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MULTICOMPONENT ANALYSIS OF THE REPETITION EFFECT IN WORD IDENTIFICATION AND LEXICAL DECISION

by

LAWRENCE FREEDMAN

B.A. UNIVERSITY OF CALIFORNIA SANTA CRUZ
M.A. RADFORD UNIVERSITY

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to the required standard

[redacted]

Otfried Spreen

[redacted]

Esther Strauss

[redacted]

C. Brian Harvey

[redacted]

Donald Knowles

[redacted]

Larry L. Jacoby

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Supervisor: Professor Michael E.J. Masson

ABSTRACT

The purpose of this study was to examine the mechanisms responsible for the repetition effect in word identification and lexical decision. The repetition effect refers to the facilitative effects of a prior presentation of a word on its later identification. An explanatory model of repetition effects was proposed in which facilitation in word identification and lexical decision is viewed as being based on memory for prior lexical access in modality-specific and modality-free systems of representation. Four experiments were conducted in order to explore the efficacy of the model. Experiments 1 through 3 employed a study-test format in which the test phase involved a visual-perceptual word identification task. The results from Experiments 1 and 2 indicated that repetition effects are sensitive to word-specific features demonstrated by the absence of orthographic (Experiment 1) and semantic (Experiment 2) facilitation in word identification. Facilitation was observed only when the same word was presented during study and test phases. In addition, although both visual and auditory study yielded significant facilitation when identical words were studied and tested, intramodal repetition produced greater facilitation than cross-modal repetition. The findings from Experiment 3 indicated that both visual and auditory encoding facilitated later word identification over a retention interval of 24 hours. Experiment 4 involved repeated presentation of homographs in a lexical decision task and demonstrated that the degree of facilitation in lexical decision was highly dependent upon repeating a specific homograph meaning across presentations.

The results from the 4 experiments tentatively support a model of repetition effects that consists of two systems of representation. Repetition effects are seen as being based on memory for prior access to a specific lexical entry in a modality-specific system and a modality-free system. In these interactive lexical systems, exposure to a word produces a memory representation for access to the word's entry in each system. Activation of these memory representations facilitates identification when the word is later repeated.

Examiners:

[redacted]

Michael E.J. Masson

[redacted]

Otfried Spreen

[redacted]

Esther Strauss

[redacted]

Donald Knowles

[redacted]

Larry L. Jacoby

Daniel Schacter

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Multicomponent Analysis of the Repetition Effect in Word Identification and Lexical Decision

A current topic of interest in human memory research is the phenomenon known as the repetition effect. The repetition effect refers to the facilitative effects of a single presentation of a word on its later identification. This facilitation is quite robust and has been demonstrated using a variety of tasks such as perceptual identification (Clarke & Morton, 1983; Feustel, Shiffrin, and Salasoo, 1983; Jacoby, 1983a, 1983b; Jacoby & Dallas, 1981; Jacoby & Witherspoon, 1982; Jacoby & Brooks, 1984; Morton, 1979; Murrell & Morton, 1974; Salasoo, Shiffrin, & Feustel, 1985), lexical decision (Carroll & Kirsner, 1982; Dannenbring & Briand, 1982; Forbach, Stanners, & Hochhaus, 1974; Kirsner, Milech, & Standen, 1983; Kirsner & Smith, 1974, Scarborough, Cortese, & Scarborough, 1977; Scarborough, Gerard, & Cortese, 1979), word-fragment completion (Tulving, Schacter, & Stark, 1982), and reading of transformed typography (Kolers, 1975,1976).

An important attribute of the repetition effect is its relation to episodic memory tests like recognition and recall. The memory that underlies these latter tasks typically requires an explicit (i.e., conscious) judgment about prior item occurrence (Mandler, 1980). On the other hand, the memory underlying word repetition is implicit since it is measured using tasks that do not require explicit judgments about prior item occurrence. For example, in perceptual identification, memory for an item is revealed in the greater probability of identifying previously studied items compared to items seen for the first time (Jacoby, 1983a; Jacoby & Dallas, 1981). Similarly, in a lexical decision task, where subjects are asked to decide whether a visually presented letter string is a real English word, memory is revealed by the faster decision times to repeated compared to nonrepeated target words (Carroll & Kirsner, 1982; Kirsner et al. 1983; Kirsner & Smith, 1974; Scarborough et al., 1977).

Additional evidence that supports the view that repetition effects are mediated by an implicit memory for prior episodes comes from the memory performance of amnesics. Like normal subjects, amnesic patients demonstrate preserved memory for a previous learning episode despite their severe deficits in recognition and recall ability. This preserved ability to remember in the absence of awareness has been demonstrated using perceptual identification (Cohen & Corkin, 1981), word-fragment completion (Graf, Squire, & Mandler, 1984), reading mirror-imaged words (Cohen & Squire, 1980), lexical decision (Moscovitch, 1985), and paired-associate learning (Shimamura & Squire, 1985).

Further evidence supporting the dissociation between repetition effects and recognition memory was reported by Jacoby and Dallas (1981), Jacoby and Witherspoon (1982), and Scarborough et al (1977). These investigators clearly demonstrated that the facilitation due to presenting a previously seen word for perceptual identification or lexical decision was <u>independent</u> of whether these same words were identified in a subsequent recognition memory test. The observation that recognition memory does not predict perceptual identification and lexical decision performance strongly indicates that repetition effects are not mediated by explicit remembering.

The independence of repetition effects and recognition memory has led some investigators to suggest that the facilitation due to repeating an item in a word identification task represents influence of semantic, or abstract memory factors. For example, Morton (1979) claimed that facilitation in repeating a word in a tachistoscopic identification task is due to the temporary priming of word detectors, called logogens. These logogens are permanent semantic memory codes that become activated when sensory information causes the logogen to exceed its firing threshold. An important aspect of this model is that the priming associated with the identification of a word is supposed to be relatively short-lived (Morton, 1979). However, results by Jacoby and Dallas (1981), Jacoby (1983a), and Salasoo et al. (1985) have clearly shown that the effects of a single prior presentation of a word on its later identification are too persistent to be attributed to the temporary priming of an abstract memory representation. In constrast, Jacoby (1983a) has argued that repetition effects are due to an aspect of episodic memory for prior presentations that is different from the type of episodic memory that supports explicit decisions about prior item occurrence.

This distinction between explicit amd implicit episodic memory is important because it provides a basis from which to determine the types or units of information that serve to influence repetition effects. Mandler (1980) proposed that recognition of a previously presented item (i.e., episodic memory) can be based on two sources of information. One basis for recognition relies on the retrieval from memory of information that was presented in a specific encoding context. This type of recognition is associated with memory for word meaning and is sensitive to the amount of semantic processing given to a list of to-be-remembered words. The second basis for recognition relies on the feeling of familiarity gained from reading or studying a presented word. This familiarty is assumed to be dependent on the perceptual (i.e., intra-item organization) structure of words.

In a recent study, Jacoby and Dallas (1981) proposed that perceptual fluency may serve as a basis for the feeling of familiarity with respect to repetition effects. Perceptual fluency is measured by how well a subject can identify a word presented under degraded viewing conditions (Johnston, Dark, & Jacoby, 1985). Jacoby and Dallas (1981) showed that repetition effects in perceptual identification were mediated by perceptual fluency as opposed to word meaning. They found that the degree of prior item elaboration had little effect on later perceptual identification performance. In addition, this perceptually-based memory was stable over a 24-hour period. This independence of perceptual memory from the effects of prior semantic processing and retention interval indicates that this form of memory has little to do with retrieval of item meaning.

If perceptual fluency is based on the prior elaboration of non-semantic episodic information, then repetition effects in word identification may be sensitive to the physical (i.e., surface) structure of words. Evidence supporting memory for surface structure comes from the finding that nonwords, in addition to words, show facilitation when repeated in word identification (Feustel et al., 1983; Salasoo et al., 1985) and lexical decision (Kirsner & Smith, 1974; Scarborough et al., 1977) tasks. Moreover, Jacoby (1983b) has shown this memory to be dependent on the amount of data-driven processing required for initial item encoding. Jacoby found that presenting isolated words for study resulted in more accurate identification compared to when words were preceded by a related context word. Providing semantically related context presumably reduced the requirement of prior visual analysis by activating an abstract representation of the target word (Morton, 1979). In this manner, context served to increase the contribution of conceptually-driven processes which resulted in lowered performance when a test of word perception was employed. Jacoby (1983b) interpreted these findings to suggest that repetition effects are based on memory for prior processing episodes.

The observation that memory for surface structure depends on the prior elaboration of physical item features suggests that effects in word repetition may transfer to perceptually similar stimuli. Research investigating physical transfer effects has generally taken two approaches. One approach has been to examine the degree of transfer along orthographic and phonemic dimensions. The other approach has focused on the influence of encoding modality (i.e., visual vs. auditory) on later word identification.

Neisser (1954) demonstrated that phonemic information does not contribute to repetition effects involving word identification. In his study, prior presentation of a list of words did not facilitate later identification of phonemically similar words. Thus, pre-training with the word "FRAYS" did not facilitate later identification of its homonym, "PHRASE". Murrell and Morton (1974) similarly found that repetition effects in word identification are not sensitive to phonemic structure.

The contribution of low-level physical information to repetition effects was investigated by Feustel et al. (1983), Jacoby and Witherspoon (1982), and Scarborough et al. (1977). These studies found that changing the case of letters in repeated words (e.g., BOAT-BOAt; BOAT-boat) did not influence the size of word facilitation effects. Similar null effects of changing the visual appearance of repeated words were demonstrated by Morton (1979). These findings are consistent with the claim that word recognition entails the activation of abstract letter identities (Evett & Humphreys, 1981).

