Canadian Journal of Psychology, 1991, 45(4), 492–506

Rereading Text: Words and Their Context

Betty Ann Levy, *McMaster University*
Michael E.J. Masson, *University of Victoria*
Maria A. Zoubek, *McMaster University*

ABSTRACT Two experiments examined recent claims that rereading benefits are mediated by abstract word-level representations (Carr, Brown, & Charalambous, 1989) and are subject to the reader's focus of attention (Carr & Brown, 1990). The effect of prior reading history was measured when readers reread a normal text and when they reread a scrambled word version of the text. The prior reading history was either with the normal or the scrambled versions. In Experiment 1 readers were oriented to surface level processing by a Greek letter detection task while reading. In Experiment 2 they were oriented to message level processing by a later summarizing requirement. Results indicated that transfer to normal text rereading is context specific, and this specificity is resistant to influences by focus of attention. Transfer to rereading scrambled word displays is variable, usually nonspecific, and perhaps open to attentional strategy. We argue that lexical contributions to transfer while reading normal text cannot be assessed by use of measures at different linguistic levels.

RÉSUMÉ Nous avons examiné dans deux expériences des propositions récentes selon lesquelles les effets bénéfiques de la relecture seraient médiés par des représentations abstraites au niveau du mot (Carr, Brown, & Charalambous, 1989). Les effets d'une expérience préalable de lecture étaient mesurés quand les lecteurs relisaient un texte normal et quand ils relisaient une version du texte dans lequel les mots étaient brouillés. L'expérience préalable de lecture était acquise soit avec la version normale ou avec la version brouillée. Dans l'expérience 1, les lecteurs étaient dirigés vers un niveau de traitement de surface par le biais d'une tâche de détection d'une lettre grecque pendant la lecture. Dans l'expérience 2, ils étaient orientés vers un niveau de traitement de message par une demande plus tardive de résumer le texte. Les résultats ont montré que le transfert à la relecture du texte normal est spécifique au contexte et cette spécificité est résistante aux influences grâce au foyer d'attention. Le transfert à la relecture du texte brouillé est variable, habituellement non spécifique et peut-être ouvert à une stratégie attentionnelle. Nous proposons que les contributions lexicales du transfert pendant la lecture d'un texte normal ne peuvent être évaluées par l'utilisation de mesures de différents niveaux linguistiques.

Rereading tasks provide an avenue for exploring the perceptual and conceptual processes involved in reading. Savings in reading time between the original and later reading trials act as indirect indicators of memory for the initial reading encounter. Like other indirect memory measures, reading time does not require the reader to actively remember the previous experience, yet it reflects the memories that are available to aid later performance. Recent studies have indicated that perceptual, lexical,

The research reported here was supported by operating grants from the Natural Sciences and Engineering Research council to Betty Ann Levy and to Michael Masson. We thank Lee Ann Tait for her assistance in this work.

Correspondence regarding this article should be addressed to Betty Ann Levy, Department of Psychology, McMaster University, Hamilton, Ontario, Canada L8S 4K1.

and conceptual processes may be involved in mediating rereading benefits. The present studies address problems encountered in trying to understand how these different types of representations act in concert to determine rereading transfer. Our major concern is with the appropriateness of using tests at different linguistic levels to assess transfer during normal reading.

In one of the earliest uses of rereading time as an indirect measure, Kolers (1975) demonstrated the involvement of perceptual processes in reading by showing that sentences could be reread faster in a rotated typescript, if they had previously been read in that rotated form rather than in normally oriented script. This rereading benefit for sentences previously read in rotated typescript was reduced when the first encounter with the passage was auditory or in a different language. Kolers credited the rereading benefit to improvements in visual pattern recognition processes because transfer was disrupted when the visual configurations were altered between the two reading encounters (changes in typescript or in spatial arrangement). Recent word recognition studies support the view that indirect measures are very sensitive to perceptual factors. Changes in modality or in characteristics of the visual display have been shown to decrease transfer from single word processing to indirect memory measures such as word fragment completion, word stem completion, and perceptual identification (e.g., Bassili, Smith, & MacLeod, 1989; Jacoby & Hayman, 1987; Levy & Kirsner, 1989; Roediger & Blaxton, 1987). Levy and Kirsner (1989) reported these same perceptual specificity effects when subjects read and then reread normally oriented texts. All of these studies support Kolers's original claim that perceptual recognition processes are involved in reprocessing benefits.

Other recent studies indicate that indirect memory measures reflect processing changes related to the context in which the target word was processed. This contextual effect suggests that higher order relational processes can influence the magnitude of reprocessing benefits. Jacoby (1983) reported the intriguing finding that words originally read in the context of an associated word were better recognized in a later recognition memory test, but less well identified in a later perceptual identification task, compared with words originally read in isolation. He suggested that when words are read in a context they receive less perceptual analysis because their recognition is aided by associative processes. Words read in isolation receive primarily data-driven processing, and this type of processing particularly facilitates perceptual identification. In addition, Bassili et al. (1989) found more facilitation on a word stem completion task when the target noun had been read rather than inferred during original processing, presumably because reading provided additional perceptual information to mediate transfer to the word stem completion task. Masson and MacLeod (in press), however, have shown that this low level of enhancement for the perceptual identification of generated items may be the result of context dependent encoding of the targets. Note also that there was a transfer benefit, even for words read in context or originally inferred rather than read, indicating a conceptual component to the reprocessing effect.

