SPOKEN WORD RECOGNITION
AS A FUNCTION OF LEXICAL KNOWLEDGE
AND LANGUAGE PROFICIENCY LEVEL
IN ADULT ESL LEARNERS

by

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Abstract

This study assesses the usefulness of Marslen-Wilson's (1989, 1987; Marslen-Wilson & Welsh, 1978) cohort model of spoken (first language) word recognition as a method of explaining the high-speed, on-line processes involved in recognizing spoken words while listening to a second language. Two important assumptions of the model are: 1) syntactic and semantic properties of mental lexical entries can function to facilitate spoken word recognition and 2) spoken word recognition is a function of the frequency of exposure to words in the general language environment. These assumptions were tested in three functionally defined levels of language proficiency: Native Speakers of English, Fluent Users of ESL, and Advanced learners of ESL. Their performance was compared on a reading cloze test and a spoken-word recognition task in which there were five different levels of contextual richness prior to a target word, and two levels of word frequency.

The cloze results indicated that the three groups differed in their general English proficiency. Congruent with the cohort model, there was a significant overall effect of sentence context and word frequency on recognition latency. Despite the difference in cloze scores and immersion experience between the two ESL groups, there were no reliable differences in their recognition latencies or latency profiles across sentence contexts or across word frequency. There was an interaction of ESL group, word frequency, and sentence context. This may be due to a reorganization of rules used during processing or a restructuring of lexical knowledge. There was also an interesting non-linear relationship between recognition latency and language immersion time. Spoken word recognition speed decreased in the early immersion experience, and
then increased with further exposure.

There was a significant difference in overall mean recognition latency between the Native and the ESL speakers, with the ESL subjects responding on average 98 msec slower than the Native Speakers. However, there were no significant differences in the way Native Speakers and the ESL subjects used sentence context. In contrast with the comparison across the sentential contexts, there was a significant difference in the recognition profiles of the Native English speakers and the ESL subjects across word frequency.
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Chapter I. Research Problems

In order to comprehend a spoken language, it is essential to recognize, quickly, correctly and automatically, which word is being spoken. Connected speech moves in real time and any impediment to recognizing the individual words as they flow past will surely disrupt any attempt to create meaning from the spoken sentences. This is as true for second-language comprehension as it is for first language. Although some work has been done in the general area of comprehension during spoken, second-language processing (McDonald, 1987b; McDonald & Heilenman, 1991; Sasaki, 1991), not much attention has been paid to the high-speed, on-line processes and knowledge involved in spoken-word recognition during speech comprehension in a second language (see Hayashi, 1991).

In research on the processes involved in speaking and comprehending a second language (McLaughlin, Rossman, & McLeod, 1983; Long & Sato, 1985; Sasaki, 1991), a common approach has been the application of models or theories of first language processing and acquisition to the area of second language (Bates & MacWhinney, 1981; Bialystok, 1990; Flynn, 1987; Flynn, & O’Neil 1988; Gass, 1984, 1987; Harrington, 1987; MacWhinney, 1987a). The present research follows this approach in order to examine the fundamental processes of spoken word recognition in a second language. In particular, it evaluates the extension of Marslen-Wilson’s (1989, 1987; Marslen-Wilson & Welsh, 1978) cohort model of spoken (first language) word recognition to a second language context. It does so by (a) investigating the effects of three types of lexical knowledge, syntactic, semantic and pragmatic, on the speed of spoken-word recognition by second language users, (b) comparing, as a group, their word recognition-time
profile with that of native speakers of the target language, and (c) examining how two different levels of second language proficiency interact with different types of lexical knowledge to affect word-recognition speed.

The research was motivated by the belief that having a theoretical model of the fundamental, high-speed processes involved in spoken, second-language word-recognition would provide a useful foundation for further theoretical and practical research in the areas of second language learning and instruction. The cohort model of spoken word recognition in particular was chosen because of the importance it places on the role of lexical knowledge during the recognition process and because of the belief that growth of lexical knowledge is an integral and essential part of growth in second language proficiency.

In the present study, lexical knowledge refers to information attached to individual entries in an internal mental dictionary, information that will allow for quick analysis of syntactic and semantic relationships among words that have been heard. As Haegeman (1991) notes, in modern Chomskyan linguistics,

> We postulate that speakers of a language are equipped with an internal 'dictionary', which we shall refer to as the mental lexicon, or lexicon, which contains all the information they have internalized concerning the words of their language. (p. 29).

Importantly, she also notes a further assumption that "... the lexicon of a language is learnt [italics added] by each native speaker. The speaker learns [italics added] the words of the language..." (p. 29). It seems reasonable to assume that second language learners also develop, through learning, a lexicon that is appropriate to the new language and furthermore, that the knowledge stored in this lexicon plays some functional role during the processing of the language when it is spoken by others.
Given this assumption, to what extent is that role parallel to the role played by lexical knowledge in first language processing?

