Phonological recoding in reading of fluent bilinguals

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A Thesis

in

The Department

of

Psychology

Presented in Partial Fulfillment of the Requirements
for the Degree of Master of Arts at
Concordia University
Montréal, Québec, Canada

March 1985

Abstract

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The research reported in this thesis examined whether the slower second language reading rates of many fluent bilinguals could be attributed to a differential reliance on phonological codes in reading. Two different experimental tasks were used in each of two experiments. A lexical decision task examined the possibility of pre-lexical phonological recoding and a sentence verification task that of post-lexical phonological recoding. The first experiment was conducted with monolingual Anglophones and monolingual Francophones in order to investigate possible differences in reliance on phonological codes in reading as a function of the particular language being read. The second experiment was conducted with Anglophone bilinguals whose levels of reading comprehension were equivalent in their first and second language. Two groups of bilinguals were included: 1) bilinguals who read their first and second language equally fast (Criterion A) and 2) bilinguals who read their second language more slowly than their first (Criterion B). In the first experiment, it was found that language-specific factors influenced the extent to which phonological codes were implicated in lexical access during the reading of individual words. The results of the second experiment

revealed that when reading in the second language, Criterion B bilinguals, compared to Criterion A bilinguals, were more influenced by the particular characteristics of the language they were reading when single words were processed. When reading sentences for meaning in the second language, both groups of bilinguals phonologically encoded the words in the sentences. However, Criterion B readers were slower with such encoding processes, relative to Criterion A readers.

Acknowledgements

I wish to express my sincere appreciation to my thesis supervisor, Dr. Norman Segalowitz, for his advice and continuous support throughout this research and for his constructive comments during the writing of this thesis.

I am also grateful to Dr. Melvin Komoda, for his guidance at various stages of this research and for his insightful comments on an earlier draft of this thesis. I also wish to thank Dr. Diane Poulin-Dubois for her careful review of an earlier draft of this thesis.

My gratitude extends to Cathy Poulsen for her technical assistance and to Nicole Blake for her helpful comments on the characteristics of the French language.

This research was supported by a grant from the Quebec Ministry of Education (FCAC-EQ-1163) and the author was supported by fellowships awarded by the Natural Science and Engineering Research Council and the Bourse F.C.A.C pour l'aide et le soutien a la recherche.

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Previous investigations have shown that many fluent bilinguals, despite having an adequate knowledge of the second language's vocabulary and syntax, nevertheless read more slowly in that language compared to their first (Daitchman, 1976; Favreau & Segalowitz, 1982). In one study, bilingual Anglóphones (native speakers of English), even though they demonstrated equivalent high listening and reading comprehension levels in their two languages, were found to read approximately 33% slower in the second language than in the first (Favreau, Komoda & Segalowitz, 1980). It appears then, that for many fluent bilinguals, a high level of reading comprehension in the second language, comparable to that in the first language, is achieved to the expense of a reduction in overall speed.

The research reported in this thesis is part of an ongoing project concerned with delineating the sources of second language reading difficulty of many fluent bilinguals. Previous research has found that fluent bilinguals were not as sensitive to the orthographic redundancies of the second language as they were to those of their first language, since they showed a smaller word superiority effect in the second language than in the first (Favreau et al., 1980). In another investigation, Favreau and Segalowitz (1983) selected fluent bilinguals and classified them into two groups: bilinguals who show similar reading rates in the two languages (Criterion A) and bilinguals who read more slowly in their second language compared to their first (Criterion B), who comprise the majority of fluent bilinguals. Favreau and Segalowitz (1983) investigated whether differences in automatic/controlled processes for lexical activation could account for the second language slower reading rate of Criterion B bilinguals. Their findingsindicated that while automatic processing was evident for the Criterion A bilinguals in both their first and second language, automatic mechanisms were found for Criterion B bilinguals in the first language but not in the second language.

The research reported here examined a different aspect of second language reading. It investigated whether the slower second language reading rate of many fluent bilinguals could be attributed to a differential reliance on phonological codes in reading.

The question of whether phonological codes are involved in reading has been of interest to researchers for almost a century now. In the beginning of the century, Huey (1908) wrote: "It is perfectly certain that the inner hearing or pronouncing or both, of what is read, is a constituent part of the reading of by far the most of people, as they ordinarily and actually read" (pp. 117-118). Since then, the field has witnessed a proliferation of studies attempting to support or refute Huey's proposal.

Most of these studies have focused on the reader of English. Recent investigations have shed doubts as to whether the conclusions of these studies, for example as we will see later, that phonological codes may be involved but are not necessary for lexical access of words, could generalize to readers of other languages. Feldman and Turvey (1983) for instance, have argued that the conclusions reached may reflect particular characteristics of the English language and may not apply to languages which possess a more direct relationship between written and spoken forms, such as Serbo-Croatian. The present thesis has examined the issue of phonological codes in the reading of monolingual subjects with respect to two languages: English and French. Moreover, the possibility of phonological recoding in reading has been investigated with respect to bilingual subjects. It is often the case that bilingual individuals, while demonstrating good fluency in a second language, nevertheless read more slowly in that language compared to their first. The present thesis examined whether this slower second language reading rate could be attributed to a differential reliance on phonological codes. Before discussing these issues, it is necessary to review the studies pertaining to the involvement of phonological codes in reading for fluent readers of English.

The findings of these studies are difficult to evaluate unless one clearly distinguishes between the functions phonological codes might serve in the reading process. As Kleiman (1975) and Perfetti and McCutchen (1982) have noted, phonological codes could be involved at two different stages of the reading process. A first stage is at the pre-lexical level, that is, a speech recoding mechanism on the visual input before lexical access of individual words is achieved. A second stage is at the post-lexical level, that is, after lexical access of individual words has occured. Phonological codes at this level would be used for the maintenance of information in short-term memory. These two possible functions for a mediating code in reading will be discussed in turn.

It has been proposed that a mediating code between print and sound could act as an access code to the lexicon of word meanings (Rubenstein, Lewis & Rubenstein, 1971). The term lexicon refers to a sort of internal dictionary containing the meaning of words as well as information about each word's orthographical, phonological, morphological and syntactic characteristics. In this proposal, a phonological code would be generated from a printed word, on the basis of spelling-to-sound correspondence rules, and this code would be used to access semantic information stored in the lexicon. The meanings of printed words, under this model, would be obtained in the same way meanings of spoken words are derived. The alternative view proposes that meanings of individual words are obtained directly from their visual characteristics (Kolers, 1970; Smith, 1971). This view argues that no mediation between print and sound is necessary and access to the lexicon can be achieved solely on the basis of the visual characteristics of the printed words. This latter view has been called the direct route, while the former has been termed the indirect or mediated route.

A second possible function that has been proposed for phonological codes in reading is that its role would be located beyond lexical access of word meaning. It has been argued that a speech recoding mechanism, although perhaps not necessary for lexical access, may be used for memory purposes in that it can provide the reader with a strategy for maintaining individual words in memory until they can be integrated into a meaningful sentence (Baddeley, 1979; Kleiman, 1975). The assumption that visually encoded letters and words are recoded into a phonological form has been investigated in memory tasks. Conrad (1962, 1964) has found that the errors subjects made, when required to repeat back sequences of consonants, were phonologically similar to the correct item. Thus, although the consonants were presented visually, if a subject had forgotten the letter "B", he was more likely to report seeing a "V" rather than an "F". Baddeley (1966) found that short-term recall was significantly worse when subjects were presented with a list of acoustically similar words than when presented with a list of acoustically dissimilar words, even when the words were presented visually. Since short-term memory appeared to rely heavily on speech codes, researchers have argued that phonological codes might be involved in the reading process at a post-lexical stage.

To recapitulate, phonological codes have been proposed to play a role at two different stages in the reading process; pre-lexically and post-lexically. The evidence for each of these functions will now be reviewed briefly.

Pre-lexical phonological recoding

Several studies have attempted to determine whether lexical access is based on a visual or a phonological code. The method they have used consists of determining whether phonological variables (e.g., homophony and spelling-to-sound regularity) influence performance in tasks involving lexical access. When such variables are found to influence word recognition, results are taken as support for the pre-lexical phonological recoding proposal. The results are interpreted in favor of the direct access or visual route when such variables do not influence word recognition. Two such variables will be discussed, 1) homophony and 2) spelling-to-sound regularity.

1) Homophony

The homophone effect is probably the most cited finding in favor of the phonological recoding hypothesis. The homophone effect was found by Rubenstein et al. (1971) who were the first to use the lexical decision task to investigate the pre-lexical phonological recoding hypothesis. In a lexical decision task, subjects are presented with letter strings, both real words and nonwords visually. Their task is to decide whether a given letter string comprises a real word or not and both the latencies and accuracies of the subject's decisions are recorded. It has been argued that the lexical decision task is probably the best method for investigating lexical access procedures, as long as the nonwords do not consist of orthographically illegal letter sequences (Coltheart, 1978). When no illegal letter strings are included, readers must consult their internal lexicon to determine whether a given letter string is a real word or not.

In the Rubenstein et al. (1971) experiment, lexical decision latencies and accuracies to homophone words (SALE/SAIL) were compared to latencies and accuracies to control nonhomophonic words (LAMP). In addition, the two categories of words were varied on frequency (high vs. low). As well, latencies and accuracies to pseudowords, that is, letter strings which sound like real words (e.g., BRANE, BURD), were compared to that of control nonwords (e.g., SLINT). The results indicated that homophones produced longer reaction times (slower "yes" responses) and more errors than did the control words and the effect was especially prominent for the less frequent member of a homophonic pair. The results also showed that pseudowords produced longer latencies (slower "no" responses) and a higher percentage of errors than control nonwords.

Rubenstein et al. (1971) proposed a model of lexical access to explain these results. They suggested that visually presented words are recoded into a phonological code before lexical search, and that lexical entries are then scanned, for a matching phonological representation. The search is performed in order of word frequency, that is common words are scanned first. As the scanning proceeds, when a match between the phonological representation and a lexical entry is found, the scanning is terminated. The response however, is not made until a spelling check procedure is performed. If the spelling check procedure succeeds, that is if the spelling of the lexical entry corresponds to the target letter string's spelling, the search is terminated and the "yes" decision can be made.

The spelling check would fail in the case of a low frequency member of a homophone pair such as SAIL, since the first match would be the lexical entry for SALE. In this case the scanning through the lexical entries would continue until a second match is found (the lexical entry corresponding to SAIL). The spelling check would also fail if the letter string is a pseudoword. Thus being recoded to sound, the pseudoword BRANE (/breyn/) would be first accepted as a match with the phonological code for the word BRAIN and later rejected on the basis of the spelling check. The scanning through the lexicon, in this case, would continue exhaustively and the response "no" would be made only after an exhaustive search. Thus, the longer latencies to low frequency members of homophone pairs and to pseudowords are produced by false phonological matches with lexical entries.

The Rubenstein et al. (1971) study has been criticized on methodological grounds (apart from the issue of statistical generalizability of the results raised by Clark (1973)). One criticism pertains to the fact that homophone and control words were not matched on frequency of occurrence, number of letters and part of speech, factors which affect lexical decision times (e.g., Forster & Chambers, 1973). A second criticism relates to the lack of control of visual similarity of the nonwords. It has been argued that the pseudoword effect may be of a visual nature rather than a phonological one (Taft, 1982). Martin (1982) has suggested that pseudowords, since they sound like real words, tend to share many letters in common with the underlying words from which they are derived, and thus may be more visually similar to real words than control nonwords.

Coltheart, Davelaar, Jonasson & Besner (1977), in a study that replicated the Rubenstein et al. (1971) design, matched the homophone and control words on frequency of occurrence, number of letters, number of syllables and part of speech. The homophones included were the less common member of a homophonic pair. For the nonwords, the authors included pseudohomophones (letter strings that sound like real homophone words, for example GRONE, PORZE), and control nonwords derived by changing a single letter (for example, BRONE derived from GRONE).

The results showed that homophones did not produce longer lexical decision latencies than control words. However, pseudohomophones were processed more slowly than control nonwords. The authors concluded that while phonological codes may be involved in the processing of nonwords, one could not conclude that phonological codes were involved for the lexical access of words. They proposed that both forms of lexical access are available to the reader, but that phonological access is slower than visual access in most cases. When the letter string is in fact a word, a visual access procedure is achieved before a phonological one and thus no pre-lexical phonological effects are produced.

The effect of phonological codes on the processing of nonwords has been replicated in many studies and appears to be a reliable effect. For example, Besner and Davelaar (1983) replicated the pseudohomophone effect in a lexical decision task, even when they controlled for the visual similarity of the pseudohomophones and control nonwords by using a measure of N as discussed by Coltheart et al. (1977). The N of a letter string is defined as the number of words that can be produced by changing one letter of a given letter string, without changing letter positions. Thus, the nonword BUCH has an N of 4 since MUCH, SUCH , BUCK and BUSH can be derived. As well, Bias and McCusker (1980) presented words and nonwords at recognition thresholds for lexical decisions and found that pseudowords led to significantly more errors than control nonwords.

Using a Stroop paradigm, Dennis and Newstead (1981) included pseudowords of color names (e.g., GREAN, BLOO) and investigated the involvement of phonological codes in reading. They found that color-naming times were delayed with color pseudowords as much as with color words when the printed letter strings were incongruent with the actual color seen.

Davelaar, Coltheart, Besner and Jonasson (1978) introduced the notion of coding flexibility in lexical access. They argued that both a phonological and a visual strategy are available to the reader and that the strategy used will depend on which is more efficient to perform a given task. In their experiment, they found a homophone effect in a lexical decision task (for the less frequent member of a homophonic pair) when the nonwords included were control nonwords (SLINT type) but not when the nonwords were pseudowords (BRANE type). McQuade (1981) reported that this optional strategy was also evident in nonword decisions. She found a pseudoword effect when a high proportion of control nonwords were included in the stimulus set (when using a phonological strategy is beneficial to performance) but not when a high proportion of pseudowords were included (when using a phonological strategy is inefficient).

Davelaar et al. (1978) proposed a model to account for the differential effect of phonological codes depending on the situations. The authors suggested that visual and phonological codes are used in parallel to access the lexicon and that phonological recoding is best conceptualised as an optional strategy under the control of the reader. Thus, the reader is capable of figuring out if using phonological codes will be beneficial in a given situation; if the stimulus set includes several pseudowords, a phonological strategy would produce many errors and therefore the reader will not rely on it. If, however, it is useful, as in the case where the set includes mostly control nonwords, the reader will rely on the outcome of a phonological route.

The authors also adopted Morton's (1969) idea of logogens. Logogens are defined as: "neural devices... that accept information, regardless of source, concerning particular word responses. When a sufficient amount of information has been accumulated within a particular logogen, that logogen passes its threshold value and the corresponding word response becomes available" (Davelaar et al. (1978), p. 398). To explain the differential influence of low frequency members of homophone pairs, they argued that the more frequent member of a homophone pair will reach threshold before the less frequent member, since the threshold will be reached faster for higher frequency words than for lower frequency words. As well, the authors maintained that the spelling check procedure, postulated by Rubenstein et al. (1971), is carried out whenever a threshold is reached. However, they proposed that lexical entries for the two homophones of a pair are accessed in parallel and not serially. The spelling check procedure however, is carried out serially, that is, the higher frequency homophone being verified first. They further argued that a "no" response could be made only when no logogen had reached threshold after a given time period.

2) Spelling-to-sound regularity

A second variable that has been widely used to test the phonological recoding hypothesis is the degree of spelling-sound regularity of a letter string. The English language contains many so-called exception words, that do not follow the grapheme-phoneme correspondence rules (Venezky, 1970). Moreover, these exception words tend to be words with high frequencies of occurrence in the language (e.g., HAVE, SAYS, DOES, etc.). The assumption then, is that if phonological recoding does take place, words which do not conform to the spelling-to-sound rules should be harder to recognize than regular words which do, since application of the rules would yield incorrect phonological representations. If lexical access, on the other hand, takes place through a visual route, exception words should be as easy to recognize as regular words. These proposals have been investigated with many different paradigms (e.g., lexical decision, pronunciation and category judgments). A brief discussion of some of these studies follows.

Baron and Strawson (1976) presented subjects with lists of ten regular or ten exception words. They found that lists consisting of regular words were read significantly faster than list of exception words. On the other hand, Coltheart, Besner, Jonasson and Davelaar

(1979), failed to find a regular word advantage in a lexical decision task and concluded that lexical access is achieved via a visual route. One possible reason for the discrepancy between these two studies is that one used a pronunciation task whereas the other used a lexical decision task. It can be argued that word-naming tasks do not require lexical access, since a word can be named without lexical access in the same manner as nonwords are pronounced. Thus, studies using a pronunciation measure may involve different processes and their results may not tell us about lexical access procedures but more about different strategies used when a phonological representation must be produced.

In a series of experiments, Stanovich and Bauer (1978) also compared latencies to exception and regular words and found an advantage for regular words in both a pronunciation task and a lexical decision task. However, when they used a response time deadline technique, where subjects are forced to respond faster than usual (the average was 337 ms instead of 634 ms in the lexical decison task) and the error rate is taken as a measure of processing difficulty, the authors failed to find a difference in error rates between the two types of words. Stanovich and Bauer (1978) concluded, on the basis of these results, that the phonological effects previously found were post-lexical and not pre-lexical, since they disappeared when subjects were required to make their lexical decisions faster than usual. In other words, phonological recoding is not necessary for lexical access per se, but since the phonological information still becomes available as a consequence of lexical access (even if a visual route is used for lexical access), it may affect the decision latencies of subjects using a more conservative strategy (i.e. when no deadline is set).

In subsequent investigations, authors have questionned the definition of irregularity in spelling-to-sound correspondence rules. Parkin (1982) for example, in a lexical decision task, found an exception effect only for exception words that have their unusual pronunciation listed in the "Oxford Paperback Dictionary" (e.g., VASE, WARD) but not for exception words whose pronunciations are not listed (e.g., DOVE, POUR). The results were replicated in a pronunciation task. In a similar way, Seidenberg, Waters, Barnes and Tanenhaus (1984) have emphasized a distinction between irregularity in spelling and irregularity in spelling-to-sound correspondence. They found the two factors to have different effects on word recognition depending on whether the task required a lexical decision or a pronunciation response.

As well, Glushko (1979, 1981), attacking the regular-exception distinction, argued that an "activation-synthesis" model, that distinguishes between regular consistent and regular inconsistent words would better explain the data. His basic argument is that words are only exceptional or regular in the context of other similar words (sharing the same spelling pattern) that they activate. Consistent words are words that share similar spelling patterns and which have the same pronunciation (e.g., MEAL, DEAL, VEAL) whereas inconsistent words are words for which the same spelling patterns have different pronunciations (e.g., SAVE, GAVE vs. HAVE).

In a series of experiments, Glushko (1979, 1981) found that regular inconsistent words produced longer naming latencies than regular consistent words. According to the author, lexical access is first performed by a visual route and the phonological information becomes available post-lexically. The reason why regular inconsistent words produce longer latencies is that activation of a given lexical entry also activates other words that are visually similar and their respective phonological codes. Thus, in the case of a regular inconsistent word, conflicting phonological information will be produced, and this will slow down pronunciation. No conflicting information will be produced, in the case of regular consistent words since they activate neighboring words which share similar pronunciations. Bauer and Stanovich (1980) have replicated the regular inconsistent effect in a lexical decision task. An argument has been made however, that the regular-inconsistent effect may in fact be due to a response bias introduced by the repetition of spelling patterns with different possible pronunciations within the list of words presented. Seidenberg et. al (1984), in a pronunciation task, have found that regular inconsistent words produced longer naming times only when they were preceded by their corresponding exception words.

To summarize the results concerning pre-lexical phonological recoding, there is no consistent evidence suggesting that phonological codes are necessary for lexical access. The evidence in favor of the phonological recoding hypothesis comes mainly from decisions involving pseudowords ("no" responses) (Coltheart et al., 1977). Moreover, in the studies investigating the involvement of phonological codes in reading with the spelling-to-sound regularity variable, no consistent evidence in favor of the phonological recoding hypothesis has emerged. Furthermore, in somes cases where phonological effects were found, authors have argued that they were post-lexical and not pre-lexical (Glushko, 1979; Stanovich & Bauer, 1978).

