INCIDENTAL TEXT PRIMING WITHOUT REINSTATEMENT OF CONTEXT: THE ROLE OF DATA-DRIVEN PROCESSES IN IMPLICIT MEMORY

By

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A Thesis submitted to the Faculty of Graduate Studies
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Abstract

Implicit memory for individual words is often eliminated when the words are studied in text. These context effects are thought to reflect the fact that context reduces data-driven processing at study and inhibits transfer to an implicit, data-driven task (e.g., word-fragment completion), which has led to the argument that reinstatement of context at test is critical for priming to occur. Some text priming procedures, however, have shown that words read in text can be primed on a word fragment completion test without reinstatement. These results led to the hypothesis that the promotion of perceptual processing at study enables text-to-word level priming. One criticism of these studies is that priming was obtained only because the context involved relatively short and unrelated passages or texts. In Experiment 1, participants read long and more meaningful and detailed texts under conditions that either promoted data-driven processing or conceptual processing, followed by a word fragment completion task consisting of words selected from those texts. Proofreading text (data-driven processing) led words assimilated into larger meaning units to act as single transfer units, whereas this transfer did not occur under normal reading conditions (conceptual processing). Experiment 2 replicated the results of Experiment 1, and tested whether proofread participants were extracting meaning from the text. Participants wrote brief post-experimental summaries of the texts to compare the degree of meaning extracted and remembered under the two orienting tasks. As expected, participants who read the texts under data-driven conditions showed better priming on an implicit memory task, and participants who read the texts under conceptually-driven conditions showed superior performance on the explicit, summarizing task. This suggested a trade-off between perceptual and conceptual processing and a dissociation between the two types of memory tasks as a function of orientation. These findings are discussed within a transfer-appropriate processing view of implicit memory.

Incidental Text Priming Without Reinstatement of Context: The Role of Data-Driven Processes In Implicit Memory for Words In Text1

Ever since Ebbinghaus first demonstrated that memory can be experimentally tested (1885/1964), memory research has continued to be a vast and expansive area of study. This is due, in part, to a particularly exciting turn in the history of memory research which took place as recently as two decades ago. Until then, research into memory processes had primarily restricted itself to what a majority of researchers would call explicit remembering. The discovery of a separate system or process of memory, implicit memory, has and is continuing to dominate the focus of current memory research. The implicit memory phenomenon, however, was anticipated by Ebbinghaus (1885/1964) who claimed that there existed forms of remembering that, although based on prior experiences, nonetheless "remain concealed from consciousness and yet produce an effect which is significant and which authenticates their previous experience" (p. 2). Ebbinghaus even provided a way to demonstrate this form of memory which excluded awareness, using his measure of savings through relearning. Today, most implicit memory research is directed at supporting either one of two major theoretical approaches to understanding the basis of implicit memory, that is, the multiple memory systems view and the processing view.

Much of the existing data reported in the implicit memory literature can be accounted for by models that prescribe either a systems or a processing view. This paper will review some of the major findings concerning implicit memory (and how it differs from explicit memory) and, at the same time, show how the evidence supports one or the other of the major theoretical accounts of implicit memory. Although theoretical perspectives will be discussed where appropriate, the principal focus of this article and the studies reported here involve an area of implicit memory research that remains to date small and vastly unexplored. Current theories of implicit memory, in their present form at least, are not fully compatible with some of the research, in addition to the findings of the two experiments in this report. Additionally, the discussion will reveal that, however wide-ranging and broad the study of implicit memory has been, the traditional paradigms used by researchers, and the myriad variables studied, have been used almost to the exclusion of one variable. This variable itself entails a somewhat different research paradigm. The variable is verbal context and the paradigm incidental text priming. A simple contrast would be to describe the traditional paradigm as based on word-level priming and the incidental text priming paradigm as based on message- or text-level priming. It should be noted, however, that both procedures refer to priming at the lexical level during the test phase of a typical implicit memory experiment. The difference lies in the material that is presented during the study phase (e.g., a list of words versus text within which target words are embedded). In both cases, the initial learning of the study items is incidental and both are expected to facilitate performance on an implicit memory test of those items presented in isolation.

As stated, only a handful of published studies have used an incidental text priming procedure. As will be seen, a review of those findings led to some interesting questions that came to form the basis of the present experiments. Before the discussion moves to a review of the pertinent data on text-level or text-based priming, I will begin by covering some basic terms and definitions and providing a general overview and background of implicit memory research, conclusions concerning the nature of implicit memory, and finally how different researchers and theorists have conceptualized implicit memory.

Implicit versus Explicit Memory

While the idea of a memory system separate and independent from explicit memory is now well established, its exact nature, effects, and relationships to other cognitive processes remain the domain of much of current experimental memory research. While we know that different factors act to cause implicit and explicit memory to operate differently in some cases and similarly in others, there is much evidence to suggest that they depend on separate neurological substrates. Indeed, the idea that memory is subserved by distinct neurophysiological systems is supported by research that describes the effects of damage to those areas. For instance, the hippocampal system is widely used to refer to a system of interrelated brain regions that appear to play a special role in learning and memory. An extensive lesion of this system can produce a profound deficit in new learning while leaving other cognitive functions and memory performance based on material acquired well before the lesion apparently normal. The effects of lesions to the hippocampal system appear to be selective to certain forms of learning (McClelland, McNaughton, & O'Reilly, 1995). In humans, the effect of particular lesions to this system can result in a severe loss of ability to form or verbally attest to explicit memories, whereas some kinds of learning appear to be completely unaffected by hippocampal system lesions (Cohen & Eichenbaum, 1993). Cohen and Squire (1980) introduced the term declarative memory to encompass the former type of memories, whereas Squire (1992) characterized the latter forms of memory as nondeclarative. This term stresses the fact that nondeclarative memories influence behavior without depending on conscious or deliberate access to memory for the contents of the events that led to these influences.

Early seminal work by Warrington and Weiskrantz (1968, 1970) demonstrated that, under the right conditions, even profoundly amnesic patients can show intact retention beyond just a few moments (Roediger, Guynn, & Jones, 1993). If such patients are presented with a series of words or pictures and then given tests of recall or recognition, they perform very poorly relative to control participants. This much is not surprising given the severe anterograde amnesia produced by lesions to their hippocampal systems. What was interesting was that when Warrington and Weiskrantz gave these patients fragmented forms of pictures and words and asked them to guess their identity, they benefited from the past experiences. That is, they performed better at naming a fragmented picture or word if it had been presented to them previously in an intact form in a list, even when they were unable to consciously recollect having seen them before.

Intact priming with amnesics was also reported by Graf, Shimamura, and Squire (1985, Experiment 1). Ten amnesic patients, eight of whom suffered from Korsakoff's syndrome were compared to two control groups, one composed of alcoholic participants who did not suffer from Korsakoff's syndrome and another of medical in-patients in the same facility. All participants were tested individually on four word lists. As they studied each word on the list, they judged on a scale of 1-5 how much they liked the named object. For two of the lists, the words were presented visually, and for the other two they were presented auditorily. After one list of each type the participants were given a free recall test. After the other two lists, the participants were given a word stem completion test: they were provided with the first three letters of several words (half had been recently studied and half had not) and were told that each of the cues was the beginning of an English word. They were instructed to write a "few letters to make each into a word. You can write any English word - but please write the first word that comes to mind" (Graf et. al., 1985, p. 389). On the free recall tests, the in-patient and alcoholic controls showed better recall than did the amnesics after visual and auditory presentations of the list, which was unaffected by mode of presentation. On the word stem completion test, amnesics showed just as much priming as did the two control groups. For all three groups, mode of presentation did make a difference with visual presentation producing greater priming than auditory presentation.

The data collected from memory-impaired participants (see Shimamura, 1986, for a review) suggests that episodes or events could not be recalled or recognized in a deliberate or conscious manner, but were preserved at a nonconscious level. That is, the performance of amnesics and other memory-impaired patients might not compare to normal participants on an explicit test of memory, but would equal or even perform better than normals when given an implicit test of memory. Such findings led to the now well-established distinction between explicit and implicit memory (Graf & Schacter, 1985).

Schacter (1987) defined implicit memory as that which is "revealed when previous experiences facilitate performance on a task that *does not require* conscious or intentional recollection of those experiences," and explicit memory as memory which is "revealed when performance on a task *requires* conscious recollection of previous experiences" (p. 501, emphasis added). One can see that this distinction implicates two distinct memory systems and the memory tasks that are said to reveal them. This ambiguity has often led to confusion or controversy among researchers and subsequently to the use of other terms. Although they are less frequently used terms, a clearer distinction is found in Johnson and Hasher's (1987) use of "direct" and "indirect" to distinguish between types of memory tasks. The direct and indirect distinction classifies memory tests with respect to task instructions and measurement criteria while avoiding the need to postulate the possible mental states or processes involved in performing those tasks (Richardson-

Klaveln & Bjork, 1988). I will use the implicit/explicit distinction interchangeably with the direct/indirect distinction. It should be kept in mind that "implicit memory" is only meant to be a descriptive label for conveying how the influence of prior experiences "can be expressed in subsequent task performance - unintentionally and without conscious recollection of a learning episode" (Schacter, Chiu, & Ochsner, 1993, p. 160). Thus, I will adopt the conventional terminology here, using direct and explicit and indirect and implicit to refer to both the behavioral manifestations that are revealed by particular tests of memory and the tests of memory themselves, which reveal explicit and implicit memory processes.

Measuring Implicit Memory

Although implicit memory has been investigated in many ways, the contemporary study of implicit memory focuses on priming (Challis, 1996). More specifically, direct or repetition priming occurs when a word or object on a study list facilitates its subsequent identification when only degraded perceptual cues are provided in a later test (Tulving & Schacter, 1988). In priming studies then, performance is based on the measurement of the facilitation, if any, in the unintentional retrieval of a stimulus by a previous encounter with that stimulus.

Direct and indirect measurement of memory retention for explicit and implicit forms of memory in cognitive research has been based on research with normal subject populations. There is an ever-growing empirical database showing functional dissociations (or uncorrelated effects) between implicit and explicit memory. One key methodological criterion in the use of direct and indirect memory tests is based on the instructions that are provided to participants during the experiment.

Direct tests such as free recall and recognition are those in which a subject is given instructions at the time of test that make specific reference to an earlier event. Thus, before a test episode, the experimenter would instruct the subject to think back to the original learning or study episode, and hence, this type of task is explicit in nature. Conversely, indirect tasks of memory (for example, word fragment or word stem completion, perceptual identification, and lexical decision) involve instructions to the subject that do not make any reference to a prior study or learning episode or experience. The emphasis in this case is on ensuring that the subject concentrates only on the task at hand. No connection is made between the study and test episodes of the experiment and the subject is typically required to complete or identify the test items with the first words that come to mind.

As already mentioned, neuropsychological research on amnesics first provided the impetus for the distinction between explicit and implicit memory and the types of tests that seem to dissociate them. Studies with amnesics have reliably produced a functional dissociation between the two forms of memory. Whereas normal people perform well on explicit or direct tests of memory, amnesics do not. The two groups, however, perform similarly on implicit or indirect tests of memory. Memory-disordered patients do not seem to retain information when given direct memory tests such as free recall or recognition, but do show such retention under implicit test conditions. Therefore, it would seem that implicit tests of memory retention assess or access a different form of stored information, memory process, or system than that which is measured by explicit tests of memory. Whether the tests are demonstrating different levels of information-processing or separate neurophysiological memory systems has led to some argument and speculation with the majority of researchers falling on either side of the debate. I will return to this later. First, I will describe some of the experimental findings that demonstrate functional dissociations between implicit and explicit memory and then go on to consider some of the major theoretical accounts of the phenomena.

Functional Dissociations Between Implicit and Explicit Memory

Unlike the subject variable introduced by studies with amnesics, for example, independent variables introduced by the experimenter in studies with normal human participants permit a more systematic investigation of dissociation. Manipulating a particular variable may produce differences between memory performance on explicit tests and implicit tests or it may have a certain effect on one type of test and a completely opposite effect on another type of test. Both direct and indirect tests are typically used within the same experiment, by varying the instructions. This way researchers can reliably demonstrate a dissociation between incidental (implicit) and intentional (explicit) retrieval or retention. Like the data provided from amnesics, analogous findings have been repeatedly reported from normal participants with no observable brain damage. The assumption typically made is that performance on implicit memory tests in normal participants reflects unconscious or unaware expressions of retention, just as in the case of amnesic participants. Of course, this assumption has been called into question because normal participants may realize that the ostensibly implicit test can be solved by explicitly retrieving or thinking back to prior experiences from an earlier phase in the experiment. Schacter, Bowers, and Booker (1989) provided an excellent orientation to the problem. They noted that conscious processes can be invoked at several stages during an implicit memory test, even if participants do not intend to use test items as recall cues. One possibility is that a subject may unintentionally invoke conscious recollection, which might, in itself, not pose a problem unless this awareness caused the subject to change his or her strategy and adopt intentional retrieval processes on subsequent test items. The evidence to date, however, indicates that contamination on implicit testing by some form of explicit remembering rarely occurs (Roediger, 1990). Many procedures for assessing or preventing contamination of explicit retrieval strategies have been suggested (Roediger & McDermott, 1993). Jacoby's (1992) process dissociation procedure is a recent example.

From this point, it will be assumed that measures of implicit memory tap an unaware form of retention that traditional explicit measures do not. The data from amnesics already provide strong support for this position, as do the many dissociations that have been reported in the literature between explicit and implicit measures of retention in normal participants to which we now turn. Only a brief overview of some of the more important and relevant findings will be provided here. Readers can consult excellent reviews by Richardson-Klavehn and Bjork (1988), Roediger and McDermott (1993), and Schacter, Chiu, and Ochsner (1993) for fuller treatments.

<u>Empirical Demonstrations of Functional Dissociations</u>

In order for a variable to show a functional dissociation between implicit and explicit tests of memory, a reliable difference in the performance on these tests must be observed. That is, there must be an interaction between the task (implicit versus explicit, for example) and some other variable. Many independent variables have been shown to produce such effects. One of the more commonly studied aspects of performance on implicit memory tests are manipulations of surface features. In most experiments involving direct priming, alterations in surface features between study and test presentations usually involve changes of modality (auditory or visual presentation at study), and variation in typography (font or case) of visually presented words.