There are various models of spoken language processing for the first language context (for overviews see Forster, 1989 and Klatt, 1989). One is Marslen-Wilson's (1989, 1987; Marslen-Wilson & Welsh, 1978) cohort model of spoken word recognition. This model assumes a significant facilitative role for lexical knowledge (beyond phonological encoding) in the recognition process and thereby allows investigation into the structure of lexical knowledge. In first language speech-processing, available research findings indicate that sentential context has an influence on the speed with which words are recognized (Grosjean, 1980; Marslen-Wilson, 1985; Tyler & Wessels, 1983). Because stored lexical knowledge can be linked to prior sentential context, it can be used in a manner that will facilitate the recognition process as long as those sentence contexts are syntactically, semantically and pragmatically normal. However, sentence contexts that have syntactic disruptions or pragmatic or semantic anomalies in them effectively block the use of certain aspects of lexical knowledge and consequently word recognition is slower in these contexts.

Interestingly, these different contextual disruptions have different effects on word recognition time, suggesting different roles for different types of lexical knowledge. In experiments by Marslen-Wilson, Brown & Tyler, (1988; Tyler, 1988, 1985), word-recognition time under normal sentential context was compared to recognition time in contexts such as those in sentences 1, 2 and 3, (adapted from Tyler, 1985) in which the target word is guitar. In sentence 1, the action of burying the guitar is unusual, although the sentence itself is otherwise correct. In their experiments, this
type of context has been labelled *pragmatically anomalous*. In sentence 2, there is a

*semantic anomaly* in the relationship between the verb *drink*, which anticipates a direct

1. The young man buried the guitar and ...
2. The young man drank the guitar and ...
3. The young man slept the guitar and ...

object that is 'fluid', and the actual direct object *guitar*, which does not meet this
criterion. In sentence 3, there is a *syntactic violation* because sleep is an intransitive verb
and yet it appears to be taking a direct object. Consideration of sentence 3 also reveals
that there can be no structurally dictated semantic relationship between the verb and
the target noun that follows. Thus, in sentences which are disrupted in this manner
there is neither syntactic nor semantic information which can be used to aid in
recognition of the target word.

For speakers of Dutch as a first language, it was found that pragmatic anomalies
slowed down recognition time on average 28 ms compared to the normal context, while
the delay due to semantic anomalies was 50 ms and that due to the syntactic disruption
with its concomitant lack of semantic relation, 79 ms (Marslen-Wilson, Brown & Tyler,
1988). Tyler (1985, 1988) found very similar results for her English speaking controls.
That is to say, when recognition times to target words in these four (normal,
pragmatically, semantically, or syntactically anomalous) contexts are compared across
the different experiments, there appears to be a consistent, increasing recognition-time
profile which characterizes the differing contributions to the word recognition process
of these different types of lexical knowledge. These studies were conducted in the
framework of first language processing, but they can form the basis of a number of
questions that will enable a direct comparison of the role played by lexical knowledge in first and second language processing, and at the same time address the central aim of the present research: to assess an extension of the cohort model of spoken word recognition to the second language context.

If it is assumed that second language learners do learn lexical knowledge related to the words of the new language, then certain questions arise naturally as a consequence. Do second language learners become capable of using the new language in a high-speed, on-line manner that is at all comparable to native speakers? In other words, would high-functioning second language users show a recognition-time profile similar to that of native speakers? More generally, does lexical knowledge, other than the obviously requisite phonological knowledge, enter into the word recognition process at all during the process of comprehending a second language? Or, is it the case that, in comprehending a second language, lexical information can only be projected onto the developing mental representation of a utterance after the word has been recognized? Finally, if lexical information does play a role during the word recognition phase of spoken second language processing, what are some specific aspects of lexical knowledge that are instrumental in this process? These questions are, in essence, concerned with how close a second-language processing system comes to replicating the functionality of a first language processing system. Some initial information on this can be brought to light by asking whether, under the particular conditions found in the above-cited research, the word-recognition profiles of first language users and fluent second language users are the same.

Questions regarding how development of second language proficiency is related
to word recognition speed also arise. Second language users will develop a functional lexicon in the second language but the lexical knowledge of a fluent or expert user of a second language and that of a learner or novice user of the language will be different, at least because the novice will not have as many or as complete lexical entries as the expert, and perhaps for other reasons as well. For example, it is not obvious whether, over the course of learning a new language, different types of lexical knowledge will develop at the same rate. The adult learner may be able to make use of semantic or pragmatic conceptual knowledge acquired through the first language in order to fill out word entries in the developing second language lexicon. Bialystok (1990) argues that "... adults in general need only to structure and analyze the linguistic domain as they build a new lexicon to serve the expressive functions of a conceptual structure already constructed through another language" (p. 133).