The important point is that single words may be processed differently when they are read in isolation rather than in the context of another word. This point has been made by Masson and Freedman (1990). They showed strong contextual sensitivity in a lexical decision paradigm for repetition effects that depended on the interpretation

of the target items. The interpretation of the critical words was determined by the contextual items, thus again indicating the importance of word context in determining transfer benefits. Masson and Freedman attributed their transfer effects to conceptual rather than perceptual processes. Similarly, Masson (1989) described a study in which subjects reread sentences in a transformed typography after a 4-month delay. For sentences that had originally been read with words arranged in a random order, no rereading benefit was obtained relative to new sentences despite the fact that their specific words had been read earlier. A reliable rereading benefit was found, however, for sentences that consisted of the same meaningful word order on both readings. This pattern of results suggests that rereading fluency was determined by memory for the message conveyed in meaningful sentences, not by memory for the pattern analysis of individual words.

The complexity of these contextual influences on rereading transfer has been highlighted by a series of recent articles. Levy and Kirsner (1989) asked subjects to read target words presented either as a set of unrelated words or as part of a meaningful text. When the target words were included in a later perceptual recognition task, their identification was facilitated only if they had originally been read in a word display. The text context during original reading eliminated any benefit from prior reading to later perceptual identification of those targets. Similarly, Oliphant (1983) reported that the benefit for words repeated on two lexical decision trials was lost when the target words were first processed as part of the task instructions, rather than as items in the initial lexical decision trial. Here again, the text context seemed to negate any benefit from having previously read those words. Finally, MacLeod (1989) found that transfer from reading to a later fragment completion task was much less if the words were first read in short paragraphs rather than in word lists. Further, more transfer was found for words processed in incongruous phrases than for words read in meaningful phrases, again suggesting that when words can be assimilated into larger meaning units they lose their ability to act as single transfer units.

Do these findings indicate that when associative contexts are present during original reading, then the data-driven processes involved in analyzing individual words are not well represented in memory? Levy and Kirsner (1989) argued against this view because when the text context was reinstated during the later transfer phase (i.e., read-reread paradigm), then transfer again showed the perceptual specificity effects taken to be the hallmarks of data-driven involvement in reprocessing benefits. They suggest that text representations are not recruited by later single word measures, but that such failures of retrieval cannot be taken as evidence that word level representations do not participate in transfer. The basic argument is that the word representations are bonded to the episodic context, and only when that episodic representation as a whole is recruited can the word level effects be observed.

If single word tasks cannot be used to evaluate lexical involvement in text rereading, how can one measure word level processes as these occur during text reading? Carr et al. (1989) used a scrambled text control to separate word from meaning level contributions to rereading transfer. They first asked subjects to read aloud short coherent texts or scrambled word versions of those texts. Subjects then reread aloud either the scrambled or the normal version. The surprising finding was that the savings in reading time on the second reading were the same whether the organization

(version) matched or mismatched on the two readings. Carr et al. took these results to indicate that transfer was at the individual word level because text context variations did not influence transfer magnitude. Because transfer in their studies was also insensitive to script changes between readings, Carr et al. argued that abstract lexical representations mediated all of the rereading benefits observed. These findings are clearly counter to the studies described above that indicate contextual specificity.

Two responses to Carr et al. (1989) have indicated problems with the claim that abstract lexical representations account for rereading transfer. Levy and Burns (1990) described three studies similar in design to the Carr et al. work. Subjects first read a normal or a scrambled version of a text. They then reread either the normal or the scrambled version. Across the three studies, Levy and Burns varied the linguistic level of the scrambling manipulation. In the first study the paragraph ordering was scrambled, but the text was otherwise intact. In the next experiment the order of the sentences was scrambled, and in the final experiment the words were scrambled. Thus, across the three studies more and more of the linguistic organization was changed. Levy and Burns found that the magnitude of rereading transfer decreased across the three studies, indicating considerable sensitivity to textual constraints. In fact, in the scrambled word study, a prior reading of the scrambled words conferred no advantage to rereading the normal text. This finding suggests that primed word logogens do not transfer their activation to those same words now reread in an organized argument framework. Levy and Burns followed Levy and Kirsner (1989) in crediting this contextual specificity to the likelihood that the second text recruits the representation of the first text. The more similar the two versions, the higher the probability of recruitment and, therefore, of transfer for all aspects of the text.