There are only a few studies to date that have directly compared modality effects in explicit and implicit tests. The indication is that modality is generally a less important factor in direct tests than it is in indirect tests of memory. While obtaining a significant effect of modality on a word completion test, Graf et al. (1985) found no difference on a free recall test between visual and auditory presentation. That is, only implicit memory performance was attenuated when modality changed between study and test. Blaxton (1988) obtained the same results across tests using free recall and word fragment completion. Similar findings have been reported with respect to recognition memory. Comparing modality match versus mismatch between study and test, Kirsner, Milech, and Standen (1983, Experiments 1-3) found no effect on recognition memory but a significant modality effect on lexical decision. Roediger and Blaxton (1987) found the same pattern of results using recognition and fragment completion tests.

Although this effect is largely absent on explicit measures of retention, the typical finding on implicit tests of retention is that an attenuation in priming occurs when there is a change in modality of presentation between study and test. Compared to situations in which study-test modalities shared the same surface features, priming is typically significantly reduced when study and test modalities mismatch. Thus, it is fairly well-established that visual word priming is largely modality specific. Auditory presentation of target materials reduces and sometimes eliminates priming on stem completion (Graf, Shimamura, & Squire, 1985), fragment completion (Donnelly, 1988; Roediger & Blaxton, 1987), perceptual identification (Hashtroudi, Ferguson, Rappold, & Chrosniak, 1988; Jacoby & Dallas, 1981), and lexical decision (Scarborough, Gerard, & Cortese, 1987).

That repetition priming is enhanced when the targets in the study and test conditions are both visual was clearly shown in a recent study by Rajaram and Roediger

(1993). Their participants either read words, heard words, or saw pictures of the objects corresponding to the words. After this study episode, participants took one of four tests: word identification, word fragment completion, word stem completion, or anagram solution. Although priming was essentially the same on all four tests, there was a progressive decline in the amount of priming as a function of modality, with the greatest amount of priming occurring from visually presented words, less from auditorily presented words, and least from pictorial representations of the words on each of the four tests.

Several researchers have also used auditory tests when the study condition was varied with respect to modality. Using an auditory stem completion test, Bassili, Smith, and MacLeod (1988) showed that auditory presentation of words produced more priming than did visual presentation on this test. Auditory tests of lexical decision (Kirsner & Smith, 1974) and perceptual identification (Jackson & Morton, 1984) also show modality effects. These findings again suggest that performance on implicit memory tests is somehow dependent on the perceptual similarity between the material presented to participants in both the study and test conditions, whether it is visual or auditory.

Others have attempted to find the effects of typographical changes in priming tests of implicit memory. Changing letter case (upper to lower, lower to upper) between study and test has been shown to reduce priming in perceptual identification (Jacoby & Hayman, 1987). Changing script (handwritten to typewritten, typewritten to handwritten) resulted in small decrements in priming on fragment completion (Roediger & Blaxton, 1987, Experiments 1 & 2). Masson (1986, Experiment 3) found a significant effect on re-reading time when he presented participants with words in mixed-case (e.g. KeTtLe). Reading time was faster when the mixed-case form of a word matched between study and test (e.g. KeTtLe at both study and test) than when it mismatched (e.g. study KeTtLe, test kEtTlE).

Picture/word manipulations have also been shown to have an effect that functionally dissociates explicit and implicit memory. For standard explicit tests of memory such as free recall, paired associate learning, and recognition, there exists a picture superiority effect. We have already seen that, in many studies of implicit memory, words produce more priming than do pictures (Rajaram & Roediger, 1993). Madigan (1983) however, has shown that presentation of pictures during a study phase results in better retention of their corresponding names at test than the presentation of the names themselves on direct tests of memory performance.

Another variable that appears to influence implicit memory is presentation time and repetition. In most explicit memory experiments, presentation or study time has positive effects (Roediger, Rajaram, & Srinivas, 1990). Jacoby and Dallas (1981), however, reported that 1- versus 2-second rate of presentation of words had no effect on perceptual identification, but did affect recognition performance under the same conditions. Neill, Beck, Bottalico, and Molloy (1990) varied presentation time over the range of 1, 3, and 6 sec and found a large effect on recognition but no effect on amount of priming on a word fragment completion task. The results from massed repetition studies, in which the stimulus is repeated with no extraneous events, are similar to those of study time. For example, Challis and Brodbeck (1992) found no difference in amount of priming from one and two massed presentations on a word fragment completion test, but the number of massed presentations did significantly affect either recall or recognition. In a study by Green (1986), participants repeated words aloud for either 2 sec or 10 sec before taking either a word stem completion or word stem cued recall test. He found no difference of memory retention on the implicit test, but a sizable effect on the explicit test. Using word fragment completion, Challis and Sidhu (1993) presented words 1, 4, or 16 times and tested participants on explicit and implicit tests with word fragments as cues. Number of massed repetitions had no effect on the implicit test, but a reliable effect on the explicit word fragment test (as it did on free recall and recognition).

Another heavily studied aspect of performance on implicit memory tests is an instructional manipulation that is intended to cause participants to process materials in different ways. Some of the variables that have been considered in the literature include incidental versus intentional instructions, divided or focused attention, levels of processing, and the effects of generating compared to reading. Green (1986) manipulated intention to learn using the digit-recall paradigm. In this task, participants were given digits to remember on every trial, and then were given a word to repeat for various periods of time as a distractor task. As with the distinction between implicit and explicit instructions at test, participants in an intentional learning condition are forewarned that they will be tested on material to which they are exposed, whereas participants in an incidental learning condition are not. Green's participants were tested with word stems under either implicit or explicit test instructions and it was found that intention to learn did not affect priming, but had a sizable affect on a word stem cued recall test.

Some experiments require participants to divide attention between the learning material and some other task. Parkin, Reid, and Russo (1990) had participants perform a sentence verification task while simultaneously performing a tone monitoring task. Retention was assessed either by a direct recognition test or an indirect fragment completion test on items embedded in the sentences. Dividing attention at study affected recognition but had no effect on primed fragment completion.

Levels of Processing. Probably one of the more commonly studied variables on implicit memory tests is levels of processing. Subjects are typically exposed to material and directed to focus attention on the graphemic, phonemic, or semantic aspects of the material. The general finding from researchers in which level or depth of encoding of target items during a study task has been manipulated is that while there are large effects on explicit memory, there is little effect on priming on implicit memory. Jacoby and Dallas (1981) manipulated levels-of-processing and found that when the encoding of a word emphasized its meaning, rather than its surface features, performance on direct tests of memory (recognition) was enhanced, whereas there was no effect on indirect tests of memory, fragment completion, and perceptual identification. Graf and Mandler (1984) replicated this outcome with a stem completion task. In subsequent studies, null effects of study levels of processing on repetition priming have been found for lexical decision (Kirsner et al., 1983, Experiments 2 & 3), and perceptual identification of pictures (Carroll, Byrne, & Kirsner, 1985, Experiment 4), whereas in both cases, there were large effects of levels of processing for the same items on a direct memory test. Graf and Schacter (1985) and Schacter and Graf (1986) showed that elaborative processing (e.g., generating a sentence including the study word) did not increase the amount of repetition priming obtained in fragment completion, in comparison with a condition in which study words were orthographically processed.

Probably one of the more paradigmatic cases of dissociation between implicit and explicit memory comes from studies investigating what has come to be called the generation effect (Jacoby, 1978; Slamecka & Graf, 1978). Generating a word versus reading a word has shown opposite effects on explicit and implicit memory tests. Of course, it is these kinds of interactions that provide a more solid basis for concluding that different underlying factors are at work in the two tests (Roediger et al., 1993). Memory performance has often been found to be superior for study items that have been self-generated. However, such generation effects have been almost exclusively observed on explicit rather than implicit memory tasks (Begg & Snider, 1987; Hirshman & Bjork, 1988; Nairne, 1988). On implicit memory tests, self-generated study items have typically been found to lead to greatly reduced priming effects, compared with those obtained for study items that were read (Jacoby, 1983; Roediger & Blaxton, 1987; Roediger & Weldon, 1987). Winnick and Daniel (1970, Experiment 2), probably the first to report on the generation effect, had participants either read words or generate them from pictures or from definitions in a study phase. On an explicit, free recall test, one group of participants were instructed to verbally recall the items. A different group of participants performed an early form of the word identification procedure by identifying the words from brief tachistoscopic displays. On this implicit test of memory for studied or generated items, Winnick and Daniel found greater priming from reading words than from generating them from either pictures or definitions. Recall was better for items that had been generated from either pictures or definitions than for those that had been read.

In a series of experiments, Jacoby (1983), obtained a similar generation effect when participants either read aloud a word (e.g., COLD) out of context (XXX-COLD), read it in a meaningful context (hot-COLD), or generated it from the context (hot-????). Following the study phase in these three conditions, participants took either a recognition test or a perceptual identification test. The results revealed that generated words were recognized better than those read in context, which in turn were recognized better than those read out of context. On the perceptual identification test, the exact opposite ordering of conditions occurred. In particular, the greatest priming occurred for words read out of context and the least for words that were generated.

Theoretical Accounts of Dissociations

Researchers have considered dissociations between implicit and explicit memory in theories about the organization and process of memory. The interpretation of these dissociations hinges on whether they reflect the function of separable, brain-based memory systems (e.g., Schacter, 1989; Squire, 1987; Tulving, 1983) or the recruitment of different processes at encoding and retrieval of information (Blaxton, 1989; Roediger & Blaxton, 1987; Roediger et al., 1989). A third view (which we will omit from further discussion primarily because of the current dominance of the first two accounts) is generally referred to as an activation view. It holds that priming effects in implicit memory tests are attributable to the temporary activation of preexisting representations, knowledge structures, or logogens (e.g., Graf & Mandler, 1984; Mandler, 1980). This perspective has recently lost much of its explanatory power. This is because many of the recent findings in the literature, such as the fact that implicit memory does not seem to be affected by long delays, even up to a year, and that implicit memory has been demonstrated for newly associated items (Roediger & McDermott, 1993) are inconsistent with an activation view.

A distinction needs to be introduced to distinguish the present type of priming from a different type of priming. In the studies I have reviewed the priming has largely been perceptual in nature, as opposed to conceptual. Thus, a perceptual implicit test is one that challenges the perceptual system (usually vision) by presenting stimuli rapidly or in fragmented form (Roediger et al., 1989). Conversely, conceptual priming tests (such as free associating to category names and answering general knowledge questions) are implicit tests in which the target is not physically present at test.

Multiple Memory Systems

Any theory of perceptual priming, according to Schacter et al., (1993) has to be able to adequately account for the fact that: a) it can occur independently of semantic-level processing; b) it shows a large degree of modality specificity; and c) it is preserved in amnesic patients. According to Roediger et al., (1989), the most popular accounts of functional dissociations between memory measures are in terms of distinct memory systems. The memory systems approach receives its strongest support from studies of brain-damaged patients, where perceptual priming is intact. The basic neurological argument is that brain damage selectively affects the memory system for conscious recollection, making priming independent of the memory system for explicit retrieval of episodes. Damage to the brain leaves intact those systems responsible for other forms of learning, which are supposedly closely tied to the hippocampus and other limbic structures (Cohen & Eichenbaum, 1993; Squire, 1987, 1992).

The systems approach states that, in general, performance of one memory system is reflected in one measure (e.g., recall or recognition) and operation of the other system is reflected in some other measure (e.g., word stem and fragment completion). These two different systems may be, for example, the episodic and semantic memory systems proposed by Tulving (1983) among others. However, several commentators have questioned whether or not dissociations should be taken as evidence for the episodic/semantic memory distinction (e.g., Hintzman, 1984; McKoon, Ratcliff, & Deli, 1986; Neely, 1989). As Roediger et al. (1989) argued, it is not clear why a particular experimental manipulation, say generating versus reading a word, or levels-of-processing, would have large effects on episodic memory and no effect (levels) or an opposite effect (generating) on priming with a semantic memory task. As this argument suggests, the form of the interaction between independent variables and retention tests in normal participants is not predicted by the theory. Accounting for all possible dissociations necessitates the postulation of that many more different memory systems. One might want to include episodic and semantic memory within Squire's (1986) distinction between declarative and procedural memory. Declarative memory would then be said to reveal performance on explicit tests and procedural memory on implicit tests. Yet the criticism by Roediger et al. (1989) then is simply given more force. That is, the memory systems approach has the potential of becoming too complex, requiring the need of yet further distinctions between and within systems, in the face of more and more empirically derived functional dissociations.

Indeed, this type of reasoning can be seen in systems theories (Schacter, 1990, 1992; Tulving & Schacter, 1990). For instance, it has been suggested that priming effects on perceptual implicit tests reflect experiential modifications to a cortically based, presemantic perceptual representation system. This in turn is composed of several domain-specific subsystems (Schacter et al., 1993). These subsystems have apparently been implicated in visual word priming, visual object priming, and auditory word priming. Yet, as Schacter et al., (1993) admitted, this hypothesized presemantic perceptual representation system and its subsystems do not account for all priming phenomena. Thus, it might be, as Schacter states, necessary "to subdivide visual and auditory word form systems further into abstract and form-specific subsystems that are associated with the left and right hemispheres" (p. 174). This type of argument, according to Roediger et al. (1993), raises the number of plausible systems to at least 25. Although it is clear that much of the evidence can be interpreted within a distinct memory systems framework, it should also be remembered that "with enough memory systems, any pattern of performance appearing in data of normal or brain-damaged participants can be explained" (Roediger et al., 1993, p. 119). It is interesting to speculate that Kolers and Roediger (1984) may have anticipated this type of regression within the systems approach. They stated that a more parsimonious explanation of dissociations is that "dissociation phenomena be viewed as still another instance of the specificity of learning and transfer" and that what needs to be explained are not the dissociations but "the characteristics of tasks - and relations among their underlying procedures - that needs explaining" (p. 439). The processing approach currently advocated by Roediger and colleagues is probably the more favored explanatory framework, at least among cognitive researchers.

Transfer-Appropriate Processing

The processing approach, also known as transfer-appropriate processing (TAP), stems from various ideas already expressed in Tulving's (1983) encoding-specificity principle, the procedural view of Kolers (1973), and Morris, Bransford, and Franks (1977), and Jacoby's (1983) distinction between data-driven and conceptually driven processing. The processing view highlights the specificity of operations during perceptual priming. It is believed that memory tests benefit to the extent that the operations required at test recapitulate or overlap the encoding operations performed during prior learning (Roediger & Blaxton, 1987; Roediger & Srinivas, 1993). On the basis of the nature of processing requirements of memory tasks, processes underlying memory performance have been grouped into two broad classes: perceptual and conceptual (Roediger et al., 1989).