As an illustration, consider the target word and the verbs in sentences 2 and 3 on page 3. It may be that learners quickly fill out some semantic features of the lexical entries for guitar (e.g. that guitars are solid), drink (e.g. that drink is associated with liquids), and sleep (e.g. that inanimate things do not sleep), but will take longer to fix syntactic information regarding the transitivity of drink or sleep. In this case, recognition times to targets in sentences like 2 and 3 may be very similar, since, unlike in the case of native speakers, neither verb would supply syntactic constraints on the following words. No doubt a number of other possibilities could also be proposed. However, in general, the question is whether in second languages users, differences in the extent and possibly the structure of lexical knowledge will result in different word-recognition-time profiles under such contexts as above. In other words, do proficiency-based lexical
differences in a second language have differing effects on the speed with which a word is recognized, or will the recognition-time profiles of, say, fluent users and advanced learners be parallel, though perhaps separate? If they are not parallel, will the differences in recognition time under different lexical knowledge constraints increase or decrease as a person moves from novice to expert user of the second language? These questions of an interactional nature define the final aim of the research: to examine how differing levels of language proficiency and different types of lexical knowledge interact to affect word-recognition speed.

Although the above questions are interesting in and of themselves, the answers to them will be of greatest value when applied to the development of a model of spoken-word recognition within second-language processing. Such a model could supply a conceptual basis that will generate questions for future study in a variety of areas of second language learning research. For example, in the area of second language testing there has been an on-going thread of research and discussion regarding the construct validity of common test types. It has been questioned, for example whether tests called reading comprehension or listening comprehension really do, or even can measure different, specific language abilities as distinguished from a more global, general language ability (Bachman & Palmer, 1982; Barbour, 1983, Powers, 1982; Oller, 1981; Oller, & Hinofotis, 1980; Buck 1992). In a recent multi-trait, multi-method research report, Buck (1992) supplies some evidence of a separate listening comprehension trait. In his discussion of the results, Buck says,

Finally, there is also a need for research into the nature of the listening trait to be related to current theories of listening. Having said this, it ought to be pointed out that there is no such thing as a generally accepted theory of listening comprehension (italics added). (p. 350)
A detailed model of word recognition in a second language can make contributions to the development of a comprehensive theory of listening comprehension in a second language by describing some of the central mechanisms that operate during on-line processing of spoken language. This in turn can make suggestions relevant to the construction and analysis of tests that propose to test listening comprehension.

The study of second language learning is another area which could benefit from the development of a valid second language spoken-word recognition model. The focus of the present research is lexical access during processing of a second language, not second language learning per se. However, as Ellis (1985) points out, "A little is known about L2 phonology, but almost nothing about the acquisition of lexis" (p. 5). By looking at the effect of lexical knowledge on spoken word recognition across different levels of language proficiency, aspects of second language acquisition can be stated in terms of the existence or completeness of lexical representations. Approaching the topic from this conceptual point of view should stimulate a novel genre of empirical investigations of second language acquisition. If clear effects of lexical knowledge could be found in the recognition of words in spoken (second) language, then this fact may provide the foundation for some illuminating experimental designs in language instruction/learning research. That is to say, it should be possible to investigate the relationship between types of instructional methods and the growth of lexical knowledge by experimentally manipulating instructional variables and then testing for changes in word recognition effect by using one or another of the various experimental paradigms that have been used in this area in first language research.

Theoretical research into second language processing should also profit.
Throughout this chapter, I have referred to "first language" and "second language" as though they were categories that had a fixed or constant relationship. This is not so. In fact, one area of intensive study in second language research is the attempt to characterize the differences in language processing strategies among the various possible first language--target language dyads that can exist (Kilborn & Cooreman, 1987; McDonald, 1987a; McDonald & Heilenman, 1991; Sasaki, 1991). Most of this investigation has been done in the context of the competition model of speech processing (Bates & MacWhinney, 1981, 1982). In the present research the first language is English and the second language is English, also, but as targeted by native Cantonese speakers. However, the present research should demonstrate that the cohort model of spoken-word recognition and its associated research paradigms can also be extended to provide a new approach to investigating the role any first language plays in the processing of any second language.

In summary, motivated by the questions posed earlier and the points just presented, the present study extends Marslen-Wilson's cohort model of word recognition to the context of second language processing and investigates the role of lexical knowledge in the word-recognition phase of spoken second-language comprehension. In doing so, the research attempts to determine whether lexical knowledge is used at all during the word recognition phase of second-language processing and if so, whether different types of lexical knowledge have greater or lesser facilitative effect. Using the cohort model, the research compares native and second language word-recognition processes in order to compare the functional role of lexical knowledge in these two systems. In addition, the research examines how differing
levels of second language proficiency interact with different types of lexical knowledge to affect word-recognition reaction times. Most importantly, the over-riding aim of the research is to provide a basis on which to construct a model of second-language word recognition processes.
Chapter II. Background of Research Problems

The aim of the present research is to assess the extendability of Marslen-Wilson’s (1989, 1987; Marslen-Wilson & Welsh, 1978) cohort model of spoken word recognition, originally developed to account for processes in a first language, to the second language context. In doing so it addresses several questions regarding the role of lexical knowledge during spoken word recognition in a second language and the development of lexical structure with increased second language proficiency. The choice of this model is motivated by the apparent lack of research within the second language area on the relationship between lexical knowledge and the high-speed, unconscious processes that operate during spoken language comprehension.