On the other hand, memory for surface structure may be sensitive to orthographic variables. For example, Feustel et al. (1983) demonstrated that prior presentation of a word facilitated the later identification of an orthographically similar word (e.g., TROUT-OUT). However, this orthographic facilitation was, at best, marginal for real words. On the other hand, significant orthographic facilitation was demonstrated using nonword stimuli. Feustel et al. (1983) interpreted these results to suggest that orthographic structure may have some role in influencing facilitation in word repetition.

Contrary to these findings, Murrell and Morton (1974) showed that facilitation in word identification is sensitive to morphemic structure. They showed that prior study facilitated later word identification only when the test word included the same root morpheme as the study word. Thus, prior study of "CARD" facilitated later identification of "CARDS" but not "CARS", indicating that there was no transfer to orthographically similar words in the absence of repeated morphemic structure. Since morphemes represent the smallest linguistic unit of meaning, these results indicate that the episodically-based memory underlying word repetition may, after all, be dependent on word meaning.

The results reported by Murrell and Morton (1974) that repetition effects may be sensitive to morphemic structure raises an interesting question. If the basis for facilitation in word repetition is morphemic, how does one explain nonword facilitation (e.g., Feustel et al., 1983)? Nonword facilitation provides the clearest example of memory for surface structure since nonwords do not typically contain morphemes. This apparent contradiction is made worse by the findings of Feustel et al. (1983) in which they suggested that the equal facilitation observed for both words and nonwords was due to enhanced episodic memory for recent encodings of specific physical images. The faster identification times found for words, on the other hand, was interpreted to reflect the influence of preexisting codes in lexical memory that provided a unitized response for word stimuli. Since nonwords theoretically do not have established codes in the lexicon, the availability of such unitized codes for words would account for their faster identification.

The faster identification times found for words by Feustel et al. (1983) is somewhat misleading for the following reason. Since words presumably have preexisting representations in lexical memory, their baseline performance levels would be significantly superior to nonwords. This difference between word and nonword identification remained constant over three presentations demonstrated by a nonsignificant lexical status X presentation interaction (Feustel et al., 1983, Experiment 2). Although this finding indicates separate contributions of lexical status and presentations to repetition effects (Sternberg, 1969), further examination of Feustel et al.'s results suggest a different interpretation.

Presenting both words and nonwords together in a within-subjects design, Feustel et al. (1983, Experiment 3) found a significant interaction between lexical status and presentations. This interaction was due to the greater decrease in identification time for nonwords compared to words. In fact, after just four presentations, word and nonword identification times were nearly equivalent! This suggests that the greater reduction in identification times for nonwords may be due to the formation of a nonword code in lexical memory. The formation of such a nonword code was recently demonstrated by Salasoo et al. (1985). In this respect, the repetition effects for words and nonwords reported in Feustel et al. (1983) and Salasoo et al. (1985) appear to be supported by the development and availability of word and nonword codes in lexical memory.

Furthermore, that repetition effects may be due to facilitation from memory of specific physical representations implies that there should be no facilitation when words are repeated across different modalities. An experiment by Jacoby and Dallas (1981) supported this claim by showing that prior auditory study did not enhance later visual-word identification. However, when subjects were instructed to spell-out auditorily presented words, subsequent identification of these words in a visual-perceptual task was enhanced (Jacoby & Witherspoon, 1982). This cross-modal facilitation in word repetition was interpreted as reflecting memory for specific physical information since orthographic encoding at study was compatible with a later test of visual-word identification.

In contrast to these results, several investigators have found significant auditory to visual transfer in the absence of any manipulation of encoding demands. Thus, Clarke and Morton (1983) demonstrated weak, although significant cross-modal transfer using brief tachistoscopic presentations while Kirsner and Smith (1974) and Kirsner et al. (1983) found unequivocal transfer using lexical decision. In all these studies, however, there was greater facilitation in word identification when presentation modality was held constant across repetitions.

This superiority in modality-specific word repetition is consistent with the view of Feustel et al. (1983) that facilitation is due to the memory for specific physical images. Their explanation, however, is inconsistent with evidence of cross-modal facilitation. How then, is cross-modal transfer to be explained?

One explanation is that initial auditory encodings are automatically translated into orthographic codes (Tanenhaus, Flanigan, & Seidenberg, 1980). This recoding process would then make prior auditory study physically compatible with a later test of visual-word identification. Modality- specific facilitation would still be superior to cross-modal facilitation since some loss of information would occur due to the translation process. Notice that this explanation predicts cross-modal transfer using nonwords. However, Kirsner and Smith (1974) found no evidence of cross-modal facilitation using orthographically legal nonwords in a lexical decision task. Whether or not a phonologic to orthographic translation process mediates cross-modal transfer in _word_ repetition is an empirical issue and thus should not be discarded as a possible contributing factor to cross-modal facilitation.

A different account of cross-modal facilitation was proposed by Kirsner et al. (1983). They suggested that repetition effects are sensitive to two separate sources of information. One source is sensitive to non-lexical, physical information and accounts for the memory facilitation for words and nonwords (Feustel et al., 1983; Jacoby & Witherspoon, 1982; Kirsner & Smith, 1974; Salasoo et al., 1985; Scarborough et al., 1977) and the superiority of modality-specific over cross-modal repetition (Clarke & Morton, 1983; Kirsner et al., 1983; Kirsner & Smith, 1974;). The second source is modality-independent and is sensitive to lexical information and accounts for the memory facilitation in cross-modal repetition (Clarke & Morton, 1983; Kirsner et al., 1983; Kirsner & Smith, 1974;). The lexical nature of this second source of information is supported by the absence of memory facilitation for nonword stimuli using a cross-modal paradigm (Kirsner & Smith, 1974) and by the observation that the attenuation of word-frequency effects in word repetition is not affected by changes in encoding modality (Kirsner et al., 1983).

From this account, facilitation in word repetition is seen to be influenced by memory for both physical and lexical information. This two-source account, however, is inconsistent with the view offered by

Feustel et al. (1983) which states that the equal facilitation found for words and nonwords is due to memory for specific physical (letter) representations. The faster identification times for words was attributed to their lexical status, but this was independent of facilitation. Moreover, recent evidence provided by Salasoo et al. (1985) demonstrated equivalent identification times for both words and nonwords after just five repetitions, suggesting the formation of a unitized code for nonwords in lexical memory. Thus, "lexical" status is seen as having little influence on repetition effects.

There are two inherent problems with the explanations put forth by Kirsner et al. (1983) and Feustel et al. (1983) in explaining repetition effects. First, although the two-source account of Kirsner et al. (1983) explains the influence of encoding modality on word repetition, it does not indicate whether these sources are linked or connected in any manner. It is therefore possible that facilitation in word repetition can involve only the lexical system, which suggests that there should be no differences between modality-specific and cross-modal memory using words. However, this is not supported by empirical findings. On the other hand, the model proposed by Feustel et al. (1983) is entirely consistent with a physical basis for repetition effects, but is not able to accommodate cross-modal facilitation. That is, their model does not indicate whether stored, episodic images are based on physical features independent of presentation modality, or whether they are specific to the physical properties of the receiving sensory system.

I propose an explanation of word repetition effects that accounts for these discrepancies. The model is based on an adaptation of Forster's (1976) account of word recognition. In his model, word identification entails access to both peripheral and master files, in which the former are organized along physical dimensions. The master file is modality-free, and contains all the entries in the lexicon. Access to this master file can only occur by engaging one of the peripheral files which are linked to their corresponding entries in the master file.

I suggest that different peripheral files receive and accumulate information from specific sensory receptors. Thus, different peripheral files are sensitive to visual and auditory information. I also argue that these files have direct routes (i.e., connections) to their entries in the master files. Such an account of modality-specific processing routes was described by LaBerge and Samuels (1974). An additional feature of these modality-specific files relates to their mutual exclusivity. That is, I propose that any damage that affects the functional integrity of a modality-specific access file does not inhibit nor impede the normal functioning of the remaining peripheral file. I base this latter assumption on neuropsychological evidence demonstrating that impairment in word recognition can be modality-specific (i.e., alexia without agraphia and auditory-word agnosia) (Kertesz, 1983).

Facilitation in visual word identification can be explained by assuming that prior presentation of a word produces a memory representation for prior lexical access in both the peripheral and master files. Cross-modal facilitation is postulated to occur due to retrieval of a memory representation for prior access to a word's entry in the master file produced by prior auditory word recognition. On the other hand, the superiority of modality-specific repetition is attributed to the retrieval of memory representations in <u>both</u> peripheral and master files.

This account of repetition effects can also be used to explain the weak findings of orthographic facilitation reported by Feustel et al. (1983) by assuming that priming can occur between physically similar entries within the visual and auditory peripheral files. Such an example of physical priming between entries was demonstrated by Hillinger (1980) using a two-word lexical decision task. He found that lexical decision latencies to targets in phonemically similar word pairs (e.g., PITCH-DITCH; EIGHT-LATE) were faster than word pairs having no phonemic similarity (e.g., VEIL-MATE). In addition, this phonemic priming was demonstrated even when the prime word was presented auditorily. The faster responses to phonemically similar word targets was interpreted to reflect priming between physically similar entries in peripheral access files. However, since evidence has shown that facilitation due to repetition is qualitatively different from the type of facilitation seen in traditional two word priming tasks (Dannenbring & Briand, 1982), the generalization of these findings to repetition effects remains unanswered.

The present study attempted to test the efficacy of this model with respect to repetition effects. A total of four separate experiments were conducted. Experiment 1 investigated the two-file memory hypothesis using intramodal and cross-modal presentations. In addition, Experiment 1 examined the issue of orthographic and phonemic priming within peripheral files using a word identification task. Experiment 2 examined the issue of priming between semantically and associatively related words in the master file, whereas Experiment 3 investigated the sensitivity of memory for prior lexical access to retention interval. Finally, Experiment 4 attempted to determine whether facilitation in word repetition is due to memory for prior access to a specific lexical entry in the master file by repeating homographs in a lexical decision task.