McCusker, Hillinger and Bias (1981) in reviewing the literature have concluded that dual access models, in which lexical access can occur through either a visual or a phonological route, are best suited to explain the wealth of data produced in this field. It appears that phonological recoding is not required for lexical access and is best viewed as either 1) an optional strategy that can be used depending on factors such as task demands and materials or 2) an access route used in combination with a visual route that affects decisions only in certain situations (e.g., when no deadline is set) (Crowder, 1984). It should be pointed out that some authors have opposed the view that phonological recoding may be subjected to control and have argued instead that phonological information, although not necessary for lexical access, is an unavoidable automatic consequence of lexical access (McCutchen & Perfetti, 1982; Underwood & Thwaites, 1982). McCusker et al. (1981) concluded that for the skilled reader of English, access to the lexicon does not require phonological recoding, at least for high frequency words, a conclusion shared by Perfetti and McCutchen (1982).

However, it remains possible that reading processes subsequent to lexical access require phonological codes. This possibility will now be discussed.

Post-lexical phonological recoding

The proposal that phonological codes may serve a function beyond lexical access of individual words for memory and comprehension of connected prose has been investigated in several studies. Kleiman (1975) for example, has investigated this possibility by using the concurrent articulation technique, in which subjects are required to articulate nonsense syllables or numbers while reading. The assumption behind this technique is that concurrent articulation should disrupt performance on a given reading task to the extent that phonological recoding is required for performance on the task.

In a first experiment Kleiman (1975) examined lexical access strategies, by requiring subjects to perform three decisions about pairs of words visually presented with or without concurrent articulation. The concurrent articulation task consisted of repeating digits heard from a tape. The three decisions were: 1) a phonemic decision (do the two words rhyme? TICKLE - PICKLE (Yes) - TOUCH - COUCH (No)), 2) a graphemic decision (are the two words spelled alike after the first letter? HEARD - BEARD (Yes) - GRACE - PRICE (No)) and 3) a synonymy decision (do the two words have the same meaning? INSTANCE - EXAMPLE (Yes) - DEPART - COUPLE (No)). The logic of his experiment was as follows. The phonemic decision, since it requires speech recoding, should show a large effect due to shadowing digits but the graphemic decision, since it only requires that the visual characteristics of the words be analysed and phonological recoding is not useful for this task, should not show a large shadowing effect. As for the synonymy decision task which required lexical access, if phonological codes are necessary for lexical access, it should show a large shadowing effect, similar to the phonemic decision task. However, if phonological recoding is not required for lexical access, the synonymy decision should show little shadowing effect as in the graphemic decision task. The results showed a small increase of latencies on the graphemic decision (+125 ms) and synonymy decision (+120 ms) and a large increase on the phonemic decision (+372 ms) in the shadowing condition relative to the non-shadowing condition. Kleiman (1975) concluded that subjects were able to access lexical information necessary to perform the synonymy decision without phonological recoding.

In another experiment, Kleiman (1975) tested the idea that phonological codes although not necessary for lexical access, as shown by his first experiment, may be involved beyond lexical access for memory purposes. Sentences consisting of five words were selected and four types of decisions tasks were included. In the phonemic decision (is there a word that sounds like CREAM in the sentence HE AWAKENED FROM THE DREAM (True) - is there a word that sounds like SOUL in THE REFEREE CALLED A FOUL (False)), it was found that shadowing digits, significantly increased decision times (+312 ms) compared to the no shadowing condition. In the graphemic decision (is there a word that looks like BURY in YESTERDAY THE GRAND JURY ADJOURNED (True) - Is there a word that looks like GATHER in RUNNING FURTHER WAS TED'S

MOTHER (False)), shadowing had only a minimal effect (+140 ms). As well in the category decision (is there a word that names a GAME in EVERYONE AT HOME PLAYED MONOPOLY (True) - Is there a word that names a SPORT in HIS FAVORITE HOBBY IS CARPENTERY (False)), the effect of shadowing was in the graphemic decision was small (+78 ms). In all three tasks, subjects could perform the task by processing only one word at a time. In the fourth decision, that of semantic acceptability however, subjects had to determine if sentences presented were meaningful (e.g., NOISY PARTIES DISTURB SLEEPING NEIGHBORS) or meaningless (e.g., PIZZAS HAVE BEEN EATING JERRY). This last decision, contrary to the previous ones, required not only lexical access, but also comprehension processes and a memory load since subjects needed to maintain individual words in short-term memory until they could be integrated, enabling subjects to reach a decision. Shadowing had a large effect in this decision (+394 ms). Kleiman (1975) concluded that, since shadowing impaired performance only when judgments of meaning required the processing of several words, as in the semantic acceptability decision, phonological codes were not necessary for lexical access but needed after lexical access in working memory.

Levy (1975) presented subjects with a set of three sentences either auditorily or visually and instructed subjects to either read them silently or count while they were reading it. After a set of three sentences was presented, one of the sentences was represented with or without a lexical change (substitution of a word by a synonym) or a semantic change (subject-object reversal). The results indicated that concurrent articulation reduced the ability to detect either type of change when sentences were presented visually, while it had little effect when they were presented auditorily. Levy (1975) concluded that the concurrent vocalisation prevented the production of a phonological code, which played a role in maintaining words in memory for purposes of sentence comprehension. Levy (1975) argued that the decrement found was not the result of the concurrent articulation task taking up resources since no similar effect was found in listening condition.

Further studies with the concurrent articulation paradigm, have attempted to delineate what specific processes in reading were interfered with by suppression. In a later experiment, Levy (1978) found that concurrent articulation disrupted the ability of subjects to retain the exact wording of sentences but not the ability to recognize paraphrases. Levy (1978) concluded that phonological codes were not necessary for the comprehension of meaning of sentences but helped memory for the order of words in sentences.

Similarly, Slowiaczek and Clifton (1980) required their subjects to count or pronounce "colacolacola..." while reading. They found that the effects of concurrent articulation were limited to tests requiring subjects to draw inferences within or across sentences. However as in Levy (1978), no disruptive effect for the ability to recognize paraphrases was produced.

The concurrent articulation paradigm, although widely used, is not free of criticisms. Baddeley (1979) for example, has argued that shadowing digits, being a demanding cognitive task, may not only interfere with phonological recoding per se, but may also place demands on the reader's memory. This interpretation has some support since in Kleiman's (1975) study, performance was impaired in both the graphemic and category decisions, although less than that found in other decisions. As well, Waters, Komoda and Arbuckle (1985) have provided convincing evidence that although interference effects can be produced by a shadowing task when subjects are reading continuous text, these effects are not the result of speech-specific interference. Instead, these effects appear to be a consequence of the shadowing task reducing the general processing capacity.

In their attempt to delineate what specific reading tasks required phonological recoding, Hardyck and Petrinovich (1970) have used electromyographic (EMG) measures of subvocalisation, and have found a greater EMG increase when subjects were required to read difficult essays than when they read easy essays. Moreover, when they trained subjects to suppress EMG activity while reading by biofeedback, they found that suppression of vocalisation interfered with the comprehension of difficult essays but not easy ones.

Using a different paradigm, Baron (1973) has investigated the possible role of phonological codes in reading sentences. Subjects were presented with four types of sentences and were required to verify if each sentence they read was meaningful or not. The four types of sentences were as follows: 1) meaningful sentences that contained a homophone word (e.g., MY NEW CAR, PIECE OF PIE), 2) meaningless sentences that contained a homophone word that was orthographically incongruent with the context so that if phonologically recoded, the sentence would sound meaningful (e.g., MY KNEW CAR, PEACE OF PIE), 3) sentences that were meaningless both orthographically and phonologically (e.g., WE HERE READY, ICE CREAM COIN) and 4) matched sentences that did make sense (e.g., WE ARE READY, ICE CREAM CONE). The critical comparisons were between type 2 and 3. If phonological codes are used, one would expect readers to have difficulty with sentences that sound correct when phonologically recoded (type 2). The results indicated no significant differences in classification latencies, leading the author to conclude that phonological recoding was not necessary in reading sentences for meaning. However, the sentences used were relatively short (three words) and may not have placed great demands on memory but instead functionned as single units. It should be added that although no latencies difference were found, significantly more errors were made on type 2 sentences compared to type 3, thus suggesting some involvement of phonological codes in this task.

Doctor (1978) has extended Baron's (1973) experiment in the following way. Six different types of sentences were used: 1) meaningful sentences containing a homophone (e.g., We <u>wait</u> in the queue); 2) meaningful sentences containing a non-homophonic word (e.g., We <u>stand</u> in the queue); 3) meaningless sentences that sound correct if recoded (e.g., We <u>weight</u> in the queue); 4) meaningless sentences that sound incorrect (e.g., We <u>grate</u> in the queue); 5) sentences containing a nonword that sound correct (e.g., We <u>wate</u> in the queue) and finally 6) sentences containing a nonword that neither look or sound correct (e.g., We grait in the queue). These two last sentence types were included to examine whether any phonological effect found were due to pre-lexical or post-lexical phonological recoding. The results revealed that homophone sentences (type 1) led to more errors that control sentences (type 2). As well, as in Baron (1973), meaningless sentences that sounded correct (type 3) produced significantly more errors than meaningless sentences that did not (type 4), although they did not differ in decision latencies. Classification decisions to sentences containing a nonword that sounded correct (type 5) however, did not lead to longer latencies or more errors than sentences that contained a nonword but did not sound correct (type 6). In addition, nonwords sentences overall were rejected faster than meaningless sentences which did not contained a nonword.

Coltheart (1980) in reviewing Doctor's (1978) results, has suggested the following interpretation. Lexical access for each individual word in the sentence is performed by the means of a visual analysis. The sentence is classified as a meaningless sentence if any letter string in it does not achieve lexical access. Thus, sentences containing a nonword can be rejected faster than those which do not. If all the letter strings included in the sentence are words, the task becomes to determine whether the sentence as a whole is acceptable. In order to achieve this, individual words must be held in short-term memory, in which information is represented in a phonological form, until they can be integrated into a unit. Thus, phonological codes of individual words will need to be generated, and this phonological representation will be held in memory until the reader decides whether the sentence presented is acceptable or not. The way by which this decision is made is not clear. If readers were making their decisions on phonological information alone, they would presumably always accept sentences such as "We weight in the queue" as meaningful. One possibility discussed by Coltheart (1980) is that a visual re-checking procedure that is not error-free or not consistently used comes into play.

Baddeley, Elridge and Lewis (1981) have also used a sentence verification paradigm. Meaningful sentences (e.g., She doesn't mind going to the dentist to have fillings but doesn't like the pain when he gives her the injection at the beginning) and meaningless sentences created by substituting a inappropriate word in the sentence (e.g., RENT insteand of PAIN in the above example) were visually presented and subjects' latencies and accuracies to classify them were measured. Half of the sentences were read normally while half were read with concurrent articulation (counting repeatedly from one to six). The results based on the latencies indicated no significant effect of concurrent articulation. The only significant effect was sentence meaningfulness in that meaningless sentences were processed faster than meaningful sentences. The results based on the error measures, however, revealed a significant effect of concurrent articulation and sentence meaningfulness as well as an interaction between the two variables. The interaction suggested that a significantly higher error rate was found when meaningless sentences were read while counting, than in the other three conditions, which did not differ among themselves. The authors concluded that while concurrent articulation did not affect decision times, it affected accuracy in that subjects were more likely to fail to detect an anomolous sentence while concurrently counting. Since concurrent articulation had no effect on the processing of meaningful sentences, the authors concluded that phonological codes were not necessary for deriving the gist of a sentence. However, phonological codes played a role in the processing of meaningless sentences, since a decrement in accuracy in rejecting these sentences was found when readers were required to count.

To recapitulate, the evidence as to the involvement of phonological codes in reading at a post-lexical stage is less than consistent. It appears that phonological codes may be used in some conditions such as when the retention of the exact wording of a sentence is required (Levy, 1978), when the task demands are to draw inferences across sentences in a text (Slowiaczek & Clifton, 1980) or when reading difficult material (Hardyck & Petrinovich, 1970). Phonological codes are not essential when the task demands are to extract the vague gist of sentences (Levy, 1978) and disruption of phonological codes appears to affect accuracy but not speed of processing when only a single sentence has to be judged (Baddeley et al., 1981).

The conclusions as to the role of phonological codes at a pre-lexical and post-lexical stage apply to the fluent reader of English. Some authors have suggested that the conclusions drawn may not apply to non-alphabetic writing systems, such as Chinese (e.g., Treiman, Baron & Luk, 1981). Moreover, recent investigations at the Haskins Laboratories (Feldman, 1981; Feldman & Turvey, 1983; Katz & Feldman, 1983; Lukatela, Popadic, Ognjenovic & Turvey, 1980; Turvey, Feldman & Lukatela, 1983) have cast doubts on whether even among different alphabetic writing systems, the same lexical access procedures are used. The Haskins group have examined the lexical access strategies of readers of Serbo-Croatian, the principal language of Yugoslavia. Serbo-Croatian has a very consistent and direct relation between graphemes and phonemes (a shallow orthography) and contrary to English, it has no exception words. The studies have shown that in Serbo-Croatian, contrary to English, phonological codes are <u>necessary</u> for lexical access and cannot be suppressed even if detrimental to performance. Thus phonological recoding cannot be viewed as an optional strategy for readers of Serbo-Croatian.

As well, it has been argued that the conclusions drawn as to the role of phonological recoding in fluent reading may not apply to the child learning to read. Considerable attention has been focused on the role phonological codes may play in learning to read and there is evidence that knowledge of word decoding skills is an important prerequisite in learning to read (Firth, 1972, Perfetti & Hogaboam, 1975). Moreover, some investigators have suggested that skilled and less skilled children readers may differ upon their reliance on phonological codes in reading. Barron (1978, 1980), for instance, found that 5th and 6th grade good readers were relying on a phonological strategy for lexical access, since their decision latencies were influenced by spelling regularity and homophony of nonwords, while poor readers were not. The author has proposed that less skilled readers may not be as fast as skilled readers to activate phonological codes or more likely to produce inadequate phonological representations because of weaker knowledge of spelling-to-sound rules.

Doctor and Coltheart (1980), in a sentence verification task similar to that developed by Baron (1973), have examined the differential reliance on phonological recoding of younger (6 years old) and older (10 years old) children. They found that overall, subjects made significantly more errors in classifying meaningless sentences that sounded correct when phonologically recoded (e.g., She blue up the balloon) than meaningless sentences that remained meaningless even if recoded to sound (e.g., She know up the balloon). Moreover, there was a significant interaction between sentence type and age, indicating that the difference in error rates between the two types of sentences decreased as a function of age. Doctor and Coltheart (1980) concluded that younger children relied extensively on phonological codes when reading sentences for meaning and older readers less so.

This developmental difference in reliance on phonological codes was also evident in a study by Backman, Bruck, Hebert and Seidenberg (1984) which investigated children's knowledge of spelling-to-sound correspondence rules in a pronunciation task. They found that 2nd and 3rd grade good readers made significantly more errors in pronouncing exception (e.g., HAVE), regular inconsistent (e.g., GAVE) and ambiguous words (for which the spelling pattern has more than one pronunciation, each represented by several words, for example, CLOWN, LOVE) compared to regular words (e.g., HOPE). Good readers in grade 4 and high school students, on the other hand, made a similar number of errors across all four word classes.

Furthermore, some authors have suggested that one factor that distinguishes between skilled and less skilled reading is the coding strategy used in short-term memory. Liberman, Shankweiler, Liberman, Fowler and Fisher (1977) for example, in a memory task, have found that 2nd grade skilled readers were influenced by the phonological similarity of the consonants to be recalled, whereas less skilled readers were not. More specifically, while good readers recalled more items overall than poor readers, their recall performance was worse when the consonants rhymed compared to when they didn't rhyme. The poor readers, on the other hand, performed at about the same level for rhyming and non-rhyming lists of consonants. Mann, Liberman and Shankweiler (1980) had 2nd grade good and poor readers recall phonologically confusable sentences (e.g., Kate ate a steak and a plate of date cake that Jake baked) and phonologically nonconfusable sentences (e.g., Sam drank a coke and a glass of fruit punch that Joan made). Their results indicated that while skilled readers made less errors than less skilled readers on phonologically nonconfusable sentences, their performance fell to level of that of less skilled readers when recalling phonologically confusable sentences. Thus, good readers were more vulnerable to the effects of phonological similarity, leading the authors to conclude that good readers used phonological codes for short-term memory coding, while poor readers were deficient in the use of phonological codes in short-term memory.

The literature then, suggests that one variable that may distinguish between skilled and less skilled readers is related to a differential use of phonological codes for both lexical access of individual words and for memory coding purposes. The aim of the present thesis was to investigate the extent to which phonological codes are implicated in the second language reading of fluent English-French bilinguals. Since, as it was mentioned previously, languages that differ as to their degree of regularity in spelling-to-sound mapping may encourage a different degree of reliance on phonological codes for lexical access, a first experiment was conducted with monolingual Anglophones and monolingual Francophones individuals. The purpose was to investigate possible differences in reliance on phonological recoding due to the language being read.

Although French is not as regular in grapheme-to-phoneme correspondences as Serbo-Croatian is, it differs from English in one important respect; that of the number of exception words. In French although a given sound may have many spellings (e.g., the sound /o/ can be spelled as O, OT, AU, AUT, AUX, EAU), a given spelling is usually pronounced only one way. Thus spelling-to-sound correspondence rules may be more efficient in French compared to English.

The involvement of phonological codes in reading was examined in two different tasks: a lexical decision task and a sentence verification task. In the lexical decision task, similarly to the Rubenstein et al. (1971) and Coltheart et al. (1977) studies, subjects were presented with both words and nonwords and their classification latencies and accuracies were recorded. Two categories of words were included: homophones (less frequent members of homophonic pairs) and control words, matched on number of letters, CVC structure and frequency of occurrence. As well two categories of nonwords were included: pseudowords (e.g., GREAN) and control nonwords derived by changing one letter (e.g., TREAN). The two categories of nonwords were matched on the N variable as described by Coltheart et al. (1977) in order to control for the visual similarity of the two categories of nonwords to real words. In the sentence verification task, similarly to the tasks used in the Baron (1973) and Doctor and Coltheart (1980) studies, subjects were visually presented with meaningful and meaningless sentences and asked to classify them. The meaningful sentences were of two types: 1) those that contained a homophone word (e.g., She said the weather was <u>fair</u> outside) and 2) those that contained a non-homophonic word (e.g., She said the weather was <u>nice</u> outside). The meaningless sentences were also of two types: 1) those that contained an incorrectly spelled homophone, so that if the sentence was recoded to sound, it sounded meaningful (e.g., She said the weather was <u>fare</u> outside) and 2) those that contained a homophone word but which remained meaningless even if recoded to sound (e.g., She said the weather was <u>hair</u> outside).

In the second experiment to be reported, bilinguals who showed equivalent levels of reading comprehension in their first and second languages were included in the study and performed the lexical decision task and the sentence verification task in both their first and second language. As in the Favreau and Segalowitz (1983) study, the subjects were divided into two groups: 1) those bilinguals who read their first and second languages equally fast (Criterion A) and 2) those bilinguals who read their second language more slowly than their first (Criterion B). The latter group is particularly interesting since it consists of individuals who read both relatively fast and slowly depending upon the language they are faced with. Thus, they present the possibility of investigating different levels of skills within the same individual. The aim of the study was to examine whether the slower second language reading rate of Criterion B bilinguals could be attributed to a differential reliance on phonological codes relative to Criterion A bilinguals.

EXPERIMENT 1

For both the French and English language, the grapheme-phoneme relationship is not a one-to-one correspondence. Thus, two letters may correspond to only one sound (e.g., /th/ as in THINK or /ch/ as in CHAT). As well, one letter may represent more than one sound (e.g., PLACE and TALL or PAPA and BANC) and different letters may correspond to the same sound (CHEQUE and CAR for the sound /k/ in English and QUATRE and CAPE for the sound /k/ in French). Neither language then are as regular as Serbo-Croatian, which has a very close correspondence between its written and spoken forms. In fact Serbo-Croatian is a language that one can "write as you speak and speak as it is written" (Feldman, 1981, p.172).