Although the recruitment of similar traces nicely handled the transfer to text rereading in the Levy and Burns (1990) study, it could not accommodate transfer to the rereading of scrambled text. A surprising result was that transfer to rereading scrambled text was greater when subjects first read the normal rather than the scrambled version. According to the similarity principle, the scrambled rereading text should best recruit the earlier scrambled text representation, not the normal text representation. Levy and Burns suggested that their scrambled text results stemmed from the strong text processing orientation used in their study. In order to ensure that subjects actually read the words in the scrambled texts, they were told to try to make sense of the scrambled message to help them with later recall. Because the passages were on familiar topics and the title was given for scrambled versions, readers recalled some correct ideas even when they read scrambled word displays. If subjects were trying to form meaningful messages while reading scrambled text, it may not be surprising that first reading the real message helped to reread the scrambled display. If this view is correct, it points to a major problem in using scrambled word sets as measures of lexical involvement in text reading. Subjects may adopt varying strategies in dealing with scrambled word displays, so they may not treat them as isolated word sets without meaning. In that case, the scrambled word set cannot provide a pure index of word level processing with no higher level process intervention. The present experiments will pursue this point.

In a recent comment on Carr et al. (1989), Whittlesea (1990) argued that in the Carr et al. design, the normal and scrambled texts differ in two ways — the context of

individual words and the level of linguistic structure. These confounded aspects of the manipulation make it difficult to evaluate the contextual specificity of words read in these displays. To demonstrate the contextual specificity of transfer for words read in scrambled displays, Whittlesea compared transfer from reading to rereading the same scrambled display with transfer from reading one scrambled display to rereading a different scrambling of the same word set. He found more transfer for rereading the same, rather than a different, scrambling of the word display, indicating contextual association of words read in supposedly unrelated words sets. The problem, then, is that scrambled word displays are not processed as a set of unrelated words. Higher order organizational patterns are formed during initial reading. Consequently, rereading transfer associated with scrambled word displays does not offer a clear indication of the contribution of word level processes only.

In response to Whittlesea's (1990) observation, Carr and Brown (1990) reported further evidence of contextual specificity in repeated oral readings. They further noted that in Whittlesea's data and in some work from their laboratory there is considerable variability in the amount of specificity observed in transfer to rereading scrambled displays. The magnitude varies with individual texts, perhaps suggesting that different scrambled word sets afford different amounts of organization. Carr and Brown also suggested that subjects may use different rereading strategies (as in the Levy and Burns, 1990, case) that will alter the representations formed when reading. They suggested a *level of focal attention* hypothesis, whereby transfer during reading varies with the focus or orientation to the reading task. They suggested that if the reader focusses on the surface features or on the individual words of the text, this should produce abstract lexical facilitation during transfer that will be indifferent to encoding context. On the other hand, if the initial orientation is to message-level processing, then this should produce contextual specificity in later transfer. The studies described below were a further attempt to examine the notion that reading orientation can change the pattern of rereading transfer. Of particular interest is how reading orientation affects transfer for rereading normal texts versus rereading scrambled texts. Levy and Kirsner (1989) reported that although test expectation and instructions to read for meaning versus to remember exact wording influenced reading times, these factors did not affect the magnitude or specificity of rereading transfer for normal texts. On the other hand, Carr and Brown's level of focal attention hypothesis suggests that reading strategy should influence both normal text and scrambled text transfer, such that a surface-level reading strategy should lead to no contextual specificity for either type of text, while a message-level or semantic strategy should lead to contextual specificity in both cases.

Experiments 1 and 2 studied transfer from reading to rereading, where the first text was either normal or scrambled and the rereading text was also either normal or scrambled. The studies differed in that during the first experiment subjects were required to cross out Greek letters embedded in the text as they read, while in the second experiment they were told to read for main ideas so that they could write a summary of the passage following each reading. The Greek letter detection task was used to orient the reader to a detailed analysis of the visual display, thus increasing the amount of surface-level processing. The summary task was used to replicate the text reading orientation used by Levy and Burns (1990), so as to increase

TABLE 1
The First Four Paragraphs of a Text With Embedded Greek Letters

ETHIOPIA

The drought and famine in Ethiopia has received much publicity recently. It is estimated that six thousand people are dying everyday and the threat of starvation faces a quarter of Ethiopia's population. Considered the worst famine in the past decade, it is a traηedy beyond the imagination of many people.

This disaster can be blamed on a number of factors. Geograπhically, Ethiopia lies south east of the Sahara desert and covers a region of arid and semi-arid lοnd. The climate is hot and dry, and survival is dependent on sparse and variable rainfall.

Due to the prolonged period of drought and the lacλ of rainfall, there is a shortage of food and water. The scarcity of water has resulted in a reduction of grain-crop yields — such as rice, maize and wheat — and there is little fodder to support the herδs of camel, sheep and goats.

The famine situation is aggravated by the fact that only one percent of the adult population uses some ζorm of birth control. It is therefore not surprising that children and mothers — who represent the high risk category — contribute to a large proportion of the death toll. Moreover, the high population density in some regions has almost exhaφsted food and water supplies, and the situation is getting worse.

associative or message-level processing. The question was whether these different reading orientations would affect rereading transfer to normal and scrambled texts in the same or in different ways.

EXPERIMENT 1

Method

Subjects: Fifty undergraduate volunteers from an introductory psychology course participated in the study. They were all native speakers of English, and they received course credit for their participation.