Experiment 1

The purpose of Experiment 1 was to examine the contribution of encoding modality and physical word structure to repetition effects. One unresolved issue in word repetition concerns the type of stimulus information that serves to enhance memory using perceptual identification tasks. Previous empirical findings have suggested that repetition effects are mediated, in part, by the similarity of physical features among words (Feustel et al., 1983; Jacoby, 1983a; Jacoby & Dallas, 1981). These studies, however, did not provide a systematic examination of the contribution of physical similarity to repetition effects.

A second issue of related interest concerns the presence of cross-modal repetition. Previous investigations have produced conflicting results regarding the influence of prior auditory encoding on later visual-word identification (Clarke & Morton, 1983; Jacoby & Dallas, 1981; Kirsner & Smith, 1974; Kirsner et al., 1983). However, if repetition effects can occur cross-modally, it remains to be demonstrated whether such transfer can occur at the physical feature level.

The present experiment attempted to address these two issues with respect to the two-file model of word repetition. Priming between similar orthographic and phonemic entries within the visual and auditory peripheral files was examined by having subjects study words that were similar to test words in both orthography and pronunciation. The separation of these two surface characteristics afforded a closer examination of their contribution to enhanced word identification compared to previous studies (Feustel et al., 1983; Jacoby & Dallas, 1981). On the other hand, within-subject manipulation of study modality serves to evaluate the presence of cross-modal transfer as well as determine whether such transfer can occur at the physical feature level.

Method

Subjects. Fifty-four undergraduate psychology students at the University of Victoria volunteered to serve as subjects in the experiment. All reported normal to corrected-to-normal vision and hearing and were native speakers of English.

Stimulus Materials. A master list of ninety primary words was constructed. The master list was developed in such a manner that for every primary word it was possible to generate three types of derived words that were similar to primary words. One list of derived words was composed of words that were orthographically and phonemically similar to primary words (e.g., couch-pouch). A second list consisted of words that were orthographically but not phonemically similar to primary words (e.g., couch-touch). The third list consisted of the same words which made up the primary list (e.g., couch-couch). These derived word lists constitute three conditions of surface similarity to primary words, respectively: Orthographic + Phonemic, Orthographic, and Identical. A majority of the primary and derived words were taken from Meyer, Schvaneveldt, and Ruddy (1974), Glushko (1979), Hillinger (1980), Rockey (1973), and Tanenhaus, Flanigan, and Seidenberg (1980). The primary and derived word lists of Experiment 1 are presented in Appendix 1.

Design. The experiment involved a mixed factorial design with two factors. The between-subjects factor was type of study list (Identical, Orthographic + Phonemic, or Orthographic). Eighteen subjects were randomly assigned to each of the three list conditions. The within-subjects factor was modality of study (visual and auditory).

Apparatus. Presentation of visual stimuli was controlled by an Apple II plus microcomputer interfaced with a Zenith display monitor. All stimuli were presented in lower-case letters. In addition to the display monitor, a 3-button response box was positioned in front of each subject who viewed the monitor from a distance of approximately 50 cm.

The auditory version of the presentation task was recorded and played back on a Revox, high-fidelity, reel-to-reel tape player and presented over Tenco TSIS-250 8 ohm headphones.

Procedure. Subjects were individually tested in a small, quiet room. Experiment 1 employed a study-test format. In the encoding phase of the experiment, subjects were instructed to rate single words presented visually and auditorily according to their perceived "pleasantness" on a three point scale (low, medium, high). Subjects were told to make their ratings based on the word's meaning rather than on their surface characteristics. This encoding procedure was used in order to prevent subjects from becoming aware that their memory for study words would be later tested.

The ninety derived words for any study list were divided into three sublists of thirty words each. Sublists of words in each list were presented for study: 30 in the visual modality and 30 in the auditory modality. The remaining 30 words were not shown during the encoding phase. Assignment of sublists to presentation condition (visual, auditory, none) was counterbalanced across subjects. All words presented in one modality were shown in one block and words in the other modality were presented in another block. Order of blocks was counterbalanced across subjects.

For visual encoding, each subject read a set of instructions displayed on the computer monitor and initiated the study phase by pressing a specified key on the response box. A word which was <u>one</u> of three types (Identical, Orthographic + Phonemic, Orthographic) was then displayed for 2500 ms followed by a 1500 ms interval in which time subjects made their pleasantness ratings.

Auditory encoding was similar to visual study except that subjects heard words presented binaurally over stereo headphones. Interstimulus interval was approximately 4000 ms.

In the test phase, subjects were administered a visual-perceptual identification task consisting of all ninety primary words; two-thirds of which were previously studied as derived words in the visual and auditory modalities and the remaining 30 words whose corresponding derived words were not presented for study. The identification times to these "new" words served as a baseline for estimating the size of repetition-priming effects.

The test of word identification was similar to the technique used by Feustel et al. (1983) and followed the study phase by a short (approximately 60 s) time interval. The identification task began with a display of instructions that explained the nature of the task to each subject. After pressing a specified response key, a "Ready" signal appeared in the middle of the screen which preceded each experimental trial. By pressing the same key, an experimental trial began with the display of a random dot mask-pattern equal in length to a 20-character string. Each presentation of a word and mask was called a cycle and lasted for 100 ms. Due to the display characteristics of the monitor, the initial exposure duration was approximately 16 ms. A complete cycle consisted of the presentation of a word for duration x ms followed by a mask lasting for 100-x ms. This word-mask cycle was presented four times, with the exposure duration for words nominally increased in 2 ms increments for each new set of 4 cycles up to a maximum of thirty steps. Actual change in duration varied due to the refresh cycle of the monitor, but in the whole the duration generally increased with x. The subjective appearance of the visual display was one of a rapidly flickering row of changing dot patterns out of which a word gradually emerged. Subjects were required to press the middle response key as soon as they could identify the word. Following a response, the word disappeared and response time was recorded by the computer. Guessing as a strategy was strongly discouraged. This procedure allowed for the estimation of processing time (latency) for word identification. Using this technique, word identification should be close to 100% and was checked by having subjects write identified words on a response sheet. Only correct spellings (responses) were accepted and included for later statistical analysis. An entire experimental session lasted approximately 30-40 minutes.

Results

Since the presence of repetition effects were determined by comparing identification times of old and new words, the major focus of statistical analysis utilized difference scores (new-old) as the dependent variable. In this manner, analysis of significant repetition effects for any experimental condition could be evaluated against a true zero point. In all analyses, a significance level of .05 was adopted.

An initial analysis found no effects of order of study modality (AV vs. VA) so subsequent analysis of reaction time and accuracy data was collapsed across this factor.

<u>Difference Score Analysis</u>. Table 1 presents the mean response and facilitation times in word identification for each combination of encoding modality and similarity list. Analysis of the facilitation scores for each subject with modality and study list as factors revealed a main effect of encoding modality, $F(1,51) = 9.12$, $MSe = .470$. Thus, prior visual study produced faster identification times than did auditory study across the three similarity conditions. There was also a main effect of similarity list, $F(2,51) = 31.6$, $MSe = 1.33$. Inspection of Table 1 reveals that facilitation in the Identical condition was vastly superior compared to the Orthographic + Phonemic and Orthographic conditions. This was further verified by performing separate ANOVA's testing the significance from zero of facilitation for each similarity condition. The only significant finding was that the facilitation in the Identical condition was different from zero, $F(1,17) = 58.1$, $MSe = 2.17$. Moreover, while visual study produced greater facilitation than auditory study in the Identical condition, $F(1,17) = 9.66$, $MSe = .381$, separate ANOVA's revealed that facilitation reaction times in both the visual, $F(1,17) = 89.53$, $MSe = .97$, and the auditory conditions, $F(1,17) = 27.34$, $MSe = 1.59$, were

significantly different from zero.

Accuracy Data. Table 2 presents the accuracy scores in word identification. Accuracy scores were high and uniform across all conditions. A 3 X 3 mixed factorial ANOVA did not reveal any significant effects.

Discussion

The results of Experiment 1 are consistent with previous reports (Feustel et al., 1983; Jacoby & Dallas, 1981; Jacoby & Witherspoon, 1982; Kirsner et al., 1983) that prior presentation of a word can facilitate its later identification in a perceptual task. This facilitation was observed only when identical words were studied during visual and auditory encoding. There was no facilitation of test words that shared similar orthographic and phonemic and orthographic structure to study words. These findings suggest two conclusions. One is that repetition effects appear to be due to memory for prior access to a word's entry in a modality-specific and modality-free lexical file. The other conclusion is that the lack of any facilitation in word identification between physically similar words in intramodal repetition suggests that priming does not occur between entries in the visual-peripheral file.

The absence of any intramodal transfer across the physical feature level in Experiment 1 runs contrary to the findings reported by Feustel et al. (1983). They showed that perceptual identification of a word was marginally facilitated by a previous presentation of an orthographically similar word. The reason for this discrepancy may lie in the type of task used to assess repetition memory. Feustel et al. (1983) employed a continuous perceptual identification procedure while the present experiment used a study-test format. Whatever the reasons for this discrepancy, the results from Experiment 1 suggest that the memory for physical and lexical information is highly specific.