The French language however, is more regular in spelling-to-sound correspondence rules than English in the following sense. French is characterized by a many-to-one mapping pattern, while English has a many-to-many mapping pattern. Thus, in French a given sound may have many corresponding spellings (e.g., the sound /o/ can be spelled as O, OT, AU, AUT, AUX, EAU), and these are all always given the same pronounciation. In contrast, in English a given sound may have more than one corresponding spelling (e.g., the sound /ijə/ may be spelled as in DEER or DEAR), but each corresponding spelling may not be given the same pronunciation (e.g., EAR in DEAR is pronounced /ijɚ/, while in BEAR it is pronounced /ɛɚ/). This is not to say that in French there are no deviations from the many-to-one pattern of correspondences. For instance, while the spelling pattern ENT is pronounced /ɑ̃/ in the words DENT, LENT and VENT, it is not pronounced if it serves as the ending of the plural form of a verb (e.g., as in ILS AIMENT). Moreover, some words may have a silent consonant in some context and a pronounced one in another context. This is the case when one performs the "liaison" process as in VOUS ECOUTEZ, in contrast to VOUS REGARDEZ (Dell, 1973). These are not however, exceptions as in the English case. They can all be accounted for as "regular" if one allows liaison and morphemic considerations to enter into the rules governing orhographic-phonological correspondences in French. The only true exception words in French that come to mind are DOT, GAIE, SENS and GROSSE. In contrast, it is not possible to explain many of the English exception words in terms of morphemic or "liaison" or some other type of underlying regularity.

Clearly, there are not as many words with exceptional pronunciations in French than there are in English. Moreover, exception words in English tend to be words that are very common, that is, with high frequency of occurence in the language (e.g., DOES, DONE, HAVE and SAYS). Thus, it will be more often the case that a strategy using spelling-to-sound correspondence rules will produce inadequate phonological representation for English words than for French words. French readers then, may be more likely to rely on phonologically recoded information than English readers, as it will produce adequate phonological representations, because of the regularity of the mapping from print to sound. Thus, in the lexical decision task, we might expect monolingual Francophones to show longer reaction times and a greater error rate on homophone words relative to their matched control words.

This possibility was examined in Experiment 1. A group of monolingual Anglophones and monolingual Francophones performed the lexical decision task and the sentence verification task described previously. The aim of Experiment 1 was to investigate possible differences in reliance on phonological coding due to the language being read and provide baseline reference data for the study with Anglophone bilinguals reported in Experiment 2.

Method

Subjects

Monolingual Anglophones and monolingual Francophones participated in this experiment. They were recruited by advertisements at Concordia University, the Université de Montréal and the Université du Québec à Montréal (UQAM). Subjects were first administered the screening procedure described below and only subjects that met the following criteria were selected. First, a subject's optimal reading rate had to be at least 275 words per minute (wpm) and second, subjects had to achieve a comprehension score of at least 70%. In addition, subjects needed to report no fluent knowledge of a second language.

The resulting sample consisted of 12 monolingual Anglophones (six females and six males) and 12 monolingual Francophones (six females and six males). The monolingual Anglophones had a mean age of 22.42 years and the monolingual Francophones has a mean age of 25.17 years. Subjects were paid $4.00 for their participation in the screening procedure and $4.00 for their participation in the experiment.

The mean optimal reading rates and the mean comprehension scores of the monolingual Anglophones and Francophones are presented in Table 1. T-tests revealed that the two groups did not differ significantly on mean optimal reading rates (t = .17, n.s.) or mean comprehension scores (t = 1.46, n.s.).

Screening procedure

The screening procedure used for the selection of subjects was that described by Favreau & Segalowitz (1982). The procedure consisted of having subjects read standardized texts and answer multiple-choice questions. The texts and questions were taken from the Educational Developmental Laboratories Inc, Don Mills, Ontario. The English texts had an average length of 1435.75 words while the French texts had an average length of 1293.25 words. Subjects were instructed to read the texts silently as quickly as possible and they were told they would have to answer 10 multiple-choice questions afterwards. The monolingual Anglophones read two different texts in

Table 1

Mean optimal reading rates (in wpm) and mean comprehension scores (in %) for the monolingual subjects

Group	Reading rate (wpm)	Comp. score (%)
Monolingual Anglophones	314	82.50
Monolingual Francophones	312	77.92

English and the monolingual Francophones read two different texts in French. The total time to read each text was measured with a stopwatch and the optimal reading rate was computed in words per minute (wpm) based on the performance on the two texts. Each subject's performance on the multiple-choice questions was measured in terms of percent (%) correct. The comprehension score for each subject was obtained by averaging each subject's scores on the two sets of questions.

Stimuli

Lexical decision task

Two lists of stimuli were constructed: an English list and a French list. Each list consisted of 36 homophones, 36 control words, 36 pseudowords and 36 control nonwords. All letter strings were monosyllabic and consisted of four or five letters. In the French list, all nonwords included obeyed the rules of French orthography. As well, in the English list, all the nonwords included obeyed the rules of English orthography. Moreover, none of the letter strings appearing in the French list were valid words in English and none of the letter strings appearing in the English list were valid words in French.

The homophones included in the lists were the lowest frequency member of a homophone set. Thus for example, for the WEAK/WEEK set, WEAK was the homophone selected since its frequency of occurrence in the English language is lower than that of the word WEEK. Each homophone was matched with a control non-homophonic word on number of letters, CVC structure and frequency of occurrence. For the English list, the average frequency of occurrence per million was 24.19 for the homophones and 24.03 for the control words based on Kucera & Francis (1967) ratings ($\underline{t}$ = .02, n.s.). For the French list, the average frequency of occurrence per million based on Baudot's (1975) ratings were 29.92 for the homophones and 29.08 for the control words ($\underline{t}$ = .08, n.s.). The English list and the French list of words can be found in Appendix A and B respectively.

For the nonword stimuli, most of the pseudowords appearing in the English list were selected from the list provided by Bias & McCusker (1980), while the pseudowords included in the French list were created specifically for this experiment. A control nonword was derived from each of the pseudowords by replacing one of its letters. Thus for example, the corresponding control nonword for the pseudoword GREAN was TREAN. In order to control for the visual similarity of the pseudowords and the control nonwords to real words, the two categories of nonwords were matched on the variable N as described by Coltheart & al. (1977). The N of an English letter string is the number of different English words that can be derived by replacing one of the letters in the strings by another, without changing letter positions. As an example, for the letter string SNAIR, the N value is two, since two real English words can be derived; STAIR and SNAIL. For the English list, the average N was 6.11 for the pseudowords and 6.00 for the control nonwords ($\underline{t}$ = .14, n.s.). For the French list, the pseudowords and the control nonwords had an average N of 5.86 and 4.89 respectively (t = 1.04, n.s.). The English list and the French list of nonwords can be found in Appendix C and D respectively.

Sentence verification task

Two lists of sentences were developed: an English list and a French list. Each list consisted of 288 sentences, half of which were meaningful and required a "yes" response and half of which were meaningless and required a "no" response. The meaningful sentences were of two types: 1) those that contained a homophone (e.g.,"She said the weather was fair outside") and 2) those that did not contain a homophone (e.g., "She said the weather was nice outside"). The meaningless sentences were of two types: 1) those that contained an orthographically incongruent but phonologically congruent homophone, that is, sentences that when phonologically recoded sounded meaningful (e.g., "She said the weather was fare outside") and 2) those that contained an orthographically and phonologically incongruent homophone (e.g., "She said the weather was hair outside"). The sentences ranged in length from five to 12 words.

The sentences were constructed as follows. Eighteen four-word sets of pairs of homophones were used to derive the 288 sentences in each of the English and the French lists. As an example, for the English sentences, one set of pairs of homophones was FAIR/FARE - HAIR/HARE and another was SEEM/SEAM - SEES/SEAS. An effort was made to select visually similar sets of pairs of homophones. Thus, each pair of homophones was matched on number of letters and CVC structure with the other pair forming the set (for three of the pairs of French homophones, the words could be matched only on number of letters). From each set of pairs of homophones, 16 sentences were derived; four of each of the four categories described above. Thus, for the FAIR/FARE - HAIR/HARE set, four different sentence frames were constructed so that each of the four homophones appeared once in a sentence that was meaningful and required a "yes" response: "She said the weather was ____ outside", "He paid his ____ before he got on the bus", "Your sister has beautiful ____" and "I saw a little ____ running to the bushes". Each of the sentence frames then served to derive four sentences; the first sentence was derived by inserting the appropriate homophone so that the sentence was meaningful (e.g., "He paid his <u>fare</u> before he got on the bus"), the second by inserting a nonhomophone word and preserving the meaningfulness of the sentence (e.g., "He paid his <u>bill</u> before he got on the bus"), the third sentence was obtained by inserting the phonologically congruent but orthographically incongruent homophone (e.g., "He paid his <u>fair</u> before he got on the bus") and finally the fourth sentence by inserting a homophone that was both phonologically and orthographically incongruent (e.g., "He paid his <u>hare</u> before he got on the bus"). The homophone selected to form this last category was visually similar to the homophone that formed the first type of sentence in terms of numbers of letters and CVC structure. Each homophone appeared once in a sentence that was meaningful and required a "yes" response, once in a sentence that only sounded correct and required a "no" response, and once in a sentence that did not look or sound correct and required a "no" response.

The 288 English sentences and the 288 French sentences were each divided into four lists in such a way that no two similar sentence frames appeared in the same list. For example, the sentence "He paid his fare before he got on the bus" appeared in list A, the sentence "He paid his bill before he got on the bus" appeared in list B, the sentence "He paid his fair before he got on the bus" in list C and the sentence "He paid his hare before he got on the bus" apeared in list D. Each list then contained 72 sentences; 18 of each type. The English sentences and the French sentences are listed in Appendix E and F respectively.

Procedure

The experiment was controlled by an Apple IIe microcomputer equipped with a real-time clock, an Amdek video display and a Gexelex French character board. For the lexical decision task, each letter string was presented individually, in lower case letters, in the center of the video display. The letter strings remained on the screen until the subject made a response. If after three seconds, no response was made, the trial was scored as an error. Two seconds after the letter string had disappeared, the next letter string was presented. The computer recorded the response latencies and the accuracy of the responses individually for each subject.

Subjects read the instructions in their mother tongue. They were instructed to press the right lever (labelled "yes") if the letter string presented was a real word and the left lever (labelled "no") if it was not. They were instructed to make their responses as quickly as possible, while at the same time being as accurate as they could. Each subject received a practice list of 48 letter strings (12 of each category) in order for them to familiarize themselves with the task. Letter strings were presented in the same pseudo-random order for each subject with the constraint that no more than three letter strings from the same category appeared in sequence.

For the sentence verification task, each sentence was presented individually in lower case letters. The sentence remained on the screen until the subject made a response. If after five seconds, no response was made an error was recorded. Two seconds after the sentence disappeared, the next sentence was presented. The computer recorded the response latencies and accuracies individually for each subject.

Subjects read the instructions in their mother tongue. They were asked to judge the meaningfulness of the sentence presented. Subjects were instructed to press the right lever (labelled "yes") if the sentence presented made sense and the left lever (labelled "no") if the sentence presented did not make sense. They were asked to respond as quickly and accurately as possible. Each subject received first a list of 48 sentences (12 of each category) before proceeding with the experimental task. The sentences were presented in the same pseudo-random order for each subject with the constraint that no more than three sentences from a given category appeared in sequence.

Each subject participated in the lexical decision task followed by the sentence verification task. For the sentence verification task, the sentences were presented in four different lists. Each subject received the four lists in the same order and there was a pause between each list. The testing session lasted approximately 40 minutes.

Results

Separate analyses of variance were performed on the subjects' reaction times and accuracies. The reaction time analyses are based on latencies to correct responses only. All analyses were conducted once using raw scores and once using transformed scores because of concern regarding homogeneity of variances. For the reaction time data, the transformed scores were obtained by deriving the natural log of the raw scores. For the error data, the transformation used was the arcsin transformation. Both the analyses using raw scores and the analyses using transformed scores gave similar results. The results to be discussed and the statistics to be reported are based on the analyses using the transformed scores. However, for purposes of clarity, the means reported are those based on the untransformed raw scores.

All analyses were also conducted using both subjects' and item means as recommended by Clark (1973). When both the subject and item analyses were significant, the min F' statistic was calculated. The min F' statistic is reported when it was found to be significant, otherwise the F statistics for the subject ($F1$) and item ($F2$) analyses are reported. For the subject analyses, whenever an interaction was significant, post hoc multiple comparisons were performed using the Tukey procedure.

For both the lexical decision and the sentence verification tasks, letter strings or sentences giving rise to more than a 70% error rate were excluded from the analyses. This resulted in very few exclusions: one item in the lexical decision task and two items in the sentence verification task for the monolingual Anglophone group and no items in the lexical decision task and one item in the sentence verification task for the monolingual Francophone group. For all subjects, latencies and accuracies to the pseudoword TAUL and the control nonword DAUL were also excluded from the analyses for the lexical decision task, as it was realized that DAUL was in fact a pseudoword and had been misclassified.

Lexical decision task

The word and nonword data were analysed separately. The mean reaction times and associated mean percentage error rates for the two word categories (homophone and control) are presented in Table 2.

Log reaction times for correct responses for the word categories were analysed in a 2 (Mother Tongue) x 2 (Word Category) analysis of variance (ANOVA). There was a significant word category effect in the

Table 2

Mean reaction times (RT) (in ms) and mean percentage of errors (%E) to the homophone and control words for the monolingual groups in the lexical decision task

	Homophone		Control	
Group	RT	%E	RT	%E
Anglophones	736	9.08	730	5.54
Francophones	765	16.54	720	7.73

subject analysis ($F1(1,22) = 5.04$, $p<.05$), indicating that overall homophones produced longer reaction times than control words (750 vs. 725 ms); the effect failed to reach significance in the item analysis ($F2(1,139) = 2.27$, n.s.). However, the Mother Tongue x Word Category interaction was marginally significant in the subject analysis ($F1(1,22) = 3.46$, $p<.07$) and is suggestive of a homophone effect for the monolingual Francophones (+45 ms) but not for the monolingual Anglophones (+6 ms).

The arcsin error data were subjected to a 2 (Mother Tongue) x 2 (Word Category) ANOVA. There was a significant word category effet in both the subject and item analyses (min $F'(1,161) = 5.52$, $p<.05$) revealing that homophones produced more errors than matched control words (12.81 vs. 6.64%). There was also a significant Mother Tongue x Word Category interaction in the subject analysis ($F1(1,22) = 5.16$, $p<.05$). This interaction was not significant in the item analysis ($F2(1,139) = 1.06$, n.s.). Post-hoc tests on the Mother Tongue x Word Category interaction revealed that Francophones showed a homophone effect (16.54. vs. 7.73%, $p<.01$) while Anglophones did not (9.08 vs. 5.54%, n.s.). Moreover, the post-hoc analyses indicated that while control words produced a similar number of errors for both Francophones and Anglophones (7.73 vs. 5.54%, n.s.), homophones gave rise to significantly more errors for the Francophone group than for the Anglophone group (16.54 vs. 9.08%, $p<.01$). There was also a significant mother tongue effect in the item analysis ($F2(1,139) = 4.47$, $p<.05$) indicating that overall, the French list of words gave rise to more errors than the English list of words (12.11 vs. 7.32%).

The mean reaction times and associated mean percentage error rates for the two nonword categories (pseudowords and control nonwords) are given in Table 3.

Log reaction times for correct responses for the nonword categories were analysed in a 2 (Mother Tongue) x 2 (Nonword Category) ANOVA. The analyses yielded a significant nonword category effect, indicating that pseudowords produced greater latencies than control nonwords (889 vs. 814 ms) in both the subject and item analyses (min $\underline{F}'(1,83) = 4.56$, $\underline{p}<.05$). There was also a significant mother tongue effect in the item analysis ($\underline{F}2(1,138) = 26.30$, $\underline{p}<.001$) revealing that overall reaction times to the English list of nonwords was slower than reaction times to the French list of nonwords (935 vs. 785 ms).

Arcsin error data were analysed in a 2 (Mother Tongue) x 2 (Nonword Category) ANOVA. There was a significant nonword effect in both the subject and item analyses (min $\underline{F}'(1,81) = 6.55$, $\underline{p}<.05$), indicating that pseudowords produced more errors than control nonwords (21.60 vs. 13.36%). However, there was also a significant Mother Tongue x Nonword Category in both the subject ($\underline{F}1(1,22) = 6.90$, $\underline{p}<.05$) and the item analysis ($\underline{F}2(1,138) = 4.62$, $\underline{p}<.05$). Post-hoc tests indicated that the Anglophone group made significantly more errors on pseudowords than control nonwords (25.32 vs. 11.70%, $\underline{p}<.01$) while the Francophones had a similar error rate in both nonword categories (17.88 vs 15.02%, n.s.).

Table 3

Mean reaction times (RT) (in ms) and mean percentage of errors (%E) to the pseudowords and control nonwords for the monolingual groups in the lexical decision task

	Pseudowords		Control nonwords	
Group	RT	%E	RT	%E
Anglophones	979	25.32	867	11.70
Francophones	799	17.88	761	15.02

Sentence verification task

The results from the meaningful sentences and the meaningless sentences were analysed separately. The mean reaction times and associated mean percentage error rates for the two types of meaningful sentences (those containing a homophone and those containing a control word) are presented in Table 4.

Log reaction times for correct responses for the meaningful sentences were analysed in a 2 (Mother Tongue) x 2 (Sentence Type) ANOVA. There was no significant sentence type effect in either the subject or the item analysis indicating that meaningful sentences containing a homophone were processed as quickly as meaningful sentences containing a non-homophone word (2108 vs. 2100 ms). There was a mother tongue effect in the item analysis ($F2(1,283) = 7.42$, $p<.01$) indicating that the English list of sentences produced longer reaction times than the French list (2191 vs. 2062 ms).

The ANOVA performed on the arcsin error data revealed a significant sentence type effect in both the subject and item analysis (min $F'(1,221) = 5.57$, $p<.05$) indicating that overall homophone sentences produced more errors than non-homophone sentences (8.31 vs. 5.09%). However, the subjects analysis also yielded a marginal Mother Tongue x Sentence Type interaction ($F1(1,22) = 3.84$, $p<.06$). This interaction appears to be related to the finding that monolingual Anglophones showed a greater error rate on homophone sentences than on

Table 4

Mean reaction times (RT) (in ms) and mean percentage of errors (%E) to the homophone and control sentences for the monolingual groups in the sentence verification task

	Homophone		Control	
Group	RT	%E	RT	%E
Anglophones	2174	10.05	2141	5.49
Francophones	2042	6.57	2060	4.69

control sentences (+4.6%), relative to monolingual Francophones (+1.9%).

The mean reaction times and corresponding mean percentage error rates for the two types of meaningless sentences (those phonologically congruent and those phonologically incongruent) are presented in Table 5.

The 2 (Mother Tongue) x 2 (Sentence Type) ANOVA performed on the log reaction times for correct responses for the meaningless sentences failed to produce a significant sentence type effect suggesting that phonologically congruent sentences were processed as fast as phonologically incongruent sentences (2009 vs. 1980 ms). There was a mother tongue effect in the item analysis ($\underline{F}2(1,281) = 24.00$, $\underline{p}<.001$) indicating that the English list of sentences gave rise to longer latencies than the French list of sentences (2096 vs. 1893 ms).