Materials and Design: Subjects read and then immediately reread five 525-word passages. The passages, previously used by Levy and Kirsner (1989), each consisted of approximately two typed pages that began with a story title and then discussed some interesting problem (pollution, overweight children, overpopulation, Ethiopia, and drug abuse). Each text consisted of 50 propositions (idea units) that were divided equally across 10 paragraphs. Each passage conformed to a particular argument structure that began with an introduction to the problem, followed by a discussion of the cause, effects, and possible solutions to the problem, and then ended with a set of conclusions. For each of the normal stories a scrambled version was formed by rearranging the 525 words so that no word combinations made obvious sense. Pseudosentences and pseudoparagraphs were formed by adding sentence and paragraph breaks as near equivalent as possible to those in the normal texts. Again the passages were typed on two pages, beginning with the passage's title, so that the scrambled pages looked like the meaningful texts, but they lacked coherent structure.

For each text, 20 letters were replaced by their Greek alphabet equivalents. The population of Greek letters was η, π, α, λ, ζ, ϕ, ξ, ψ, δ, σ, and each page of text used each letter replacement once. The location of the 10 Greek letters differed on each page for both the normal and the scrambled texts. Table 1 provides an example of a text segment with its Greek letters. The Greek letters were distributed across each page and required careful reading to detect. They were included in both normal and scrambled texts, and the detection task was used on both original and rereading trials. Subjects were instructed to read both normal and scrambled versions carefully, crossing out any Greek letters detected while reading. No indication of the number of Greek letters or which Greek letters would be present was given. Subjects were aware that their reading speed was being measured on each reading trial. Although the instructions indicated that the reader should attempt to understand the message, no emphasis was

TABLE 2
Mean Reading Times (in s) in Experiment 1

		Normal Version		Scrambled Version		
Reading		N-N	N-S	S-N	S-S	New
Original	*M*	131.17	127.80	148.65	144.76	122.30
	SD	33.68	28.62	45.77	39.40	28.45
Rereading	*M*	116.28	125.35	138.71	140.71	
	SD	29.93	31.14	42.71	40.00	

placed on meaningful processing. The instructions emphasized rapid and accurate reading, while crossing out as many Greek letters as possible.

The basic design was a 2 × 2 factorial, whereby the original reading text was either the normal or scrambled version and the rereading text was in the normal or scrambled form. Each subject read one passage in each of the four conditions created by this factorial combination: normal-normal, (N-N), scrambled-normal (S-N), normal-scrambled (N-S), scrambled-scrambled (S-S). A fifth passage was always read only once and as the last passage for each subject. This new (N) passage provided a measure of general practice effects for normal texts across the experimental session. The five passages were circulated through these five experimental conditions so that across subjects each passage was used equally often in each condition. This procedure ensured that there were no materials confounds for any experimental comparisons. The order of the four main experimental conditions was also counterbalanced across subjects, but the new condition was always tested last.

Procedure: Subjects were tested individually in a session lasting approximately 1 hr. They were instructed to read each passage silently, as quickly and accurately as possible, while also crossing out as many of the Greek letters as possible. They then received one practice passage in both its normal and scrambled forms to ensure familiarity with the task. For both practice and experimental trials, the experimenter started a millisecond timer when subjects turned over the pages in front of them and stopped the timer when subjects turned the pages face down again.

Results and Discussion

Greek Letter Detection: Subjects detected most of the Greek letters embedded in the texts, indicating that they indeed read the printed displays carefully. The mean detection rate was .975, with no reliable differences across conditions or between first and second readings.

Original Reading Times: Table 2 contains mean reading times for the first reading of passages in each condition. Planned comparisons indicated that although reading times for the two normal conditions and for the two scrambled conditions were equivalent, reading times for the two scrambled conditions combined were longer than those for the two normal conditions combined, $t(49) = 5.49$, $p < .001$. This finding provides some assurance that the scrambled texts were, in fact, thoroughly read. Finally, the new reading time was lower than the first reading times for both of the normal texts (t's(49) = 2.85, 2.28, p's $< .05$, for N-N and S-N, respectively), indicating a small but reliable general practice effect across the session. Although such general practice effects are rarely found in our studies (e.g., Levy & Burns, 1990; Levy & Kirsner, 1989), the effect here may have resulted from subjects becoming practiced in sharing attention between reading and detection requirements or from them becoming familiar with the visual features of the 10 Greek letters used throughout the study.

Rereading Times: Table 2 also provides the mean rereading times for the four repetition conditions. In order to investigate the effect of prior reading history on the rereading of normal texts, rereading times for the N-N and S-N conditions were compared. These two conditions were reliably different, $t(49) = 4.39$, $p < .001$, indicating that more transfer benefit accrued from a prior reading of the normal text than from a prior reading of just the words of that text. In fact, a prior reading of the words only (S-N) contributed little reprocessing advantage relative to original reading times. Rereading times in the N-N condition were reliably lower than the combined original reading time for normal texts, $t(49) = 8.64$, $p < .001$, and reliably lower than the new condition, $t(49) = 2.22$, $p < .03$, indicating transfer that was specific to the passage read. Rereading times in the S-N condition also differed reliably from the original time required to read normal texts, $t(49) = 2.26$, $p < .03$, but the magnitude of this transfer effect was small and appeared to result from general transfer effects because there was no advantage over the new condition, $t(49) = 1.10$. As in the Levy and Burns (1990) study, knowledge of a text's words without associated knowledge of the text's meaning contributed little to rereading transfer.