A second major finding from Experiment 1 concerns the presence of significant cross-modal repetition effects. This supports the claim that cross-modal repetition is due to memory for prior access to a word's entry in the master file. As in intramodal repetition, there was no transfer across to physically similar words using cross-modal presentations. This finding suggests that priming between physically similar entries does not occur within the auditory-peripheral file. In addition, while there was significant cross-modal transfer in the Identical condition, it was nevertheless inferior to modality-specific transfer (Clarke & Morton, 1983;

Kirsneret al., 1983; Kirsner & Smith, 1974;), supporting the view that intramodal repetition is due to the memory for prior access to a word's entry in a modality-specific and modality-free lexical file.

While recent empirical evidence has supported cross-modal transfer (Clarke & Morton, 1983; Kirsner et al., 1983), other studies have not (Jacoby & Dallas, 1981; Jacoby & Witherspoon, 1982). There are two possible explanations for this discrepancy. One possibility is methodological in nature. Jacoby (1983a) has shown that changing the proportion of critical test items presented across repetitions reduces perceptual identification performance. Thus, list context may be an important variable in word repetition studies. It may be that cross-modal transfer is maximized by using within-subjects designs since initial list context (e.g., auditory & visual study) would provide more processing overlap with a later test of visual-word identification than a between-subjects (auditory study-visual test) design. Indeed, Jacoby and Dallas (1981) employed a between-subjects design which may explain the lack of cross-modal transfer observed in their experiment. A second possibility may be that subjects relied on conscious retrieval strategies during cross-modal transfer. Reliance on such a strategy may have involved elaborative processing enabling subjects to use word meaning as a basis for remembering (Mandler, 1980). This issue of conscious remembering in word repetition was further examined in Experiment 2.

Experiment 2

The purpose of Experiment 2 was to determine whether the facilitation in word identification observed in Experiment 1 was due to the use of conscious remembering. One way to evaluate this claim is to see if effects in word repetition transfer to words of similar meaning. The use of conscious retrieval strategies would be expected to facilitate transfer to semantically related words (i.e., canine-dog) since memory would be based on meaning as opposed to physical structure. This hypothesis suggests that priming may occur between semantically or associatively related words in the modality-free, master file.

The premise that repetition effects are mediated by conscious remembering was tested by having subjects study words that were either high associates (cat) or synonyms (canine) to test words (dog). A second aspect of Experiment 2 examined the role of encoding modality in repetition effects using semantically related words. If effects in repetition memory are determined, in part, by conscious retrieval of semantic information, then encoding modality should have little influence on word identification latencies since any enhanced memory for semantic material would be due to priming between entries in the modality-free, lexical file.

In addition to varying the type of semantic information presented across repetitions, Experiment 2 also included an Identical condition in order to replicate the intramodal and cross-modal transfer effects observed in Experiment 1.

Method

Subjects. Fifty-four undergraduate students enrolled in a psychology course at the University of Victoria volunteered to participate in the experiment. All subjects reported normal to corrected-to-normal vision and hearing and were native speakers of English. None of the subjects participated in Experiment 1.

Stimulus Materials. A new master list of ninety words was constructed. As in Experiment 1, three lists of derived words were developed from the primary list to serve as study items. One list consisted of Identical words. The second list consisted of high (semantic) associates to each of the primary words.

These high associates were selected from the word lists presented in Postman and Keppel (1970). The high associates were stimulus items from the Postman and Keppel norms, and the primary words were the most frequently reported response items. The third derived word list consisted of synonyms to primary words. The synonyms were obtained using Webster's New World Thesaurus (Laird, 1974). These derived word lists constituted three conditions of _semantic_ similarity to primary words: Identical, High Associate, and Synonym. The primary and derived lists for Experiment 2 are presented in Appendix 2.

Design. The experiment involved a mixed factorial design with two factors. The between-subjects factor was type of study list (Identical, High Associates, or Synonyms). Eighteen subjects were randomly assigned to each of the three list conditions. The within-subjects factor was modality of study.

Apparatus. This was identical to that used in Experiment 1.

Procedure. The procedure was identical to that used in Experiment 1.

Results.

As in Experiment 1, the major focus of statistical analysis utilized difference scores (new-old) as the dependent variable. In all analyses, a significance level of .05 was adopted.

An initial analysis indicated no significant effects of order of study modality so the reaction time and accuracy data were collasped across this factor.

Difference Score Analysis. Table 3 presents the mean identification and facilitation times for each combination of study modality and similarity list. An ANOVA with modality and study list as factors revealed no difference in facilitation times between visual and auditory study across the three similarity lists ($F<1$). However, there was a significant effect of similarity list, $F(2,51) = 14.02$, $MSe = 1.35$. Inspection of Table 3 indicates that facilitation in the Identical condition was greater compared to the High Associate and Synonym conditions. The only significant finding was that facilitation in the Identical condition was different from zero, $F(1,17) = 19.57$, $Mse = 2.79$. The facilitation times for the High Associate and Synonym conditions were not significantly different from zero.

Accuracy Scores. Table 4 presents the accuracy scores in word identification. A 3 X 3 mixed factorial ANOVA revealed a main effect of study modality, $F(2,102) = 3.47$, $MSe = 9.99$. Post-hoc analyses revealed that prior visual study yielded greater accuracy (97.5%) than either auditory study (96.1%) or "new" words (96.1%). The higher accuracy in word identification for the visual study condition may account for the lack of a modality effect found in the Identical facilitation data. There were no other significant effects with respect to accuracy scores.

Discussion

The results of Experiment 2 are not consistent with the view that the repetition effects were mediated by conscious memory processes. This was supported by the finding that repetition effects do not transfer to semantically related stimuli. Similar results were demonstrated by Kirsner, Smith, Lockhart, King, and Jain (1984). In their study, prior presentation of a word did not facilitate later lexcial decision to its synonym. Therefore, the absence of any transfer using semantically related words in the present experiment indicates that there is no priming between semantically related entries in the master file.

The significant intramodal and cross-modal facilitation observed in the Identical condition replicates the results from Experiment 1. In addition, the failure to replicate the superiority of intramodal repetition may be due to a small speed-accuracy tradeoff when presentation modality was held constant across repetitions. Together with the null effects of physical similarity observed in Experiment 1, the findings reported thus far strongly support the view that memory for prior access to an entry in both the peripheral and master files is highly specific.

While the results of Experiment 2 appear to rule out the use of conscious memory strategies, Experiment 3 was conducted in order to provide an additional and perhaps more sensitive evaluation of the role of conscious retrieval to repetition effects.

Experiment 3

Previous studies have demonstrated the persistence of intramodal repetition effects over long retention intervals using tasks such as perceptual identification (Jacoby, 1983a; Jacoby & Dallas, 1981), lexical decision (Scarborough et al., 1977), word-fragment completion (Tulving et al., 1982), and reading of transformed typography (Kolers, 1976). These long-term repetition effects have been interpreted as reflecting an episodically-based perceptual memory that is independent of the type of conscious remembering that serves to support recognition memory (Jacoby, 1983a; Jacoby & Witherspoon, 1982). Findings that recognition memory decreases with increasing retention interval (see Tulving et al., 1982) supports the view that repetition effects are mediated by memory processes that are unavailable to conscious awareness. If prior auditory study can serve to facilitate later visual-word identification over a 24 hour interval, it would be inconsistent with the claim that cross-modal transfer effects are mediated by conscious memory.

Method

Subjects. Eighteen University of Victoria undergraduate students enrolled in a psychology course volunteered to participate in the experiment. All reported normal to corrected-to-normal vision and hearing and were native speakers of English. None of the subjects participated in Experiments 1 and 2.

Stimulus Materials. Words from the Primary and Identical word lists from Experiment 1 were used as stimuli.

Design. The experiment involved a completely within design with two factors. One factor was type of study list (Identical). Modality of study (visual and auditory) was the other within-subjects factor.

Apparatus. This was identical to that used in the previous experiments.

Procedure. The procedure was identical to that of Experiments 1 and 2 except that a 24-hour delay between the study and test phase was introduced. Subjects studied words that were identical to test (primary) words. Following visual and auditory encoding, subjects were instructed to come back in 24 hours. Upon return, they were administered the test of perceptual identification. In addition, a modification of the identification task was made by reducing the number of word-mask cycles from four to two and increasing the number of maximum steps to fifty. The result of this change allowed test words to emerge more quickly.

Results

As in Experiments 1 and 2, the main statistical analysis utilized difference scores (new-old) as the dependent variable. A significance level of .05 was adopted for all statistical analyses.

Difference Score Analysis. The mean identification and facilitation times are presented in Table 5. An ANOVA with modality as the independent variable showed that the main effect of encoding modality was significant, $F(1,17) = 6.33$, $MSe = .06$, with prior visual study yielding a 206 ms repetition advantage over auditory encoding. Despite this superiority of intramodal repetition, facilitation scores in both the visual , $F(1,17) = 14.37$, $MSe = .31$, and the auditory conditions, $F(1,17) = 8.83$, $MSe = .17$, were greater than zero.

Accuracy Scores. Table 5 presents the mean accuracy scores in word identification. There was no significant effect of encoding modality on word identification accuracy.

Discussion

The major result of Experiment 3 was that prior auditory study facilitated later visual-word identification over a 24-hour interval. This is the first time that long-term facilitation has been demonstrated using cross-modal presentations and parallels previous findings using intramodal repetition (Jacoby, 1983a; Jacoby & Dallas, 1981). In addition, the long-term persistence observed for both intramodal and cross-modal repetition is consistent with the claim that this facilitation is mediated by implicit memory processes (Jacoby & Dallas, 1981; Jacoby & Witherspoon, 1982).

Of related importance was that maintaining presentation modality across repetitions produced a 206 ms advantage in word identification latency. This modality-specific superiority in long-term word repetition is consistent with previous findings using immediate (i.e., no delay) presentations (Kirsner et al, 1983; Kirsner & Smith, 1974). The results from Experiment 3 support the view that the memory for prior access to a word's entry in the peripheral and master file remains available over at least a 24-hour retention interval.