The arcsin error data were subjected to a 2 (Mother Tongue) x 2 (Sentence Type) ANOVA. There was a significant sentence type effect in both the subject and item analysis (min $\underline{F}'(1,93) = 9.23$, $\underline{p}<.005$) indicating that subjects made significantly more errors on the phonologically congruent sentences than on the phonologically incongruent sentences (23.08 vs. 14.99%). However, a marginal Mother Tongue x Sentence Type interaction ($\underline{F}1(1,22) = 4.04$, $\underline{p}<.055$) suggests that the effect may have been more prominent for monolingual Anglophones showing an increase of 10.8% in error rate on phonologically congruent sentences compared to phonologically incongruent sentences, than for monolingual Francophones, showing an

Table 5

Mean reaction times (RT) (in ms) and mean percentage of errors (%E) to the phonologically congruent and incongruent sentences for the monolingual groups in the sentence verification task

	Phonologically congruent		Phonologically incongruent	
Group	RT	%E	RT	%E
Anglophones	2132	22.83	2061	12.00
Francophones	1886	23.32	1898	17.98

increase of 5.34%. There was also a significant mother effect in the item analysis ($F2(1,281) = 3.97$, $p < .05$) indicating that the French list of sentences gave rise to a higher error rate than the English list (20.70 vs. 17.77%).

Discussion

For both Experiment 1 and 2, the discussion will be limited to results that were found to be statistically significant in both the subject and item analyses or in the subject analysis alone (these will be qualified appropriately). Since results that were significant only in the item analysis would permit a generalization to new samples of words only and not to new samples of subjects, they will not be discussed.

Lexical decision task

The analysis of latencies to homophone and control words for the monolingual Francophone and Anglophone groups revealed a statistically marginal Mother Tongue x Word Category interaction ($p<.07$) (subject analysis only). Inspection of the data indicates that monolingual Anglophones had similar latencies to homophone and control words (736 vs. 730 ms) while monolingual Francophones had longer reaction times on homophone words compared to control words (765 vs. 720 ms). The data are suggestive then of a differential influence of phonological information in lexical access for the two groups. The results of the accuracy analysis to homophone and control words revealed a similar trend. The interaction between groups and word type (subject analysis only) indicated that monolingual Anglophones were as accurate in classifying homophone and control words, while monolingual Francophones made significantly more errors on homophone words compared to their matched control words.

The results for the monolingual Anglophone group are consistent with those obtained by Coltheart et al. (1977) who failed to replicate the homophone effect reported by Rubenstein et al. (1971). As was mentioned in the introduction, in the Rubenstein et al. (1971) study, the homophone and control words were not matched on frequency of occurrence, number of letters and part of speech. In the Coltheart et al. (1977) study, the two categories of words were matched on these variables and in the present experiment the homophone and control words were matched on number of letters, CVC structure, frequency of occurrence and number of syllables. This methodological difference may account for the different results obtained.

Thus, when one considers the results obtained from the analyses of the two word categories, it appears that monolingual Anglophones did not rely on phonological recoding for lexical access of words and were able to obtain the meaning of individual words by visual information alone. The monolingual Francophones, however, appear to be relying on phonological recoding for lexical access of words, as both their decision latencies and classification accuracies were influenced by homophony. Thus, the results are suggestive of language-specific factors that influence the lexical access route relied upon, for extraction of word meaning. Coltheart et al. (1977) have argued that for readers of English, both visual and phonological access are available, but that phonological access is slower than visual access in most cases. Thus, the argument is that, when the letter string presented is a word, a visual access procedure is achieved before a phonological one and therefore no pre-lexical effects of phonological influence are found in the case of words. One possibility is that in the case of French readers, phonological access to the lexicon of word meanings is not slower than visual access and pre-lexical phonological influence can thus be evident. As was discussed previously, French differs from English in one important aspect. It is usually the case that in French, a given spelling pattern will be associated with a given sound, while in English, a given spelling pattern (e.g., __AVE) will be associated with a regular pronunciation (CAVE, GAVE, SAVE) and an exceptional one (HAVE). This may lead to faster and more accurate generation of phonological representations by spelling-to-sound correspondence rules in French than in English, and consequently phonological codes may be more influential in lexical access of individual words for French readers than for English readers.

Consider now the results concerning the two nonwords categories. The analyses indicated that both the monolingual Anglophones and Francophones were slowed down by letter strings that sounded like real words (e.g., GREAN). Although the interaction between groups and nonword categories was not significant, inspection of the data suggests that the pseudoword effect may be greater for Anglophone readers (+ 112 ms) than Francophone readers (+ 38 ms). Moreover, the results indicated that while both monolingual Anglophones and monolingual Francophones had longer latencies to pseudowords than control nonwords, only monolingual Anglophones were less accurate in classifying pseudowords compared to their matched control nonwords. Monolingual Francophones were as accurate with both categories of nonwords.

This result obtained for the monolingual Anglophones is consistent with previous reports of the pseudoword effect (Besner & Davelaar, 1983; Bias & McCusker, 1980; Coltheart et al., 1977). The pseudoword effect has been explained by false phonological matches with existing lexical entries. Having been recoded to sound, a pseudoword such as BRANE (/breyn/) is first accepted as a match with the phonological code for the word BRAIN. The response, however,is not made before a spelling check procedure is carried out, thus leading to longer decision times. In the present experiment, for the monolingual Anglophones, the pseudoword effect was obtained even when the pseudoword and control nowords were matched on visual similarity to real existing English words by the N measure. Thus the pseudoword effect appears to be of a phonological nature and not of a visual one.

An interesting finding is that while monolingual Francophones were slowed down in their decision times when a letter string sounded like a real word, they were not less accurate with such letter strings. Some characteristics inherent in the French language may explain these results. One of these characteristics is that in French, it is generally the case that a given sound has many possible spelling patterns. To take some examples from the list of nowords included in this study, the sound /wɛ̃/, can be spelled OIN, OING, OINS and OINT and the sound /ɛ̃/ can be spelled IN, INT, INGT, AIN, AIM, AINT, EIN and EINT, all of which have at least one examplar in the language. However usually, one or two of these possible spelling patterns are more "standard" or representative than the others (for example, for the sound /ɛ̃/, IN and AIN are much more common endings). In contrast, in English a given sound usually has only two or three possible spelling patterns. For example, the sound /ijn/ can be spelled EAN or EEN, and the sound /owl/ can be spelled OAL, OLE and OLL. Moreover, it seems that in English, each possible spelling pattern is more or less equally used in the language (e.g. EAN has for examplars BEAN, DEAN, LEAN, MEAN, TEAN and EEN had TEEN, GREEN, SEEN, BEEN, KEEN), thus each spelling pattern may be considered "standard".

Thus, a certain bias may have been inadvertantly built into the list of pseudowords used in the present experiment. In English, the derivation of the paeudoword GREAN from GREEN results in a pseudoword that looks like a real word since the spelling pattern __EAN has many examplars in the English language and may be as "standard" as __EEN is. In contrast, in French the derivation of EIGLE from AIGLE has resulted in a pseudoword that, although an orthographically valid letter string, may nevertheless not look as much like a real French word since the spelling pattern EI__ at the beginning of a word is rarer than the more "standard" spelling pattern AI__. Thus, although both GREAN and EIGLE both have an N measure of 4, GREAN may in fact look more like an acceptable word in English than EIGLE does in French.

In the French list of nonwords then, subjects may have been more able to make their decisions on the basis of visual information since some of the pseudowords had a spelling pattern that was not the "standard" one (an inspection of the list indicates that this was the case for 11 pseudowords out of 36). This would be consistent with the fact that although both groups showed a pseudoword effect in latencies, the data indicate that the increase in latencies was greater for monolingual Anglophones (+112 ms) than for monolingual Francophones (+38 ms).

It is also possible that it is generally easier for a French reader to detect mispellings than it is for an English reader. Thus for a reader of English, since in most cases for a given sound, two spelling patterns are possible and each is equally plausible (each is represented by a similar number of examplars in the language), it is more difficult to decide if a letter string is an acceptable word or not on the basis of visual information and knowledge of "standard" spellings for a given sound. In contrast, in French, given that one spelling pattern is usually more "standard" than others it is easier to decide if a letter string is an acceptable word or not.

Thus one possibility is that for the monolingual Anglophones, when a pseudoword was recoded to sound, a spelling check procedure had to be carried out with existing lexical entries. For monolingual Francophones, while it was not necessary to carry out a spelling check per se, a decision could be made on the basis of knowledge of "standard" spelling patterns alone, at least for some cases.

Another characteristic of the French language that may have played a role, is that the correctness of an orthographic spelling pattern may, in some cases, be verified by derivation of feminine or verb equivalents. Thus, for adjectives such as BLOND, the feminine version is BLONDE and the verb is BLONDIR. By such derivations, a reader could determine that the correct spelling pattern for /on/ in this case is OND and not ONT or ONS. Thus, as an example, when the pseudoword GRANS was presented, subjects may have attempted to derive the feminine (GRANDE) or verb equivalent (GRANDIR) to make their decisions. This strategy was possible for six of the pseudowords used.

Sentence verification task

The results concerning the meaningful sentences indicated that sentences containing a homophone word were judged as quickly as those containing a non-homophone word, for both the monolingual Anglophones and Francophones readers. As for the accuracy data, an overall sentence type effect revealed that homophone sentences produced more errors than control sentences. This statement needs to be qualified however as a marginally statistically significant ($p < .06$) interaction indicates that this may hold true more for monolingual Anglophones (+4.6%) than for monolingual Francophones (+1.9%).

The results obtained with the monolingual Anglophone group coincide with those of Doctor (1978), who found that acceptable sentences which contained a homophone word (for e.g. We wait in the queue) led to more incorrect classification responses than equivalent sentences which contained a non-homophonic word (for e.g. We stand in the queue), but the two types of sentences produced similar classification times.

A comparison of the differences between the monolingual Anglophones' and Francophones' performance in this task relative to the lexical decision task, reveals some interesting distinctions. Since monolingual Francophones showed a homophone effect in both their latencies and accuracies in the lexical decision task and monolingual Anglophones did not, one might have expected to observe a similar pattern when the task is evaluating sentences. However, one must keep in mind that the lexical decision task and the sentence verification task are evaluating the influence of phonological codes at different stages in the reading process. The lexical decision task evaluates possible pre-lexical phonological influence effects whereas the sentence verification evaluates possible post-lexical phonological influence effect (Coltheart, 1980). In the sentence verification task, the reader needs to determine if the sentence presented is aceptable as a whole. In order to do this, it is argued that each individual word have to be held in memory, until a decision can be reached. Phonological codes are argued to facilitate the storage of individual words in short-term memory that is necessary for comprehension of sentences. While we may expect differences in reading different languages at a lexical access stage, due to a different degree of regularity in spelling-to-sound mapping, there is no reason to expect a difference at a memory stage, where phonological recoding may serve as a general strategy to maintain information (Tzeng, Hung & Wang, 1977).

To consider now the results concerning the meaningless sentences, the analyses indicated that there were no difference in reaction times to sentences sounding meaningful when phonologically recoded and those that did not sound meaningful. As for the error data, an overall sentence type effect suggests that sentences that sounded correct produced more misclassifications than sentences which did not sound correct and this for both groups. However, a statistically marginal interaction ($p<.055$) in the error data suggest that monolingual Anglophones made more errors on phonologically congruent sentences (+10.8%) relative to phonologically incongruent sentences, than monolingual Francophones did (+5.34%).

The finding that for monolingual Anglophones, sentences like "He turned left at the <u>mane</u> intersection" produced more incorrect "yes" responses than sentences like "He turned left at the <u>pain</u> intersection" is consistent with previous results reported (Baron, 1973; Doctor, 1978). One objection to the interpretation of this finding as a phonological effect is that, as Doctor and Coltheart (1980) pointed out, it may be that the incorrectly spelled homophone looks more similar to the correct homophone in the acceptable form of the sentence than the incorrect homophone in the phonologically incongruent sentence does. This is unlikely to have been the case in the present experiment since the homophone selected to form the phonologically incongruent sentence was similar to the correct homophone in terms of number of letters, CVC structure and in most cases shared two or three letters (e.g., PAIN vs. MAIN or GREAT vs. BREAK).

A comparison between the performance of monolingual Anglophones and monolingual Francophones reveals that, if anything, monolingual Francophones were not relying as much on phonological codes when reading sentences for meaning as were monolingual Anglophones. This difference between the two groups is difficult to explain. While it may be argued that for Francophone readers, due to a more regular print-to-sound mapping in French, phonological information can be derived faster or more accurately, it is difficult to explain why phonological information was not influential, compared to monolingual Anglophones when the task necessitated judging the meaningfulness of a sentence as a whole. Although an attempt was made to construct list of sentences that were equivalent, it is possible that overall, the English sentences were inadvertantly more difficult and complex sentences than the French ones. If the English sentences were in fact more difficult to process, they may have been more likely to impose greater demands on memory and thereby encouraged a greater reliance on phonological coding. This interpretation may have some support since overall, the English list of sentences led to significantly longer reaction times than the French sentences in the item analyses (both for the meaningful and meaningless lists) even though the monolingual Anglophones and Francophones obtained similar reading rates in the screening test (314 vs. 312 wpm).

EXPERIMENT 2

As was mentioned in the introduction, many fluent bilinguals read more slowly in their second language relative to their first, despite the fact that they demonstrate equivalently high level of reading comprehension in both languages (Daitchman, 1976; Favreau, Komoda & Segalowitz, 1980; Favreau & Segalowitz 1982). Previous investigations have found that fluent bilinguals that read more slowly in their second language may not be as sensitive to the orthographic redundancies of the second language as they are to those in the first language (Favreau et al,. 1980) and that they may not be as capable of automatic processing when reading in their second language compared to their first (Favreau & Seglowitz, 1982).

The aim of the present experiment was to examine whether the slower second language reading rate of many fluent bilinguals could be related to a differential reliance on phonological information in reading. The performance of skilled bilinguals who show equivalent optimal reading rates in both their first and second language (Criterion A) was compared to that of bilinguals who are slower readers in their second language than in their first (Criterion B).

One might expect that the critical difference between the second language performance of relatively more skilled (Criterion A) than less skilled (Criterion B) readers to lie in skilled readers being better able to use phonological codes in reading single words. Thus, Criterion B bilinguals in their second language may have a performance similar to the less skilled readers in Barron's (1978, 1980) studies, showing less reliance on phonological information, either because they have more difficulty in generating phonological information or they are more likely to produce inadequate phonological codes due to a weaker knowledge of spelling-to-sound correspondence rules. Criterion A bilinguals may rely more on phonological recoding while reading in their second language relative to Criterion B bilinguals, perhaps because the activation of phonological codes is more automatic for them.

It is also possible that differences might emerge between the Criterion A and B performance in the second language, in reading sentences, where memory demands are greater and reliance on phonological codes might serve as a strategy to maintain individual words in short-term memory until they can be integrated into a meaningful unit. Several studies have found less skilled readers to be deficient in using phonological codes in short-term memory (Liberman et al., 1977; Mann et al., 1980) relative to skilled readers.

Thus, one possibility is that relatively less skilled readers in the second language would be less able to keep phonological codes active for memory purposes. In other words, they may be able to generate phonological codes but these speech codes may deactivate more rapidly (Perfetti & McCutchen, 1982). On the other hand, less skilled second language readers may be more dependent on phonological coding than skilled readers, performing like the younger readers in Doctor and Coltheart (1980), relying extensively on phonological codes when reading sentences for meaning.

These possibilities have been, explored in a lexical decision task where single letter strings had to be classified as real words or not, and in a sentence verification task where printed sentences had to be classified as being meaningful or meaningless.

Method

Subjects

Bilingual Anglophones subjects with French as a second language participated in this experiment. They were recruited by advertisements at Concordia University. Subjects were first administered the screening procedure described below and only subjects that met the following criteria were selected for participation in the experiment. First a subject's optimal reading rate had to be at least 275 words per minute (wpm) in the first language and at least 175 wpm in the second language. Second, subjects had to achieve comprehension scores of at least 70% in both the first and second languages. Inclusion in the A or B bilingual group was contingent upon the difference between the first and second language optimal reading rates as assessed by the screening procedure. Subjects who showed a difference of 15% or less between their first and second language optimal reading rates were included in the Criterion A group, while subjects who showed a difference of 25% or more were included in the Criterion B group.

The sample consisted of 24 bilingual Anglophones, half of which were classified as Criterion A subjects and half as Criterion B subjects. The Criterion A subjects (seven females and five males) and the Criterion B subjects (six females and six males) had mean ages of 25.17 and 25.66 years respectively. Subjects were paid $4.00 for their participation in the screening procedure and $8.00 for their participation in the experiment.

The mean optimal reading rates and the mean comprehension scores of the bilingual Anglophones in first and second languages are presented in table 6. Separate 2 (Criterion Group) x 2 (Language) analyses of variance (ANOVA) with repeated measures on the last factor were performed on the reading rate data and on the comprehension scores. The analysis performed on the reading rate data revealed a significant language effect ($\underline{F}(1,22) = 78.56$, $\underline{p} < .001$) indicating that overall first language reading rate was faster than second language reading rate (350 vs. 261 wpm). There was also a significant Criterion Group x Language interaction ($\underline{F}(1,22) = 48.06$, $\underline{p} < .001$). Post hoc tests using the Tukey procedure on the Criterion Group x Language interaction indicated that the Criterion A subjects had similar optimal reading rates in their first and second languages (322 vs. 303 wpm, n.s.) whereas the Criterion B subjects had a slower optimal reading rate in the second language compared to the first (219

Table 6

Mean optimal reading rates (in wpm) and mean comprehension scores (in %) for the Criterion A and B Anglophones in their first (L1) and second (L2) languages

	Reading rate (wpm)		Comp. score (%)	
Group	L1	L2	L1	L2
Criterion A	322	303	87.50	86.25
Criterion B	378	219	84.17	81.00

vs. 378 wpm, p<.01). The post hoc tests also revealed that Criterion B subjects had a significantly faster optimal reading rate than Criterion A subjects in the first language (378 vs. 322 wpm, p<.01) and a significantly slower optimal reading rate in the second language (219 vs. 303 wpm, p<.01). The analysis performed on the comprehension scores revealed no significant effect indicating that comprehension level was equivalent for both Criterion groups in both the first and second languages.

Screening procedure

The screening procedure was the same that was described in Experiment 1 except that each subject read two different texts in the first language and two different texts in the second language. Thus, optimal reading rates and comprehension scores were derived for both first and second language performances.

Stimuli

The stimuli for both the lexical decision task and the sentence verification task were the same as described in Experiment 1.

Procedure

The procedure followed was the same that was described for Experiment 1. In this experiment however, subjects performed the lexical decision task and the sentence verification task in both their first and second languages. Subjects then, came in for two different sessions lasting approximately 40 minutes. Half of the subjects performed the first session in their first language while half did in their second language.

Results

The procedure for the analyses of the results was the same as that described for Experiment 1. All analyses were conducted once using raw scores and once using transformed scores. As well, all analyses were also performed using both subjects' and item means. For both the lexical decision and the sentence verification tasks, letter strings or sentences giving rise to more than a 70% error rate were eliminated from the analyses. This resulted in the exclusion of one item in the French lexical decision task and one item in the French sentence verification task as well as one item in each of the English lexical decision task and sentence verification task for the Anglophone Criterion A group. For the Anglophone Criterion B group, six items in the French lexical decision task and two in the French sentence verification task were excluded.

Lexical decision task

The word and nonword data were analysed separately. The mean reaction times and corresponding mean percentage error rates for the two word categories (homophone and control) are presented in Table 7.