Within the area of second language research, the potential of the cohort model and the work of Marslen-Wilson appears to be recognized, directly or indirectly. Buck (1992) notes that more of the type of research Marslen-Wilson has done into speech perception is needed before a theory of listening comprehension can be developed. Bates and MacWhinney (1981), in their seminal paper on the application of the competition model to second language research, point out that the type of research done, and the early model developed by Marslen-Wilson was compatible with the proposals that they were putting forward. Carroll (1992) explicitly relies on the cohort model in her development of a theory of cognates. Hayashi (1991) extends some of the research methods used by Marslen-Wilson and Tyler (1980) to the area of second language processing. However none of these studies addresses the questions posed earlier in the first chapter. Nor do they question whether the cohort model itself is applicable to the second language situation.
Two of the salient features of the cohort model are its focus on the high-speed, real time processes involved in language comprehension (see below), and their relation to lexical knowledge. Within the second language research literature there are numerous approaches to the treatment of the second language lexicon. Some, such as Bialystok (1990), refer to it within the larger context of second language processing and proficiency, while others, such as Carroll (1992) and Hudson (1989), present theoretical treatments of more specific aspects of the lexicon. Where data is actually gathered, it tends to be based on responses to printed material (e.g. Singleton & Little, 1991), on written material produced by subjects in response to auditory stimulus (Kelly, 1991), or on written samples gathered from subjects' compositions (Zoble, 1989).

In second language research, perhaps the only model (and certainly the most productive one in terms of generating research articles) which professes to look at language processing and performance in real time is the competition model (Bates & MacWhinney (1982, 1981; MacWhinney, 1987b; MacWhinney, Bates, & Kliegl, 1984). The competition model has been variously described as "a general model of language processing and acquisition" (MacWhinney, Leinbach, Taraban, & McDonald, 1989 p. 256.), "a probabilistic model of speech processing" (Harrington, 1987, p. 352), "a probabilistic theory of grammatical processing" (Kilborn and Cooreman, 1987, p. 417), and "a general psycholinguistic model" (MacWhinney, 1987a, p. 317). In terms of the empirical methods used, it is "a model of sentence processing" (MacWhinney, Bates & Kliegl, 1984, p. 128), for the predominant approach has been to use sentence interpretation studies (though see MacWhinney et al., 1989, for an expression and test of the model in a connectionist architecture). It has as its basis a functionalist
perspective (see Bates & MacWhinney, 1982) to the analysis of language. Initially this model was developed in the context of research on the pragmatic and semantic influences on first language grammar in children and adults. However, much of the research has been cross-linguistic and, prompted by Bates and MacWhinney (1981; MacWhinney 1987a), there has been a logical extension of its application to the area of bilingualism and second language research (Gass, 1987; Harrington, 1987; Kilborn, & Cooreman, 1987; McDonald, 1987a, 1987b; McDonald, & Heilenman, 1991; Miao, 1981; Sasaki, 1991; Wulfeck, Juarez, Bates, & Kilborn, 1986).

The competition model is primarily interested in the processes involved in constructing meaningful interpretations of the spoken (or sometimes written) sentence. It recognizes that there is a significant contribution to these processes from, in particular, the animacy/inanimacy knowledge associated with stored lexical items. It also attempts to evaluate the relative weights of this contribution among different languages and to evaluate the change in weights, as a learner increases in proficiency in a second language. Research in the model's framework provides compelling evidence of the influence of first-language cue-interpretation strategies on the processing of cues in the second language. However, the model is not concerned with word recognition or assessing the implicit use of lexical knowledge during word recognition.

In fact, it might be argued that, although response latencies are occasionally used as dependent measures, the method used in most of the studies falls short of directly tapping on-line processes at all. Mean decision latencies, when reported, are in the order of 1.5 to 2 seconds after the end of the entire utterance (e.g. Harrington, 1987), as compared to the much faster times of approximately 300-400 ms after word onset which
are obtained in the word monitoring research of the cohort model. Furthermore, in some of the research (e.g. Gass, 1987), subjects were given a maximum of 20 seconds in which to respond; or, in some cases, the subjects actually acted out their conceptions of the actions. Both of these tasks allow plenty of time to perform a retrospective, conscious analysis of the sentence. Thus, although Bates and MacWhinney speak of it as "a performance grammar that can account for the rapid and simultaneous integration of many aspects of discourse during sentence comprehension and production" (Bates & MacWhinney, 1981, p. 191), it seems, at least in the context of its predominantly-used paradigm of sentence interpretation, the competition model has yet to be used to assess the contribution of lexical knowledge to the high-speed and apparently unconscious process of word recognition during speech processing.