Experiment 4

The purpose of Experiment 4 was to provide further evidence that repetition effects are due to memory for prior access to specific lexical entries in the master file. One way to examine this hypothesis is to repeat homographs in a lexical decision task. Homographs represent a class of ambiguous words that share identical surface structure yet have multiple meanings. This unique characteristic of homographs has led to their wide use in studies examining the structure and organization of the lexicon (Rubenstein, Garfield, & Millikan, 1970; Simpson, 1984).

Simpson (1984) has reviewed the lexical ambiguity literature in great detail and was led to the conclusion that homograph recognition involved the initial activation of all meanings, with the subsequent access and selection of individual meanings being determined by the presence of such factors as context and meaning dominance. For example, a study by Seidenberg, Tanenhaus, Leiman, and Bienkowski (1982) showed that selective access to a particular homograph meaning was enhanced by preceding the homograph with a related lexical prime. In addition, this context-dependent access was found to be dependent on the type of homograph used, with only noun-noun homographs exhibiting selective access.

Simpson and Burgess (1985) examined the time course of homograph activation by focusing on the influence of meaning dominance. Their results suggested that homograph recognition occurs in two stages, with the first stage entailing the activation of all homograph meanings, and retrieval of individual meanings in the second stage being sensitive to meaning dominance. Thus, following initial activation, selective access proceeds to the more frequent and dominant meaning with the simultaneous inhibition of subordinate meanings.

These findings suggest that there may be separate entries for individual homograph meanings in the lexicon. While many studies have attempted to examine the lexical organization of homographs, no study has yet investigated the specificity of homograph recognition with respect to <u>memory</u> for prior access to meaning. The present experiment attempted to investigate memory for homographs by repeating them in a lexical decision task. A lexical decision task was used in lieu of word identification because it was necessary to use procedures that required relatively fast response decisions in order to maximize selective access to meaning. In this respect, the lexical decision task is the preferred experimental procedure (see Simpson, 1984). An attempt was made to access specific meanings by preceding homographs with related context words. These context words were used to bias homographs toward a same or different meaning on a repeated trial. Therefore, if repetition effects are due to memory for prior access to a specific lexical entry, then biasing the same meaning across homograph presentations should yield greater facilitation compared to when the same homograph is repeated yet biased towards a different meaning on the repeated trial. On the other hand, if repetition effects are due to memory for a previously presented perceptual pattern (Carroll & Kirsner, 1982), then context should have little effect on lexical decision times. In addition, a yes/no recognition memory test was included in the experiment in order to verify the reported dissociation between repetition effects and recognition memory (Jacoby & Dallas, 1981; Jacoby & Witherspoon, 1982; Scarborough et al., 1977).

Method

Subjects. Twenty-four undergraduate students attending the University of Victoria volunteered to participate in the experiment. All reported normal to corrected-to-normal vision and were native speakers of English. None had participated in the previous experiments.

Materials. Sixty noun-noun homographs were selected to serve as critical target items in the lexical decision task. Noun-noun homographs were selected because empirical findings have demonstrated that they yield selective access to meaning when preceded by lexical primes (Seidenberg et al., 1982). The homographs were taken from Wollen, Cox, Coahran, Shea, and Kirby (1980), Nelson, McEnvoy, Walling, and Wheeler (1980), Gorfein, Viviani, and Leddo (1982), Yates (1982), Holley-Wilcox and Blank (1980), and Schvaneveldt, Meyer, and Becker (1976). In addition, for each critical homograph (e.g., organ), two sets of context words were selected that biased the interpretation of the homograph toward each of its two meanings. Two of the context words (context set 1) biased interpretation to one of the meanings (e.g., piano-organ; music-organ) while the other two context words biased the interpretation toward the other meaning (e.g., <u>transplant</u>-organ; <u>heart</u>-organ). The list of the homographs and their associated context sets are presented in Appendix 3.

<u>Design</u>. The experiment involved a completely within-subjects factorial design with two factors. The two factors were homograph presentation (1 and 2) and type of context relationship across presentations (repeated, same meaning, and different meaning). In certain analyses, homograph dominance (high/low) was treated as a factor. Dominance was determined using norms provided by Wollen et al. (1980), Nelson et al. (1980), and Gorfein et al. (1982).

<u>Apparatus</u>. All stimuli were presented on a Zenith display monitor interfaced with an Apple II plus microcomputer. Context words were presented in upper-case letters while target homographs were presented in lower-case letters. Collection of reaction time and response accuracy data was controlled by the microcomputer.

<u>Procedure</u>. Subjects were individually tested in a small, quiet room. The experimental session consisted of a lexical decision task followed by a recognition memory test.

The lexical decision task consisted of 360 trials: Sixty context-homograph pairs presented twice (N=120); 60 semantically and associatively related context-target word pairs presented once (N=60); 60 word-nonword pairs presented once (N=60); and sixty word-nonword pairs presented twice (N=120). Of these latter pairs, one third (N=20) repeated the same context word across repetitions (e.g., HAVE-reba; HAVE-reba) while the remaining 40 pairs used a different context word on the second presentation (e.g., SHIRT-kalt; DIGITAL-kalt). Thus, critical homographs constituted 33% of the total critical trials. Ten practice trials (5 word-word pairs and 5 word-nonword pairs) preceded the formal lexical decision task.

With respect to trials involving homographs, the repeated context condition involved the identical context word at each presentation (e.g., piano-organ; piano-organ). In the same context condition, homographs were biased toward the same meaning using different context words (e.g., piano-organ; music-organ). Finally, in the different context condition, homographs were biased toward a different meaning on the second presentation using a different context word (e.g., piano-organ; transplant-organ). Thus, initial homograph meaning was sustained across repetitions in the repeated and same conditions, while homograph meaning was changed in the different condition.

The 60 critical homographs were divided into three sets of 20. Assignment of context type (repeated, same, and different) to each homograph set, the homograph meaning to be biased on the first presentation (context set 1 or 2), and the initial context word (context word 1 or 2 within each context subset) were counterbalanced across subjects. Within each set of 20 homographs, the context word on the first presentation of ten homographs biased the dominant meaning and the other ten homographs were biased toward their subordinate meaning.

A master list was constructed that specified the trial number of each 120 critical and 240 filler trials. Homographs were randomly assigned to the 120 slots for each subject with the restriction that the lag between homograph repetition be 15 items (see Scarborough et al., 1977). The lag between repeated filler words was variable, ranging from 1 to approximately 300 items.

Each trial of the lexical decision task consisted of the following sequence. A series of crosses (++++++) appeared at the center of the display monitor for 500 ms. A blank field was then displayed for 500 ms followed by the presentation of a context word for 1000 ms. Following a blank 100-ms interval, a target word (i.e., homograph, nonhomograph, or nonword) was presented and remained on the screen until the subject made a response. Subjects were instructed to decide as quickly and accurately as possible whether the target item was a real English word by pressing either the "Yes" or "No" button on a response box positioned in front of the display monitor. Reaction time was measured from the onset of the target item to the subject's response, up to a maximum of 2 s. A blank field was then displayed for 250 ms prior to the presentation of the next trial sequence.

Following trial 180, a message was displayed on the screen informing subjects that they could take a short rest. No initial homograph presentation occurred between trial numbers 166 and 180, inclusively. Upon pressing a response key, trial 181 was initiated.

Upon completion of the lexical decision experiment, subjects were administered a 10-minute distractor task that evaluated their knowledge of world geography. This distractor task was used to reduce recognition accuracy.

The final phase of the experiment consisted of a yes/no recognition memory test which immediately followed the geography test. The recognition test consisted of all 60 homographs plus 30 of the non-homographic filler target words along with 20 noun-noun homographs and 10 non-homographic foil words.

Targets and foils were presented in isolation on the display monitor until subjects made a response (yes/no) regarding the prior occurrence of the presented word. Recognition of a previously seen homograph presented in isolation would presumably require retrieval of all homograph meanings leading to independence between lexical decision performance and recognition memory. A typical experimental session lasted between 30-40 minutes.

Results

Reaction times to critical homographs were analyzed only when responses to both presentations were correct. Data for the homograph repetition and filler trials were analyzed separately. In all analyses, a significance level of .05 was used.

Homograph-Repetition. Table 6 presents the mean reaction times for first and second presentations of critical homographs. A 3 (context type) X 2 (presentation) within-subjects ANOVA revealed significant main effects of context, $F(2,46) = 17.25$, $MSe = 2{,}180.5$, and presentation, $F(1,23) = 131.55$, $MSe = 1{,}435.6$. There was also a significant interaction between context and presentation, $F(2,46) = 14.76$, $MSe = 1{,}624$. This interaction was due to the fact that the size of the repetition effect for the repeated context condition was 117 ms, compared to 72 ms and 28 ms for the same and different context conditions, respectively.

A more relevant analysis, however, concerns the comparison between the same and different context conditions. Although both repeat the same homograph using a pair of non-identical context words, only the same context condition biases the _same_ meaning across both presentations. Thus, a finding of a significant context X presentation interaction would support the claim that repetition effects are influenced by memory for prior access to a specific lexical entry.

A 2 (context) X 2 (presentation) ANOVA revealed a significant main effect of presentation, $\underline{F}(1,23) = 41.59$, $\underline{MSe} = 1{,}440$. Of more importance, however, was the significant interaction between context and presentation, $\underline{F}(1,23) = 5.34$, $\underline{MSe} = 2{,}169$. This interaction was due to the greater facilitation for the same context condition (72 ms) than the different context condition (28 ms).