Log reaction times for correct responses for the word categories were analysed in a 2 (Criterion Group) x 2 (Language) x 2 (Word Category) ANOVA. There was a significant language effect in both the subject and the item analyses (min $F'(1,37) = 10.74$, $p<.005$), revealing that overall latencies were slower in the second language than in the first (846 vs. 724 ms). There was a significant word category effect only in the subject analysis ($F1(1,22) = 7.60$, $p<.05$) indicating that homophones were processed slower than control words overall (799 vs. 770 ms). Moreover, a marginally statistically significant Criterion Group x Language x Word Category interaction was also found ($F1(1,22) = 2.83$, $p<.10$) which suggests that Criterion B bilinguals showed a relatively greater homophone effect in their second language (+61 ms) than they did in their first (+14 ms). This marginal interaction is also consistent with the interpretation that in the second language, Criterion B bilinguals showed a relatively greater homophone effect (+61 ms) than Criterion A bilinguals (+5 ms). These findings are illustrated in Figure 1. Other effects that were significant were the group effect in the item analysis ($F2(1,272) = 8.12$, $p<.005$) and the Criterion Group x Language interaction in the

Table 7

Mean reaction times (RT) (in ms) and mean percentage of errors (%E) to the homophone and control words in the first (L1) and second (L2) language for the Criterion A and B groups in the lexical decision task

		Homophones		Controls	
Group	Language	RT	%E	RT	%E
Criterion A	L1	744	11.19	709	6.25
	L2	792	13.16	787	14.05
Criterion B	L1	728	5.56	714	4.44
	L2	932	17.38	871	15.94

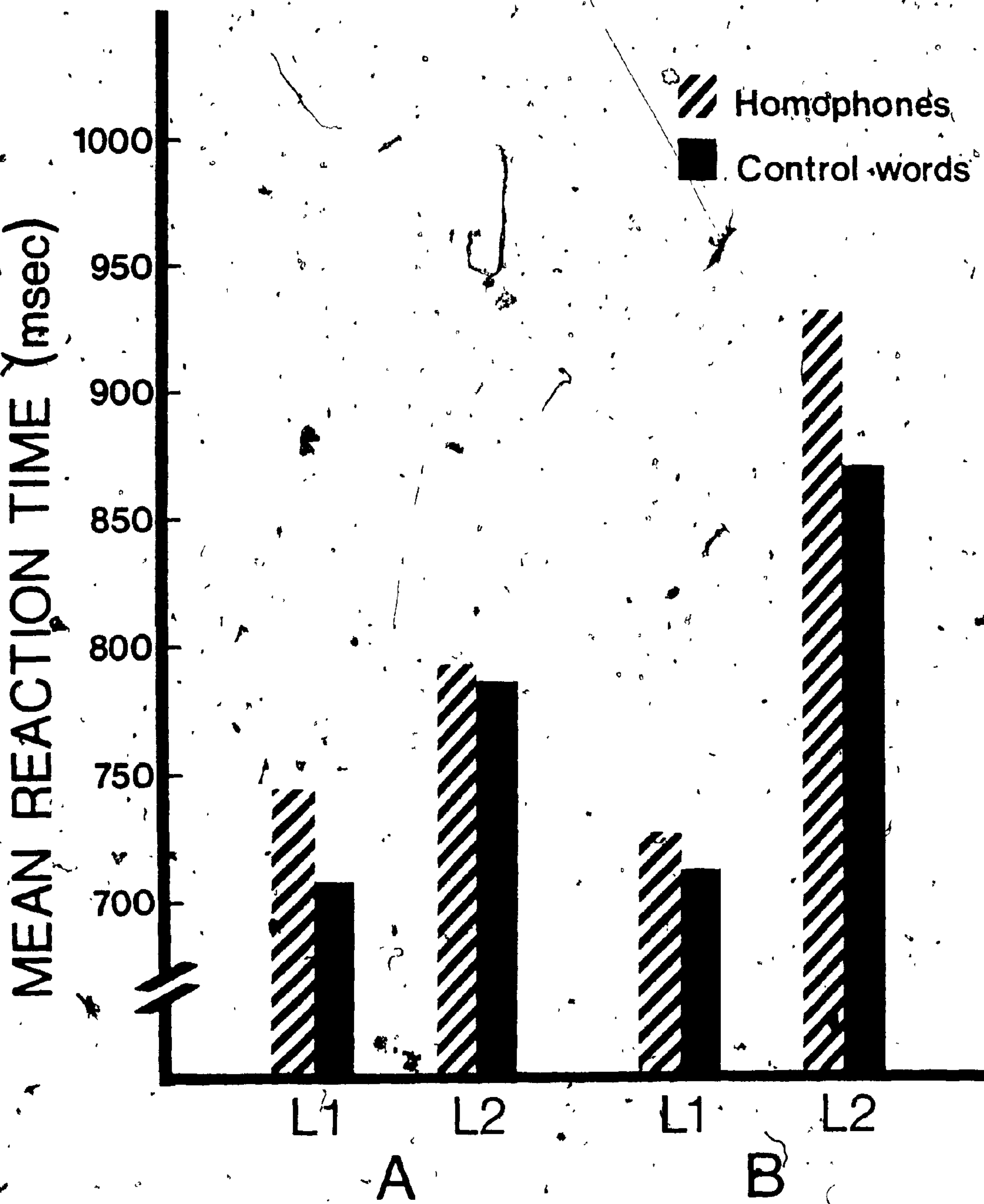

Figure 1. Mean reaction times (in ms) to homophone and control words in the first (L1) and second (L2) language for the Criterion A and B Anglophone groups in the lexical decision task.

item analysis ($F2(1,272) = 10.34$, $p<.001$).

The ANOVA performed on the arcsin error data revealed a significant language effect in both the subject and the item analysis (min $F'(1,179) = 12.41$, $p<.001$). This effect reflects the fact that overall more errors were produced in the second language than in the first (15.13 vs. 6.86%). However, the Criterion Group x Language interaction was significant in both the subject analysis ($F1(1,22) = 7.67$, $p<.05$) and the item analysis ($F2(1,272) = 3.98$, $p<.05$). Post-hoc tests indicated that while the Criterion A subjects had similar error rates in the first and second languages (8.72 vs. 13.60%, n.s.), Criterion B subjects made more errors in the second language than in the first (16.66 vs. 5.00%, $p<.01$).

The mean latencies and associated mean percentage error rates for the nonwords (pseudowords and control nonwords) are reported in Table 8.

A 2 (Criterion Group) x 2 (Language) x 2 (Nonword Category) ANOVA was performed on log reaction times for correct responses. The analysis revealed a significant nonword category effect in both the subject and item analysis (min $F'(1,172) = 8.83$, $p<.005$). Pseudowords produced longer latencies than control nonwords (917 vs. 857 ms). There was also a significant language effect (min $F'(1,28) = 4.20$, $p<.05$); second language performance was slower than first language performance (937 vs. 837 ms). A significant Criterion Group x Language interaction was found in the item analysis ($F2(1,276) = 11.40$, $p<.001$) and a significant Language x Nonword Category in the

Table 8

Mean reaction times (RT) (in ms) and mean percentage of errors (%E) to the pseudowords and control nonwords in the first (L1) and second (L2) language for the Criterion A and B groups in the lexical decision task

Group	Language	Pseudowords RT	Pseudowords %E	Control nonwords RT	Control nonwords %E
Criterion A	L1	898	25.17	825	14.83
	L2	946	19.09	892	16.00
Criterion B	L1	857	15.00	766	10.04
	L2	965	20.20	946	14.16

subject analysis ($F1(1,22) = 9.48$, $p<.01$). Post-hoc tests on this last interaction revealed that all of the possible comparisons were significant. The interaction which is illustrated in Figure 2 suggests a greater pseudoword effect in the first language than in the second. Moreover, a marginal Criterion Group x Language x Nonword Category ($F1(1,22) = 3.50$, $p<.07$), which is illustrated in Figure 3 was evident. The results suggest that Criterion B bilinguals showed a less pronounced pseudoword effect in their second language (+19 ms) than they did in their first (+91 ms) or than Criterion A bilinguals did in either their first (+74 ms) or second (+54 ms) language.

The ANOVA performed on the error scores produced a significant nonword category effect in both the subject and item analyses (min $F'(1,69) = 5.27$, $p<.05$). Pseudowords gave rise to more errors than control nonwords (19.86 vs. 13.76%). There was also a significant Criterion Group x Language interaction effect in both the subject analysis ($F1(1,22) = 7.61$, $p<.05$) and the item analysis ($F2(1,276) = 4.73$, $p<.05$). Post-hoc tests indicated that while Criterion A subjects had a similar error rate in the first and second language (20.00 vs. 17.54%, n.s.) the Criterion B subjects made more errors in the second language than in the first (17.18 vs. 12.52%, $p<.01$). The post-hoc test also revealed that while Criterion A and B subjects had a similar error rate in the second language (17.54 vs. 17.18%, n.s.), Criterion A subjects made more errors in the first language compared to Criterion B subjects (20.00 vs. 12.52%, $p<.01$). The item analysis also revealed a significant group effect ($F2(1,276) = 7.35$, $p<.01$),

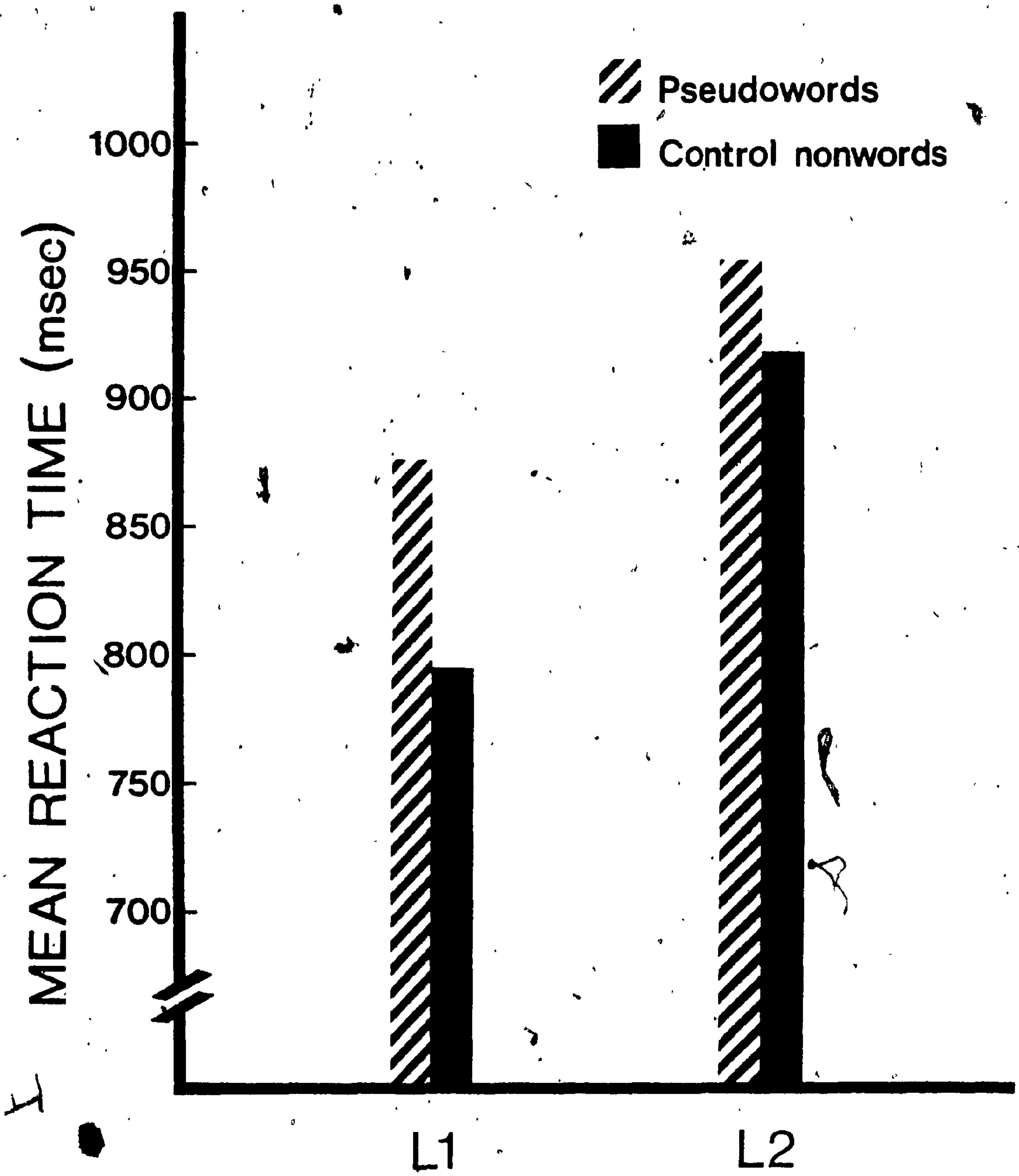

Figure 2. Mean reaction times (in ms) to pseudowords and control nonwords in the first (L1) and second (L2) language collapsed across Criterion A and B Anglophone groups in the lexical decision task.

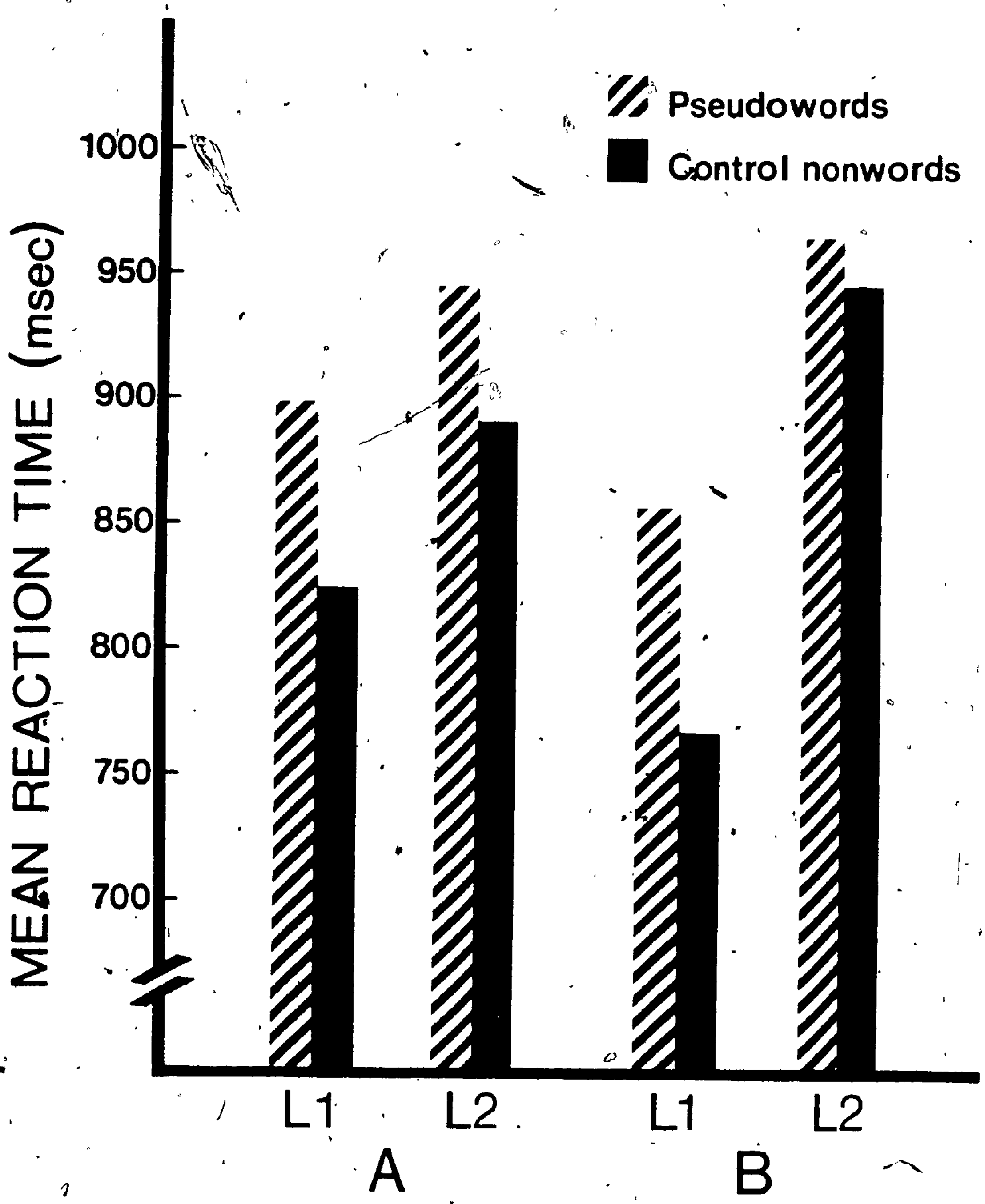

Figure 3. Mean reaction times (in ms) to pseudowords and control nonwords in the first (L1) and second (L2) language for the Criterion A and B Anglophone groups in the lexical decision task.

indicating that overall, Criterion B subjects made more errors than Criterion A subjects (19.02 vs. 16.64%).

Sentence verification task

The mean latencies and associated mean percentage error rates for the two types of meaningful sentences are reported in Table 9.

Log reaction times for correct responses to the meaningful sentences were analysed in a 2 (Criterion Group) x 2 (Language) x 2 (Sentence Type) ANOVA. The analysis yielded a significant language effect (min $F'(1,41) = 58.74$, $p<.001$) and a significant Criterion Group x Language interaction (min $F'(1,38) = 20.24$, $p<.001$). Tukey tests indicated that while Criterion A subjects had a similar reaction times to sentences read in both their first and second language (1942 vs. 2120 ms, n.s.), Criterion B were significantly slower in their second language compared to their first (2460 vs. 1742 ms, $p<.01$). The locus of this difference was in the second language performance where Criterion B were slower than Criterion A (2460 vs. 2120 ms, $p<.01$), while they were similar to Criterion A in the first language (1742 vs. 1942 ms, n.s.). The ANOVA also revealed a significant Language x Sentence Type interaction ($F1(1,22) = 6.35$, $p<.05$), which is illustrated in Figure 4. The interaction suggest that there was more phonological effects in the first language than in the second.

Table 9

Mean reaction times (RT) (in ms) and mean percentage of errors (%E) to the homophone and control sentences in the first (L1) and second (L2) language for the Criterion A and B groups in the sentence verification task

		Homophones		Controls	
Group	Language	RT	%E	RT	%E
Criterion A	L1	1962	10.74	1922	4.77
	L2	2105	8.82	2136	7.50
Criterion B	L1	1762	6.72	1721	2.82
	L2	2449	17.55	2471	9.45

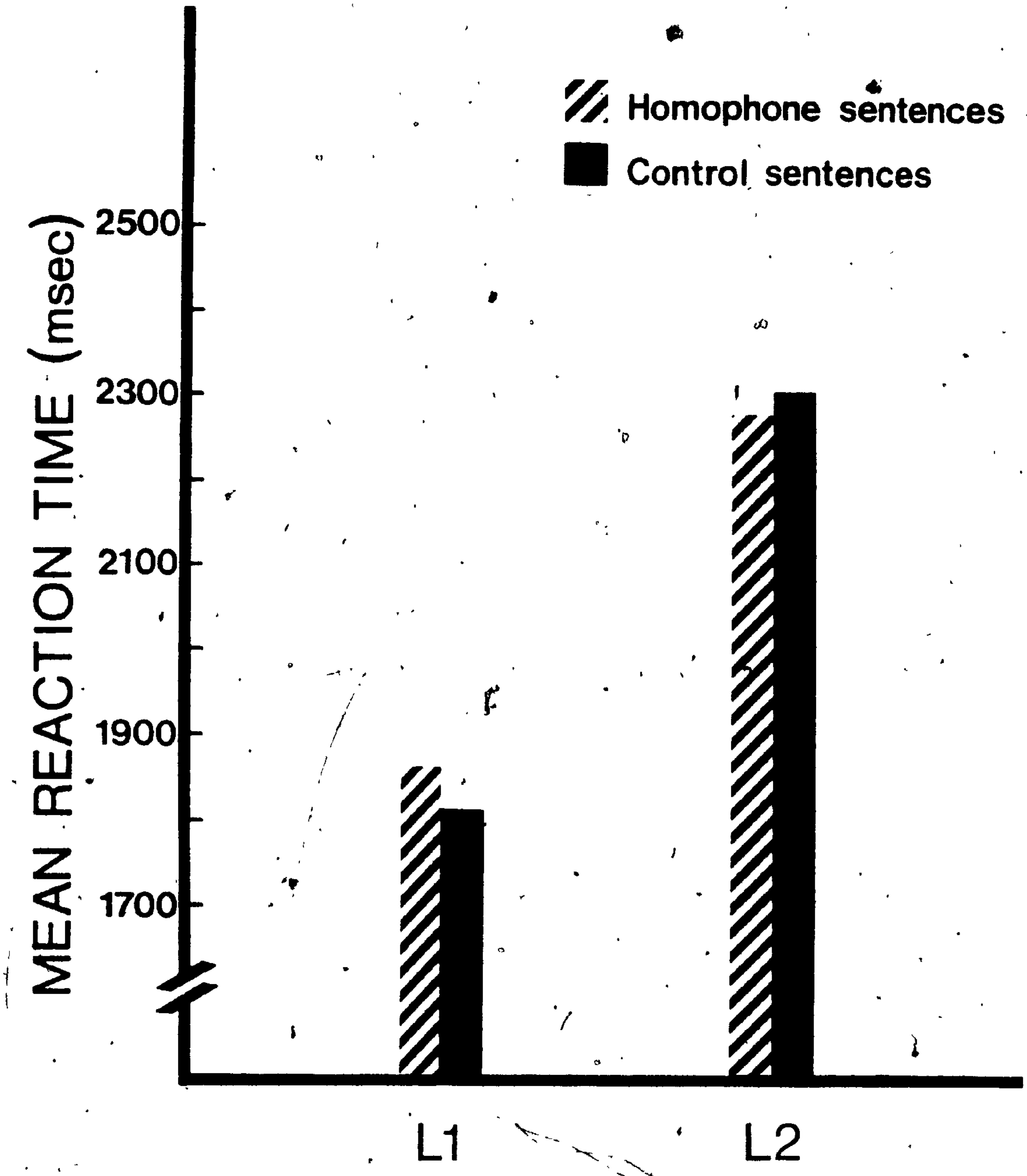

Figure 4. Mean reaction times (in ms) to homophone and control sentences in the first (L1) and second (L2) language collapsed across Criterion A and B Anglophone groups in the sentence verification task.