Performance is considered to result from perceptual processes to the extent that it is dependent on the perceptual relations between study and test stimuli. Thus, perceptual priming is reduced when study and test stimuli appear in different modalities (e.g., auditory-visual) rather than in the same modality (visual-visual). Furthermore, perceptual priming is only marginally affected by conceptual analysis of study-phase items. By these criteria, priming is largely perceptual on tasks such as perceptual identification, word stem completion, word fragment completion, and lexical decision (Blaxton, 1989; Jacoby & Dallas, 1981; Roediger & Blaxton, 1987). In contrast, performance is considered to result from conceptual processes to the extent that it is dependent on the analysis of stimulus meaning or content. Thus, conceptual priming is enhanced by conceptual analysis of study-phase items, such as semantic versus nonsemantic processing or generating versus reading words. Conceptual priming is also unaffected by changes in perceptual relations between study and test stimuli, and by these criteria, priming is largely conceptual on tasks such as category-exemplar generation, word association, and general knowledge (Blaxton, 1989; Srinivas & Roediger, 1990).

A transfer-appropriate processing account of functional dissociations assumes the following: a) explicit and implicit memory tests typically require different retrieval operations (or access different forms of information), and consequently will benefit from different types of processing during learning; b) most explicit memory tests rely heavily on the encoded meaning of concepts, or on semantic processing, elaborative encoding, or mental imagery, and therefore requires conceptually driven processing; and c) most standard implicit memory tests rely heavily on the match between perceptual processing during the learning and test episodes and are therefore dependent on data-driven processing (Roediger & Blaxton, 1987; Roediger & Srinivas, 1993; Roediger et al., 1989). Central to Roediger's view is the notion that there is no necessary correlation between the implicit or explicit nature of a memory task and the requirement for data-driven or conceptually driven processing. Instead, these processing dimensions are thought to be orthogonal to the implicit-explicit memory distinction emphasized by systems theories (Roediger, 1990). Thus, it is also logically possible to develop explicit tests that are largely data-driven and implicit tests that are largely conceptually driven (Blaxton, 1989; Weldon & Roediger, 1987). Blaxton (1989) has also proposed that Jacoby's (1983) generate-read encoding manipulation can be used to operationally define a test as data-driven when reading the target produces better priming or retrieval than generating it from a conceptual cue, and a test as conceptually driven when generating the target from a conceptual cue produces better priming or retrieval than simply reading it. Based on this operational definition, all of the explicit and implicit tasks I have discussed can be classified according to their data-driven or conceptually driven components (Roediger et al., 1989). A free recall test would be considered the prototypical case of conceptually driven processing (Hunt & Toth, 1990) because no "data" are provided at the time of recall, and consequently, retrieval processes cannot be data-driven. Perceptual identification is taken as the paradigm case of a task involving data-driven processing because the subject is required to read a word, albeit in degraded form, not judge its prior occurrence (Hunt & Toth, 1990). Thus, performance on a free recall test would not be expected to be affected by manipulations of surface features, but should be influenced by encoding variables that cause elaboration of processing. Similarly, perceptual identification should not be influenced by elaborative factors, but should be affected by manipulations of surface variables.

Regardless of one's position in the debate between memory systems versus transfer-appropriate processing, it is clear that the distinction between perceptual priming and conceptual priming is an important one (Blaxton, 1989; Tulving & Schacter, 1990).

It is also clear that implicit memory phenomena are diverse and no single theory or distinction between types of processing or independent memory systems can account for all of the data. This is true, even though all the data in the foregoing review have referred to research on repetition priming at the word level. That is, the paradigmatic implicit memory experiment is usually a situation in which a list of unrelated items is studied and then later tested in isolation on a particular implicit memory measure. We have seen that there are many variables that can influence a person's performance on one of these tests. As such, our view of implicit memory has become more episodic because many variables, once believed to be unimportant, have become common experimental manipulations (Lewandowsky, Kirsner, & Bainbridge, 1989). It is surprising then that the effects of context have received so little attention, especially since context may be one of the most episodic of all variables. The role of context in implicit memory is of considerable theoretical interest for many reasons. For instance, a principal concern of many researchers studying implicit memory is explicit contamination of the study stimuli during an implicit memory test. Adding context to test stimuli at study would seem a natural way of reducing the chance that a subject may make the connection between the study and test episodes (Madigan, McDowd, & Murphy, 1991). Indeed, it is likely that embedding target words in a larger context would have the effect of reducing or eliminating the centrality of that word at study. Therefore, if those words are tested alone on word-stem completion, for example, repetition of that word would seem to indicate an even greater degree of memory without awareness than if that word had been studied alone.

The well-established effects of levels-of-processing on implicit memory might also be affected by contextual manipulations. The common finding that levels of processing manipulations do not affect performance on implicit tests refers to manipulations of items presented in isolation. There is no effect on implicit tests because of the data-driven nature of these tests, and only conceptual processes are assumed to be altered by levels-of-processing manipulations. Yet, if context is added to a study item, that would presumably alter the processing involved of that item, and LOP manipulations would be expected to affect implicit memory performance.

Text-Level Priming

Context effects, as they have come to be known, refer to the general finding that reading an isolated word aloud without context produces more priming than reading a word with context (e.g., Blaxton, 1989; Jacoby, 1983). Jacoby (1983) argued that if a target item was generated from a cue word or paired with a cue word at study, the original encoding of that stimulus was conceptual. Thus the word would not be expected to transfer to a perceptual identification test since this test relies heavily on the data-driven processing of stimuli. This type of interpretation of context effects, however, has more recently been challenged (Levy & Kirsner, 1989; Masson & MacLeod, 1992), and provide the basis of the present study.

Context, as it will be used here, will refer only to manipulations of local, verbal context in which target items are embedded as opposed to global or environmental. For present purposes, I will restrict the following review to studies that have measured repetition priming on an implicit, perceptual memory test for words that were embedded during study in a larger text, be it a sentence, phrase, short passage, or set of instructions. Although the available data on text-based priming and the role of context in implicit memory is relatively sparse, a look at the extant literature on the role of context immediately leads to a number of questions because of the inconsistent results that have been reported. Although some studies have shown successful incidental text priming effects, others have not. We will look at these in turn and then focus on some of the possible reasons for the inconsistency.

Positive Effects

Madigan et al. (1991) presented a good example of what is meant here by text-level or text-based priming. Their participants read two sets of instructions that described a word fragment completion task. Half of the words on the test were embedded in one set of instructions and half were control words from the other set of instructions for each group of participants. Primed fragments were correctly completed significantly more often than unprimed fragments. Participants in this study appeared to have demonstrated memory for words which appeared in the instructions without their conscious awareness of these words, even though their prior experiences with the words were of obvious benefit to them on the fragment completion test.

The role of data-driven processing in an incidental text priming procedure was demonstrated by Nicolas et al. (1994) using a word fragment completion test. Nicolas et al. showed small priming effects for words previously studied in phrase contexts. Moreover, the magnitude of priming obtained was greater if the reading situation was made perceptually difficult by filling the gaps between the words, compared to a normal reading situation. Nicolas et al. argued that this perceptual manipulation enhanced the data-driven component of the original encoding of the phrase contexts. This then facilitated positive transfer to a perceptual, indirect test of individual words from those phrases. Consistent with Jacoby's (1983) argument, this study demonstrated the role of perceptual processing for words read in a context. More importantly, contrary to Jacoby's argument, it showed that the reinstatement of study context at test was not necessary for repetition priming to occur.

Using a somewhat different paradigm, MacLeod (1989) also obtained priming for words previously read in text on a word fragment completion test. MacLeod's (Experiment 1) participants read short passages which contained target words that either fit sensibly into the context or did not. The subject's task was to cross out phrases in the text, which included the target word, that did not fit meaningfully with the rest of the text. Compared to unread words, the sensible words produced only 4% priming and the crossed-out words led to a significant 14% priming effect. As suggested by the data-driven/conceptually driven distinction, MacLeod reasoned that bringing the subject's attention to specific words in the text (crossed-out condition), made these words less bound to the passage context. The words then acquired the characteristics of words read in isolation, promoting data-driven processing. More priming was thus found for these words than target words that did fit in meaningfully with the flow of the passage (sensible condition) which effectively eliminated or reduced data-driven processing. This finding may have been due to the fact that higher frequency words occurred more often in the sensible condition and lower frequency words in the crossed-out condition. After making modifications to his word sets, MacLeod (1989, Experiment 3) once again compared sensible and crossed-out conditions in a normal text reading situation and this time found evidence of priming in both conditions. Words in text that were crossed out were correctly completed on a later fragment completion test 31% of the time, and words read in text which were not crossed out were correctly completed 25% of the time, both of which differed significantly from the baseline value of 19%. These results supported MacLeod's suggestion that there may be a priming gradient which is consistent with a transfer-appropriate processing account of priming effects. As MacLeod stated, "as words move from no context (list) to a non-meaningful context (crossed-out) to a meaningful context (sensible), the degree of conceptual processing increases, and the degree of data-driven processing decreases" (p. 404).

In further support of this text-based priming effect, Sills (1986, cited in MacLeod, 1989) tested memory for words that were embedded in the instructions that participants read and then were later included on a test of word fragment completion. Across two experiments, Sills found a significant difference at test: 38% and 35% fragments completed in the primed conditions and 24% and 25% in the unprimed conditions, respectively. It is not clear whether Sills manipulated the surface form or processing of his instructions in any way but the study does demonstrate implicit memory for words in text and supports the findings of Madigan et al. (1994).

MacLeod's (1989) third experiment presents a nice contrast to that of Nicolas et al. (1994) in that they both report the same effect through different means. That is, Nicolas et al. obtained priming for words in text by promoting the perceptual nature of the initial processing task. MacLeod, in contrast, obtained the same effect by demoting the conceptual nature of the initial processing task. Together, these studies clearly suggest the importance of the data-driven/conceptually-driven processing distinction. Also, in both experiments, reinstatement of the original encoding context was not necessary for the significant priming effect these studies demonstrated. That is, even though target words were studied as part of a larger meaning unit, they transferred as single units on an implicit test of these words presented in isolation.

Negative Effects

The studies reviewed above clearly contradict Oliphant's (1983) conclusion that reading words in passages does not produce positive transfer. Like Madigan et al. (1991)

and Sills (1986, cited in MacLeod, 1989) Oliphant embedded target words in a brief pre-experimental questionnaire and a set of instructions for each subject and later tested them on a test of lexical decision. Another group initially made a lexical decision for the target word before it was repeated again as a test word in the lexical decision task. A control group only saw the words once, during the actual lexical decision test. Compared to the average response latencies of the control group (11.1 msec), participants who encountered the word twice showed a significant difference at a 32 msec average response time. Subjects who first read the words as part of the questionnaire or instructions showed no evidence of priming, however, differing from the control group by only 1.8 msec. Monsell and Banich (cited in Monsell, 1985) confirmed Oliphant's results when they found weaker repetition priming effects in lexical decision when primes were read as part of sentences than when they were presented as stimuli in the lexical decision task.

Levy and Kirsner (1989) studied these issues using an incidental text priming procedure with several long and more detailed texts. The authors constructed five 525-word essays, each divided into 10 short paragraphs with four target words embedded in each of the paragraphs. The same target words were also included on a standard word list and two groups of participants studied either the texts or the word lists and were later tested on a perceptual identification test. Like Oliphant (1983), Levy and Kirsner's participants did not demonstrate implicit memory for words read in text but did show a benefit from having read the words as part of a word list.

Levy and Kirsner's (1989) incidental text priming procedure showed an absence of priming, in contrast to the other studies discussed above. It also demonstrated Jacoby's argument that context, or the absence of it, at test determines the fate of words studied in isolation or in context. It may also help to explain, as previously suggested, why Oliphant (1983) failed to find priming on a lexical decision task for words embedded in pre-experimental text. In a second experiment, Levy and Kirsner tried to demonstrate this argument directly. This time, two groups of participants only read the texts under different orienting tasks and were later tested with a re-reading measure. In addition, a subgroup of participants, in an auditory condition, only heard the texts. Under these conditions, Levy and Kirsner did find priming on the re-reading task with faster re-reading times for the second reading. The modality manipulation showed reading times to be faster for the same study-test conditions than when they were different (visual-auditory). Levy and Kirsner concluded that participants were indeed processing the texts at a data-driven level. They stated that "the re-reading task showed clear evidence of a role for data-driven representations in mediating transfer between tasks" (p. 412).

The second finding reported by Levy and Kirsner is important because it extends Jacoby's (1983) argument by the claim that participants do indeed engage data-driven processes while reading text. This only shows up, however, when the text is reinstated at test, as it is in a re-reading task, but which is absent on a perceptual identification task. The re-reading benefit was a consequence of being a similar sort of experience as the first reading whereas, as the argument goes, perceptual identification presented stimuli at a different linguistic level and therefore, there was no benefit of the prior reading of the text.

Methodological Considerations

One of the more puzzling contradictions in findings is that between Madigan et al. (1991) and Oliphant (1983), both of whom embedded target words in their experimental instructions. Only Madigan et al. was able to show priming for words previously encountered in text. One possible reason that the outcomes of these two studies differed is that the retention interval between exposure and test of the words in the Madigan et al. (1991) study was much shorter than in Oliphant's (1983) experiment (Roediger & McDermott, 1993). Also, the two studies tested priming using different measures. Whereas Oliphant used lexical decision, Madigan et al. used word fragment completion. Alternatively, Oliphant's failure to obtain priming could be interpreted in the same way that Jacoby (1983) explained his negative finding: priming was not obtained on an indirect test because of the lack of perceptual processing at study. In both cases, the context of the original presentation of the word determined whether later priming was found. The series of experiments by MacLeod (1989) and the study by Nicolas, Carbonnel, and Tiberghian (1994), however, suggest that it is not just the context which is the determining factor but what is done to the context, or how it is processed, during study that determines whether or not priming will be obtained.

Text Length. Even though these experiments are clearly at odds with other studies using an incidental text priming procedure, with the exception of Oliphant (1983), Levy and Kirsner's (1989) argument (to follow) does seem to provide a valid interpretation of their data. In explaining the outcome of MacLeod's (1989) third experiment, and presumably by implication those of Madigan et al. (1991) and Nicolas et al. (1994), Levy and Kirsner (1989) stated "MacLeod's texts were very short compared with ours, and transfer was measured after reading a few short unrelated passages rather than several long and more detailed texts. The small amount of transfer he found for words originally processed in sensible sentences may disappear when longer messages are processed" (p. 414).

Certainly, Levy and Kirsner's (1989) experiments were the first to use the type of texts they described. It could indeed be that text length is an important factor where text-to-word priming is concerned. Other studies, such as Oliphant's (1983), which did use relatively short texts, but which failed to show any priming could, of course, be explained. According to Levy and Kirsner's argument, it would be the fact that Oliphant tested his participants at a linguistic unit that was smaller than it was at study. Another possibility, as suggested by MacLeod (1989) is that Levy and Kirsner chose relatively high frequency words as their primes. It has been shown that lower frequency words prime more than higher frequency words (Tulving et al., 1982). Still, the effects of word frequency are not certain because results have generally been mixed (Roediger & McDermott, 1993). In any case, this argument may not be valid as it concerns Levy and Kirsner's study because they did show priming on perceptual identification with those same words when they were originally studied as part of a word list.