One interpretation of this transfer failure is that words read from scrambled displays are interpreted in the context of surrounding words, and these interpretations are not consistent with the interpretations given to those words in normal texts. Thus no transfer occurs for words interpreted in different episodic contexts. Alternatively, the word representations laid down in scrambled text reading may be abstract or context insensitive, but when linguistic boundaries have been crossed, as in the S-N case, then the act of rereading a text does not recruit the memory for these abstract operations. Levy and Kirsner (1989) have shown that when words are reread in their episodic context, data-driven specificity (i.e., modality specificity) occurs. Clearly then, the episode contains or can access word specific information. Levy and Kirsner argued, and we agree, that the best way to measure processes involved in text reading is through tasks that require text reading, not word reading, so that retrieval problems are minimized.

These normal text rereading results contrast with those found for the rereading of scrambled text (S-S vs. N-S). Unlike the Levy and Burns (1990) study (Exp. 3), where more transfer was observed after first reading a normal rather than a scrambled version, in the present study rereading times for the N-S and the S-S conditions were not reliably different. However, both conditions showed a reliable rereading benefit, in that the rereading times were reliably lower than the original time required to read a scrambled text, t's$(49) = 3.52, 2.64$, p's $< .01$, for N-S and S-S, respectively. Because neither our studies, nor those of Carr (Carr & Brown, 1990; Carr et al. 1989) or Whittlesea (1990), have included a new-scrambled condition at the end of the experiment, we cannot be sure that the scrambled rereading benefit is specific to the trained texts, rather than a general practice effect. However, all earlier demonstrations of word level transfer using indirect measures have been specific to the trained words, and there is no reason to expect the present result to be different. For the present purposes, it is only important to know that any transfer that is observed here for scrambled rereading is context insensitive, in contrast to the strong context sensitivity of transfer observed when rereading normal texts.

TABLE 3
Mean Reading Times (in s) in Experiment 2

		Normal Version		Scrambled Version		
Reading		N-N	N-S	S-N	S-S	New
Original	*M*	146.08	146.76	206.19	202.12	144.50
	SD	31.39	24.45	48.98	39.39	27.28
Rereading	*M*	125.41	147.12	190.38	195.29	
	SD	29.28	30.70	50.46	41.25	-

Conclusion: To summarize the main results, then, rereading normal text showed considerable specificity of transfer, with a prior reading of a text leading to considerable savings in rereading that text. However, a prior reading of the words, without their text message, led to little benefit in rereading the text. Clearly these data are inconsistent with any notion that attributes text rereading benefits entirely to abstract word representations. The contextual specificity of words read in text is very clear. This is not true, however, for words read from scrambled word displays. Here we found no difference in transfer for words previously read in texts or in scrambled contexts. The present results resemble those reported for oral rereading by Levy and Burns (1990, Exp. 4), where oral compared with silent reading appeared to force a word-by-word reading strategy, and this eliminated differential transfer in scrambled but not in normal rereading conditions. The present results are inconsistent with those of Carr et al. (1989), where oral reading provided no transfer specificity for either normal or scrambled rereading. Does this mean that there is no specificity in the word representations? Following Whittlesea (1990), we would argue against this view because the comparison crosses linguistic boundaries, thus confounding word context and level of linguistic processing. Comparison of the present results with those of Levy and Burns suggests that transfer for rereading scrambled text may be more susceptible to reading orientation than transfer for rereading normal text. In order to examine yet another reading orientation, Experiment 2 replicated the basic design of Experiment 1, except that this time attention was directed to the meaningful message conveyed by the text.

EXPERIMENT 2

Method

This experiment used the same design, materials, and procedure as in Experiment 1, except that there were no Greek letters in the passages and subjects did not engage in detection while reading. Rather, subjects were instructed to read so as to grasp the main ideas of the passage in order to write a brief summary of the text after each reading. For scrambled passages they were told to try to understand the message, and the passage titles were included to aid this endeavor. Subjects were encouraged to write down any words or ideas they thought appropriate during the summary task. Fifty different volunteers from the same undergraduate class participated for course credit.

Results and Discussion

Original Reading Times: Table 3 presents the first reading times for the main conditions. The two normal conditions and the two scrambled conditions were not reliably

different with respect to original reading time, but the combined reading times for the normal conditions were lower than those for the scrambled conditions, $t(49) = 9.74$, $p < .001$. As in the first study, subjects adjusted their reading rates to suit the display type. A comparison of reading times in Tables 2 and 3 indicates that readers also adjusted their rates to meet the task demands, taking longer to read the passages in Experiment 2. As Levy and Kirsner (1989) found, subjects took longer to read texts when a message-level orientation rather than a surface-level orientation was used. In Experiment 2 the new reading time did not differ from the time required to read texts on the first reading, indicating that no general practice effect occurred across the session. This result supports the view that the general effect in Experiment 1 was likely due to the dual task requirements or to visual learning of the Greek letters in that study.