Homograph Dominance. Analysis of the dominance factor focused on two comparisons. The first analysis involved lexical decision times for homographs in the different context condition. It compared reaction times on first presentation of homographs that were biased toward their subordinate meanings to reaction times on second presentation of homographs that were biased toward their subordinate meanings. The latter type of homograph represents the lexical decision time to a repeated homograph that was biased toward a dominant meaning on the first presentation. Thus, if retrieval of a memory representation for prior access to a specific lexical entry is responsible for speeded lexical decision, then there should be little difference in latencies between these two conditions. On the other hand, the perceptual hypothesis (e.g., Carroll & Kirsner, 1982) predicts a difference (i.e., a repetition effect), since facilitation would be based solely on memory for visual features. This analysis focused on the repetition effect after the first presentation biased the dominant meaning because it is unlikely that the subordinate meaning would have been accessed on the first presentation. The 28-ms repetition effect reported above for the different context condition probably was due to the access of both dominant and subordinate meanings on the first presentation when the subordinate meaning was biased.

The second analysis compared the mean response latencies to second presentation of homographs in the same context condition that were biased toward their subordinate meanings to second presentation reaction times for different context homographs that were biased toward their subordinate meanings on the second presentation. In both conditions, there is repetition of a perceptual pattern but meaning is only repeated in the same context condition. In this case, a perceptual hypothesis would predict no difference in response latencies in constrast to the lexical access hypothesis which predicts greater facilitation for the same context condition.

The analysis involving the two classes of homographs in the different context condition showed that there was no difference in mean response latencies to homographs biased toward their subordinate meanings on the first presentation and to homographs that were biased toward their subordinate meanings on the second presentation (618 ms vs. 611 ms, respectively), $\underline{F}(1,23) < 1.00$, $\underline{MSe} = 3{,}946$. On the other hand, in the ANOVA comparing homographs in the same vs. different conditions, there was a significant 49 ms difference between the mean reaction times to same context homographs biased toward their subordinate meanings on the second presentation and different context homographs that were biased toward their subordinate meanings on the second presentation (562 ms vs 611 ms, respectively), $\underline{F}(1,23) = 8.02$, $\underline{MSe} = 3{,}594$. These results strongly support the claim that repetition effects are due to memory for prior access to a specific lexical entry.

Homograph Accuracy. Table 7 presents the response accuracies for the three types of contextually-biased homographs. A 2 X 3 ANOVA revealed only a main effect of repetition, $F(1,23) = 6.09$, $MSe = 22.3$. Thus, response accuracies were significantly higher on the second presentation across the three context conditions. The accuracy data presented in Table 7 clearly indicate that the faster responses to repeated homographs were not due to a speed-accuracy tradeoff.

Filler Trials. The response times to first and second presentations for repeated nonwords were 695 ms and 668 ms, respectively. This 27 ms repetition effect was significant, $F(1,23) = 11.14$, $MSe = 799.8$. The response accuracy for repeated nonwords was 92.7% and 95.8%, for first and sceond presentations, respectively. Mean lexical decision time to filler word targets was 574 ms and the mean repsonse time for nonword targets was 702 ms. Response accuracy for filler word and nonword targets was 97% in both cases.

Recognition Memory. Table 8 presents the recognition scores for the three types of contextually-biased homographs. There was no difference between these recognition scores, $F(2,46) = 2.53$, $MSe = 74.2$, $p > .10$. Recognition accuracy for the non-homographic targets, homographic foils, and non-homographic foils are also presented in Table 8.

Lexical Decision Conditionalized on Recognition Memory. Table 6 presents the unconditionalized and conditionalized lexical decision latencies for each prime-homograph condition. Lexical decision response times conditionalized on correct homograph recognition in phase 2 were not faster than unconditionalized response times for the repeated, same, and different context conditions. Similarly, the size of the repetition effect for the conditionalized and unconditionalized data failed to reach significance in each of the three context conditions. This independence between lexical decision and recognition memory in homograph repetition suggests that the memory for prior access to a specific homograph meaning is implicit (Jacoby & Witherspoon, 1982).

Discussion

The results of the present experiment indicate that repetition effects are due to memory for prior access to a specific lexical entry in the master file. The repetition of a homograph facilitated that homograph's later lexical identifcation only when the homograph's biased meaning was the same on both presentations. Although there was facilitation in the different context condition when a homograph was biased toward its subordinate meaning on the first presentation, there was no facilitation when homographs were initially biased toward their dominant meanings. This indicates that there is no repetition effect when dominant meanings are initially accessed in the different context condition since subjects would not "think" of the subordinate meaning when it was biased on the second presentation. It appears that the mere repetition of a homograph has little effect on lexical memory. Had this not been the case, the significant context X presentation interaction between the same and different context conditions would not have been observed.

Additional evidence that repetition effects are due to memory for prior lexical access comes from the two analyses that focused on homograph dominance. Biasing a homograph in the different context condition toward its subordinate meaning on the second presentation did not produce faster lexical decision times compared to homographs that were biased toward their subordinate meanings on the first presentation. This suggests that the memory representation established for prior access to a homograph's dominant meaning was not useful when the homograph's subordinate meaning was biased on the repeated trial. On the other hand, when the subordinate meaning was biased on both presentations, as in the same context condition, lexical decision was facilitated due to the presence and retrieval of a pre-established memory representation for prior access to the homograph's subordinate meaning.

The large facilitation due to prior access to a specific homograph meaning strongly suggests that homographs have multiple entries in the master file that can be accessed independently from the peripheral file. It appears that the context activates a separate peripheral-to-master file "connection" that directs lexical access to the context-appropriate entry. As such, it is this memory for access to a specific entry in the master file, when repeated again, that facilitates lexical decision.

The lowered facilitation times observed when homographs were repeated using different context words is inconsistent with Carroll and Kirsner's (1982) claim that repetition effects in lexical decision are due to memory for a previously presented visual pattern. Contrary to their view, the degree of facilitation was highly dependent upon prior access to a specific homographic entry, since all three context conditions repeated the same visual pattern. Thus, while memory for surface structure may have some role in contributing to repetition effects (Jacoby & Dallas, 1981), it appears to be less important than the memory associated with accessing a specific lexical entry.

A final result of Experiment 4 concerns the observed independence between lexical decision and recognition memory for repeated homographs. This result is consistent with previous findings supporting the independence of repetition effects from the explicit forms of episodic memory that serve to mediate tasks like recognition and recall (Jacoby & Dallas, 1981; Scarborough et al., 1977). This independence between lexical decision and recognition memory in the present experiment suggests that the memory for prior access to a specific lexical entry is implicit.

General Discussion

The empirical findings from the four experiments support the two-file model of repetition effects described earlier. It appears that repetition produces a strong and durable facilitation in memory due to the establishment and retrieval of memory representations in both a modality-specific and modality-free file in the mental lexicon. These memory representations become established from a single exposure to a word presented in a specific encoding context. Thus, when a word is repeated, identification is facilitated due to its pre-established memory representation in both files.

An important aspect of the model that was supported by the experimental findings concerns the influence of encoding modality on repetition memory. As noted earlier, there has been disagreement as to what mechanisms or processes contribute to two findings in the repetition effect literature: The presence of facilitation in word identification and lexical decision using cross-modal presentations and the greater facilitation observed for intramodal repetition (Jacoby & Dallas, 1981; Kirsner & Smith, 1974; Kirsner et al., 1983). The present results are in agreement with the model's claim that access to a word's entry in the lexicon initially proceeds through a modality-specific processing system. Once the word has been located in this system and a memory representation for its access is established, then its corresponding entry in the modality-free, master file is located, accessed, and coded in memory to complete the identification process. The greater facilitation observed for intramodal compared to cross-modal repetition is attributed to the availability of memory representations in both the modality-specific and modality-free files. This means that cross-modal facilitation is due to retrieval of a previously established memory representation located in the modality-free file. This implies that the difference in facilitation for cross-modal and intramodal repetition is due to memory for prior access in one, as opposed to two, lexical files.

Two points need to be clarified with respect to this two-file model of repetition effects. First, it is emphasized here that identification of a word is viewed as requiring access to the word's entry in both files which are "linked" together in the lexicon. That is, for each word's single entry in the modality-specific file, there is a direct route to its location in the master file. This suggests that the multiple homographic entries in the master file are connected to a common or shared representation in the visual-peripheral file. A similar arrangement is assumed for the auditory-peripheral file. Second, as mentioned earlier, there can be no exchange of information between the modality-specific files. If such inter-file communication could occur, then there should have been no differences in identification times between visual and auditory study in the Identical conditions of Experiments 1 and 2. The fact that Jacoby and Witherspoon (1982) reported equivalent intramodal and cross-modal facilitation when they instructed subjects to orthographically encode auditorily presented words suggests that entries in the modality-specific file can be accessed by internally generating a word in the master file. However, there is no evidence to indicate that this form of "backward" lexical access occurs in the absence of specific encoding demands (see Kirsner et al., 1983).

Assuming that repetition effects represent retrieval of established memory representations in a modality-specific and modality-free interactive lexical system, then the absence of significant facilitation in Experiment 1 using orthographically similar words indicates that priming among physically similar entries does not occur <u>within</u> peripheral files. This view does not conflict with the results of Feustel et al. (1983), however, since they only showed weak and nonsignificant orthographic transfer effects. Moreover, prior presentation of a word did not facilitate later identification of the word's synonym (Experiment 2) indicating that "priming" cannot occur between semantically related entries in the modality-free, master file. I do not suggest, however, that such within-file priming cannot take place, since both physical (i.e., phonemic; LATE-EIGHT) (Hillinger, 1980) and semantic (i.e., NURSE-DOCTOR) (Meyer & Schvaneveldt, 1971) facilitation have been demonstrated using a two-word lexical decision task. I merely wish to indicate that these latter forms of facilitation are short-lived and have been shown to be qualitatively different from the specific type of long-term facilitation that characterizes repetition effects (Dannenbring & Briand, 1982; Kirsner et al., 1984).