Test type. Yet another possible explanation for these discrepant results lies in the different dependent measures in these studies. In each case where even small to moderate priming was reported, implicit memory for text-level words was assessed by performance on a word fragment completion test (Macleod; 1989, Experiment 3; Madigan et al., 1991; Nicolas et al., 1994; Parkin et al., 1990; Sills, cited in MacLeod, 1989). Conversely, in each case where the same variable (context) was manipulated and repetition priming was not reported, a different indirect test was used to assess the magnitude of priming: lexical decision (Monsell & Banich, cited in Monsell, 1985; Oliphant, 1983) and perceptual identification (Jacoby, 1983; Levy & Kirsner, 1989, Experiment 1; Masson & MacLeod, 1992). Together these results raise the question as to whether it is the use of word fragment completion that reveals text-level priming. Indeed, Macleod (1989) suggested that test differences might be the reason for the different pattern of results obtained from his study and those of Oliphant (1983) and Levy and Kirsner (1989). As he suggested, "perhaps fragment completion is a more sensitive index of priming in text than are lexical decision and perceptual identification" (p. 404). Other studies, reported later, appear to provide some support for this suggestion in favor of fragment completion, although little else has been reported in the literature with respect to the other indirect memory tests, making it difficult to be certain at this point just how critical, if at all, word fragment completion may be in demonstrating text-level priming.

The Present Study

Levels-of-Processing. One critical difference between Levy and Kirsner's (1989) experiments and those of MacLeod (1989) and Nicolas et al. (1994), which has not yet been mentioned but which the foregoing discussion has been leading up to, are the different LOP manipulations or orienting tasks used on the stimuli at study or at test. Recall that processing at study was manipulated by either having participants cross out inappropriate phrases within the text (MacLeod, 1989) or increasing the perceptual difficulty of the reading situation (Nicolas et al., 1994). It was argued that, in both cases, the promotion of perceptual processing or the demotion of conceptual processing facilitated positive transfer to a perceptual, implicit test, word fragment completion. Levy and Kirsner (1989, Experiment 1) used different orienting tasks in their text condition but it may be that their surface-level orientation instructions were insufficient to promote data-driven processing in their participants of the texts. Their participants were asked to either read the texts "for gist" or read "to remember the words". It is not unreasonable to suppose that Levy and Kirsner's failure to obtain priming on perceptual identification in their first experiment was a direct result of a relatively 'weak' surface-level orienting task. One of the purposes of their second experiment was to show that their participants were indeed processing the texts at a data-driven level. The argument being made here is that their participants did not process the material at a perceptual level sufficient enough to show priming on perceptual identification. It seems likely that simply being asked to "remember the words" caused the participants to process the texts at a semantic level, ultimately giving way to a more conceptual analysis of the text, and hence, the failure to show priming on a data-driven task. This possibility formed part of the basis for the present study. That is, we propose that the mixed results of those studies reported here that used an incidental text priming procedure can be attributed to the differences in the level of the initial encoding processes. The present studies shed some light on whether this is indeed the case.

Context-Sensitivity. A second major focus of the current study, which is directly related to the first, concerns the claims that have been made about the necessity of the reinstatement of study context at test in order to show priming for words presented in context at study. Based on the work of MacLeod (1989) and Nicolas et al. (1994) and others, I have been discussing the role of context in priming in terms of its data-driven components. This has been useful as a way of offering a tentative explanation for the negative findings reported by Oliphant (1983), Jacoby (1983) and Levy and Kirsner (1989). Masson and MacLeod (1992), however, offered an alternative interpretation of these negative results that directly challenges any interpretation that relies on the data-driven/conceptually-driven processing distinction.

Part of Masson and MacLeod's argument is based on findings that reading a word in isolation produced more priming on perceptual identification than reading it in a meaningful context. These results replicate those of Jacoby (1983), Oliphant, (1983) and

Levy and Kirsner (1989). In addition, however, Masson and MacLeod reported some puzzling findings in that priming after a Read condition equaled priming after a Generate condition. In the latter condition, targets were generated from their given definition and their first letter (Experiment 1) or its antonym (Experiment 2), or its synonym/associate (Experiment 3). Contrary to the typical findings under such conditions, the Generate condition produced priming, but only when the generation cue present at study was also present at test.

Masson and MacLeod (1992) argued, along with Jacoby (1983) and Levy and Kirsner (1989), that reinstatement of context is necessary for priming to occur. However, Masson and MacLeod suggest that it is not a lack of data-driven processing at study (Jacoby) or at test (Levy and Kirsner) that is responsible for the absence of priming. Instead, they argue that a different distinction, other than the processing distinction, is needed to explain such results. In general, Masson and MacLeod argued that there are two classes of encoding processes: "those that contribute to the construction of an initial interpretation of an item, and those that elaborate on the interpretation" (1992, p. 147). In addition, the interpretive encoding processes are assumed to be context-sensitive. As evidence, they point to Oliphant's (1983) and Levy and Kirsner's (1989) failure to show text-to-word priming as an example of the context-sensitive nature of the initial encoding processes.

Masson and MacLeod (1992) suggested that they failed to obtain priming among generated items (in Experiments 8A, 8B, and 9) because of the difference between the original encoding context and the test context. They stated that "by testing a generated item in isolation, the interpretive encoding operations applied during study would not be redintegrated and little or no priming would be found" (p. 147). They argued that "words read in isolation during study, however, would be appropriately encoded for testing in isolation and would show priming." These are not new ideas, however, already expressed in similar forms by Jacoby (1983) and Levy and Kirsner (1989). What is new about Masson and MacLeod's argument is that the data-driven/conceptually-driven distinction does not play a role in the effects of context. With its de-emphasis on the processing distinction, however, the argument loses the capacity to account for reports of successful incidental text priming that we have discussed, and which form the basis for the argument that the processing distinction is in fact the crucial distinction for understanding such effects. The present study addressed both the idea of reinstatement of context, and also the merit of Masson and MacLeod's (1992) argument that the processing distinction is an inadequate one.

With this in mind, then, one question that was asked here is whether or not it is necessary to reinstate study context at test if the data-driven nature of the text processing at study is augmented by an appropriate orienting task. The more general question involves the conditions under which text-based priming of individual words can be produced on a data-driven, perceptual test of implicit memory. It is evident from the foregoing discussion that numerous variables may play a critical role in incidental text priming, and so only a few of these variables, already mentioned, were investigated.

In setting out to do this, we instructed participants in this study to read texts under one of two conditions: In one condition they were asked to read for comprehension of the content and in another they were instructed to read the texts and detect spelling errors they encountered within the texts. It was believed that this latter proofreading condition would promote data-driven processing and subsequently facilitate transfer to a word fragment completion test of words taken from the texts. If it was perceptual processing that aided in the implicit memory performance of participants in MacLeod's (1989) and Nicolas' et al. (1994) experiments, then this should be shown by a proofreading task as well. This is because this type of orienting task should cause participants to focus more on the processing of individual words. Conversely, if Levy and Kirsner's (1989) failure to obtain priming for words in text was the result of a greater degree of conceptual processing that canceled out any data-driven representations, then this absence of a priming effect should replicate in the normal reading condition. It is not being argued here that the data-driven component will be absent, but rather it is expected to be more superficial and automatic, giving way to a conceptual analysis of the texts. Thus, positive transfer to a word fragment completion test would not be expected under these conditions.

This study contained some important improvements over past research. This experiment incorporated elements of both MacLeod's (1989) experiments and Nicolas et al. (1994). Two conditions were used: Either perceptual processing or conceptual processing were emphasized. Also, the current experiment contained an important aspect of Levy and Kirsner's (1989) experiments in that it incorporated their textual materials. Their texts not only provided a ready set of materials, but more importantly, it was an opportunity to use texts that have been tested in an incidental text priming procedure where priming was not obtained. Additionally, using these texts permitted a test of Levy and Kirsner's claim concerning text length and their arguments that longer and more detailed texts would inhibit repetition priming.

The dependent measure used in this study was word fragment completion. This test was chosen for two reasons. First, the extant data on the role of context in implicit memory suggests that this test produces reliable, albeit sometimes small, priming effects.

Second, recent suggestions have been made concerning the status of word fragment completion. For example, Hirshman, Snodgrass, Mindes, and Feenan (1990) have proposed that fragment completion is best considered a conceptual implicit memory test, rather than a perceptual indirect test, as is commonly supposed. This experiment provided a way to test this notion as well. For one thing, if word fragment completion is a conceptually driven test, then participants in the Read condition should show evidence of priming, whereas participants in the Proofread condition would not be expected to show priming. It was expected, however, that fragment completion would maintain its status as largely a perceptually-driven task.

Finally, another advantage of this study was the inclusion of a questionnaire designed to assess the extent, if any, of the awareness on the part of the participants of the relationship between the texts and the fragment completion test. A primary concern of researchers studying implicit memory has always been explicit contamination on an ostensibly implicit memory test. Bowers and Schacter (1990) have successfully used postexperimental questionnaires to determine if an implicit test is contaminated by intentional retrieval strategies. They asked participants if they were aware of a study-test relationship and found equivalent priming for both aware and unaware participants. An incidental text priming procedure such as this one may be less susceptible to this problem because of the length of the study material and the use of two distractor tasks before the test. As Toth, Jacoby, and Reingold (1994) have shown, the likelihood of explicit contamination decreases with increased study-test delay and with increasing list length. Nonetheless, the addition of an awareness questionnaire made this the first study investigating text-level priming to at least attempt an assessment of its occurrence. Additionally, participants were given a second fragment completion task, following the questionnaire, once they had learned that the implicit fragment test contained words from the essays they had studied. Thus, this test was an explicit or cued fragment completion test in that participants were told to think back to the essays to assist them in completing the word fragments. The purpose of this additional task was principally exploratory and so analysis and discussion of the results focused primarily on implicit memory performance.

Experiment 1

Method

Participants. The participants were 38 Introductory Psychology students at the University of Manitoba. Participants received credit towards a class requirement.

Materials and Design. Four out of the five essays used by Levy and Kirsner (1989) were borrowed for this study. The four texts were selected as being the most closely related to one another in terms of their subject matter. The fifth text in Levy and Kirsner's experiments was used as a control and was not used in this experiment. As described by Levy and Kirsner each text "contained 50 propositions (defined as simple sentences) divided into 10 short paragraphs. The text structure of each passage consisted of the introduction of a problem, followed by a discussion of the problem's cause, its effects, possible solutions, and some conclusions" (p. 409). The texts required some modification in that some target words were four- or five-letter words that were not amenable to word fragment pattern construction. These words were replaced with other words from the same paragraph or synonyms if a non-repeated word could not be found. Otherwise, the texts remained virtually unaltered. Each of the four two-page texts were divided into two sets of one-page texts, one of all the first pages of the original texts (Set A), and the second of all the last pages of each of the texts (Set B). It was determined that this did not disrupt the cohesiveness of the essays. The construction of two text sets was done to reduce the number of targets words coming from the same essay, thereby limiting any semantic relatedness among the primes on the word fragment completion test.

Each text consisted of five paragraphs (approximately 260 words), with four targets embedded in each paragraph, totaling 80 target words for each set of texts. The 80 targets for one set of texts were used as control fragments for the other set of texts. From each pool of 80 targets, 40 targets (ten per text, two per paragraph) were assigned to either the implicit fragment completion test or the explicit test. For the proofread condition, half of the targets were misspelled and were counterbalanced across the two sets of texts and the two tests. Misspellings were created by replacing, omitting, or adding a single letter to or from a word. There were, in all, eight different forms in the proofread condition and four in the read group.

The majority of word fragments were constructed from the same targets originally chosen by Levy and Kirsner (1989). The word fragments were created by replacing between 40-60% of the letters within a target word with blanks. All were constructed to have only one possible completion, although a few turned out to have two or three possible completions. For each test condition, the 80 word fragments were presented on two pages, 40 per page, in two columns of 20. The word fragments were presented in the same Courier font as the texts. All other materials included in the booklet were typed using a different font. Booklets were constructed and corresponded to the different versions for each of the subgroups. The booklets were identical except for the different instructions at the beginning of each booklet for the between-participants variable of orienting task (read versus proofread) and the within-subject counterbalancing of text set, read versus not read words on the two tests, and the spelling errors within the texts.

Procedure. Participants arrived for the experimental session in groups of 4-6. Orienting task was assigned to the groups on an alternating basis. The experimenter read the instructions aloud as the participants read them, and depending on their condition, the participants were told that they were participating in a study of either reading comprehension or reading and error detection. Participants, in both cases, were instructed that they would be timed and that they would be told when to stop reading or stop a task and when to turn to the next page of the booklet throughout the experiment. Each essay was to be read through only once, after which participants were to wait for further instructions. After reading all four texts, the participants received the first distractor task in which they were to write down as many Canadian cities as possible in a two-minute period. After this, in a second distractor task, participants were asked to write down as many words as they could think of using the letters within the word "APPOINT," again for two minutes.

Immediately following the two distractor tasks, the participants were given the word-fragment completion test instructions, and were told to complete as many of the word fragments as they could, in any order they liked, with the first word that came to mind. No mention was made of the relation between the texts and the completion task, so that it seemed like just another task after the two previous tasks. Participants were allowed one minute to try five practice items to acquaint them with the task. After any final questions were answered, the experimenter told the participants to turn to the first page of word fragments and began timing. All participants were given eight minutes per page of word fragments. The experimenter gave each group of participants regular time signals at five, three, and one minute.

After the first test, participants completed a brief questionnaire (see Appendix) to assess their awareness, if any, of the critical task and the study phase. Participants required, on average, two to three minutes to complete the questionnaire, after which instructions were given for a second word fragment completion task. These instructions were explicit in the sense that the participants were told to try to think back to the essays, or more specifically the words of the essays, to aid them in completing the word fragments. Again, they were given eight minutes to complete each of the two pages of word fragments after which they were told that the experiment was over and were debriefed. Participants were also asked not to discuss the experiment with their classmates until the study was complete. The entire session for each group of participants lasted approximately one hour.

Results and Discussion

Results are reported separately for the implicit and explicit measures although the principal focus is the implicit test. Table 1 presents the mean percentages of fragments correctly completed as a function of test type and orienting task. The principal analysis was a 2 x 2 factorial analysis of variance. The between-participants factor was orienting task (read versus proofread) and the within-participants factor was word status (primed versus unprimed items). The main effect of word status was significant, indicating that there was an overall priming effect with more primed (M = 33.1%) than unprimed items (M = 28.0%) correctly completed, $F(1, 36) = 15.27$, $MSE = 31.93$, $p < .001$.

