cat drank from the ___ on the floor.
bowl saucer

After a while they found the ___ they were seeking.

(2) The lady paid the ___ before she left.
bill cashier

The bomb destroyed everything in the ___ when it exploded.
area vicinity

At times it is the ___ we purposely avoid.

(3) The house was destroyed by the ___ before we arrived.
fire tornado

The team won the ___ of the year.
game tournament

He said it was the ___ that had ended.

(4) The locomotive pulled into the ___ late at night.
station depot

The couple adopted the ___ from the agency.
child orphan

They said it was the ___ they would remember.

(5) The hotel's guests liked the ___ they were given.
rooms accommodations

The city stored water in the ___ they had cleaned.
tank reservoir

We constantly heard about the ___ they would fill.
(6) The climber reached the ___ at supper time.
   top
   summit

   The cold girl turned up the ___ in the room.
   heat
   thermostat

   They were thinking about the ___ which was unusual.

(7) The general revised the ___ for the attack.
   plans
   strategy

   The skier lived in the ___ by the hill.
   house
   chalet

   She had thought about the ___ while she worked.

(8) The doctor gave the ___ to the patient.
   shot
   prescription

   The train went over the ___ with no cargo.
   bridge
   trestle

   Perhaps it could have been the ___ that was hidden.

(9) The fisherman exceeded the ___ for the day.
   limit
   quota

   The politician attended the ___ as he planned.
   meeting
   convention

   It could have been the ___ that was changed.

(10) The woman dialed the ___ before we came.
     number
     operator

     The bridge crossed the ___ for many years.
     river
     ravine

     Earlier we felt it was the ___ they should choose.

(11) The interpreter knew the ___ of the people.
     language
     dialect

     The baker smelled the ___ after he baked.
     bread
     aroma

     He referred to the ___ we had noticed.
(12) The pianist played at the ___ for the children. 
concert  
recital

The sun was totally hidden by the ___ they had seen. 
clouds  
eclipse

She is asking about the ___ we saw yesterday

(13) She ordered the dress from the ___ she had seen. 
store  
catalogue

The boy was bitten by the ___ on the farm. 
dog  
mosquito

He wasn’t telling us about the ___ we had seen.

(14) The sheriff fired the ___ at the Indian. 
gun  
pistols

The mountain climber was buried in the ___ for many 
hours. 
snow  
avalanche

She told her about the ___ in the village.

(15) Water dripped from the ___ all night long. 
tap  
faucet

The sick child saw the ___ after he left. 
doctor  
pediatrician

We always thought it was the ___ you really liked.

(16) The cowboy roped the ___ in the pen. 
horse  
mustang

They worshipped in the ___ of the village. 
church  
synagogue

It apparently was the ___ up for ale.
(17) Behind the wheel was the ____ of the car.
driver chauffeur

The hay was in the ___ for the winter.
barn loft

You were asking about the ____ we had used.

(18) The housewife waxed the ___ in the kitchen.
floor linoleum

The ship was in the ____ two days ago.
water harbour

In many cases it is the ____ which causes problems.

(19) The dentist filled the ____ of the child.
tooth cavity

The girl skated across the ___ in the park.
ice rink

We thought it was the ____ that was repaired.

(20) The biologist examined the ____ under the light.
slide specimen

The school allows no running in the ____ during class
time.
hall corridor

You were told about the ____ which was dirty.

(21) The comb was on the ____ beside the lamp.
table bureau

The honeymooners made up after the ____ they had
earlier.
fight quarrel

You were asking about the ____ in the room.
(22) We stayed until the ___ before we left.  
   finale  
   The drunkard poured beer into the ___ of his friend.  
   glass  pitcher  
   We knew it was the ___ you should use.  

(23) The bride drank the ___ at the reception.  
   punch  champagne  
   She walked down the ___ without her bag.  
   street  aisle  
   We all agreed it was the ___ that was needed.  

(24) The banker locked the ___ with the money.  
   safe  vault  
   The tree was uprooted in the ___ the year after.  
   flood  hurricane  
   We all agreed it was the ___ of the century.  

(25) The car came down the ___ at top speed.  
   road  boulevard  
   The stars of the circus were the ___ with red suits.  
   clowns  acrobats  
   He wasn't telling us about the ___ in the town.  

(26) The carpenter drove in the ___ with his tools.  
   nail  spike  
   The barber trimmed the ___ of his customer.  
   hair  mustache  
   It could have been the ___ that we overlooked.  

(27) It is the brightest star in the ___ besides that one.  
   sky  constellations  
   The driver stepped on the ___ after the curve.  
   gas  accelerator  
   He assumed it was the ___he complained about.
(28) The soldiers flew in the ____ during the combat.  
   plane  helicopter

   The waiter handed them the ____ as he left.  
   check  menu

   I heard that it was the ____ that was good.