The long-term facilitation observed in Experiment 3 for the visual and auditory encoding conditions is consistent with previous findings that demonstrated the relative insensitivity of repetition memory to retention interval and item-lag effects (Feustel et al., 1983; Jacoby, 1983a; Jacoby & Dallas, 1981; Scarborough et al., 1977; Tulving et al., 1982). Of particular interest was the finding that this long-term facilitation occurred even in cross-modal repetition. In addition, although the design of Experiment 3 did not permit an evaluation of the time course of memory loss for prior lexical access, the results indicate that the memory representations in both peripheral and master files remain available over substantial time periods.

Perhaps the most important result of the study concerns the findings from Experiment 4. The major result of repeating homographs in a lexical decision experiment was that although mere repetition facilitated later homograph identification, the degree of facilitation due to repetition was highly dependent on memory for prior access to a <u>specific</u> meaning. Thus, greater facilitation in lexical decision latencies was observed when the same homograph meaning was primed on both presentations compared to when different meanings were primed. This memory for a specific lexical entry was supported by the significant context X presentation interaction involving the same and different context conditions. The facilitation for the same context condition was 72 ms compared to the 28 ms facilitation in homograph repetition using different meanings. Moreover, this enhanced memory for a specific lexical entry was independent of recognition memory, indicating, as in other repetition studies, that this form of memory is implicit (Jacoby & Witherspoon, 1982).

The results from the homograph repetition experiment indicate that homographs have multiple entries in the modality-free, master file which can be selectively accessed and entered into memory. It is assumed that the establishment of a memory representation for a specific homographic entry in the master file is facilitated by the "engagement" of a specific connection linking the peripheral file to the master file. This means that each homographic entry has its own separate connection to the homograph's single entry in the visual or auditory peripheral file.

The results from Experiment 4 also provide evidence as to the role of context in lexical access. Selective access theories (Schvaneveldt, Meyer, & Becker, 1976) see the role of context as ensuring that only the homographic entry that is related to the context is accessed. This context-dependent access is compared to the view taken by Simpson (1984) and Warren, Warren, Green, & Bresnick (1978) that all entries of a homograph are initially accessed and that the effect of prior context is to select the context-appropriate entry after such access. The large effects of context on homograph identification in

Experiment 4 indicate that although all entries may be automatically activated, only the interpretation related to the context word is selectively accessed and stored in memory. In this respect, the results of Experiment 4 generally support context-dependent access to homographs (see Seidenberg et al., 1982, Experiment 2 and also Simpson, 1984).

Given the evidence that repetition effects appear to be due to memory for a specific lexical entry, it is interesting to note that previous research also has examined the effects of the number of meanings associated with a word on other cognitive processes. For example, Jastrzembski (1981) demonstrated that lexical access was faster for words having many meanings compared to words with few meanings. Rubenstein, Garfield, and Millikan (1970) found that in a lexical decision task, homographs were identified faster compared to nonhomographs. These findings suggest a major influence for the number of meanings associated with a particular word on lexical access and should be considered in any future investigation of repetition effects.

How does the two-file model compare with other explanations of the repetition effect? The model is in many ways similar to existing explanations of repetition effects. For example, Jacoby's (1983a) view that repetition effects are due to memory for prior processing episodes is consistent with the model in that processing can be seen as establishing a memory representation for prior access to peripheral and master file entries. The model of repetition effects proposed by Feustel et al. (1983) and Salasoo et al. (1985) can be modified to "fit" the two-file model by assuming that separate images can be stored in episodic memory for visual and auditory representations of the same word or nonword. In addition, their description of codes can be seen as reflecting lexical entries in the master file. Although Carroll and Kirsner (1982) claim that word meaning may play a minor role in word repetition, their view that facilitation is primarily perceptual in nature is inconsistent with the two-file model. Finally, the two-source model proposed by Kirsner et al. (1983) is perhaps the most similar to the two-file explanation of repetition effects. The only distinguishing difference between these two models is that Kirsner et al. (1983) claim that repetition effects are sensitive to two, separate sources of information (modality-specific and modality-independent), whereas the two-file model claims that repetition effects are determined by the retrieval of memory representations stored in an interactive lexical system comprised of modality-specific and modality-free entries.

In summary, the major findings from this study indicate that repetition effects are based on memory for prior access to a specific lexical entry. This memory is sensitive to the modality in which the word is presented at study and test. The results tentatively support a two-file explanation of repetition effects based on a modification of Forster's (1976) model of lexical access. Repetition effects are seen as being based on memory for prior access to modality-specific and modality-free entries in an interactive lexical system. Although the model has not been elaborated in great detail, it appears to account for a wide variety of findings in the repetition effect literature. The results of this study strongly suggest that memory for modality-specific processing and prior lexical access play an influential role in determining task performance with respect to word repetition.

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Appendix 1

Surface Word Lists for Experiment 1

Primary	Identical	Ortho/Phon.	Orthographic
couch	couch	pouch	touch
rough	rough	tough	dough
plays	plays	lays	says
match	match	latch	watch
bone	bone	lone	none
toes	toes	goes	shoes
grave	grave	gave	have
cork	cork	pork	work
maid	maid	paid	said
hand	hand	land	wand
tool	tool	fool	wool
steak	steak	break	weak
seat	seat	beat	great
road	road	load	broad
dome	dome	home	some
glow	glow	blow	plow
sour	sour	hour	tour
wives	wives	hives	gives
cross	cross	boss	gross
nut	nut	but	put
place	place	lace	palace
trash	trash	rash	wash
mad	mad	sad	wad
gather	gather	rather	father
few	few	new	sew
light	light	night	eight
sliver	sliver	liver	diver
bear	bear	pear	fear
mint	mint	tint	pint
tomb	tomb	womb	comb
cloth	cloth	moth	both
can	can	scan	cane
clasp	clasp	grasp	wasp
tooth	tooth	booth	smooth
ant	ant	pant	want
vague	vague	plague	league
hug	hug	rug	huge
sphere	sphere	here	where
lice	lice	mice	police
earth	earth	dearth	hearth
foot	foot	soot	boot
bread	bread	dead	plead
owl	owl	growl	bowl
vivid	vivid	livid	divide

leaf	leaf	sheaf	deaf
hood	hood	good	food
strip	strip	trip	stripe
tease	tease	ease	grease
evil	evil	weevil	devil
form	form	norm	worm
town	town	down	own
use	use	fuse	cause
vine	vine	line	ravine
arch	arch	march	search
roll	roll	toll	doll
sword	sword	cord	word
nose	nose	pose	lose
barn	barn	yarn	earn
seven	seven	eleven	even
post	post	most	lost
range	range	strange	orange
field	field	yield	weld
moose	moose	loose	choose
cater	cater	later	water
scare	scare	care	are
glove	glove	love	move
caper	caper	taper	diaper
rate	rate	hate	pirate
pull	pull	full	dull
child	child	wild	build
navy	navy	gravy	heavy
harp	harp	sharp	warp
hat	hat	that	what
bush	bush	push	rush
bit	bit	sit	bite
breath	breath	death	wreath
safe	safe	chafe	cafe
ever	ever	never	fever
rage	rage	page	garage
baked	baked	caked	naked
fast	fast	last	east
mouth	mouth	south	youth
end	end	bend	fiend
book	book	look	spook
power	power	tower	lower
wharf	wharf	dwarf	scarf
cart	cart	part	wart
hop	hop	shop	hope
daughter	daughter	slaughter	laughter
cub	cub	rub	cube

Appendix 2

Semantic Word Lists for Experiment 2

Primary	Identical	High Assoc.	Synonym
boy	boy	baby	lad
sleep	sleep	bed	nap
rug	rug	carpet	mat
cut	cut	scissors	slice
fear	fear	afraid	dread
nail	nail	hammer	spike
queen	queen	king	empress
fast	fast	slow	quick
lift	lift	carry	elevate
hard	hard	soft	rigid
army	army	soldier	troops
round	round	square	circular
hand	hand	finger	fist
find	find	lose	discover
stop	stop	whistle	halt
doctor	doctor	nurse	physician
law	law	justice	rule
bright	bright	star	shiny
mad	mad	angry	enraged
dirty	dirty	clean	unclean
rock	rock	boulder	stone
bottle	bottle	cork	jar
wet	wet	dry	damp
college	college	campus	university
friend	friend	enemy	comrade
gun	gun	shoot	pistol
boat	boat	harbor	ship
shape	shape	form	contour
horse	horse	pony	steed
disease	disease	germ	illness
money	money	nickel	cash
drug	drug	chemist	medicine
diamond	diamond	jeweler	gem
obey	obey	order	comply
servant	servant	maid	butler
knife	knife	dagger	blade
mist	mist	fog	haze
buy	buy	sell	purchase
bite	bite	mosquito	chew
status	status	prestige	rank
weak	weak	strong	feeble
strict	strict	stern	austere
insect	insect	spider	bug

grief	grief	sorrow	misery
animal	animal	tiger	beast
house	house	rent	home
burglar	burglar	thief	robber
country	country	cottage	nation
wide	wide	narrow	broad
ache	ache	stomach	pain
hot	hot	cold	warm
happy	happy	joy	ecstatic
mind	mind	memory	intellect
short	short	long	little
street	street	avenue	road
city	city	citizen	town
drink	drink	thirsty	sip
loud	loud	quiet	noisy
thin	thin	fat	lean
game	game	fun	contest
girl	girl	date	woman
answer	answer	question	response
deny	deny	refuse	disavow
scheme	scheme	plot	plan
method	method	device	routine
cookie	cookie	wafer	biscuit
area	area	region	territory
travel	travel	journey	tourist
sack	sack	burlap	bag
river	river	stream	creek
movie	movie	preview	film
dam	dam	beaver	dike
statue	statue	bronze	sculpture
far	far	away	distant
plane	plane	pilot	jet
smell	smell	garlic	stink
porch	porch	patio	veranda
desire	desire	need	wish
cripple	cripple	limp	lame
table	table	chair	desk
worry	worry	trouble	fret
grass	grass	green	lawn
peace	peace	war	harmony
pretty	pretty	ugly	attractive
dark	dark	light	gloomy
wife	wife	husband	spouse
night	night	day	evening
tense	tense	relax	nervous
car	car	truck	auto