Table 1. Mean Percentages of Fragments Correctly Completed as a Function of Orienting Task and Test Type (Experiment 1)

	Implicit		Explicit	
Orienting Task	Proofread	Read	Proofread	Read
Nontarget	29	26	29	29
Target	37	28	42	32
Priming	+8	+2	+13	+3

The main effect of word status was qualified by a significant interaction between word status and orienting task, $\underline{F}(1, 36) = 6.18$, $\underline{MSE} = 31.93$, $\underline{p} < .02$. This indicates that the overall magnitude of priming obtained in the proof group ($\underline{M}$ = 8.3%) was significantly greater than that for the read group ($\underline{M}$ = 1.8%). (See Tables 2 and 3). An analysis of simple effects showed a significant priming effect in the proof group only, $\underline{F}(1, 36) = 20.45$, $\underline{MSE} = 31.93$, $\underline{p} < .001$ (see Figure 1).

The effects of misspelling one half of the target words on priming in the proofread group was calculated by summing the total percentage of correctly completed fragments both for primes that were spelled correctly during study ($\underline{M}$ = 40.0%) and for primes that were spelled incorrectly during study ($\underline{M}$ =35.0%) and were compared to the average baseline completion rate of 29.0%. A one-way within-participants anova was performed on these data with three levels of the independent variable, word status: control or baseline fragments, correctly spelled primes, and incorrectly spelled primes. There was a significant main effect of word status, $\underline{F}(2, 36) = 5.88$, $\underline{MSE} = 94.22$, $\underline{p} < .006$. Tukey's $\underline{a}$

comparisons revealed that only the mean percentage of baseline fragments completed was significantly different from the mean percentage of correctly spelled primes

Table 2. 2 X 2 Factorial ANOVA Table for Correct Fragment Completion (Expt. 1)

Source	df	SS	MS	F	p
Between					
Orienting Task	1	594.16	594.16	2.33	0.135
Error	36	9166.45	254.62		
Within					
Word Status	1	487.58	487.58	15.27	.0001
Orienting Task*Word Status	1	197.45	197.45	6.18	.018
Error	36	1149.34	31.93		

Table 3. Correct Fragment Completion Summary Table for Simple Effects Analysis of the Orienting Task*Word Status Interaction In Experiment 1

Treatment Comparisons	df	MS	F	p
Primed versus Unprimed Words Within Proof Condition	1	652.80	20.45	.0001
Primed versus Unprimed Words Within Read Condition	1	32.24	1.01	.322
Proof versus Read Conditions Within Primed Words	1	738.32	4.93	.033
Proof versus Read Conditions Within Unprimed Words	1	53.29	.39	.536
Error Terms for treatment comparisons				
Error for testing word status within orienting task	36	31.93		
Error for testing orienting task within primed words	36	149.78		
Error for testing orienting task within unprimed words	36	136.77		

both for primes that were spelled correctly during study ($\underline{M}$ = 40.0%) and for primes that were spelled incorrectly during study ($\underline{M}$ =35.0%) and were compared to the average baseline completion rate of 29.0%. A one-way within-participants anova was performed on these data with three levels of the independent variable, word status: control or baseline fragments, correctly spelled primes, and incorrectly spelled primes. There was a significant main effect of word status, $\underline{F}(2, 36) = 5.88$, $\underline{MSE} = 94.22$, $\underline{p} < .006$. Tukey's $\underline{a}$ comparisons revealed that only the mean percentage of baseline fragments completed was significantly different from the mean percentage of correctly spelled primes completed, $\underline{p} < .01$. When compared to baseline (29%) the correctly spelled primes contributed to 11% of the overall amount of priming in the proofread group, whereas the incorrectly spelled primes led to only 6% priming, although that 5% difference was not significant (see also Figure 2). This indicates that the priming effect obtained in the proofread group did not depend on the words being presented as spelling errors in the texts, the words that participants actually circled. Indeed, the priming effect was stronger for words that were not originally presented as errors. This is true even though participants in the proofread condition detected most of the spelling errors embedded in the text, indicating that they did read the texts carefully. The mean error detection rate was 35 spelling errors correctly identified out of 40, or 88%. Thus, participants in this study were good at detecting errors in the text, and although the proofreading task proved to be beneficial for facilitating transfer to word fragment completion, it appears that it may have also had an adverse effect by inhibiting positive transfer of misspelled primes.

Figure 1. Mean percentage of correctly completed word fragments as a function of orienting task in Experiment 1.

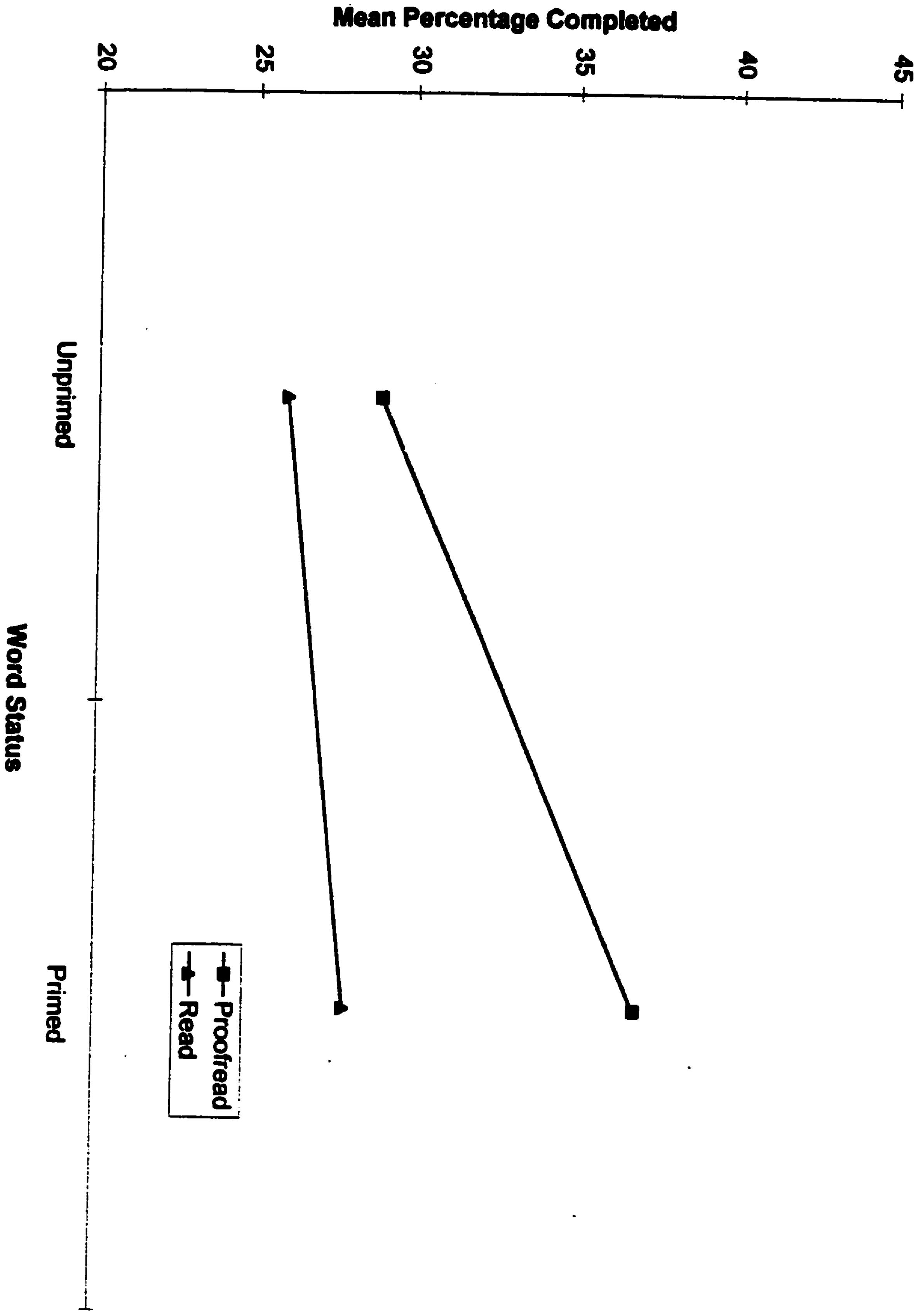
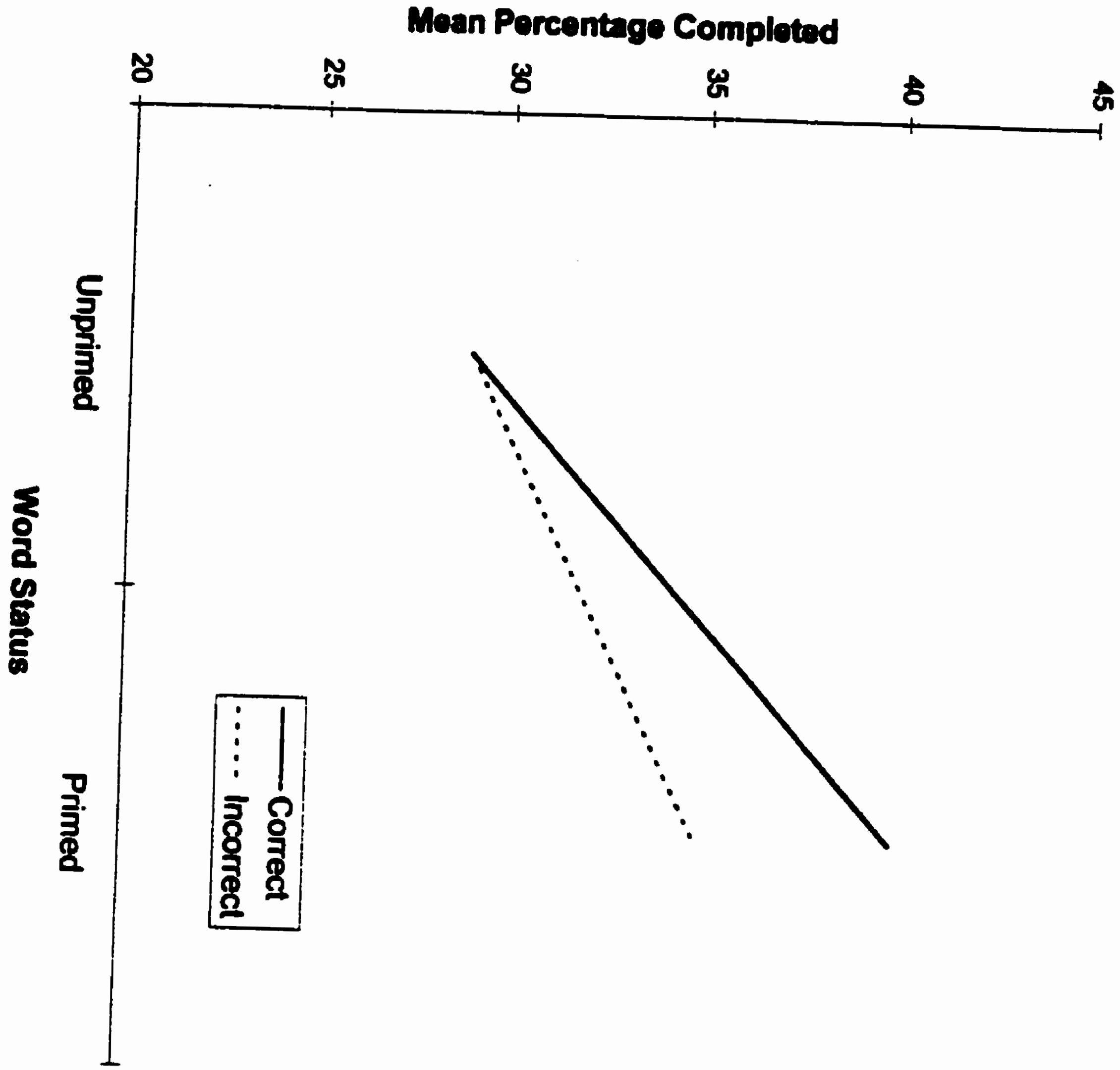

Mean Percentage Completed
20
25
30
35
40
45
Word Status
Unprimed
Primed
Proofread
Read

Figure 2. Mean percentage of correctly completed word fragments as a function of typographical presentation at study in Experiment 1.


Mean Percentage Completed
20
25
30
35
40
45
Unprimed
Primed
Word Status
Correct
Incorrect

It would seem then that the overall magnitude of priming obtained in this experiment was underestimated as a result of typographically misrepresenting one half the target words at study.

This manipulation appears to have also had another unwanted effect in that two out of the 11 participants who indicated awareness of the study-test relationship on the questionnaire cited noticing a misspelled word from the texts on the fragment completion test as the reason for their awareness. A second analysis was performed with the aware participants' data removed (five in the proof group, six in the read group) to see whether the effects were maintained when the aware participants were eliminated. The overall pattern of results did not change. The main effect of word status and the interaction between word status and orienting task remained significant, $F(1, 25) = 9.76$, $MSE = 38.53$, $p < .005$ and $F(1, 25) = 4.09$, $MSE = 38.53$, $p < .054$, respectively. The simple effects analysis also showed significance: $F(1, 25) = 13.35$, $MSE = 38.53$, $p < .001$ in the proofread condition only. The fact that the overall difference in priming between or within the two groups did not change after removing the aware participants' data is not surprising. After separating their participants into "test-aware" and "test-unaware" participants, Bowers and Schacter (1990) found that this did not produce major changes in the pattern of results they obtained.

Finally, explicit test performance showed a similar pattern of results as the implicit test. There was a significant main effect of word status, $F(1, 36) = 40.63$, $MSE = 27.24$, $p < .001$, and a significant Word Status x Orienting Task interaction, $F(1, 36) = 18.37$, $MSE = 27.24$, $p < .001$. Although these findings could suggest that having knowledge of the texts on the word fragment completion test improved subjects' performance over the implicit test (see Table 1), the two measures are not directly comparable, and as such, these results should be interpreted with caution since the tests were a within-participants variable with the explicit test always following the implicit test.