Rereading Times: The rereading times are also shown in Table 3. To examine the effect of prior history on rereading times for normal texts, times in the N-N and the S-N conditions were compared. Rereading was reliably faster in the N-N than in the S-N condition, $t(49) = 7.23$, $p < .001$, again indicating the contextual specificity of text rereading transfer. While rereading was reliably faster than the original reading time for normal texts in the N-N condition, $t(49) = 7.21$, $p < .001$, there was no reliable transfer from word reading to text rereading. The rereading times in the S-N condition did not differ reliably from the original mean reading times for texts. As in Experiment 1, and our earlier studies, words read without the textual meaning add little benefit to later rereading those words in their text context. Abstract word representations do not appear to mediate rereading transfer for normal texts.

The effects of prior processing history on the rereading of scrambled word displays was examined by comparing reading times in the N-S and the S-S conditions. There was faster rereading of word displays following normal rather than scrambled text reading, but this effect was not reliable. In the Levy and Burns (1990, Exp. 3) study this effect was significant. Although the reading times in the two studies were comparable for normal text reading, the present study's times were considerably shorter than those in Levy and Burns for the scrambled conditions. This difference may indicate that the summarizing task did not lead subjects to spend as much time constructing propositions from the scrambled text as did the recall task used by Levy and Burns.

In both rereading conditions for scrambled text in Experiment 2, however, there was reliable transfer. The rereading times were shorter than the original time required to read scrambled text, t's$(49) = 4.70, 2.28$, p's $< .05$. This very large transfer effect (10 s) is unlikely to be due to general practice, and no general effects were observed in the normal text conditions. As in Experiment 1, however, we would caution against attributing these scrambled rereading results entirely to abstract word level representations. As the standard deviations for scrambled conditions in both Experiments 1 and 2 indicate, there is more variability in times for scrambled than for normal text rereading. There may be many ways to reread large word displays, including efforts to construct meaningful propositions, that increase variability of reading times and make reliable differences among conditions difficult to obtain. One would not want, therefore, to bestow theoretical significance upon this null effect.

Summaries: The summaries for each text were scored by first writing a single statement that best captured a paragraph's main idea. Since there were 10 paragraphs in each text, there were 10 main ideas per text. A point was credited to a subject's summary for each main idea recalled in full, with half points for partially complete ideas.

For normal texts the first summaries contained, on average, 3.5 main ideas, with no difference between the N-N and N-S conditions. Following second readings, subjects in the N-N condition added an average of 1.5 new main ideas, whereas for second summarizations in the S-N condition, 3.6 new ideas were recalled. Because this latter value is similar to that for first recalls after text reading, it suggests that the scrambled first reading yielded little benefit to later idea comprehension.

For summaries following scrambled first readings, subjects recalled an average of 10.3 words in each scrambled condition. We also attempted to score any word combinations given in terms of the main idea units. The data are offered with caution because there was considerable variability across subjects. This variance adds credibility to the view that subjects vary in how they process large random word displays. Most readers produced no idea units following a scrambled text reading. However, on average, about 0.4 correct ideas were given after a first scrambled reading, and an additional 0.2 correct ideas were added in second recall following scrambled reading.

GENERAL DISCUSSION

The main findings for the two experiments are summarized as follows:

1. Transfer to text rereading was very context specific, with little or no reliable benefit if only the words of the text had been processed on the first reading encounter. Changes in the focus of attention during reading had no effect on the specificity of transfer for normal texts read silently. We would argue that it is extremely difficult for a skilled reader to process texts in any way that defocusses message meaning. If such conditions were found, the question would be whether anything resembling normal reading was being studied! The reader need only consider the difficulty encountered in proofreading his or her own manuscript to gain an intuitive feeling for the overriding power of meaning in skilled reading.

2. Transfer to rereading scrambled word displays was not reliably sensitive to prior reading context, but, in Experiment 2 where the reading focus was at the message level, the difference between N-S and S-S conditions was in the same direction as that obtained by Levy and Burns (1990) for recall instructions. The nonsignificant trend found here may indicate that focal attention effects will be difficult to obtain reliably even for scrambled text reading, because of the considerable variance in strategies used by readers faced with large unrelated word displays.

In order to highlight the consistency of these findings with those of our earlier work, we have summarized the transfer benefits for normal and for scrambled texts across four studies. All four studies used the same 2 × 2 design described here. Subjects in all studies were drawn from the same subject population. Exactly the same normal and word scrambled texts were used in all four studies. Thus the studies are comparable in all important ways. They differ only in the reading orientation given to subjects. Table 4 contains the transfer benefits that were calculated by

TABLE 4
Mean Transfer Benefit (in s) for Four Experiments With Different Task Orientations