(29) The awards were presented after the ____ had been  
   announced.  
   dinner  banquet

   The radiation caused the ____ they were experiencing.  
   illness  mutation

   Perhaps it could have been the ____ which was bad.

(30) The whale was injured by the ____ it ran into.  
   ship  harpoon

   The farmer picked an apple from the ____ on his farm.  
   tree  orchard

   This one is the ____ we had photographed.

(31) The tennis player found the ____ on the lawn.  
   ball  racquet

   The flood waters broke over the ____ during the storm.  
   dam  dike

   They said it was the ____ that was repaired.

(32) The artist painted the ____ for his client.  
   picture  mural

   The prospector found the ____ in the mine.  
   gold  uranium

   She believed it could have been the ____ which was noticed.
Appendix B

Practice sentences
We constantly saw the numbers they would buy.
The mechanic adjusted the parcel of the car.
The meteorologist forecasted the weather we all feared.
The spider slowly crawled up the web in the room.
The previous one had been the merchandise we waited for.
The gardener fertilized the channel in the yard.
The dictionary contained all the synonyms we had used.
It could have been the sandals we had found.
The swimmer swam across the plant without any help.
This one is the degree they talked about.
Appendix C

Filler sentences
The mathematician added the food to the equation.
The student studied the definition in the book.
The mailman delivered the motor early this morning.
We all agreed it was the marathon he participated in.
They were thinking about the letter we had forgotten.
The pirates hid the loot on the island.
The overturned truck dropped the earth it was carrying.
The rain swept through the certificate without any warning.
The shoemaker repaired the shoes he was given.
The first item was the gift for the baby.
The squirrel hid the digit in the tree.
The university graduate was handed the town at the ceremony.
The cook was busy in the galley for many hours.
The actor was not pleased with the arm he had seen.
The repairman adjusted the rehearsal of the television.
Many had hoped for the arrival of the cure.
The bug slowly crawled up the wall in the room.
The divers swam in the sea throughout the morning.
All had approved the brakes for public use.
The tired infant was placed in the culprit for the night.
The babysitter played with the children in the room.
The surgeon performed the crib on the patient.
She most likely had the money in the house.
In church we spoke to the parson before the service.
The skilled seamstress adjusted the mirror in her hand.
We had all argued that the umbrella would be lost.
Appendix D

Summary ANOVA tables
### Table 1

Summary Table of ANOVA Performed on Mean Target Word Reading Times

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Table 2

Summary Table of ANOVA Performed on Mean Target+1 Word

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| **Within Subjects** |    |              |     |     |
| Context (B)       | 2  | 25482.01     | 4.29 | 0.02
| Error             | 60 | 5933.72      |      |     |
| A x B             | 2  | 1275.12      | 0.22 | 0.81
| Error             | 60 | 5933.72      |      |     |
| Difficulty (C)    | 1  | 36154.04     | 7.33 | 0.01
| Error             | 30 | 4933.18      |      |     |
| A x C             | 1  | 19.98        | 0.00 | 0.95
| Error             | 30 | 4933.18      |      |     |
| B x C             | 2  | 19782.97     | 2.77 | 0.07
| Error             | 60 | 7148.97      |      |     |
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Summary Table of ANOVA Performed on Mean Last Word Reading Times

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Appendix E

Mean reading times and standard deviations
for target, target+1, and last words
Table 4

Means Reading Times and Standard Deviations for Target Word Conditions

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### A x B x C

**Good**
- Congruous - Easy: 730.56 \[\text{ms}\] \[240.49\]
- Congruous - Difficult: 787.65 \[\text{ms}\] \[262.18\]
- Neutral - Easy: 732.82 \[\text{ms}\] \[277.78\]
- Neutral - Difficult: 787.00 \[\text{ms}\] \[219.66\]
- Incongruous - Easy: 814.04 \[\text{ms}\] \[231.65\]
- Incongruous - Difficult: 787.04 \[\text{ms}\] \[224.33\]

**Poor**
- Congruous - Easy: 739.51 \[\text{ms}\] \[167.73\]
- Congruous - Difficult: 749.77 \[\text{ms}\] \[159.08\]
- Neutral - Easy: 722.12 \[\text{ms}\] \[178.23\]
- Neutral - Difficult: 786.09 \[\text{ms}\] \[170.10\]
- Incongruous - Easy: 773.80 \[\text{ms}\] \[139.53\]
- Incongruous - Difficult: 779.97 \[\text{ms}\] \[185.81\]
Table 6

Means Reading Times and Standard Deviations for Last Word Conditions

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REFERENCES


VITA AUCTORIS

1965: Born in Montreal, Quebec.

1982: Graduated from Lester B. Pearson Comprehensive High School, Montreal, Quebec.

1984: Obtained the Diploma of Collegial Studies in Social Sciences (Psychology) from Vanier College, St.-Laurent, Quebec.

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