Overall, the main results were in the predicted direction. Most important was the finding that words originally presented in context transferred to a data-driven, implicit test in isolation. This lends further support to previous research that showed repetition priming for words studied in context on a word fragment completion test. The prediction that incidental text priming would be enhanced by data-driven processing was also borne out by the results, because the task orientation in this experiment had a strong effect on the magnitude of priming obtained. Only participants who proofread the texts showed repetition priming at test because their data-driven representations of the texts were augmented at study. This experiment not only confirms the results found by MacLeod (1989, Experiment 3) and Nicolas et al. (1994), but appears to extend them as well by showing priming for words embedded in texts even larger than those used in their studies. Thus, contrary to Levy and Kirsner's (1989) argument, longer texts did not inhibit priming when words taken from those texts were tested alone. It seems that the incidental text priming effect can be obtained even when words are read as part of relatively long, detailed, and more meaningful text. Moreover, the texts did not need to be reinstated at test, as in a re-reading task, in order to mediate transfer from study to test.

Another prediction of the current study was that words would not transfer to a perceptual test when processed under the read condition. The absence of priming in this condition replicates Levy and Kirsner's (1989, Experiment 1) failure to obtain priming under similar conditions on a perceptual identification test. This suggests that their outcome might have been different if their texts had been processed at a stronger perceptual level. One implication of this replication is that test differences may not be accountable for the discordant results between their experiment and MacLeod's (1989) third experiment. Both perceptual identification and word fragment completion are considered perceptual, indirect tests of memory. Furthermore, fragment completion has now been shown to act similarly to perceptual identification under study conditions that promote conceptual processing. Therefore some other variable must be operating to cause that same pattern of performance. This experiment suggests that the way participants are oriented to the study material determines their performance on these tests. It follows that manipulating levels-of-processing of text can dissociate implicit memory performance on the same perceptual, indirect test of memory.

An interesting finding of this experiment was the effect of the spelling manipulation, that mirrored the study reported by MacLeod (1989, Experiment 3). MacLeod's participants were tested for words they had read as part of an inappropriate phrase within a passage which they crossed out (crossed-out condition) or words that did fit meaningfully within the text (the sensible condition). Priming was found in both conditions but was greater for words that were crossed out. In the present experiment, participants were tested for words which were either misspelled or not, and showed less priming for words they identified (by circling them in the text) than they did for words that were not misspelled. These were words which were presumably processed in the same way that participants processed words in MacLeod's sensible condition. This finding highlights the sensitivity of the perceptual overlap between the presentation of a stimulus at study and at test (Roediger & Srinivas, 1993). In other words, this experiment seems to show that lexical access to the perceptual record of a primed item at test seems to be attenuated if that item is typographically misrepresented at study.

In conclusion, this experiment was designed to show that words can be assimilated into larger meaning units and still act as single transfer units given that the original encoding processes involve an adequate level of perceptual processing. That this study was successful in providing some evidence for this argument suggests that, contrary to claims made by Levy and Kirsner (1989) and Masson and MacLeod (1992), incidental text priming can occur without the reinstatement of study context at test. The study and test conditions of this experiment were not at all a similar experience for the participants and yet they still benefited from the prior experience of reading the essays on an implicit word fragment completion task. The results of Experiment 1 seem to demonstrate not only the importance of the data-driven versus conceptually-driven distinction but also call into question the idea that the initial encoding operations at study are context-sensitive at test. Experiment 2, however, was designed to address this specific question more carefully.

Experiment 2

A critical question that came out of Experiment 1 was whether participants in the proofread group actually integrated the study material at the text- or message-level. It is not certain that participants actually processed the study material as text. Although the purpose of the proofreading task was to promote data-driven processing, it was not the concomitant goal to reduce or eliminate conceptual processing. If such was the case, it would be difficult to make the argument that participants were not merely studying the texts as they would study a list of words. Thus it might work directly against the argument that anything resembling incidental text priming was actually being observed. At the same time, however, and regardless of orienting task, the original encoding conditions for all participants were text-based (or processed at the message-level). If shallow processing of text (proofreading) simultaneously enhances perceptual priming and reduces conceptual processing then this would suggest a trade-off between the two types of processing. If nothing else, it was expected that the effects observed in that experiment would be shown to be reliable and consistent ones in Experiment 2. Given the new procedure used in Experiment 1, it is important that the findings are shown to be replicable, especially concerning the role of proofreading text on a word fragment completion task consisting of words selected from those test.

Another problem that occurred during the first experiment was that study times were not controlled and so the two groups were not equal with respect to the amount of time each spent on the study task. Participants in the proofread group required on average 14 min (or 3.5 mins per essay) to complete the study task, whereas participants in the read group took an average of 10 (or 2.5 min per essay) to complete the task. Granting that proofreading an essay may require more time than simply reading an essay, it is possible that participants in the proofread group outperformed those in the read group simply as a result of the greater amount of time they spent on the essays during the study task. An obvious remedy for Experiment 2 was to equate the two groups with respect to study time so that neither group had an advantage. Further, in order to acquaint all the participants with the timed task, they were provided with a practice essay to read/proofread before the actual study task.

An important goal of Experiment 2 was to determine whether participants in a proofreading task would also have memory for the semantic content of the texts. There may be a number of ways to do this. For example, a method used by Levy, Masson, and Zoubek (1991) was to obtain written summaries of the texts from their participants in a study of text-rereading. For our purposes, this seemed to be a reasonable method for comparing the degree of message meaning extracted from the texts by participants under the two different orienting tasks. It was expected that this additional task would show a reliable similarity between the groups in their recall of the texts, and thus further validate the interpretation of the findings from Experiment 1.

Method

Participants. Participants consisted of 104 volunteers from Introductory Psychology classes at the University of Winnipeg. Each participant received one credit towards their course grade for experimental sessions that lasted approximately 60 minutes.

Materials and Design. All of the materials used in Experiment 1 were used again for this experiment, with some minor changes and additions. The fifth text from Levy and Kirsner (1989), not used in Experiment 1, was used here as the practice essay. The original two-page essay was modified to be made similar in structure and length to the study essays used in this experiment. The same version was constructed for the two orienting tasks except that the text for the proofread condition contained spelling errors. Except for the practice essay, the same counterbalancing measures taken in the first experiment were repeated here for text sets and target words, so that each word served as both control words and primes. The 80 word fragments that made up the implicit test in Experiment 1 and the 80 word fragments that made up the explicit test were combined into one implicit test for this experiment. The design was a 2x2 factorial with the between-participants variable of orientation task (read versus proofread) and the within-participants variable of word status (primed versus unprimed items).

Procedure. The procedure for Experiment 1 was used again with a few important changes. As before, the conditions for all participants were identical except for the orienting instructions to the texts. For the practice essay, participants were told that they had two minutes to complete the task. At the end of that time, participants were told to "slow down" if they finished too early or "speed up" if they took too long. The actual study task was timed similarly, that is, two minutes per essay with warning signals after 30 seconds. Following study, the same two distractor tasks as before were presented, followed by the critical implicit fragment completion test, allowing eight minutes per page of fragments. The summarizing task was given to participants immediately after completion of the fragment completion task, with the instruction to recall as many as the main ideas of each the four texts as possible. As with the fragment completion task, participants were not aware of the summarizing task before it followed in the test booklet. Four blank pages were provided at the end of each booklet for each of the summaries and participants were timed by allowing four minutes to complete each of them. Timing participants on the summaries, it was believed, should have prevented some of them from either trying to complete the task too quickly or from taking too long a time. Following completion of the summaries, participants were informed that the experiment was complete and were debriefed. The average duration of each experimental session was approximately 60 minutes.

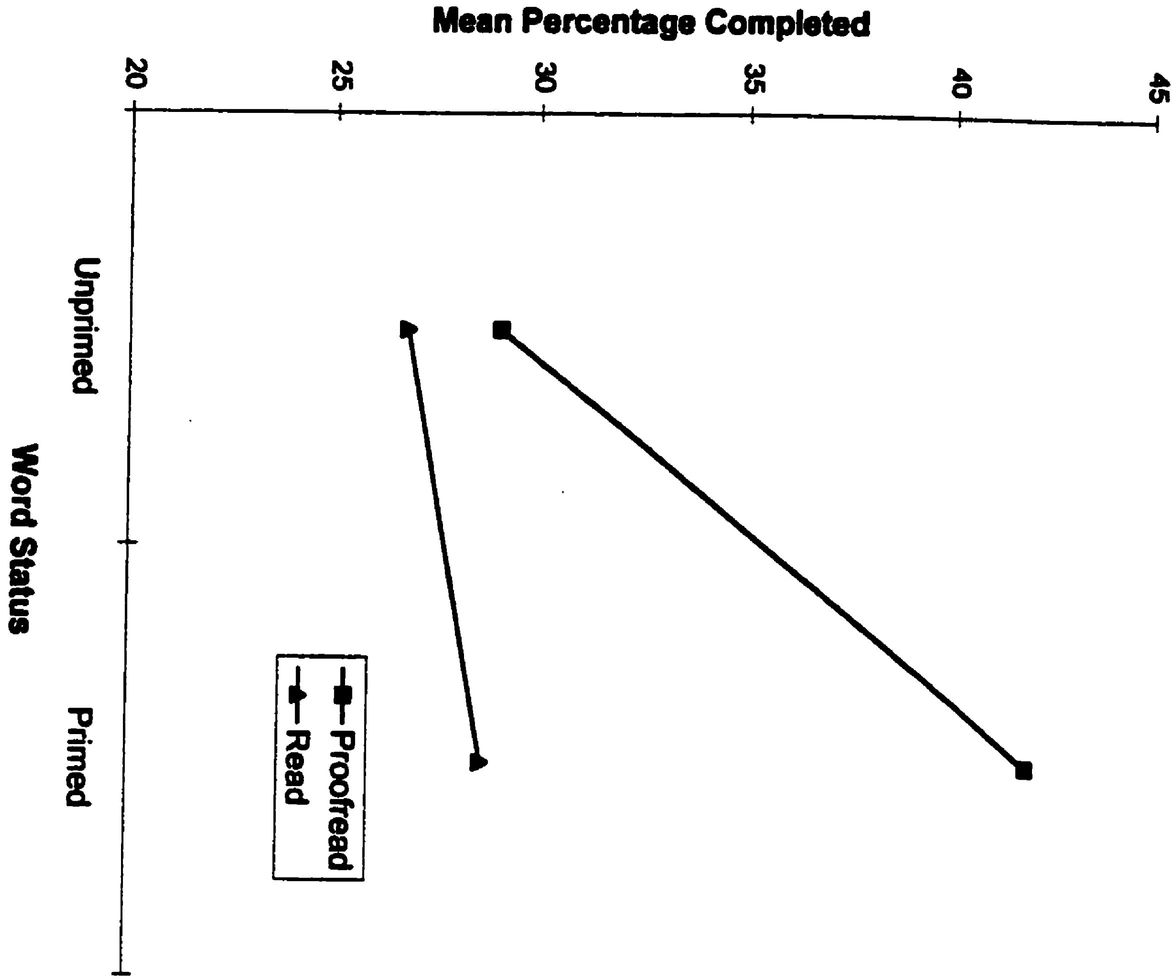
Table 4. Mean Percentages of Fragments Correctly Completed as a Function of Orienting Task (Experiment 2)

	Orienting Task		
Word Status	Proofread (All targets)	Proofread (Correct spelling)	Read
Nontarget	29	29	27
Target	37	42	29
Priming	+8	+13	+2

Results and Discussion

Table 4 presents the mean percentages of fragments correctly completed as a function of test type and orienting task. As in Experiment 1, the principal analysis was a 2 x 2 factorial analysis of variance with the between-participants variable being orienting task (proofread versus read) and the within-participants variable being word status (primed versus unprimed items). Again, the analysis was conducted on proportions of correctly completed word fragments in each of the two conditions. There was a significant main effect of orienting task, $F(1, 102) = 5.83$, $MSE = 45.01$, $p = .018$; a significant main effect of whether a word had been primed or unprimed, $F(1, 102) = 25.64$, $MSE = 45.01$, $p < .001$; and a significant interaction, $F(1, 102) = 8.98$, $MSE = 45.01$, $p < .003$ (see Tables 5 and 6). These results replicate what was found in Experiment 1.

Figure 3. Mean Percentage of correctly completed word fragments as a function of orienting task in Experiment 2.


Mean Percentage Completed
20
25
30
35
40
45
Unprimed
Primed
Word Status
Proofread
Read

Again, however, a one-way within-participants ANOVA was performed on the results of the spelling manipulation with three levels of the independent variable, word status: baseline fragments, correctly spelled primes, and incorrectly spelled primes. As in Experiment 1, it was found that for the proofreading orienting task, there was a significant main effect of whether a target word had been spelled correctly or misspelled, $F(2, 102) = 24.21$, $MSE = 88.39$, $p < .0001$. The completion rate for misspelled targets (32%) did not differ significantly from baseline (28%), whereas the completion rate for correctly spelled targets (42%) showed a significant difference. It was decided that in order to reach a more accurate estimate of priming in the proofread condition, the principal analysis should be conducted excluding misspelled primes. Naturally, based on this re-analysis of the data, the F values reported above increased (see Tables 7 and 8). In terms of overall priming (see Table 4), primed items (35%) were completed about 7% more often than were unprimed items (28%). With respect to orienting task, the completion rate of primed items for the proofreading condition was 42% and for unprimed items 29%. The respective completion rates for the read condition were 29% and 27%. An analysis of simple effects showed there to be a significant priming effect in the proofread condition only, $F(1, 102) = 32.49$, $MSE = 45.01$, $p < .0001$.