The ANOVA performed on the transformed error scores produced a significant language effect (min $\underline{F}'(1,84) = 10.96$, $\underline{p}<.005$) and a significant Criterion Group x Language interaction (min $\underline{F}'(1,83) = 8.90$, $\underline{p}<.005$). Post-hoc tests indicated that the Criterion Group x Language interaction was due to Criterion B subjects making more errors in the second language than in the first language (13.50 vs. 4.77%, $\underline{p}<.01$) while Criterion A subjects had a similar error rate in both the first and second language (7.76 vs. 8.16%, n.s.). Moreover, the Tukey test revealed that while Criterion A and B subjects performed similarly in the first language (7.76 vs. 4.77%, n.s.), Criterion B subjects made more errors in the second language than Criterion A subjects (13.50 vs. 8.16, $\underline{p}<.05$). The ANOVA also yielded a significant sentence type effect (min $\underline{F}'(1,101) = 10.78$, $\underline{p}<.005$) in that homophone sentences produced more errors overall than control sentences (10.96 vs. 6.14%). However this effect is coloured by a three-way interaction found in both the subject ($\underline{F}1(1,22) = 6.04$, $\underline{p}<.05$) and the item analysis ($\underline{F}2(1,565) = 3.89$, $\underline{p}<.05$) which is illustrated in Figure 5.

The interaction shows that while Criterion B subjects made more errors on homophone sentences than control sentences in both the first and second language (6.72 vs. 2.82%, $\underline{p}<.05$; 17.55 vs. 9.45%, $\underline{p}<.01$), Criterion A subjects did so only in their first language (10.74 vs. 4.77%, $\underline{p}<.01$) and not in their second language (8.82 vs. 7.50%, n.s.). The Tukey procedure also revealed that while A subjects demonstrate a

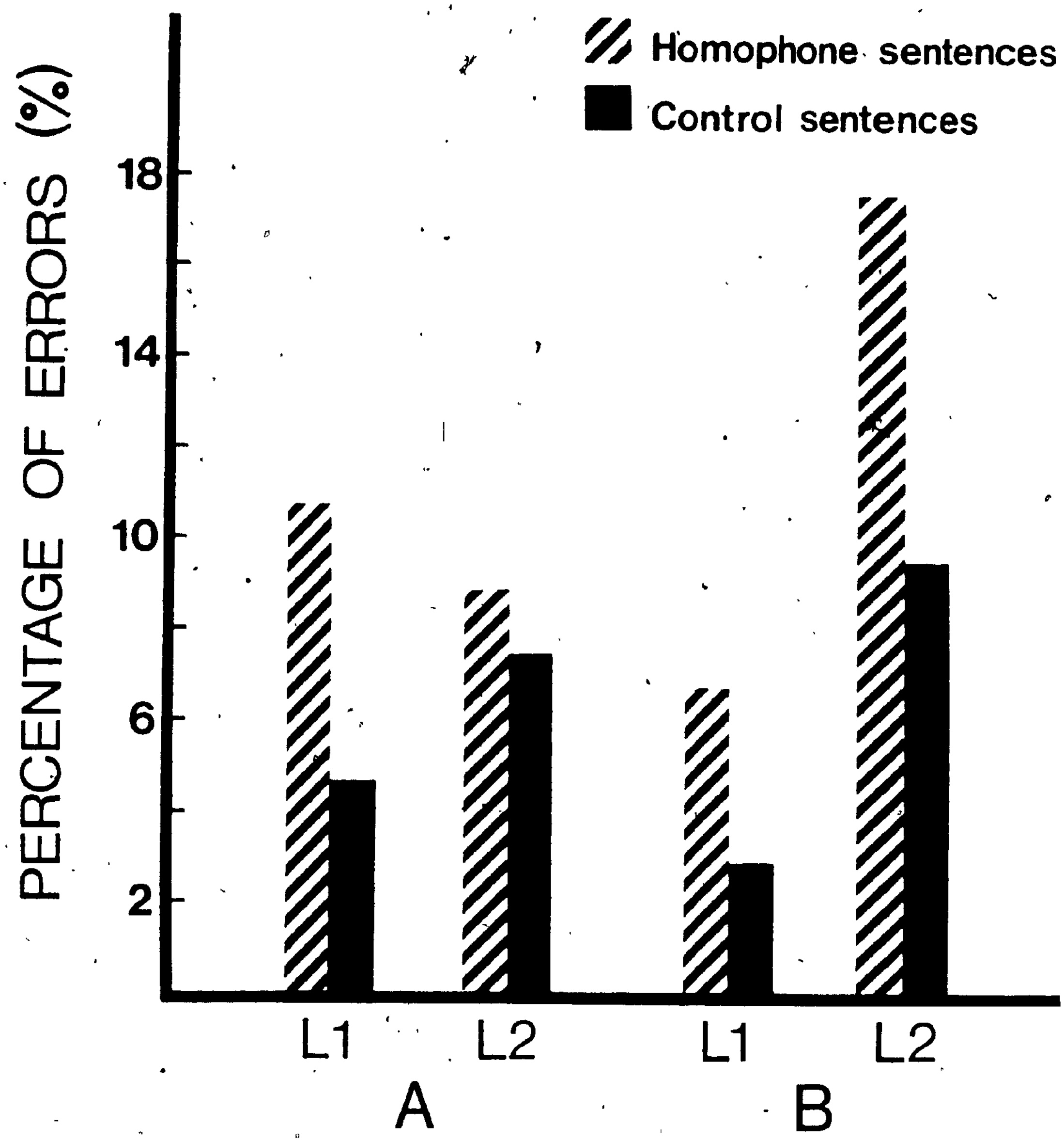

Figure 5. Mean percentage of errors to homophone and control sentences in the first (L1) and second (L2) language for the Criterion A and B Anglophone groups in the sentence verification task.

similar error rate for the two sentence types in both languages (homophone: 10.74 vs. 8.82%; control: 4.77 vs. 7.50%, n.s.), Criterion B subjects make significantly more errors in the second language than in the first for both the homophone sentences (6.72 vs. 17.55%, $p < .01$) and control sentences (2.82 vs. 9.45%, $p < .01$).

The mean reaction times and corresponding mean percentage error rate for the two types of meaningless sentences are presented in Table 10.

The analysis performed on the log reaction times for correct answers to the two types of meaningless sentences produced a significant language effect (min $F'(1,44) = 42.71$, $p < .001$) indicating that second language performance was slower than first language performance (2202 vs. 1822 ms). However a significant Criterion Group x Language interaction was also found (min $F'(1,40) = 18.85$, $p < .001$) and the post- hoc analysis suggested that while Criterion A subjects had similiar latencies in both languages (1923 vs. 2052 ms, n.s.) Criterion B subjects were slower in the second language compared to the first (2353 vs. 1722 ms, $p < .01$). Furthermore, the Tukey test indicated that while Criterion B subjects were slower than Criterion A in the second language (2353 vs. 2052 ms, $p < .01$); they were faster in first language performance compared to A subjects (1722 vs. 1923 ms, $p < .05$). The ANOVA revealed as well a three-way interaction ($F1(1,22) = 4.30$, $p < .05$) which is depicted in Figure 6. The interaction suggests that when reading in the second language, B subjects were slower on phonologically congruent sentences than on phonologically

Table 10

Mean reaction times (RT) (in ms) and mean percentage of errors (%E) to the phonologically congruent and incongruent sentences in the first (L1) and second (L2) language for the Criterion A and B groups in the sentence verification task

		Phonologically congruent		Phonologically incongruent	
Group	Language	RT	%E	RT	%E
Criterion A	L1	1932	25.85	1914	19.14
	L2	2031	27.22	2072	16.77
Criterion B	L1	1704	20.12	1739	13.59
	L2	2380	24.38	2326	15.94

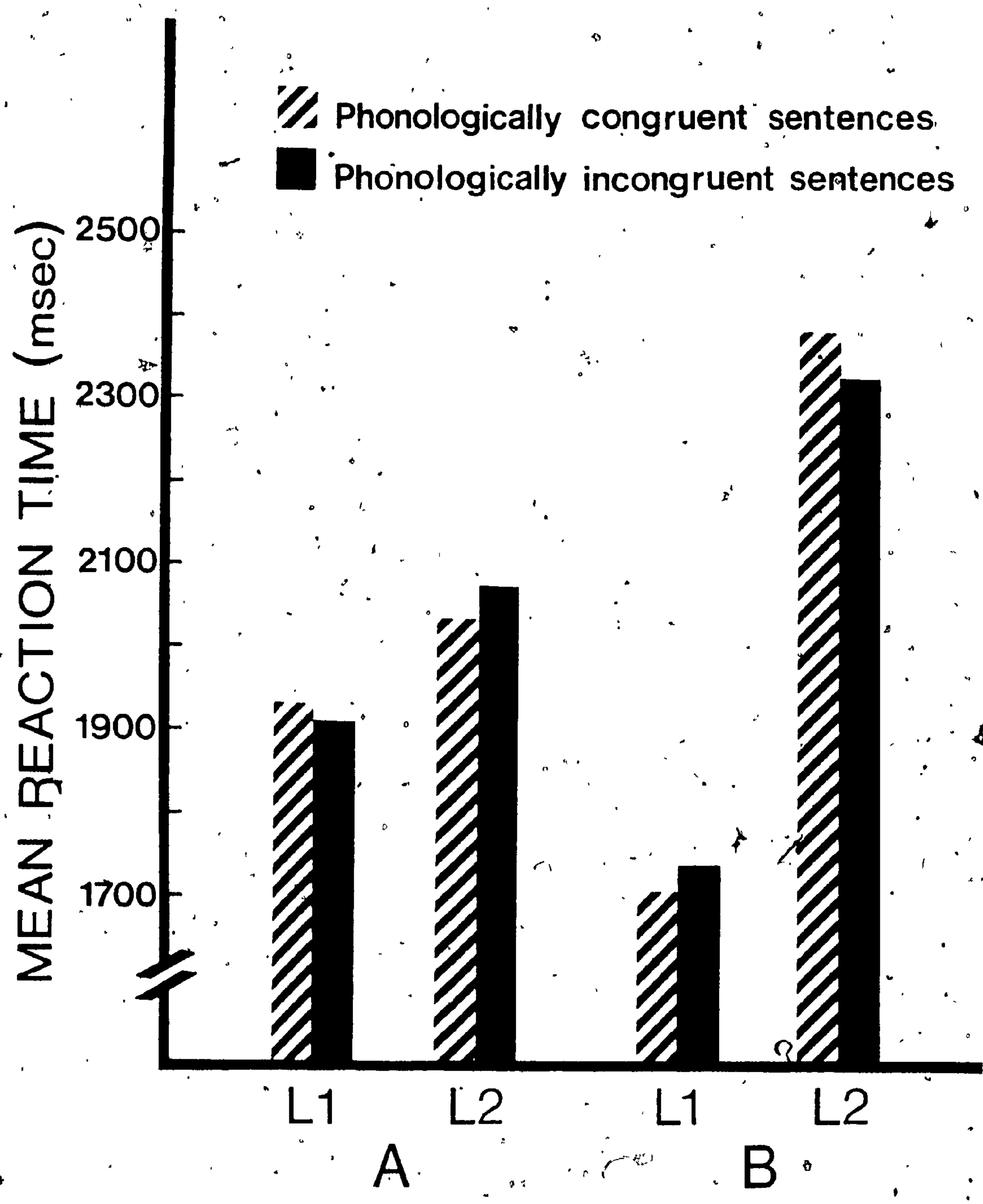

Figure 6. Mean reaction times (in ms) to phonologically congruent and incongruent sentences in the first (L1) and second (L2) language for the Criterion A and B Anglophone groups in the sentence verification task.

incongruent sentences, while they were not when reading in the first language. Criterion A bilinguals showed similar latencies to the two types of meaningless sentences in both their first and second language.

The ANOVA performed on the arcsin error data revealed a sentence type effect (min $F'(1,81) = 20.77$, $p<.001$) indicating that overall phonologically congruent sentences gave rise to a higher error rate than phonologically incongruent sentences (24.39 vs. 16.36%). A significant group effect was also found in the item analysis ($F2(1,566) = 10.11$, $p<.005$), revealing that Criterion A subjects overall made more errors than Criterion B subjects (22.30 vs. 18.60%).

Discussion

Lexical decision task

The analysis of latencies to homophone and control words revealed that both Criterion A and Criterion B bilinguals were slower in classifying homophone words compared to their matched control words and this was true whether they were reading in their first or second language (subject analysis only). A different picture emerges however, if one considers the marginally statistically significant ($p<.10$) Criterion Group x Language x Word Category interaction effect. This marginal interaction is suggestive of different lexical access procedures between Criterion A and B bilinguals in the second language. Thus, when reading in their second language, Criterion B Anglophones showed a relatively greater homophone effect (+61 ms) compared to Criterion A Anglophones (+5 ms). As well, Criterion B Anglophones showed a relatively greater homophone effect in their second language (+61 ms) compared to when reading in their first language (+14 ms). The results then are suggestive of a differential influence of phonological codes between the two groups of bilinguals in the second language; Criterion B bilinguals being relatively more influenced by phonologically recoded information for lexical access when they were reading in the second language compared to Criterion A bilinguals. It is tempting to conclude from this that less skilled readers were more dependent on phonological information in their second language than skilled readers were, or than they were themselves in their first language. However, one has to consider in this case the influence that the specific language read may have played. It is interesting to note that the pattern of results for Criterion B bilinguals is consistent with the pattern of results obtained for the two monolingual groups. It is almost as if Criterion B bilinguals were dependent on the characteristics of the language they were reading; thus they showed more influence of phonological coding for words when reading in the more regular in spelling-to-sound mapping second language (French) and less influence of phonological coding when they were reading in their first language (English). Criterion A bilinguals, on the other hand, did not appear to be influenced by language-specific factors when reading in their second language (French) as they showed little phonological effects (+5 ms).

As for response accuracy with homophone and control words, neither Criterion A or B bilinguals showed differential effects with these targets in either language. Although Criterion B subjects made overall more errors in the second language than Criterion A did, these errors were not specific to homophone words. Thus Criterion B bilinguals were influenced by homophony of words in latencies but not accuracy. It appears then, that when reading in their second language, Criterion B bilinguals were influenced by phonological information, leading to longer latencies on homophone words, but were particularly careful in carrying out the spelling check procedure.

The results from the two word categories in the lexical decision task then, suggest that one difference between Criterion A and B bilinguals is that in the second language reading Criterion B subjects are more likely to rely on the outcome of phonologically recoded information for lexical access of words, relative to Criterion A bilinguals. This conclusion is necessarily tentative because the evidence comes only from a marginal effect in the latency results and not from the accuracy measures. Moreover, the second language read was in this case French, and as we saw in Experiment 1, French may be more likely to produce phonological influence effects for words, by itself. Thus, relative to Criterion A bilinguals, slower second language readers may be more dependent on the particular characteristics of the language they are reading in the case where single words are processed.

Consider now the results from the two nonword categories. The analysis of latencies to pseudowords and control nonwords indicated that both Criterion A and B bilinguals were slower with and made more errors on letter strings that sounded like real words (e.g., GREAN) than those which did not (e.g., TREAN). This statement needs qualification however, in the following way. If one considers the latency data, a significant Language x Nonword Category interaction (subject analysis only) revealed that the pseudoword effect may be greater in the first language (+82 ms) (in this case English), than in the second (+37 ms), (French). Moreover, if one takes into account the marginal Criterion Group x Language x Nonword Category ($p < .07$) interaction, the interpretation becomes that this differential language effect is more evident for Criterion B than for Criterion A bilinguals. Thus, Criterion B bilinguals showed a less pronounced pseudoword effect in latencies when they were reading in their second language (+19 ms) than when they were reading in English, their first language (+91 ms), or than Criterion A did in either their first (+74 ms) or second (+54 ms) language. The performance of Criterion B bilinguals then, resembled that of the skilled readers in Barron's (1978) study, when reading in the first language and that of the less skilled readers when reading in the second language. This finding may at first glance, appear to support the notion that slower second language readers are less likely to be influenced by phonologically recoded information in the second language than skilled readers are, perhaps because they have a greater difficulty in generating phonological codes compared to skilled readers for which the activation of phonological codes may be more automatic. However, one has to take into consideration certain language-specific factors that were evident in the performance of monolingual Anglophones and Francophones. As with the latency results concerning decision to words discussed previously, Criterion B bilinguals showed a similar performance to that of the two monolinguals groups, where a relatively greater pseudoword effect was found for monolingual Anglophone readers (+112 ms) than for monolingual Francophone readers (+38 ms). As well, Criterion B bilinguals did not show a different influence of phonological information between the two languages in terms of their accuracies. When one considers the error data, a pseudoword effect was evident for Criterion B bilinguals in both their first and second language. Furthermore, Criterion B bilinguals were able to generate phonological information and were influenced by phonologically recoded information when faced with words, as they were slowed down when the letter strings presented were homophones compared to control words in their second language.

The results from the two nonword conditions in the lexical decision task then, suggest that the difference between Criterion A and B performance in the second language lies in the fact that, if anything, Criterion B subjects were showing relatively less phonological coding effects. Again this statement is tentative as only the reaction time data support it. As with the trend observed for the word data, the patterns of results for the Criterion B bilinguals in the second language follows the trend observed for the two monolingual groups. Taken together, the evidence from the word and nonword data suggest that Criterion B bilinguals appear to be more easily influenced by the language they are reading, behaving like monolingual Anglophones when reading in their first language and like monolingual Francophones when reading in the second language. Criterion A bilinguals, on the other hand, appear to be more likely to apply the strategies they use in reading their first language, when reading isolated words of their second language.

Sentence verification task

The analysis of the latencies to the two types of meaningful sentences indicated that both Criterion A and B bilinguals were slower in classifying sentences when they contained a homophone word compared to when the sentence contained a non-homophonic word. This was true, however when they were reading in their first language (English) but not when reading in their second language (French) (subjects analysis only). In addition, both Criterion A and B groups made significantly more errors on homophone sentences than on control sentences in their first language. This last result is consistent with those reported by Doctor (1978) with monolingual Anglophones.

Although Criterion B bilinguals made more errors on homophone sentences than on control sentences in the second language, neither bilingual group took more time in classifying homophone sentences when reading in their second language. In fact, for both groups, when they were reading in French, the results were nonsignificantly in the opposite direction, that is they took slightly more time to classify sentences containing a non-homophonic word than those containing a homophone word. This pattern is the same observed for the monolingual group.