Appendix 3

Critical Homographs and Context Words

for Experiment 4

Homographs	Context Set 1		Context Set 2	
bat	VAMPIRE	DRACULA	BASEBALL	STICK
spade	DIG	SHOVEL	ACE	CARD
cane	CRUTCH	LIMP	SUGAR	CANDY
cape	SHAWL	CLOAK	PENINSULA	OCEAN
horn	TRUMPET	BUGLE	ANTLER	TUSK
comapny	BUSINESS	CORPORATION	GUESTS	VISITORS
sap	SYRUP	RESIN	FOOl	DOLT
letter	ENVELOPE	MAIL	ALPHABET	VOWEL
tear	CRY	WEEP	RIP	CUT
chest	BODY	BREAST	DRAWERS	FURNITURE
star	ACTOR	MOVIE	ASTRONOMY	SUN
organ	TRANSPLANT	HEART	PIANO	MUSIC
bank	RIVER	SHORE	MONEY	TELLER
gas	METHANE	AIR	FUEL	PETROL
sentence	GUILTY	VERDICT	WORDS	PARAGRAPH
band	RUBBER	HAT	ORCHESTRA	QUARTET
earth	SOIL	DIRT	PLANET	WORLD
beam	RAFTER	CEILING	LIGHT	LASER
club	MALLET	CAVEMAN	ORGANIZATION	PRIVATE
nerve	BOLDNESS	COURAGE	NEURON	BRAIN
sense	COMMON	INTELLIGENT	TOUCH	HEAR
limb	LEG	ARM	TWIG	BRANCH
puzzle	CROSSWORD	JIGSAW	RIDDLE	MYSTERY
bar	TAVERN	SALOON	STEEL	POLE
pen	BALLPOINT	INK	CORRAL	PIG
plant	SHRUB	BUSH	FACTORY	REFINERY
palm	TREE	OASIS	WRIST	HAND
yard	DISTANCE	METER	LAWN	GRASS
ruler	INCH	MEASURE	PRESIDENT	KING
labor	WORK	UNIONS	PREGNANCY	CHILDBIRTH
top	TOY	SPIN	SUMMIT	MOUNTAIN
tank	CONTAINER	AQUARIUM	ARMY	WEAPON
speaker	MUSIC	STEREO	LECTURER	ORATOR
race	ETHNIC	NATIONALITY	RUNNER	MARATHON
range	PRAIRIE	CATTLE	OVEN	STOVE
nut	BOLT	WRENCH	ACORN	ALMOND
bass	TENOR	SOPRANO	FISH	TROUT
ball	DANCE	GALA	SPORT	SOCCER
model	FASHION	POSER	AIRPLANE	PLASTIC
nail	THUMB	FINGER	HAMMER	SPIKE
sage	GURU	PROPHET	SPICE	SEASONING

mass	CATHOLIC	CHURCH	VOLUME	SIZE
tablet	STONE	SLAB	PILL	ASPIRIN
cold	FREEZING	ICY	FLU	COUGH
vessel	SHIP	BOAT	JAR	CONTAINER
crane	MACHINE	HOIST	BIRD	SWAN
plot	CONSPIRACY	BOOK	BURIAL	CEMETERY
mold	FUNGUS	MILDEW	FORM	PATTERN
colon	COMMA	PUNCTUATION	STOMACH	INTESTINE
pupil	TEACHER	STUDENT	EYE	DILATED
iron	LAUNDRY	CLOTHES	METAL	STEEL
degree	TEMPERATURE	CELCIUS	DIPLOMA	GRADUATION
cell	BIOLOGY	NUCLEUS	JAIL	PRISON
mole	PIMPLE	WART	GOPHER	RODENT
squash	RACQUETBALL	RECREATION	VEGETABLE	PUMPKIN
growth	TUMOUR	CANCER	DEVELOPMENT	MATURATION
grain	SAND	SALT	WHEAT	CEREAL
coat	PAINT	LAYER	JACKET	SWEATER
calf	THIGH	LEG	COW	BULL
pipe	PLUMBER	FAUCET	SMOKE	TOBACCO

Table 1
Mean Identification Times (in seconds) and Facilitation in Word Identification in Experiment 1

	Study Modality			Facilitation	
Study List	Visual	Auditory	New	Visual	Auditory
Identical	3.61	4.25	5.80	2.19	1.55
	(2.64)	(2.42)	(2.97)	(.98)	(1.26)
Ortho/Phon	3.45	3.79	3.68	.23	-.10
	(2.47)	(2.70)	(2.50)	(.68)	(.80)
Orthographic	5.35	5.58	5.42	.06	-.16
	(3.05)	(3.28)	(3.29)	(.84)	(1.00)

Note. Ortho/Phon= Orthographic + Phonemic. Standard deviations in parentheses.

Table 2
Mean Accuracy Scores (in percent) in Word Identification in Experiment 1

	Study Modality		
Study List	Visual	Auditory	New
Identical	95.3	95.6	93.4
	(5.12)	(4.44)	(5.75)
Ortho/Phon	92.3	91.9	92.5
	(7.54)	(4.76)	(7.41)
Orthographic	93.4	95.1	92.9
	(6.28)	(3.70)	(5.56)

Note. Ortho/Phon= Orthographic + Phonemic. Standard deviations in parentheses.

Table 3
Mean Identification Times (in seconds) and Facilitation in Word Identification in Experiment 2

	Study Modality			Facilitation	
Study List	Visual	Auditory	New	Visual	Auditory
Identical	2.47	2.67	3.80	1.33	1.13
	(2.15)	(2.34)	(3.11)	(1.30)	(1.10)
High Assoc.	4.14	4.08	4.04	-.09	-.04
	(2.48)	(2.43)	(1.97)	(.52)	(.60)
Synonym	4.21	3.88	4.07	-.13	.18
	(2.09)	(1.97)	(2.16)	(.84)	(.67)

Note: High Assoc.= High Associates. Standard deviations in parentheses.

Table 4

Mean Accuracy Scores (in percent) in Word Identification in Experiment 2

	Study Modality		
Study List	Visual	Auditory	New
Identical	97	95.3	93.4
	(3.41)	(5.56)	(7.40)
High Assoc.	98.3	96.5	97.7
	(2.76)	(3.01)	(2.56)
Synonym	97.2	96.6	97.2
	(3.43)	(3.90)	(3.62)

Note. High Assoc.= High Associate. Standard deviations in parentheses.

Table 5

Mean Identification Times (in seconds) and Facilitation (in ms) in Word Identification in Experiment 3

	Study Modality			Facilitation	
	Visual	Auditory	New	Visual	Auditory
Reaction Time	1.98	2.19	2.48	496	290
	(.83)	(.97)	(1.10)	(555)	(410)
Accuracy	98	96.6	96		
	(3.20)	(5.09)	(5.09)		

Note. Standard deviations in parentheses.

Table 6
Mean Lexical Decision Latencies (in ms) for Contextually-Biased Homographs

	Presentation		
Prime Type	First	Second	Facilitation
Repeated	609 (626)	492 (487)	117 (139)
	(92.3)*	(85.1)*	
Same	630 (646)	558 (562)	72 (84)
	(89.0)*	(86.3)*	
Different	617 (618)	589 (568)	28 (50)
	(79.6)*	(96.2)*	

Note. Lexical decision conditionalized on correct recognition in parentheses. Standard deviations for unconditionalized reaction times marked by asteriks (*).

Table 7

Mean Lexical Decision Response Accuracies (in percent) for Contextually-Biased Homographs

	Presentation		
Prime Type	First	Second	Both
Repeated	95.6	98.1	94.4
Same	96	97.7	93.8
Different	95.4	97	93.1

Table 8

Recognition Scores (in percent) for Critical Homograph Targets, Non-Homograph Targets, Homograph Foils, and Non-Homograph Foils

	Prime Condition				
	Repeated	Same	Different	Homograph	Nonhomograph
Targets	84	86	89	-	57
Foils	-	-	-	88	80

VITA

Surname: FREEDMAN Given Names: Lawrence

Place of Birth: Los Angeles, California.

Date of Birth: November 27, 1954

Educational Institutions Attended:

UNIVERSITY OF CALIFORNIA SANTA CRUZ 1972 to 1976

RADFORD UNIVERSITY, RADFORD, VIRGINIA 1979 to 1981

UNIVERSITY OF VICTORIA, B.C. 1981 to 1985

Degrees, Diplomas Awarded:

B.A. 1976 UNIVERSITY OF CALIF. SANTA CRUZ

M.A. 1981 RADFORD UNIVERSITY

Honors and Awards:

University of Victoria Graduate Fellowship, 1981/82, 1982/83, 1983/84

Publications:

Snow, W.G., Freedman, L., & Ford, L. (in press). Lateralized brain damage, sex differences, and the Wechsler Adult Intelligence Scales: A re-examination of the literature. Journal of Clinical and Experimental Neuropsychology.

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MULTICOMPONENT ANALYSIS OF THE REPETITION EFFECT IN WORD IDENTIFICATION AND LEXICAL DECISION

Author Lawrence Freedman

LAWRENCE FREEDMAN

June 3,1985