Table 5. 2 X 2 Factorial ANOVA Table for Correct Fragment Completion (Full Design) in Experiment 2

Source	df	SS	MS	F	p
Between					
Orienting Task	1	1350.48	1350.48	5.83	.018
Error	102	23632.21	231.69		
Within					
Word Status	1	1154.33	1154.33	25.64	.000
Orienting Task*Word Status	1	404.33	404.33	8.98	.003
Error	102	4591.35	45.01		

Table 6. Correct Fragment Completion Summary Table for Simple Effects Analysis of the Orienting Task*Word Status Interaction (Full Design) In Experiment 2

Treatment Comparisons	df	MS	F	p
Primed versus Unprimed Words Within Proof Condition	1	1462.50	32.45	.000
Primed versus Unprimed Words Within Read Condition	1	96.15	2.14	.147
Proof versus Read Conditions Within Primed Words	1	1616.35	11.75	.001
Proof versus Read Conditions Within Unprimed Words	1	138.46	1.00	.321
Error Terms for treatment comparisons				
Error for testing word status within orienting task	36	45.01		
Error for testing orienting task within primed words	36	137.56		
Error for testing orienting task within unprimed words	36	139.14		

Table 7. 2 X 2 Factorial ANOVA Table for Correct Fragment Completion (Partial Design) in Experiment 2

Source	df	SS	MS	F	p
Between					
Orienting Task	1	3134.89	3134.89		
Error	102	25064.36	245.73	12.76	.001
Within					
Word Status	1	2832.00	2832.00	42.61	.000
Orienting Task*Word Status	1	1548.35	1548.35	23.30	.000
Error	102	6779.03	66.46		

Table 8. Correct Fragment Completion Summary Table for Simple Effects Analysis of the Orienting Task*Word Status Interaction (Partial Design) In Experiment 2

Treatment Comparisons	df	MS	F	p
Primed versus Unprimed Words Within Proof Condition	1	4284.19	64.16	.000
Primed versus Unprimed Words Within Read Condition	1	96.15	1.45	.232
Proof versus Read Conditions Within Primed Words	1	4544.77	26.26	.000
Proof versus Read Conditions Within Unprimed Words	1	138.46	1.00	.321
Error Terms for treatment comparisons				
Error for testing word status within orienting task	36	66.46		
Error for testing orienting task within primed words	36	173.05		
Error for testing orienting task within unprimed words	36	139.14		

Thus, in Experiment 2 we find an identical pattern of results to what was reported in Experiment 1. The effect of misspelling one half the primes at study was also repeated in this experiment. The priming effect of 8% was boosted to 13% in the proofread group when completed targets originally misspelled were eliminated from analysis. This was true even though the mean error detection rate for participants in the proofreading task was 34 out of 40 or 85%. Also, as in Experiment 1, some participants in both the proofread and read conditions indicated awareness of the study-test relation in the post-experimental questionnaire. But again, a separate analysis with these subjects' data removed (11 in the proofread group and 13 in the read group) failed to show any changes in the overall pattern of results.

Summaries. Participants provided a written summary for each of the four texts they had read during the study phase of this experiment. These summaries were scored for the number of main idea units recalled in those summaries by the experimenter, who remained blind to the condition of the participant. A total score was calculated for each of the four sets of summaries out of a possible 20 points (five main idea units per text). Cronbach's alpha indicated that the internal reliability of the scoring was .77. Table 9 shows the mean percentage of ideas correctly recalled for each of the four texts in both of the orienting tasks. Subjects in the read condition recalled almost twice as many main ideas (M = 39.0%) from the texts as did participants in the proofread condition (M = 22.5%). A 2 x 4 repeated measures analysis of variance with the between-participants factor orienting task and the within-participants factor of text showed a significant main effect of orienting task, $F(1, 102) = 43.19$, $MSE = 210.3$, $p < .0001$, and text, $F(3, 306) = 6.86$, $MSE = 210.3$, $p < .0002$. The interaction was not significant.

Table 9. Mean Percentage of Main Ideas Recalled From Texts On Summarizing Task As A Function of Orienting Task

	Orienting Task			
	Proofread		Read	
Text	M	SD	M	SD
Text 1	21.0	12.7	41.0	16.5
Text 2	23.0	15.6	42.1	23.0
Text 3	19.4	15.0	32.0	17.1
Text 4	27.3	20.5	41.3	20.1

The results of the explicit summarizing task are in direct contrast to that found between the two conditions on the implicit word fragment completion task. Clearly, asking participants to proofread text led to poorer memory for the essay content than did asking participants to read for comprehension. These results are not terribly surprising since a deeper level of encoding should permit a greater degree of memory for message content. Indeed, had the participants in the proofread condition performed equally to those in the read group, one might wonder how effective the proofreading task had been for those participants in promoting data-driven processing. More importantly, these results point to a clear processing trade-off between the participants in the two orienting tasks and their respective performances on the fragment completion and summarizing tasks.

Study times. In Experiment 2, more control was exerted to equalize participants in the two groups in terms of the time spent on the task during the study phase of this experiment. Table 10 reports the mean study times for the two groups for each of the four texts. It can be readily seen that the groups showed a large difference in study time for the first text but became closer for subsequent texts. A 2 x 4 repeated measures analysis of variance found significant main effects for orienting task, text, and a significant interaction: $F(1, 102) = 10.7$, $MSE = 91.35$, $p < .0015$; $F(3, 306) = 5.17$, $MSE = 91.35$, $p < .0017$; and $F(3, 306) = 6.45$, $MSE = 91.35$, $p < .0003$. It is likely that these results are largely dependent on the study time differences (mean difference = 14 secs) for text 1 and the somewhat smaller difference for text 2 (mean difference = 5.1 secs). That the instructions for the two groups during the study phase to either "slow down" or "speed up" were effective can be seen by the fact the two groups became closer and stable for texts 3 and 4. This suggests that perhaps two, rather than one, practice essay may have benefited this control measure.

To see whether the overall priming magnitude found in the primary analysis was not due to the study time differences between the two conditions for the first two texts, a separate 2 x 2 factorial analysis of variance was performed on the proportions of completed word fragments for the last two texts only. With the items from texts one and two removed, the results did not change. There was a near significant main effect of orienting task, $F(1, 102) = 3.65$, $MSE = 91.74$, $p = .059$; a significant main effect of word status, $F(1, 102) = 9.03$, $MSE = 91.74$, $p < .003$; and a significant interaction, $F(1, 102) = 5.2$, $MSE = 91.74$, $p < .03$. Simple effects analysis showed that the difference between completed primed and unprimed items in the proofread condition was significant, $F(1, 102) = 13.96$, $MSE = 91.74$, $p < .0001$, whereas that difference for the read condition was not significant, $F(1, 102) = .26$, $MSE = 91.74$, $p = .610$. Thus, even when the study times were not statistically different, the magnitude of priming held up, but only for the proofread condition, which showed a significant 7% rate of priming. It should be noted that this secondary analysis was done on all items. That is, the misspelled targets were included and so, one would expect this magnitude of priming to only increase with their exclusion as was done for the primary analysis.

Table 10. Mean Reading Times During Study Phase As A Function of Orienting Task (In Seconds)

	Orienting Task			
	Proofread		Read	
Text	M	SD	M	SD
Text 1	101.13	13.08	87.17	15.00
Text 2	96.92	12.30	91.82	13.14
Text 3	100.09	12.10	95.96	14.13
Text 4	95.27	13.00	91.15	15.06

General Discussion

The two experiments reported here confirm that text-to-word level transfer can occur when there exists a match between the encoding conditions of text at study and the retrieval processes engaged at test, even when the test represents a linguistic level different from that of text. Given a sub-semantic analysis of text in a proofreading situation, word fragment completion benefits from surface and lexical memorial representations of text. In this case, the data-driven test recapitulates the data-driven aspects of the study episode during the original encoding process. Conversely, word fragment completion did not benefit from the original encoding processes during study when those processes required a read-for-meaning orientation.

In Experiment 2, the opposite result was found when the test phase involved retrieval of conceptual representation of the texts. Whereas data-driven processing of text benefited word fragment completion it produced less transfer to a conceptual, summarizing task. On the other hand, a read-for-meaning orientation did aid performance on that task when the conceptual processes engaged by the those participants during study were recapitulated at test.

Relation to Other Research

The significant text-level priming effect obtained in these experiments supports previous work by MacLeod (1989) and Nicolas et al (1994). It also supports the argument that those results were due to a manipulation of surface processing in their incidental text priming procedures. As in the current experiments, text-level priming was obtained in those studies due to the suppression of naturally occurring conceptual level processing of text due to an experimental manipulation that invoked a greater focus on the lexical aspects of the texts, thereby promoting data-driven processing. Data-driven processing, in turn, facilitated transfer of individual words from those texts to a word fragment completion test. Conversely, because this test is a perceptual, data-driven test of implicit memory, participants who were asked to read for comprehension, not surprisingly, failed to demonstrate this positive transfer. Indeed, the difference between primed and unprimed items for the read group was practically nil in both experiments.

At the same time, the current experiments help explain why other researchers (e.g., Levy and Kirsner, 1989; Oliphant, 1983) failed to demonstrate text-level priming. Both of the two experiments here showed that text-to-word level priming can occur when the processing requirements at study recruit those processes necessary for a given test, and only when those processes are data-driven. That is, when proofreading text for spelling errors, participants process the texts in a data-driven fashion that facilitates the transfer of individual words from those texts to a word fragment completion test. Since that test is considered a perceptual, data-driven test of implicit memory it was expected and confirmed that participants who read the texts at the message-level would fail to demonstrate positive transfer.

This failure to obtain priming replicates the failure of Levy and Kirsner (1989) and Oliphant (1983) to show text-to-word priming. Their participants, it was argued, also did not process their texts in a data-driven fashion. The current experiments would suggest that Levy and Kirsner's (1989) conclusion that priming cannot occur when the study and test phases are at different linguistic levels was premature. Although Levy and Kirsner suggested that data-driven processes were present because of re-reading benefits (Experiment 2), it is believed that their study task was not sufficiently perceptual to produce priming on a perceptual identification test (Experiment 1). In two experiments, participants were able to show implicit memory for words presented in isolation and in perceptually degraded form on a word fragment completion test that were previously encountered in four detailed and relatively lengthy texts.

At the same time, however, it is important to remember two critical aspects of this finding: a) This priming appears to occur only when the study phase requires a data-driven task, such as a proofreading task, and b) That the magnitude of priming obtained from an incidental text priming procedure is still quite small relative to priming studies where the initial presentation of items is also in isolation as when participants study word lists. As MacLeod (1989) argued, "it would seem that presenting words in text limits their likelihood of showing priming on a subsequent indirect memory test" and that "individually studied words generally seem to have produced larger, more robust priming effects in the literature" (p. 401). Of course, the principal focus of the current study was to demonstrate that text-level priming simply can occur, and to show under what conditions it does occur. In doing so, these experiments help not only explain successful reports of incidental text priming but also illuminate some inconsistent results concerning text-level priming in the implicit memory literature.

Test Type

Given the present replication of Levy and Kirsner's (1989) failure to show priming with a read-for-meaning orientation, these experiments may also help eliminate alternative explanations for the inconsistent data reported in the literature and discussed earlier, concerning implicit memory for words read in text. For instance, it was suggested that employing different implicit memory tasks might produce opposite priming effects, such as the opposite results reported by MacLeod (1989) and Levy and Kirsner (1989). Yet the present work suggests that had Levy and Kirsner substituted word fragment completion for perceptual identification their result would have been the same: absence of priming for individual words previously read in continuous text, given the orientation to the texts their participants were given. Conversely, given the study phase orientations used here and in MacLeod (1989) and in Nicolas et al. (1994), it is possible that the priming would have been identical if a perceptual identification test was used. Of course, only more direct investigation of this question can determine the validity of this assumption. For instance, it may be that there are true differences between the way these two implicit memory tests act in an incidental-text priming procedure.

Since the test used in Levy and Kirsner's (1989) study was perceptual identification, we suggested earlier that this may have been one reason for their failure to show priming for words read previously in text. This possibility was one consideration in having a straight read condition in the present study similar to that of Levy and Kirsner. If test differences were a contributing factor to the dissociation between the two tests in the incidental text priming procedures used by Levy and Kirsner (1989) and MacLeod (1989), then one might expect to see participants in the read condition not fail to show transfer to a word fragment completion task, as they did in these two experiments because of the similar orienting task. Oliphant (1983) also failed to show priming for words previously read in text on a test of lexical decision. Indeed, functional dissociations between two or more data-driven tests have long been established (Roediger, Srinivas, & Weldon, 1989).

There is suggestive evidence then that the absence of a priming effect as a function of normal reading does not appear to be influenced by the type of indirect memory test. It does not necessarily follow, however, that the presence of the effect, as a function of surface-level processing, cannot be influenced by the type of test that is used. Still, since all reports to date of successful repetition priming for words read in text have involved only the use of word fragment completion, it would be worthwhile to look further into whether those effects are generalizable to other implicit tests. A good starting point would be to simply test the effects of using a proofreading, or similar data-driven orienting task, on priming on a single test of implicit memory other than word fragment completion. Even better would be to directly compare two or more perceptual, indirect memory tests within the same experiment. In any event, it seems apparent that in order to obtain repetition priming effects in an incidental text priming procedure, processing at study must be sufficiently perceptual. Whether this effect is restricted to word fragment completion or is dissociable from other indirect perceptual tests awaits, as stated, further study.

Text Length

Still another possible contribution to the discordant findings that surfaced in the literature concerned the role of text length or the amount of text context in which target items are embedded. Levy and Kirsner (1989) interpreted MacLeod's (1989) successful text-level priming effect as reflecting his use of relatively short, unrelated passages as compared to their own textual materials. The same criticism could be easily levied at Nicolas' et al. (1994) for their use of sentence length text contexts. Thus, another advantage that arose from the current study was the opportunity to partially examine this claim that longer texts may inhibit text-level priming effects.

Even though, in the experiments reported here, 4 one-page, as opposed to 4 two-page essays, were used (for the purposes of establishing baseline completion rates) the materials used here were identical to those used by Levy and Kirsner (1989). While certainly shorter in length, we do not think the same argument that MacLeod's texts were too short or not sufficiently continuous is applicable in the present study. Yet, the same effect was found. Even with longer, more detailed texts at study, priming occurred on a data-driven, perceptual test of implicit memory.

Interestingly, the results of Experiment 2 produced a 13% priming magnitude (when misspelled primes were eliminated from the analysis), which is consistent with the

12% priming effect MacLeod (1989, Experiment 3) found for words read in his crossed out condition. However, for words read in his sensible condition, which could be viewed as equivalent to the correctly spelled primes here, MacLeod obtained only a 6% priming effect. When we compare these findings to those reported by Nicolas et al., (1994), who had participants read short two-line paragraphs that were made perceptually difficult, priming increases to about 25%.

So it is possible, and likely, that the degree of text length is an important factor. Yet it is also possible that given a greater level of text context, one could simply compensate by increasing the perceptual task demands required during the learning of study episode. Since all of these experiments manipulated surface-level processing, it is difficult at this point, to determine how the amount of text and processing orientation interact to produce priming. As with test differences, one obvious solution would be to systematically investigate the role of text length. Nicolas et al. (1994) also had a normal reading condition, as a comparison, and found a small, but significant, 5% priming effect. This result, however, is likely due to the fact they used simple sentences as text. When the material is expanded to continuous text in four one-page essays, we see that priming disappears under normal reading conditions. What is important is that the results presented here support Nicolas et al., in that, as the perceptual nature of the processing task increases, so does priming on word fragment completion.

It would seem that, based on the best available evidence, priming for words embedded in text will increase when the text context is relatively small and less meaningful. As the text context becomes longer and more meaningful, so too does the probability that priming will not occur. The relative direction of priming can reverse, however, if the encoding task at study is made to be a data-driven one. Presumably, the greater the text context, the greater the perceptual nature of the study task must be in order to obtain priming.