Concern with real time processing is found in other areas of second language research. In Ellis’s (1994) review of foreigner talk (language used by native speakers toward non-native speakers of a language), he notes that there is some evidence to suggest that native speakers of language will adjust their speech rate in accordance with the level of the person spoken to. Investigating the effect of speech rate on comprehension, Conrad (1989) presented native speakers, and high-level and medium-level skill non-native speakers with sentences that were time-compressed to 40%, 56%, 71%, 83%, and 91% of the original speed. These times corresponded to 450, 320, 253, 216 and 196 words per minute (wpm). The native speakers were able to achieve almost 100% accuracy in recall at 56% compression (320 wpm). The high-level and medium-level non-native speakers only achieved 72% and 44% accuracy respectively at the slowest rate of 91% compression (196 wpm). Griffiths (1991) reviews a number of other
studies involving the relation between speech rate and "input" to second language learners and finds the majority of these studies either deficient in data to support the various claims made or containing methodological errors that undermine their conclusions. In a study of his own, Griffiths (1990) used passages recorded at approximately 100 wpm, 150 wpm, and 200 wpm to assess speech rate differences on non-native speakers of English. Comprehension, as measured by a true-false test following the presentation, was marginally lower in the moderately fast presentation (200 wpm) but there was no difference between the average (150 wpm and the 100 wpm). Studies such as these are concerned with real-time processing of speech, but they are more concerned with overall comprehension than with the roles that words and spoken word recognition play within the comprehension process.

By turning to the cohort model, it may be possible to remedy this apparent lack of research linking the second language lexicon to the fast processes that operate during spoken language comprehension. Before discussing the model, though, it would be useful to consider the concept of word recognition within the larger domain of spoken language comprehension by presenting a brief overview of speech processing and the lexicon. Following this, I will outline the essential details of the cohort model of spoken word recognition and describe in more detail the basic research paradigm adopted from Marslen-Wilson, Brown and Tyler's (1988) study in first-language word recognition and used in the present study.
A. Speech Processing and the Lexicon

1. Speech Processing

An overview of speech processing will include a number of key functions (for more extensive overviews see Forster, 1989 and Klatt, 1989). First, a stream of acoustic energy must be received by the ear and be transformed to some other physical, and ultimately mental, representation of the phonemic, phonetic or spectral structure of the original sound image. This new representation must be such that a match can be made with an internally existing pattern or mental representation so that, indeed, a word can be "re-cognized". As these words are accessed, the knowledge that they symbolize is combined to produce propositions and sentences. These are then combined and integrated with the immediate discourse context and world knowledge of the listener. In other words, the comprehension process spans the reception of physical stimuli through to integration with ongoing discourse. Clearly these functions must be fulfilled regardless of whether the listener is trying to comprehend a first or a second language.

In a very important sense the lexicon, and the process of lexical access, are at the cusp of this comprehension process. On the one side is the computation of some sort of representation of the physical input. On the other side is computation of meaning (Marslen-Wilson, 1989). In the centre is the access of meaningful units in the lexicon.

2. The Lexicon

In a narrow sense, the lexicon can be thought of as a mental dictionary in which there are entries that contain representations of the meanings of words (cf. Johnson-Laird, 1987). But considering the lexicon only in this manner may obscure the fact that other types of knowledge must necessarily be part of a lexical entry. Miller (1978; see
also Butterworth, 1983) lists a variety of information that the lexicon must minimally contain. Of particular relevance to the present research is the assertion that lexical entries must contain information on syntactic categorization (the entry is a Noun, Verb, or Adjective etc.), syntactic subcategorization (the entry is transitive or intransitive), and semantic and pragmatic relations to other concepts such that there are restrictions on the contexts in which the entry might appear. Certainly, modern linguistic and psycholinguistic theory assigns a central role to the concept of the lexicon. The assumption that syntactic structure is determined to a large extent by lexical information forms an important basis of Government and Binding Theory (Chomsky, 1965; Haegeman, 1991). Lexical Functional Grammar, which strives for a unification of linguistic and psycholinguistic research, puts even more emphasis on the lexical component (Bresnan & Kaplan, 1982; Bresnan, 1982) in processing models.