		Normal Text		Scrambled Text	
Originally Read		N	S	N	S
Story recall	*M*	15.44	4.32	18.17	6.55
(Levy & Burns, Exp. 3)	*SD*	14.13	13.94	21.20	25.95
Summaries	*M*	21.01	−0.70	13.72	8.82
(present Exp. 2)	*SD*	20.59	16.41	20.69	27.36
Greek letter detection	*M*	13.30	4.14	7.95	5.98
(present Exp. 1)	*SD*	10.73	12.99	15.98	15.97
Oral reading	*M*	10.21	0.16	6.17	11.19
(Levy & Burns, Exp. 4)	*SD*	11.38	14.87	8.35	14.95

subtracting the rereading time in each condition from the mean original reading time for that text type, for each subject. Scrambled rereading times were subtracted from the original time for S-N and S-S conditions combined. Normal rereading times were subtracted from the original means for the N-N and N-S conditions combined. The first experiment in Table 4, from Levy and Burns (1990), instructed subjects to read for meaning so that they could recall as much of the normal or scrambled text as possible. Readers were encouraged to try to make sense of the scrambled display and were provided a title to help them. These instructions were intended to provide a strong message-level orientation. The second experiment in Table 4 refers to the summary task of the present Experiment 2 that was also expected to provide a message-level orientation. The third experiment in Table 4 refers to the Greek letter detection results from the present Experiment 1. Like the first 2 studies in Table 4, it used silent reading but its focus was at the surface level in order to induce thorough processing of the visual display. Finally, the fourth experiment in the table, also from Levy and Burns, replicated the oral reading conditions studied by Carr et al. (1989). Levy and Burns argued that oral reading forces a surface-level focus by virtue of requiring word output. Thus the first 2 studies in the table focussed on message-level processing whereas the last 2 emphasized word or visual level processing.

Looking first at the data for normal text rereading in the first 2 columns of the table, it is clear that task focus or orientation to the reading material had no effect on the specificity of rereading transfer. Irrespective of whether the focus was to the surface or to the message level, substantial benefit was observed when the text itself was previously read, but little or no benefit to rereading accrued from a prior reading of only the words of the text. An analysis of variance comparing the S-N and N-N conditions across the four experiments yielded no effect of experiment, but the conditions main effect and the interaction were reliable, $F(1, 146) = 73.50$, $p < .001$, and $F(3, 146) = 3.73$, $p < .01$, respectively. In all four experiments there was reliably more transfer from a prior reading of the text than from a prior reading of the words of the text. The interaction stems from the fact that transfer from a prior scrambled reading was not reliably different (and approximately zero)

across the four experiments, but transfer from a prior normal text reading was reliably less in the fourth experiment than in the other three. This experiment used oral reading that forced word-by-word processing. These conditions did not increase abstract word level contributions to transfer, as evidenced by the lack of transfer in the S-N condition here, as in the other studies. Rather, there was a decrease in the amount of text level processing that defines the episode. Thus, even this focus of attention maintains the episodic specificity found in all transfer-to-normal reading, and the interaction stems from oral reading contributing less text information, not more abstract lexical information.

Text rereading, then, appears to be highly context specific, indicating that an episodic form of representation, rather than an abstract logogen form, mediates rereading transfer. This view is inconsistent with the data of Carr et al. (1989) and with the level of focal attention hypothesis suggested by Carr and Brown (1990). By that view, the first 2 experiments should show context specificity but the last 2 should not. The findings are consistent with those of Levy and Kirsner (1989), and we follow their suggestion that the specificity in transfer stems from crossing linguistic levels. Rereading normal text does not effectively recruit representations at other linguistic levels (e.g., scrambled word displays). This suggestion is not meant to imply that lexical items fail to be represented in text episodes, but, rather, that these lexical representations are embedded within the propositional structure derived from text comprehension, and they cannot be addressed until the text structures are themselves recruited. As Levy and Kirsner demonstrated, once the text representation is recruited, the hallmarks of surface-level processing reappear, indicating the existence of lexical information within the text's episodic representation.

The data for rereading scrambled text present a different picture. Here the effects do seem to move around with reading focus as suggested by Carr and Brown (1990). The data are inconsistent with the similarity principle that suggests that the S-S condition should consistently yield more transfer than the N-S condition, since the representations on the two occasions should be more alike in the former condition. The only case where the data are even in that direction is in the oral reading study. This condition actually replicates the Carr et al. (1989) task and their result of no reliable specificity, but we are not inclined to follow their interpretation of this null result as indicating that transfer is mediated by abstract lexical representations. The three silent reading studies suggest that specificity may actually occur in the opposite direction, with greater transfer from a prior text reading than from a prior scrambled reading. This effect is most obvious in the first 2 experiments in Table 4 that had strong text processing orientations. An analysis of variance comparing S-S and N-S conditions across the four experiments yielded no reliable effect of experiment or of condition. However, their interaction was reliable, $F(1, 146) = 2.64$, $p < .05$. Looking only at the first 2 experiments in Table 4 that had text processing orientations, the only reliable effect was of condition, $F(1, 73) = 5.47$, $p < .02$. The effects of experiment and of the interaction yielded F's < 1. Thus these experiments together showed reliable context effects for scrambled rereading, such that it is better to read a normal version first rather than the scrambled version. This phenomenon is reminiscent of levels of processing effects in memory, whereby words given more meaningful processing are better represented in memory than those analyzed in a

less relational way. They are then more available to influence later transfer. Again, the idea is that even scrambled text transfer may be episodically based, as suggested earlier by Whittlesea (1990).