Certainly all of these variables lead to the potential for very fruitful research. The variety of potential combinations of text lengths and types of memory tests permits one to design a number of interesting studies that could only further our understanding of implicit memory and text-based priming. One improvement of the present study would be to block orienting task to the texts within participants so that all participants provide data on the test for words under both the proofread (data-driven) and read-for-meaning (conceptual) orienting conditions.

Misspelling Target Words At Study

The results presented in this paper are also interesting in that proofreading (compared to normal reading of) textual materials led to better transfer to an indirect memory test of word fragment completion even though detecting spelling errors in the texts that were also repeated on the test did not provide an advantage for those words. Only those target items correctly spelled in the texts differed significantly from words on the test that did not appear in the texts originally. This suggests that it was sufficient for participants to read the texts looking for spelling errors to show priming but the primed items did not have to be misspelled and therefore identified and crossed out by the participants during the encoding task, as in MacLeod's (1989) experiments. Since participants who proofread the texts did show superior performance for correctly spelled items, and an overall inferior performance on the summarizing task, it is apparent that they minimized conceptual operations during study and emphasized perceptual or data-driven processing of inherently conceptual stimuli.

This manipulation, embedding misspelled words in the text, allowed us to also look at the completion rates of target words that were misspelled at study. These words then acted similarly to the baseline and served as another measure of control because once presented on the fragment completion test, the misspelled targets were unlike the correctly spelled targets in that they were not truly repeated. Thus, you would not expect priming for these words relative to the correctly spelled primes and, this is in fact what was observed. Repetition of a word presumes that a word was given full lexical processing during the initial presentation. But, clearly misspelled targets did not produce an absolute absence of priming, and were to a small degree completed more often than nonstudied items. It may be that when people encountered a misspelled word they stopped processing the item upon noticing the error and moved on. If this is true, then where they stopped processing the word might have also been dependent on what position in the word the error occurred (i.e., a character nearer the beginning or ending of a word). This in itself may be an interesting question to pursue in the future.

This finding also supports the view that it is the lexical, perceptual representation rather than the semantic representation that is critical in priming studies. This is consistent with the transfer-appropriate processing perspective, but only when we speak of perceptual tests of implicit memory. Clearly, conceptual tests, such as word association, involve a semantic relationship not dependent on the perceptual component, between an item presented at study and text. Since misspelled target primes introduced a physical change between study and test, and showed less priming than correctly spelled primes, it does support the idea that word fragment completion is a data-driven test of implicit memory. It also suggests that the lexical memory for individual words does depend to a degree on the perceptual match between its study and test presentations, as a transfer-appropriate processing perspective would predict.

Transfer-Appropriate Processing

In general, the findings reported here are consistent with a transfer-appropriate processing perspective, specifically the distinction between data-driven and conceptually-driven processes. There is no question that priming is reduced when a target is embedded in a larger context than when it is studied alone, even though that comparison was not made directly in the current study. But these present findings do call into question perhaps whether the central importance should be given to how similar an experience between the study and test conditions are, as Levy and Kirsner (1989) and Masson and MacLeod (1992) have argued, or whether the critical importance lies in the processing components of those conditions, specifically the perceptually- versus conceptually-driven distinction, should be weighed more carefully in an implicit text-level priming situation. Reinstating study context at test is only one method for permitting the data-driven components of text to manifest on a data-driven test. But, as the present and other research has shown, such reinstatement of context can be avoided in a text-level priming procedure if the recruitment of the initial processing operations, as opposed to the physical context, is emphasized and transferred between the study and test conditions.

More recently, Masson and MacLeod (1997) have argued that the accepted explanation for the reduction in priming given text context - that processing operations involved in text comprehension do not transfer across linguistic levels from text to words in isolation - is not the crucial factor in this reduction. That is, given a text context, words become bound to the meaningful flow of the passage and therefore do not lend themselves to identification on a test of implicit memory when presented in isolation. Instead, Masson and MacLeod suggested that words must be experienced as distinct events, singled out, or "individuated" in order to transfer from study to test. A similar reduction in priming was said to occur regardless of whether words were originally presented in text or as part of an equally long list of unrelated words.

The results presented here provide some support for this interpretation in that words read as part of a text context in a proofread condition were experienced more or less as distinct events (as opposed to the read condition). Reading items under a proofread condition could be viewed as an individuating process and could therefore lead to an increase in priming for those items. As in the present case, this should be true even when the words are presented in a test condition (word fragment completion), that does represent another linguistic level from text, by virtue of being presented without the original context, that is, in isolation and in degraded form.

Although this explanation seems to provide a framework for the present findings, it still fails to rule out other possible causes for the priming that was shown. At the very least, the question remains as to whether text context itself may or may not be still be considered a crucial factor in reducing the probability of priming on indirect tests of memory. First, given that the relative magnitude of priming obtained here was small, it is not unlikely that it could increase given a situation in which shorter text contexts were used. Second, the role of data-driven processing must be considered since it was this type of orientation to the texts that facilitated priming in this study. More generally, priming or lack of priming, was dependent on the relative input of the original encoding processes. Perhaps more consistent with the transfer-appropriate processing perspective, the current findings appear to be more favorable to the perceptual versus conceptual processing distinction.

Finally, simple individuation of words is clearly not sufficient since misspelled words did not benefit from prior presentation on the word fragment completion text. This finding is readily explained, however, by another component of the processing view relating to the perceptual match or mismatch between an item's presentation at study and at test. Since misspelled words were not repeated, it makes sense that they did not transfer since there were no perceptual records of those events. Interestingly, this may also rule out any activation process if in fact identifying misspelled words caused people to visualize the correctly spelled word, and yet still failed to complete the later word fragment at test. Although the misspelled targets were the most highly individuated items at study, by virtue of being crossed (or singled) out by the subject, they did not transfer as well as those targets that were spelled correctly during the original encoding presentation. Correctly spelled words, however, were certainly experienced less as single events than incorrectly spelled words, yet they benefited more from true repetition at test. In other words then, individuation may be necessary to some degree but not sufficient. What also needs to be present is some assurance that, regardless of whether target words are embedded in a larger text context or not, those words must be perceptually similar across the learning and testing episodes.

Perceptual similarity is not intended to mean the same thing as reinstating a similar context. Proponents of all the views discussed above have talked about text-level priming as requiring that study context be reinstated at test (i.e., Levy & Kirsner, 1989; Masson & MacLeod, 1992; and Roediger & McDermott, 1993). While it is agreed, and indeed supported by the current findings, that text context reduces priming of individual words, we maintain that the present experiments show how and why priming can occur at all, even across different linguistic levels. Promoting perceptual processing during the initial encoding of words in a text context can itself facilitate priming on a fragment completion test. Conversely, when conceptual processes are emphasized, priming does not occur. These results appear to go in the opposite direction when the test becomes conceptually-driven, as in an explicit summarizing task. What we end up with is a processing trade-off that depends on the relative degree of the specific nature of both the learning or study episode and that of the test or reprocessing episode.

In conclusion, it would seem that neither TAP (although not inconsistent), as it stands, or Masson and MacLeod's (1997) concept of individuation, is sufficient to explain the results reported here as a whole. Some combination of both ideas may be necessary to explain these and other results obtained from incidental text priming procedures. TAP has been built upon ideas and research stemming from years of studies that have principally involved word-level studies of implicit memory, whereas Masson and MacLeod (1997) represent a small number of researchers currently exploring implicit memory outside of those boundaries. Indeed, the idea of individuation of words is compatible with, and may in part be useful to a processing view, when the variable concerned is text context.

Levels-of-Processing

The pair of experiments reported here also bring to the forefront other interesting issues relating to text-level priming that have not yet been introduced into the literature. To our knowledge this was the first study to directly investigate levels-of-processing and text-level priming. As the findings indicate, the main conclusion to be drawn is that when people are asked to read texts in a manner that minimizes conceptual processing, implicit memory performance is aided on a perceptual test, whereas that benefit does not exist when conceptual processing is emphasized. Conversely, when the test is explicit or conceptual, perceptual processing of text impairs performance, whereas conceptual processing benefits the reader. The two types of test demonstrate a functional dissociation between the two types of memory, depending on the type of orienting task, or level-of-processing.

Text context is an interesting variable where levels-of-processing is concerned. This is due to the fact that traditionally research has focussed its attention on word-level studies. Studying text as opposed to a list of words automatically increases the degree of conceptually-driven processing a person will impose on that text, unless a task is introduced that changes one's orientation to that text. Thus manipulating levels of processing on a list of words is not the same thing as manipulating levels of processing on words embedded in textual material. The importance of this distinction lies in the fact that, in the former case, data-driven processes are already inherent to the initial encoding operations. This would help explain the general conclusion that manipulating levels of processing that direct a persons' attention to different features of the words have nil effects on implicit, perceptual memory tasks but large effects on explicit, conceptual tests such as free recall or recognition (i.e., Graf & Mandler, 1989; Jacoby & Dallas, 1981; and Roediger et al., 1989).

In the case of text, unlike word lists, conceptual processes are the dominant components inherent to the standard encoding operations. Levels of processing, however, can still be manipulated in the same manner as in word-level studies. That is, the semantic features can be emphasized by directing a person to read the text for comprehension. Analogous to the phonemic or graphemic processing of word sets, the perceptual features of the text can be emphasized by directing a person's attention away from the conceptual components of the text through a more shallow or data-driven orienting task, such as proofreading the text for spelling errors. Because text-based and word-based priming situations are inherently opposed with respect to their natural tendency to invoke different encoding operations, it is not surprising that manipulating levels of processing should produce opposite outcomes in the two situations, as the present article suggests. It may therefore prove useful, from a processing perspective, to not only make a distinction between the processing components of memory tests and their relationship to prior learning episodes, but also between the processing components of the prior learning episodes themselves, independent of any levels-of-processing manipulation.

Another important application of text-based priming is highlighted by the common concern faced by researchers studying implicit memory about explicit contamination during a test of implicit memory. Incidental text priming procedures may provide a more secure method of ensuring memory without awareness. A frequent reference in the literature is made to incidental versus intentional memory and it would appear that embedding target items in naturally occurring text might go a long way to making the implicit learning of those words much more incidental than when those words are simply presented as part of a standard word list. That persons in the proofread group in the two experiments here did rely on unintentional retrieval of some of the lexical components of the text, notwithstanding the awareness questionnaire, we can be certain. If persons in the normal read condition had shown priming on the fragment completion test, one might suspect that the use of conscious retrieval strategies were utilized on the word fragment completion test. Again, the importance of manipulating LOP in the current experiments is seen by the inference we can make that participants in the studies reported by MacLeod (1989) and Nicolas et al. (1994) were not consciously reinstating the context on their respective word fragment completion tests. Additionally, for participants in the current study, reinstating study context only seemed to occur when people were asked to read the texts for meaning and then to recall ideas from the texts on a summarizing task. Persons who proofread the texts were apparently unable to even reinstate study context given their poorer performance on the same task. We can be fairly certain therefore that the participants who proofread the texts relied solely on their nonconscious lexical representations of the texts as a function of a task orientation that permitted a greater degree of perceptual processing. In addition, text naturally produces a delay between the study and test episodes which only increases the probability that learning will be unintentional and, therefore, truly implicit.

Implications for Text Comprehension

These findings have interesting implications for theories of text comprehension as well, since text comprehension typically produces an inhibition of the memory for, but not the encoding of, the more data-driven or surface features of the text. We agree with Levy and Kirsner (1989) for example, that the data-driven features are indeed present during text processing but disagree, based on the current and past findings, that to show memory for them context must be reinstated at test. Kintsch's (1974) model of discourse processing at one level also seems to be at odds with the current findings relating to text processing and memory. Retrieval of information in his model is said to be based on input from all levels of representation concurrently. Yet, it would appear that in more specific instances as outlined in this article that this is not always the case. Different levels of representation can be manipulated so that memory for certain types of information are dependent on the type of processing that is emphasized during the original processing of text. Kintsch's model of text comprehension would predict that participants given a conceptually-driven task would perform similarly as those given a perceptually-driven task, and vice versa, yet the results obtained here demonstrated that manipulating text orientation to either a surface-level or text-level representation produced opposite effects on memory or retrieval of information in both groups of readers. One possible reason for this discrepancy is that the underlying system at work in the implicit memory processes said to be operating here is largely visual in nature. One implication therefore may be that the surface-level representation of text in Kintsch's model may need to incorporate some of the more basic, fundamental sensory operations that contribute to text processing and memory.

Certain aspects of the model may have implications for the theoretical processes underlying the findings in this article. For example, how might priming be affected if a word that was misspelled in a text was central to that passage or if it's sense was varied as a function of the sentence in which it was embedded (Kintsch, 1988; Kintsch, Kozminsky, Streby, McKoon, & Keenan, 1975)? Also, the Interactive Activation model put forth by McClelland and Rumelhart (1985) suggests that both top-down (conceptual) and bottom-up (data-driven) processing occur simultaneously, that is, in a parallel fashion. While this may be a viable model for the cognitive aspects of reading, it does not necessarily account for how aspects of what is read is remembered, as the findings presented here would suggest. Using the current incidental text priming paradigm, one could explore these models further by comparing populations that could be separated into groups of skilled versus unskilled readers. Presumably, the greater the abstract knowledge a reader brings to text, the more likely that knowledge will influence the perceptual-encoding of that text. Manipulating either the perceptual or conceptual features of the text could facilitate or inhibit a skilled readers' performance on a test of either implicit or explicit memory.

Intention and attention in reading might also be factors to consider in future studies with text context. If a passage or text is intrinsically interesting to a person or a person is self-motivated to read a passage or text, regardless of the orientation assigned to it, then the trade-off between perceptual and conceptual processing demonstrated here might result in varying levels of retention, explicit or implicit. Although we know that explicit and implicit memory for text and words in text are dependent on the relative degree of perceptual and conceptual processing, we don't yet know how these might interact with whole other classes of variables potentially worthy of future study.

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Appendix

1. When you first read the four essays, what was your guess about the nature of this experiment?

2. What did you think the researcher's purpose was in presenting you with a word fragment completion task?

3. Did any of the words that you completed from the fragments seem familiar to you? If yes, in what way did they seem familiar to you?

4. Were you aware that some of the words on the fragment completion task were taken from the four essays you read earlier? If yes, what made you aware of this and at what point during the task did this occur?

5. Did you use your knowledge that some of the words on the fragment completion task actually came from essays to help you on that task? Using the scale below, estimate the percentage of words you completed on the fragment completion task as a result of this knowledge. (Circle one)

0%	10	20	30	40	50	60	70	80	90	100%
None at all					About half					All of them

6. How fluent would you rate yourself in reading and writing in the English language? Use the scale below. (Circle one).

1	2	3	4	5
Not very fluent		Average fluency		Very fluent