Thus, in the results from the meaningful sentences, evidence of involvement of phonological codes in the second language appeared only for the Criterion B bilingual group and only in the accuracy data. There was no evidence of differential reliance on phonological codes in reading the second language between Criterion A and B in terms of latencies.

Consider now, the results concerning the two types of meaningless sentences. The analyses showed that both Criterion A and B bilinguals made significantly more errors with sentences that sounded meaningful when phonologically recoded (e.g., Paula seas him everyday at school) than those which remained meaningless even if recoded to sound (e.g., Paula seem him everyday at school). This result was found in both the first and second language. However, only the Criterion B subjects were slowed down with sentences that contained an incorrectly spelled homophone and this only while they were reading in their second language, not their first (subject analysis only).

The findings regarding the first language performance of the bilinguals included in the present experiment are consistent with those found that by Baron (1973) and Doctor (1978) with monolingual Anglophones. As well, the pattern of an effect on accuracy but not latency coincide with the results obtained in Experiment 1 with monolingual Anglophones.

When considering the difference between Criterion A and B bilingual performance in the second language then, it appears that both groups were making some use of phonological codes in reading sentences for meaning as they made errors in classifying sentences, that did not look meaningful but produced correct phonological representations. However, only Criterion B bilinguals were relatively slower with such sentences in their second language. Thus, both Criterion A and B bilinguals encoded the words in the sentence in a phonological form when reading in their first and second language. However, only Criterion B bilinguals were slower with such encoding processes in their second language.

If we consider the findings of the sentence verification task as a whole, the data could be taken to suggest that in the second language, Criterion B were more dependent on phonological information than Criterion A. That is, while the accuracy data for meaningful sentences and both latency and accuracy data for meaningless sentences indicate involvement of phonological codes for Criterion B bilinguals, Criterion A showed second language influence of phonological codes only when sentences were meaningless and only in terms of their accuracy.

One should keep in mind, however, that Criterion B also showed phonological effect when reading in their first language (latency and error for "yes" sentences and accuracy for "no" sentences). When confronted with printed sentences then, Criterion B bilinguals appeared to be using phonological codes in both their faster (first) and relatively slower (second) language. The critical difference between the second language performance of Criterion A and B was that less skilled bilinguals made more errors with homophone sentences and were slower with phonologically congruent sentences. Thus, Criterion

B bilinguals were not deficient in the use of phonological codes in the second language relative to Criterion A bilinguals or relatively less likely to use phonological information in their second language compared to in their first language. The data suggest that Criterion B were generally dependent on phonologically recoded information when reading sentences for meaning, in both the first and second language. In the present study, the critical distinction between Criterion A and Criterion B bilinguals was that the phonological encoding processes were slower in the second language reading of relatively less skilled biliguals.

GENERAL DISCUSSION

The first experiment reported in this thesis examined the issue of phonological codes in the reading of monolingual subjects with respect to two languages: English and French. Previous investigations have found that languages that differ as to their degree of regularity in orthographic-phonological correspondences may encourage different degrees of reliance on phonological information for lexical access of individual words (e.g., Feldman & Turvey, 1983). In the French language, a many-to-one mapping is characteristic of the spelling-to-sound correspondences, while in English a many-to-many mapping is characteristic. Readers of French then may be more likely to rely on phonologically recoded information, as spelling-to-sound correspondence rules will produce adequate phonological representations, due to a greater regularity of mapping from print to sound.

In the present thesis, the results of the lexical decision task revealed involvement of different processes in lexical access of word meanings for readers of English than for readers of French. More specifically, it was found that monolingual Anglophones were not influenced by phonological information for lexical access of individual words and were able to obtain meaning of words on the basis of visual information, while monolingual Francophones were influenced by phonological information. It has been suggested that for readers of English, phonological access to the lexicon is slower than visual access so that when a word is presented its meaning can be obtained by visual information alone first, and no effects of pre-lexical phonological information are obtained. Phonological influence effects appear when the letter string presented is not a real word, since a "no" decision is made only after a certain deadline (such as when no logogen has reached threshold after a given time period) and in this case phonological information has time to influence the reader's decision (Coltheart et al., 1977).

In the case of Francophone readers, one possibility is that since a given spelling pattern will be associated with only one sound, phonological representations can generally be derived faster and more accurately. As a consequence, phonological information may be more likely to influence lexical access of individual words in French than in English.

In the case of nonwords, in the present study, monolingual Francophones were also influenced by phonological information, as their reaction times to pseudowords were slower than to control nonwords, although the increased latencies to letter strings that sounded correct was relatively smaller than that found for monolingual Anglophones. Moreover, monolingual Francophones were not less accurate in classifying pseudowords compared to control nonwords. In addition to phonological codes, a "preliminary" spelling check procedure based on knowledge of "standard" spelling patterns appears to have been available to the readers of French. Since some of the nonwords included in the French list had a spelling pattern that was not the "standard" one, the Francophone readers may have had stronger visual information on which to base their classification decisions. Thus, both phonological information and a "preliminary" spelling check procedure may have been used in combination. In the case of words, lexical retrieval based on phonological information determined the reader's decision while in the case of nonwords, the "preliminary" spelling check determined the subject's response, at least in some cases.

The results of the lexical decision task for the monolingual Anglophones coincide with previous reports (Coltheart et al., 1977) indicating that while phonological information may influence the processing of nonwords, it is not necessary for lexical access of words. On the other hand, for readers of French, phonological information was found to influence word decisions, thus pointing to linguistic differences in the influence of phonological codes in lexical access. It would be interesting to examine how much the role of phonological information in lexical access is under strategic control for readers of French according to whether it is beneficial or detrimental to performance under various task conditions. A paradigm such as the one used by Davelaar et al. (1978) or McQuade (1981) might be appropriate to investigate this possibility.

The performance of monolingual Anglophones in the sentence verification task was similar to that found in previous studies (Doctor, 1978). Sentences that contained a homophone word were accepted as meaningful sentences as quickly as sentences that contained a non-homophonic word, although the former produced more incorrect classifications than the latter. As well "pseudo" sentences that sounded correct (e.g., He turned left at the <u>mane</u> intersection) were rejected as quickly as meaningless sentences that did not sound correct (e.g., He turned left at the <u>pain</u> intersection), although they produced more incorrect classifications. It appears then, that fluent readers of English were using phonological codes for memory purposes when the task required them to make a decision as the meaningfulness of a single sentence.

Monolingual Francophones in the sentence verification task, appeared not to rely as much on phonological codes as readers of English. As was discussed previously, this difference between the two groups was unexpected. One might argue that for readers of French, phonological information can be derived faster or more accurately. However, it is more difficult to explain why phonological codes were not as influential in their performance relative to their role for English readers when the task necessitated integration of individual words and judgment of the acceptability of the sentence as a whole. One possibility, as we discussed previously, is that the English set of sentences may have been inadvertantly more complex sentences and thus more likely to impose greater demands on memory.

In the second experiment reported in this thesis, Anglophone bilinguals with equivalent levels of reading comprehension in their first and second language performed the lexical decision task and the sentence verification task both in English and in French. Two groups of bilinguals were included: 1) bilinguals who demonstrate equivalent reading rates in the first and second language (Criterion A) and 2) bilinguals who read more slowly in the second language relative to the first despite having an adequate knowledge of the second language's vocabulary and syntax (Criterion B). The aim of Experiment 2 was to examine whether the slower second language reading rate of the Criterion B bilinguals could be attributed to a differential reliance on phonological information, relative to Criterion A bilinguals.

In the lexical decision task, there was no consistent pattern of a differential influence of phonological codes in the second language reading of Criterion B bilinguals compared to Criterion A bilinguals. In the second language, Criterion B bilinguals were more influenced by phonological information in the case where words were the targets (in latencies) than were Criterion A bilinguals. In the case where nonwords were targets, Criterion B bilinguals appeared to be less influenced by phonologically recoded information in their second language (in latencies) compared to Criterion A bilinguals or compared to themselves in their first language.

The pattern of the Criterion B bilinguals' performance is consistent with the idea that they were more sensitive to the underlying characteristics of the language they were reading when processing single words. In other words, Criterion B bilinguals appeared to be showing a behavior similar to monolingual Anglophones when they were reading in their first language and similar to monolingual Francophones when they were reading in their second language.

When the task required judgment of the semantic acceptability of a sentence in the second language, Criterion B readers made more incorrect classifications of meaningful homophonic sentences (e.g., She said the weather was fair outside) than of non-homophonic sentences (e.g., She said the weather was nice outside) while Criterion A readers did not. A second distinction, in the present study, was that although both groups of bilinguals made more errors in classifying "pseudo" sentences (e.g., She said the weather was fare outside), compared to meaningless sentences that did not sound correct (e.g., She said the weather was hair outside) across both languages, only Criterion B bilinguals were slower with the "pseudo" sentences and this only in the second language. Thus, while both groups of bilinguals encoded the words in a sentence in a phonological form when reading sentences for meaning and this in both the first and second language, only Criterion B bilinguals were slower with such encoding processes in the second language.

Criterion B bilinguals thus appeared to be using phonologically coded information for purposes of sentence comprehension both in their faster (first) and relatively slower (second) language. Thus, they were not relatively less dependent on the use of phonological coding for memory purposes in the second language relative to the first. Moreover, Criterion B bilinguals were not deficient in phonological coding in the second language compared to Criterion A bilinguals as both groups made more errors on second language sentences that sounded correct when recoded to sound. The critical distinction between the two groups of bilinguals in the present experiment was that the phonological encoding processes of the relatively less skilled readers were slower or used less efficiently in the second language. In other words, while the less skilled bilinguals were able to generate phonological codes in the second language, the processes using these phonological codes in memory, were relatively less efficient.

It is interesting to note that Criterion A and B bilinguals performed similarily in terms of their overall speed in the second language in the lexical decision task, despite the reading rate difference in the second language of the two groups, obtained in the screening measures. In the lexical decision task, an overall language effect was found suggesting that both Criterion A and B Anglophone bilinguals were slower in classifying words when they were letter strings in the second language than when they were letter strings in the first language. However, Criterion B subjects made more errors overall in the second language than in the first, while Criterion A made a similar number of errors in both languages. In constrast to the lexical decision data, the screening reading rates differences between Criterion A and B bilinguals in the second language, were reflected in the sentence verification task.

In closing, one should be reminded that the bilinguals included in this study were fluent bilinguals in terms of performance in the two languages under normal conditions of speaking and listening. The results show that despite such level of fluency, subtle differences can emerge (e.g., reading rate differences) which can have practical implications. By further identifying the underlying cognitive mechanisms that are implicated in such differences, perhaps appropriate training procedures may one day be possible to help bilinguals attain greater degrees of fluency in their second language.

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Appendix A

English words

Homophones	Frequency	Control	Frequency
poll	9	moss	9
tale	21	nude	20
bored	14	dared	14
lone	8	sane	8
pear	6	teen	6
hare	1	hove	1
feat	6	nail	6
bare	29	bone	33
fare	7	gore	7
wood	55	seat	54
prey	7	prop	7
haul	5	hook	5
deer	13	roar	13
hour	144	paid	145
whine	4	spice	4
reign	7	beast	7
waist	11	moist	11
sail	12	leaf	12
warn	11	wart	11
beech	6	gaunt	6
gait	8	raid	10
hear	153	food	147
wear	36	fool	37
roll	35	calm	35
taut	8	dead	8
blew	12	drum	11
weak	32	beef	32
tide	11	duke	11
threw	46	throw	42
sheer	15	sweep	15
mean	9	hoot	9
maid	31	meal	30
hole	58	safe	58
herd	22	palm	22
grey	12	snap	12
fore	7	lore	7

Appendix B

French words

Homophones	Frequency	Control	Frequency
vante	4	tarde	4
toit	40	miel	36
hêtre	4	perle	4
pois	2	buis	2
maux	9	meut	6
tante	26	lente	26
taire	22	coule	22
mord	2	ment	1
puits	25	liens	26
soie	42	baie	51
chêne	19	brève	19
haut	248	huit	204
thon	2	troc	2
erre	11	orne	9
poing	24	sourd	18
voeu	13	raie	10
cygne	3	campe	3
faux	67	soin	74
vaine	13	fauve	13
conte	9	linge	9
baux	1	pouf	1
foie	21	quai	33
taise	3	tuile	3
mètre	14	germe	12
croix	50	chien	49
voit	170	noir	153
thym	3	trac	2
toux	11	muet	10
taux	85	jeux	94
sain	12	poil	14
prêt	68	bref	88
pers	1	rocs	1
mont	39	parc	34
luit	1	daim	2
chas	1	croc	1
boue	12	gaie	11

Appendix C

English nonwords

Pseudohomophones		N	Control	N
grean	(green)	4	trean	2
reap	(reap)	12	feap	11
trate	(trait)	8	brate	8
noat	(note)	5	moat	13
sleak	(sleek)	5	gleak	3
dyme	(dime)	4	byme	2
deap	(deep)	10	teap	11
werse	(worse)	2	derse	2
treet	(treat)	5	freet	4
burd	(bird)	11	purd	4
nune	(noon)	8	fune	10
scail	(scale)	1	spail	3
joon	(june)	8	poon	10
freek	(freak)	4	breek	4
ploom	(plume)	2	proom	3
slait	(slate)	3	blait	2
croke	(croak)	4	droke	4
snair	(snare)	2	slair	4
choak	(choke)	3	droke	4
cloke	(cloak)	6	ploke	1
moal	(mole)	6	voal	3
voat	(vote)	4	loat	8
gole	(goal)	11	lole	12
shole	(shoal)	6	scole	5
meen	(mean)	7	veen	6
fome	(foam)	8	vome	7
tean	(teen)	15	rean	11
flaim	(flame)	3	plaim	4
blead	(bleed)	7	clead	4
hoam	(home)	3	boam	6
bote	(boat)	11	yote	7
neer	(near)	10	zeer	8
poak	(poke)	3	roak	6
pleed	(plead)	2	sleed	5
gote	(goat)	9	pote	13
taul	(tall)	8	daul	6

Appendix D

French nonwords

Pseudohomophones		N	Control	N
eigle	(aigle)	4	eible	2
engle	(angle)	5	encle	5
moint	(moins)	5	roint	2
crait	(craie)	4	drait	4
fante	(fente)	18	fance	9
drein	(drain)	2	prein	2
neine	(naine)	9	deine	6
kadre	(cadre)	2	kidre	1
clère	(clair)	3	crère	9
torce	(torse)	4	porce	10
paine	(peine)	16	faine	12
bende	(bande)	10	dende	7
trons	(tronc)	7	prons	6
heine	(haine)	8	teine	8
grein	(grain)	3	glein	1
verce	(verse)	12	terce	9
plont	(plomb)	1	plunt	1
granc	(grand)	2	tranc	2
rante	(rente)	13	bante	13
rempe	(rampe)	5	bempe	1
cinge	(singe)	3	vinge	5
frons	(front)	4	grons	1
enge	(ange)	2	ende	4
eigre	(aigre)	4	eibre	4
mant	(ment)	4	zant	2
joit	(joie)	7	goit	7
gaphe	(gaffe)	2	saphe	1
blens	(blanc)	2	brens	4
frant	(franc)	3	trant	2
frain	(frein)	4	flain	3
lante	(lente)	14	nante	11
blons	(blond)	2	clons	4
forse	(force)	13	vorse	6
froit	(froid)	6	groit	3
doeu	(deux)	3	loeu	2
saise	(seize)	5	maise	7

Appendix E

English sentences

FAIR/FARE - HAIR/HARE

She said the weather was fair outside.
She said the weather was nice outside.
She said the weather was fare outside.
She said the weather was hair outside.

He paid his fare before he got on the bus.
He paid his bill before he got on the bus.
He paid his fair before he got on the bus.
He paid his hare before he got on the bus.

Your sister has beautiful hair.
Your sister has beautiful eyes.
Your sister has beautiful hare.
Your sister has beautiful fair.

I saw a little hare running to the bushes.
I saw a little mouse running to the bushes.
I saw a little hair running to he bushes.
I saw a little fare running to the bushes.

ROAD/RODE - LOAN/LONE

The traffic on the five lane road was deafening.
The traffic on the five lane street was deafening.
The traffic on the five lane rode was deafening.
The traffic on the five lane loan was deafening.

He rode the horse with grace.
He raced the horse with grace.
He road the horse with grace.
He lone the horse with grace.

Peter just received a loan from the bank.
Peter just received a cheque from the bank.
Peter just received a lone from the bank.
Peter just received a road from the bank.

The lone stranger was wandering in the city.
The sad stranger was wandering in the city.
The loan stranger was wandering in the city.
The rode stranger was wandering in the city.

FLAIR/FLARE - STAIR/STARE

John always had a flair to find a good restaurant.
John always had a chance to find a good restaurant.
John always had a flare to find a good restaurant.
John always had a stair to find a good restaurant.

They detected the flare coming out of the woods.
They detected the flame coming out of the woods.
They detected the flair coming out of the woods.
They detected the stare coming out of the woods.

The old man had trouble walking up the stair.
The old man had trouble walking up the street.
The old man had trouble walking up the stare.
The old man had trouble walking up the flair.

It is not polite to stare at people.
It is not polite to yell at people.
It is not polite to stair at people.
It is not polite to flare at people.

ROLL/ROLE - POLL/POLE

Jane got the teacher's role in the play.
Jane got the teacher's part in the play.
Jane got the teacher's roll in the play.
Jane got the teacher's pole in the play.

You shouldn't make the ball roll on the table.
You shouldn't make the ball bounce on the table.
You shouldn't make the ball role on the table.
You shouldn't make the ball poll on the table.

The weird cat climbed up the pole.
The weird cat climbed up the wall.
The weird cat climbed up the poll.
The weird cat climbed up the role.

He went to the poll to vote for his favorite candidate.
He went to the school to vote for his favorite candidate.
He went to the pole to vote for his favorite candidate.
He went to the roll to vote for his favorite candidate.

BARE/BEAR - HERE/HEAR

He looked at his bare hand.
He looked at his left hand.
He looked at his bear hand.
He looked at his here hand.

He saw a bear coming toward the camp.
He saw a car coming toward the camp.
He saw a bare coming toward the camp.
He saw a hear coming toward the camp.

I asked him to put the book here.
I asked him to put the book back.
I asked him to put the book hear.
I asked him to put the book bare.

He wanted to hear the wonderful news.
He wanted to give the wonderful news.
He wanted to here the wonderful news.
He wanted to bear the wonderful news.

SEEM/SEAM - SEES/SEAS

They seem pretty happy today.
They look pretty happy today.
They seam pretty happy today.
They sees pretty happy today.

He tried to conceal the seam in the rug.
He tried to conceal the burn in the rug.
He tried to conceal the seem in the rug.
He tried to conceal the seas in the rug.

Paula sees him everyday at school.
Paula helps him everyday at school.
Paula seas him everyday at school.
Paula seem him everyday at school.

The captain travelled all over the Eastern seas.
The captain travelled all over the Eastern world.
The captain travelled all over the Eastern sees.
The captain travelled all over the Eastern seam.

SAIL/SALE - TAIL/TALE

Paul and Linda will sail next weekend.
Paul and Linda will leave next weekend.
Paul and Linda will sale next weekend.
Paul and Linda will tail next weekend.

That store had more items for sale than any other.
That store had more items for view than any other.
That store had more items for sail than any other.
That store had more items for tale than any other.

That animal has a big tail.
That animal has a big head.
That animal has a big tale.
That animal has a big sail.

John told a tale to his friends.
John told a lie to his friends.
John told a tail to his friends.
John told a sale to his friends.

PAIN/PANE - MAIN/MANE

The pain she felt was almost unbearable.
The ache she felt was almost unbearable.
The pane she felt was almost unbearable.
The main she felt was almost unbearable.

Peter broke the window pane.
Peter broke the window sill.
Peter broke the window pain.
Peter broke the window mane.

He turned left at the main intersection.
He turned left at the last intersection.
He turned left at the mane intersection.
He turned left at the pain intersection.

The child patted the lion's mane.
The child patted the lion's cubs.
The child patted the lion's main.
The child patted the lion's pane.