B. The Cohort Model and Research Paradigm

1. The Cohort Model

The cohort model of spoken word recognition evolved from an analysis of Morton's logogen model and Forster's "bin" model (Marslen-Wilson, 1987) and has undergone some modification over its development. While the present research will follow the version that is described in the 1987 and 1989 papers by Marslen-Wilson and the 1989 paper by Tyler, some essential points have remained unchanged. The model itself is concerned with what Marslen-Wilson and Tyler (1981) call the central processes of speech comprehension. They define these as

...the set of automatic and obligatory mental processes that are triggered when a speech input is heard, and which carry the analysis through to its message-level
interpretation. These on-line processes are not open to conscious awareness or conscious control, and form the basis for the normal, effortless comprehension of an utterance in context by a normal adult listener. (p. 108)

In the model, these processes are 'distributed' and parallel. They are distributed in that each lexical entry is a computationally active device, and parallel in that access to the lexicon and assessment of the fit of an entry to both the phonological data and the higher-level representation of the discourse are occurring at the same time.

Marslen-Wilson (1989) summarizes the important properties of the model as follows:

- It assumes discrete, computationally independent recognition elements for each lexical unit, where each such unit represents the functional coordination of the bundle of phonological, morphological, syntactic, and semantic properties defining a given lexical entry.
- Each recognition element can be directly and independently activated by the appropriate patterns in the sensory input.
- The level of activation of each element increases as a function of the goodness of fit of the input pattern to the form specifications for each element. When the input pattern fails to match, the level of activation immediately starts to decay. (p. 6-7)

In the model, word recognition is a product of two fundamental processes: access and assessment. Access is the contact of the computed representation of the speech input with the lexicon. That is to say, access occurs when, after there has been an acoustic-phonetic analysis of the speech input, "a representation of the input in these terms ... is projected onto the mental lexicon." (Marslen-Wilson, 1987, p. 72).

Fundamental to the cohort model is the notion of multiple access: all word forms which match or closely fit the initial speech input (the first 100-150 ms of the word) are accessed and activated by that input. Each of the lexical units activated by that initial input continues to monitor the incoming sensory data and remains active as long as there is a satisfactory match with it. These activated word-forms constitute the cohort of
the cohort model.

Also fundamental to the model is *multiple* assessment. At the same time that the representation of a particular string of input sounds is accessing a cohort of words in the lexicon, a higher-level representation of the continuing utterance is being constructed based on prior input and other contextual information. Under the principle of multiple assessment, all members of the cohort are assessed for lexical properties which match the contextual open spaces or locations within the current higher-level representation of the utterance and discourse. According to Marslen-Wilson (1987), "Once the appropriate senses associated with a given word-form have been bound to these locations in the representation, then we can say that recognition has taken place" (p. 98) and thus "it is at this point ... that the output of the system becomes perceptually available" (footnote, p. 98).

In earlier versions of the model, a candidate was defined on the basis of phonemic information and simply dropped out of the cohort if there was a mismatch between it and either the sensory data or the linguistic context. However, several problems became apparent with this account. First, research (reported in Marslen-Wilson, 1987) indicated that word frequency needed to be accounted for. Under certain conditions, within the same sentential context, higher frequency words were recognized sooner than lower frequency words. To overcome this shortcoming, the concept of level, or strength, of activation, which can be construed as a "metaphor to represent the goodness of fit of a given candidate to the bottom-up input" (Marslen-Wilson, 1987, p. 99), was introduced to the model. According to this, there is a differential response to the sensory input between high and low frequency lexical elements. As a consequence,
the level of activation of high frequency words will rise more rapidly and take longer to drop than the activation of low frequency words.

A second problem was that the model could not explain how the system could cope with noisy input. For example, in some research, deliberately-introduced mispronunciations would often be overlooked by listeners (Cole, 1973; Marslen-Wilson & Welsh, 1978). To deal with this, the assumptions about the input to the word-recognition process were changed. Instead of conceptualizing it as a string of phonemic labels, it was re-specified in terms of a set of feature values. For example, /p/ and /b/ would both be activated along all features except voicing, in which they differ.

The final problem was that the earlier version of the model could not explain the rather obvious fact that if a word is spoken under normal conditions, it will be perceived regardless of whether it matches the specifications of the context or not. To account for this, the model assumes that the higher-level representation of the utterance does not operate on the activation levels of the different candidates. There is no top-down inhibition of the level of activation of the lexical units so a member of a cohort will not 'drop out' of the cohort simply because it does not fit the context of the current discourse or utterance.

Under the cohort model, then, the process of word recognition is the process of selecting a single candidate out of the (possibly large) cohort that is activated by the speech signal. When a word is spoken with no context or in a meaningless context, such as a list of unrelated words, it will only be selected when enough of the signal has arrived to uniquely identify it from the competing members of the cohort.