These same analyses for the word orientation experiments (3 & 4 in Table 4) yielded no reliable differences in transfer from a prior reading of the text or of its words. Here it is tempting to conclude that there is no specificity and that scrambled text rereading is mediated by abstract lexical representations, as suggested by Carr and Brown (1990). But caution must be exercised. Subjects may not choose to read large word sets as if they consist of unrelated words. This will vary across subjects, as indicated by summary recalls in Experiment 2, or it may vary with the particular set of scrambled words. Different scrambled arrangements may afford different amounts of message-level processing, as indicated by Carr and Brown. This uncontrolled, and perhaps uncontrollable, variance will tend to produce the variable outcomes illustrated in Table 4 for the rereading of scrambled texts. Changes in focus of attention may increase the options open to subjects faced with these large word displays, such that a meaning level focus will lead some subjects to try to make sense of the unrelated words. This strategy option should increase subject variance compared to the stricter word level orientations. The scrambled text columns in Table 4 show just this increase in variance as one goes from the word to the meaning orientations. This susceptibility to strategic influences for the rereading of scrambled text highlights the difficulty that is encountered in determining the processes involved in transfer for nontextual materials. It is not a reliable indicator of pure lexical involvement in rereading.

In striking contrast to the unstable results for rereading scrambled text, transfer is remarkably stable and consistently context sensitive across experimental variations when real texts are read and then reread. Although it is tempting to view text processing as being under strategic control, we are struck by the resistance of transfer during normal text rereading to task requirements or instructional orientation. The robustness of the specificity for normal text rereading suggests that the reprocessing effect represents a fluent, automatic form of text comprehension. Transfer across readings of a text is based on a representation that maintains a record of the perceptual analysis performed (Levy & Kirsner, 1989), but this information is part of the episodic text representation that must be recruited as a whole to guide rereading. This form of skilled reading is best observed when a fluent reader is faced with a meaningful text. Fluent processing then takes on a Stroop-like quality, whereby the system will attempt to understand the message in the display, irrespective of the task demands or instructions. Other forms of text, such as scrambled text, result in less fluent reprocessing that is open to strategic influences. We should be very careful to avoid treating this nonfluent processing as a component of the fluent reprocessing executed while reading meaningful text.

References

Bassili, J.N., Smith, M.C., & MacLeod, C.M. (1989). Auditory and visual word-stem completion: Separating data-driven and conceptually driven processes. *The Quarterly Journal of Experimental Psychology, 41A*, 439–453.

Carr, T.H., & Brown, J.S. (1990). Perceptual abstraction and interactivity in repeated oral reading: Where do things stand? *Journal of Experimental Psychology: Learning, Memory, and Cognition, 16*, 731–738.

Carr, T.H., Brown, J.S., & Charalambous, A. (1989). Repetition and reading: Perceptual encoding mechanisms are very abstract but not very interactive. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 15*, 763–779.

Jacoby, L.L. (1983). Remembering the data: Analyzing interactive processes in reading. *Journal of Verbal Learning and Verbal Behavior, 22*, 458–508.

Jacoby, L.L., & Hayman, C.A.G. (1987). Specific visual transfer in word identification. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 13*, 456–463.

Kolers, P.A. (1975). Specificity of operations in sentence recognition. *Cognitive Psychology, 1*, 283–306.

Levy, B.A., & Burns, K.I. (1990). Reprocessing text: Contributions from conceptually driven processes. *Canadian Journal of Psychology, 44*, 465–482.

Levy, B.A., & Kirsner, K. (1989). Reprocessing text: Indirect measures of word and message level processes. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 15*, 407–417.

MacLeod, C.M. (1989). Word context during initial exposure influences degree of priming in word fragment completion. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 15*, 398–406.

Masson, M.E.J. (1989). Fluent reprocessing as an implicit expression of memory for experience. In S. Lewandowsky, J.C. Dunn, & K. Kirsner (Eds.), *Implicit memory: Theoretical issues* (pp. 123–138). Hillsdale, NJ: Erlbaum.

Masson, M.E.J., & Freedman, L. (1990). Fluent identification of repeated words. *Journal of Experimental Psychology: Learning, Memory, and Cogntion, 16*, 355–373.

Masson, M.E.J., & MacLeod, C.M. (in press). Re-enacting the route to interpretation: Enhanced perceptual identification without prior perception. *Journal of Experimental Psychology: General*.

Oliphant, G.W. (1983). Repetition and recency effects in word recognition. *Australian Journal of Psychology, 35*, 393–403.

Roediger, H.L., & Blaxton, T.A. (1987). Retrieval modes produce dissociations in memory for surface information. In D.S. Gorfein & R.R. Hoffman (Eds.), *Memory and cognitive processes: The Ebbinghaus centennial conference* (pp. 349–379). Hillsdale, NJ: Erlbaum.

Whittlesea, B.W.A. (1990). Perceptual encoding mechanisms are tricky but may be very interactive. Comment on Carr, Brown, and Charalambous. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 16*, 727–730.

Received 19 July 1990
Accepted 27 November 1990