MAZE/MAIZE - WAVE/WAIVE

The animal was well trained to run that maze.
The animal was well trained to run that race.
The animal was well trained to run that maize.
The animal was well trained to run that wave.

He wants to eat more maize.
He wants to eat more beans.
He wants to eat more maze.
He wants to eat more waive.

She wanted to wave at him.
She wanted to yell at him.
She wanted to waive at him.
She wanted to maze at him.

She asked permission to waive the rule.
She asked permission to drop the rule.
She asked permission to wave the rule.
She asked permission to maize the rule.

POUR/PORE - SOUL/SOLE

He didn't pour enough milk.
He didn't get enough milk.
He didn't pore enough milk.
He didn't soul enough milk.

The furniture repairman filled the pore with a special compound.
The furniture repairman filled the cut with a special compound.
The furniture repairman filled the pour with a special compound.
The furniture repairman filled the sole with a special compound.

That man has a generous soul.
That man has a generous heart.
That man has a generous sole.
That man has a generous pour.

That was the sole reason for going back.
That was the best reason for going back.
That was the soul reason for going back.
That was the pore reason for going back.

DEAR/DEER - FEAT/FEET

I went to the movies with my dear friend Dick.
I went to the movies with my good friend Dick.
I went to the movies with my deer friend Dick.
I went to the movies with my feat friend Dick.

The biologist examined the new species of deer in the laboratory.
The biologist examined the new species of frog in the laboratory.
The biologist examined the new species of dear in the laboratory.
The biologist examined the new species of feet in the laboratory.

The best trained team accomplished this great feat.
The best trained team accomplished this great show.
The best trained team accomplished this great feet.
The best trained team accomplished this great dear.

My feet ached a lot after that long walk.
My legs ached a lot after that long walk.
My feat ached a lot after that long walk.
My deer ached a lot after that long walk.

MAIL/MALE - HAIL/HALE

You should mail that letter as soon as possible.
You should send that letter as soon as possible.
You should male that letter as soon as possible.
You should hail that letter as soon as possible.

He wanted to hire a male.
He wanted to hire a man.
He wanted to hire a mail.
He wanted to hire a hale.

We went back in as soon as the hail started to fall.
We went back in as soon as the snow started to fall.
We went back in as soon as the hale started to fall.
We went back in as soon as the mail started to fall.

My mother is a hale and hearty lady.
My mother is a brave and hearty lady
My mother is a hail and hearty lady.
My mother is a male and hearty lady.

DAZE/DAYS - RAZE/RAYS

Tim was in a daze when he woke up.
Tim was in a park when he woke up.
Tim was in a days when he woke up.
Tim was in a raze when he woke up.

It took them ten days to finish the project.
It took them ten months to finish the project.
It took them ten daze to finish the project.
It took them ten rays to finish the project.

They wanted to raze the building to the ground.
They wanted to knock the building to the ground.
They wanted to rays the building to the ground.
They wanted to daze the building to the ground.

Rays of light were coming through the window.
Beams of light were coming through the window.
Raze of light were coming through the window.
Days of light were coming through the window.

GREAT/GRATE - BREAK/BRAKE

Mr. Smith is really a great helper.
Mr. Smith is really a nice helper.
Mr. Smith is really a grate helper.
Mr. Smith is really a break helper.

He used the grate to prepare the cheese.
He used the knife to prepare the cheese.
He used the great to prepare the cheese.
He used the brake to prepare the cheese.

The recital continued without a break.
The recital continued without a stop.
The recital continued without a brake.
The recital continued without a great.

He tried to brake before he hit the car.
He tried to stop before he hit the car.
He tried to break before he hit the car.
He tried to grate before he hit the car.

PLANE/PLAIN - PLATE/PLAIT

Peter is afraid to ride in a plane.
Peter is afraid to ride in a boat.
Peter is afraid to ride in a plain.
Peter is afraid to ride in a plate.

The meal she had prepared was plain.
The meal she had prepared was good.
The meal she had prepared was plane.
The meal she had prepared was plait.

Jane is bringing the cheese plate right away.
Jane is bringing the cheese dish right away.
Jane is bringing the cheese plait right away.
Jane is bringing the cheese plane right away.

He wanted to plait the wires together.
He wanted to twist the wires together.
He wanted to plate the wires together.
He wanted to plain the wires together.

HEAL/HEEL - REAL/REEL

Doctors heal the sick everyday.
Doctors cure the sick everyday.
Doctors heel the sick everyday.
Doctors real the sick everyday.

I hurt my heel while playing soccer.
I hurt my foot while playing soccer.
I hurt my heal while playing soccer.
I hurt my reel while playing soccer.

He bought him a real motorcycle.
He bought him a small motorcycle.
He bought him a reel motorcycle.
He bought him a heal motorcycle.

He left the reel on the table.
He left the tape on the table.
He left the real on the table.
He left the heel on the table.

SHEER/SHEAR - STEEL/STEAL

It was sheer luck that she wasn't hurt.
It was pure luck that she wasn't hurt.
It was shear luck that she wasn't hurt.
It was steel luck that she wasn't hurt.

The farmers shear their own sheep in spring.
The farmers shave their own sheep in spring.
The farmers sheer their own sheep in spring.
The farmers steal their own sheep in spring.

The pan she bought is made of steel.
The pan she bought is made of tin.
The pan she bought is made of steal.
The pan she bought is made of sheer.

He wanted to steal the car.
He wanted to take the car.
He wanted to steel the car.
He wanted to shear the car.

PAIL/PALE - BAIL/BALE

He will bring a pail of water.
He will bring a cup of water.
He will bring a pale of water.
He will bring a bail of water.

John looked pale last night.
John looked sick last night.
John looked pail last night.
John looked bale last night.

He wanted to pay his bail before Tuesday.
He wanted to pay his fine before Tuesday.
He wanted to pay his bale before Tuesday.
He wanted to pay his pail before Tuesday.

The machine lifted the heavy bale of hay onto the truck.
The machine lifted the heavy pack of hay onto the truck.
The machine lifted the heavy bail of hay onto the truck.
The machine lifted the heavy pale on hay onto the truck.

Appendix F

French sentences

FOIE/FOIS - VOIE/VOIX

Mon frère a subi une opération pour le foie.
Mon frère a subi une opération pour le coeur.
Mon frère a subi une opération pour le fois.
Mon frère a subi une opération pour le voie.

Il me répète la même chose à chaque fois.
Il me répète la même chose à chaque jour.
Il me répète la même chose à chaque foie.
Il me répète la même chose à chaque voix.

Un accident s'est produit dans une voie à sens unique.
Un accident s'est produit dans une rue à sens unique.
Un accident s'est produit dans une voix à sens unique.
Un accident s'est produit dans une foie à sens unique.

La chanteuse avait une voix magnifique.
La chanteuse avait une robe magnifique.
La chanteuse avait une voie magnifique.
La chanteuse avait une fois magnifique.

SALE/SALLE - DATE/DATTE

La maison que nous avons visitée était très sale.
La maison que nous avons visitée était très grande.
La maison que nous avons visitée était très salle.
La maison que nous avons visitée était très date.

La réunion se tiendra dans cette salle.
La réunion se tiendra dans cette pièce.
La réunion se tiendra dans cette sale.
La réunion se tiendra dans cette datte.

Il savait déjà la date de l'examen.
Il savait déjà la note de l'examen.
Il savait déjà la datte de l'examen.
Il savait déjà la sale de l'examen.

Marie n'a voulu manger qu'une seule datte.
Marie n'a voulu manger qu'une seule fraise.
Marie n'a voulu manger qu'une seule date.
Marie n'a voulu manger qu'une seule salle.

BOUE/BOUT - TOUX/TOUT

Les enfants aiment jouer dans la boue.
Les enfants aiment jouer dans la neige.
Les enfants aiment jouer dans la bout.
Les enfants aiment jouer dans la toux.

On apercevait des arbres au bout du chemin.
On apercevait des arbres au bord du chemin.
On apercevait des arbres au boue du chemin.
On apercevait des arbres au tout du chemin.

Cette toux semble s'aggraver de jour en jour.
Cette grippe semble s'aggraver de jour en jour.
Cette tout semble s'aggraver de jour en jour.
Cette boue semble s'aggraver de jour en jour.

Nous avons tout mangé hier soir.
Nous avons bien mangé hier soir.
Nous avons toux mangé hier soir.
Nous avons bout mangé hier soir.

MAUX/MOT - TAUX/TOT

Les maux qui affligent cet enfant sont considérables.
Les peines qui affligent cet enfant sont considérables.
Les mot qui affligent cet enfant sont considérables.
Les taux qui affligent cet enfant sont considérables.

Paul avait laissé un mot sur la table.
Paul avait laissé un livre sur la table.
Paul avait laissé un maux sur la table.
Paul avait laissé un tôt sur la table.

Le taux a été fixé à 200 dollars.
Le bail a été fixé à 200 dollars.
Le tôt à été fixé à 200 dollars.
Le maux à été fixé à 200 dollars.

Marc est parti très tôt ce matin.
Marc est parti très vite ce matin.
Marc est parti très taux ce matin.
Marc est parti très mot ce matin.

ERRE/AIRE - ELLE/AILE

L'étranger erre dans la rue.
L'étranger marche dans la rue.
L'étranger aire dans la rue.
L'étranger elle dans la rue.

L'aire de ce terrain dépasse la grandeur normale.
L'arbre de ce terrain dépasse la grandeur normale.
L'erre de ce terrain dépasse la grandeur normale.
L'aile de ce terrain dépasse la grandeur normale.

Elle part pour l'Europe jeudi prochain.
Paul part pour l'Europe jeudi prochain.
Aile part pour l'Europe jeudi prochain.
Erre part pour l'Europe jeudi prochain.

L'aile est une des caractéristiques des oiseaux.
L'oeuf est une des caractéristiques des oiseaux.
L'elle est une des caractéristiques des oiseaux.
L'aire est une des caractéristiques des oiseaux.

CHAUD/CHAUX - CHAMP/CHANT

Il fait très chaud aujourd'hui.
Il fait très froid aujourd'hui.
Il fait très chaux aujourd'hui.
Il fait très champ aujourd'hui.

L'entrée était recouverte de chaux.
L'entrée était recouverte de sable.
L'entrée était recouverte de chaud.
L'entrée était recouverte de chant.

Ils se sont endormis à côté du champ.
Ils se sont endormis à côté du lac.
Ils se sont endormis à côté du chant.
Ils se sont endormis à côté du chaud.

Julie s'est inscrite à des cours de chant.
Julie s'est inscrite à des cours de sciences.
Julie s'est inscrite à des cours de champ.
Julie s'est inscrite à des cours de chaux.

MONT/MON - BOND/BON

Ils sont allés au mont cueillir des fraises.
Ils sont allés au pré cueillir des fraises.
Ils sont allés au mon cueillir des fraises.
Ils sont allés au bond cueillir des fraises.

Mon chien n'arrête pas de japper.
Le chien n'arrête pas de japper.
Mont chien n'arrête pas de japper.
Bon chien n'arrête pas de japper.

Le chat a fait un bond et est disparu.
Le chat a fait un tour et est disparu.
Le chat a fait un bon et est disparu.
Le chat a fait un mont et est disparu.

Cet homme a toujours été très bon.
Cet homme a toujours été très riche.
Cet homme a toujours été très bond.
Cet homme a toujours été très mon.

TENTE/TANTE - DENSE/DANSE

Il m'a acheté une tente pour ma fête.
Il m'a acheté une bague pour ma fête.
Il m'a acheté une tante pour ma fête.
Il m'a acheté une dense pour ma fête.

Ma tante Lise viendra nous rejoindre.
Ma soeur Lise viendra nous rejoindre.
Ma tente Lise viendra nous rejoindre.
Ma danse Lise viendra nous rejoindre.

La forêt est très dense en conifères.
La forêt est très forte en conifères.
La forêt est très danse en conifères.
La forêt est très tente en conifères.

Elle danse à la discothèque tous les soirs.
Elle va à la discothèque tous les soirs.
Elle dense à la discothèque tous les soirs.
Elle tante à la discothèque tous les soirs.

VEND/VENT - VERS/VERT

Il vend de porte en porte.
Il cogne de porte en porte.
Il vent de porte en porte.
Il vers de porte en porte.

Le vent était plutôt violent hier.
Le jeu était plutôt violent hier.
Le vend était plutôt violent hier.
Le vert était plutôt violent hier.

Hélène et Linda sont parties vers 2 heures.
Hélène et Linda sont parties pour 2 heures.
Hélène et Linda sont parties vert 2 heures.
Hélène et Linda sont parties vend 2 heures.

Alain a acheté un superbe manteau vert.
Alain a acheté un superbe manteau bleu.
Alain a acheté un superbe manteau vers.
Alain a acheté un superbe manteau vent.

CENT/SANG - REND/RANG

Le chalet est à cent kilomètres de Montréal.
Le chalet est à trente kilomètres de Montréal.
Le chalet est à sang kilomètres de Montréal.
Le chalet est à rend kilomètres de Montréal.

Lucie a toujours eu peur du sang.
Lucie a toujours eu peur du noir.
Lucie a toujours eu peur du cent.
Lucie a toujours eu peur du rang.

Pierre se rend au gymnase tous les lundis.
Pierre se lave au gymnase tous les lundis.
Pierre se rang au gymnase tous les lundis.
Pierre se cent au gymnase tous les lundis.

Ils se sont mis en rang devant la porte.
Ils se sont mis en ligne devant la porte.
Ils se sont mis en rend devant la porte.
Ils se sont mis en sang devant la porte.

PAIN/PIN - FAIM/FIN

Nous avons acheté du pain pour le déjeuner.
Nous avons acheté du miel pour le déjeuner.
Nous avons acheté du pin pour le déjeuner.
Nous avons acheté du faim pour le déjeuner.

On a planté un pin en face de la maison.
On a planté un saule en face de la maison.
On a planté un pain en face de la maison.
On a planté un fin en face de la maison.

J'avais très faim pendant le film.
J'avais très peur pendant le film.
J'avais très fin pendant le film.
J'avais très pain pendant le film.

Ils ont tous relus la fin du roman.
Ils ont tous relus la page du roman.
Ils ont tous relus la faim du roman.
Ils ont tous relus la pin du roman.

POIS/POIDS - PUIS/PUITS

Les pois se mangent bien avec le rôti de boeuf.
Les fèves se mangent bien avec le rôti de boeuf.
Les poids se mangent bien avec le rôti de boeuf.
Les puis se mangent bien avec le rôti de boeuf.

Marie a gagné beaucoup de poids dernièrement.
Marie a gagné beaucoup de choses dernièrement.
Marie a gagné beaucoup de pois dernièrement.
Marie a gagné beaucoup de puits dernièrement.

Nous irons à Vancouver puis à Victoria.
Nous irons à Vancouver et à Victoria.
Nous irons à Vancouver puits à Victoria.
Nous irons à Vancouver pois à Victoria.

Ce puits est vraiment profond.
Ce trou est vraiment profond.
Ce puis est vraiment profond.
Ce poids est vraiment profond.

CIRE/SIRE - CITE/SITE

J'ai utilisé de la cire pour nettoyer le plancher.
J'ai utilisé de la poudre pour nettoyer le plancher.
J'ai utilisé de la sire pour nettoyer le plancher.
J'ai tuilisé de la cite pour nettoyer le plancher.

Le sire Frédéric de St-Malo était un homme riche.
Le duc Frédéric de St-Malo était un homme riche.
Le cire Frédéric de St-Malo était un homme riche.
Le site Frédéric de St-Malo était un homme riche.

Jean-Paul cite souvent des paroles de Shakespeare.
Jean-Paul dit souvent des paroles de Shakespeare.
Jean-Paul site souvent des paroles de Shakespeare.
Jean-Paul cire souvent des paroles de Shakespeare.

Ce site présente des caractéristiques pittoresques.
Ce lieu présente des caractéristiques pittoresques.
Ce cite présente des caractéristiques pittoresques.
Ce sire présente des caractéristiques pittoresques.

PONT/POND - FONT/FOND

Il a traversé le pont à côté de Québec.
Il a traversé le lac à côté de Québec.
Il a traversé le pond à côté de Québec.
Il a traversé le font à côté de Québec.

La poule pond des oeufs tous les matins.
La poule couve des oeufs tous les matins.
La poule pont des oeufs tous les matins.
La poule fond des oeufs tous les matins.

Les enfants font quelquefois des bêtises.
Les enfants disent quelquefois des bêtises.
Les enfants fond quelquefois des bêtises.
Les enfants pont quelquefois des bêtises.

Il y a des cailloux au fond de la rivière.
Il y a des cailloux au bord de la rivière.
Il y a des cailloux au font de la rivière.
Il y a des cailloux au pond de la rivière.

MAIRE/MER - FAIRE/FER

Ils ont écouté le maire attentivement.
Ils ont écouté le prêtre attentivement.
Ils ont écouté le mer attentivement.
Ils ont écouté le faire attentivement.

Il pouvait apercevoir la mer de sa chambre d'hôtel.
Il pouvait apercevoir la ville de sa chambre d'hôtel.
Il pouvait apercevoir la maire de sa chambre d'hôtel.
Il pouvait apercevoir la fer de sa chambre d'hôtel.

Le professeur nous a fait faire un poème.
Le professeur nous a fait lire un poème.
Le professeur nous a fait fer un poème.
Le professeur nous a fait maire un poème.

Le fer du cheval devrait être examiné.
Le pied du cheval devrait être examiné.
Le faire du cheval devrait être examiné.
Le mer du cheval devrait être examiné.

PRES/PRET - PRIS/PRIX

Nous nous sommes donnés rendez-vous près du bureau.
Nous nous sommes donnés rendez-vous loin du bureau.
Nous nous sommes donnés rendez-vous prêt du bureau.
Nous nous sommes donnés rendez-vous pris du bureau.

Le gouvernement m'a finalement accordé ma demande de prêt.
Le gouvernement m'a finalement accordé ma demande de bourse.
Le gouvernement m'a finalement accordé ma demande de près.
Le gouvernement m'a finalement accordé ma demande de prix.

Il a pris la lettre et l'a déchirée.
Il a lu la lettre et l'a déchirée.
Il a prix la lettre et l'a déchirée.
Il a près la lettre et l'a déchirée.

Le prix de ce maillot de bain est vraiment spécial.
Le style de ce maillot de vain est vraiment spécial.
Le pris de ce maillot de bain est vraiment spécial.
Le prêt de ce maillot de bain est vraiment spécial.

ROUX/ROUE - LOUP/LOUE

La nouvelle amie de Louis a des cheveux roux.
La nouvelle amie de Louis a des cheveux blonds.
La nouvelle amie de Louis a des cheveux roue.
La nouvelle amie de Louis a des cheveux loup.

La roue du camion a été brisée pendant l'accident.
La vitre du camion a été brisée pendant l'accident.
La roux du camion a été brisée pendant l'accident.
La loue du camion a été brisée pendant l'accident.

Bien peu d'enfants aiment le méchant loup.
Bien peu d'enfants aiment le méchant lion.
Bien peu d'enfants aiment le méchant loue.
Bien peu d'enfants aiment le méchant roux.

Il loue son chalet à des amis pendant l'été.
Il prête son chalet à des amis pendant l'été.
Il loup son chalet à des amis pendant l'été.
Il roue son chalet à des amis pendant l'été.

VAUT/VEAU - VEUT/VOEU

La maison à côté de chez moi vaut très cher.
La maison à côté de chez moi coûte très cher.
La maison à côté de chez moi veau très cher.
La maison à coté de chez moi veut très cher.

Mon plat préféré est le veau et le riz.
Mon plat préféré est le boeuf et le riz.
Mon plat préféré est le vaut et le riz.
Mon plat préféré est le voeu et le riz.

Charles veut travailler au restaurant.
Charles aime travailler au restaurant.
Charles voeu travailler au restaurant.
Charles vaut travailler au restaurant.

Il aimerait que son voeu se réalise.
Il aimerait que son rêve se réalise.
Il aimerait que son veut se réalise.
Il aimerait que son veau se réalise.