But when the signal is heard in context — and note that normal context is fluent conversational speech — there need be no explicit form-based
recognition decision. Selection — viewed as the decision that one particular word-form rather than another has been heard — becomes a byproduct of the primary process of mapping word-senses into higher-level representations. (Marslen-Wilson, 1987, pp. 98-99)

How quickly the recognition process takes place will depend on two variables: a) the extent to which the bottom-up input differentiates one candidate from its competitors and b) the extent to which the match of lexical properties of a candidate with the discourse context similarly differentiates it.

2. Primary Research Paradigm: Discourse and Sentential Context

Research within the cohort model has used a number of different research paradigms, for example, spoken word monitoring, speech shadowing, gating, auditory lexical decision, and cross modal lexical decision. Each of these can get at different aspects of spoken language processing, and each presents potential for investigating the fit of the cohort model to the second language context. However, the spoken-word monitoring tasks used by Marslen-Wilson, Brown & Tyler, (1988; Tyler, 1988, 1985) motivated, and can directly address, the research questions put forward in this paper. Those tasks occur in real-time, involve word recognition, and can explicitly manipulate contextual constraints. In the monitoring task paradigm, subjects are required to listen for the occurrence of a particular word or a type of word. Upon hearing the words, subjects press a button or speak in order to indicate that the word has been perceived. Cues to these target words can, of course, be specified in a number of ways. For example, it could be the identical word itself, a rhyming word (e.g. cue: lead, target: bread) or a category to which the target word belongs (e.g. cue: metal, target: lead). However, specifications other than identical-word monitoring involve processes other than those strictly involved in recognition (Marslen-Wilson & Tyler, 1980).
In identical-word monitoring, the context of the target words can be manipulated in order to assess the effect of different kinds of contextual constraints on the speed with which the words are recognized. Roughly speaking, in this paradigm, context can be categorized as discourse level, where meaning and context are seen as developing across sentence boundaries, or sentential level, where within-sentence contextual constraints are of interest.

a. Discourse Level Context

The effect of a broader, discourse level context on word recognition speed has been investigated and reported with mixed findings. Marslen-Wilson and Tyler (1980) contrasted the effect of the presence or absence of a sentence which preceded (led into) the test sentence which contained the target word and found that there was a facilitation of word recognition in the condition with a lead-in sentence. On the other hand, Marslen-Wilson, Brown and Tyler (1988) compared the different effects of normal and incongruous lead-in sentences (which they termed discourse incongruity) on word recognition in the test sentences which followed. In this study, each stimulus was a pair of sentences, a lead-in sentence and a test sentence which contained the target word. In half the cases, the lead-in sentences had no discourse relation to the target-bearing test sentence. That is to say, there was an incongruity between the two sentences. In the other half of the cases, the lead-in sentence and the test sentence formed a normal, connected pair of sentences. They found no effect of discourse congruity.

One explanation was that a differential advantage coming from the discourse context disappeared as a result of increasing within-sentence constraints. Support for
this explanation is drawn from the earlier experiment (Marslen-Wilson & Tyler, 1980), in which the effect of target-word location was also investigated. They found a decrease in the effect of discourse congruency/incongruency as the target word was moved further from the beginning of the test sentence.

Zwitserlood (1989), using a lexical decision task, came to the conclusion that even sentential context with a strong semantic bias did not pre-select contextually appropriate words (i.e. activate appropriate words before any word specific sensory information is available), that both contextually appropriate and contextually inappropriate words were activated during lexical access, and that contextual effects are located after word-initial access but at a point in time when the sensory data is still insufficient by itself to disambiguate the word.

A possible interpretation of these results is that there are really two quite different mechanisms at work. In the Marslen-Wilson and Tyler (1980) research, a condition of a discourse-level context was compared with a condition of no discourse-level context. In the Marslen-Wilson et al. (1988) study, a condition with an incongruous discourse-level context was compared with a condition with a congruous discourse-level context. It may be the case that lexical access is not at peak efficiency until after some, relatively short, period of activity. Then, once this short "warm-up" phase is completed, contextual effects on word recognition speed are dominated by local sentential constraints. Assuming this to be the case, it is clearly important to ensure that if the focus of investigation is the effect of local constraints on word recognition, then these local conditions must be situated far enough from the beginning of an experimental cue sentence to ensure that lexical warm-up can not be a factor in
the recognition process.

b. Sentential Level Context

Marslen-Wilson and Tyler (1980) presented subjects with three different types of prose context, which they termed Normal Prose, Syntactic Prose, and Random Word-Order Prose. The sentence context in Normal Prose is syntactically and semantically normal. The example they provide (target-word emphasized) is:

(1) The church was broken into last night. Some thieves stole most of the lead off the roof. (p. 8)

To produce Syntactic Prose sentences, all content-words (except the target-words) in the Normal Prose sentences were pseudo-randomly replaced "with new words of the same form-class and word-frequency, such that the resulting sentences had no coherent semantic interpretation" (p. 17). Sentence two is the example they give:

(2) The power was located into great water. No buns puzzle some in the lead off the text. (p. 8)

Random Word-Order Prose sentences were created by scrambling the order of the words in the Syntactic Prose sentences, as in the following:

(3) Into was power water the great located. Some the no puzzle buns in lead text the off. (p. 8)

The differences between recognition times to targets in these contexts were significant. However, while Normal Prose and Random Word-Order Prose clearly define the two limiting cases of normal lexical constraints and no lexical constraints at all, Syntactic Prose does not specify what lexical information is or is not available to the recognition process, nor does it allow investigation of specific lexical items.

In response to these problems, Marslen-Wilson, Brown and Tyler (1988) investigated word recognition in contexts where there were local rather than the more
Global violations of the Syntactic Prose. The linguistic background to this approach to manipulating sentential context is covered well in that study, but a short review of it is in order here. They turned to Chomsky's (1965) analysis of the properties of lexical representations, but the principles remain the same in more recent treatments of Government and Binding Theory (Haegeman, 1991; van Riemsdijk & Williams, 1989). Essentially, the lexicon is a repository of all information that a speaker of a language has learned about the words of that language. Each lexical entry will contain categorial information about the entry; that is, information about whether it is a noun, verb, preposition, and so on. Furthermore, the entry will contain details on what subcategory the particular entry belongs to. For example, in the case of verbs, it is necessary to indicate whether the lexical entry is intransitive, transitive or ditransitive (takes two objects). This subcategorial information is expressed in distributional frames. Two examples given by Haegeman (1991, p. 34), are:

1. *meet*: V, [——— NP]
2. *dither*: V, [——— ]

While the verb *meet* must appear in front of an NP (noun phrase), the verb *dither* takes no complement. In Haegeman's words, "*meet* subcategories for or selects an NP (p. 34)." In addition to this syntactic information on verb subcategorization frames in the lexicon, there is semantic information that limits what kind of NP can be used in the verb's frame. Chomsky (1965) makes such suggestions as +Animate or -Human and so on as selectional features which restrict what can be inserted in these frames.

By manipulating violations of these subcategorization and selection restriction constraints, four types of different sentential contexts can be created (see Table 1)
Table 1

Types of Context Derivable by Manipulating Verb Frame Features

1. normal sentences
2. pragmatically anomalous sentences
3. semantically anomalous sentences
4. syntactically anomalous sentences

(Marslen-Wilson, Brown and Tyler, 1988; Tyler, 1988, 1985). In brief, Type 1 sentences are the syntactically correct sentences in which a transitive verb is followed by a direct object (the target word) that is both semantically and syntactically congruent with the verb. For example:

1. She watched the bubbles floating in the air.

Sentences such as these define a linguistically correct and plausible context and thus allow the listener to utilize any relevant linguistic knowledge during the recognition process. Recognition times to target words in these sentences provide a base-line measurement for word recognition in the normal context of fluent conversational speech, which presumably is based on linguistic knowledge.

The normal sentences are also of a structural pattern that allows for a controlled and systematic investigation of the interaction of certain aspects of linguistic knowledge and linguistic context. The initial part of the sentence, in particular the verb, establishes constraints, via selection restriction rules, on the latter part, the word in the object slot of the verb argument frame. By deliberately violating the verb-argument relations in the utterance, and thus removing the constraints imposed by the lexical knowledge
associated with the verb, it is possible to prevent a particular kind of knowledge from being used during the recognition process. A more detailed description of the other conditions will illustrate this.

Type 2 sentence, which is labelled "pragmatically anomalous sentences" by both Marslen-Wilson et al. (1988) and Tyler (1985, 1988), presents the subjects with sentences in which a transitive verb is followed by a direct object which, to some extent, is at odds with the every-day experiences generated by the context, particularly the verb and its meaning, up to the point of the target word. For example:

2. She ate the bubbles floating in the air.

While eating bubbles is undoubtedly not impossible, and in fact is an activity that one might pursue under certain circumstances, it is not a highly likely or plausible continuation to the sentence after the verb. Furthermore, in this particular paradigm, test sentences can be preceded by a lead-in sentence. These lead-in sentences, while not supplying a highly predictable situation, can be composed so as to tend to ground the subsequent test sentence within a real world context. To the extent that the recognition process makes use of lexical knowledge related to the plausibility of the relationship between the verb and the word in the argument frame (in combination with the developing phonological representation of the word), the word-recognition process in these sentences will be slowed down. Marslen-Wilson et al. (1988) found a 28 msec slow-down in this context compared to the normal context, the smallest effect of the three anomalous contexts. On the other hand, Tyler (1985), in a study that involved an agramatic patient, found that violations of this kind caused the greatest slowdown in word recognition in this person. The patient's response profile had its peak in this
Type 3 sentences, "semantically anomalous sentences", arise from the violation of a selection restriction rule of the verb-argument relation. Following the pattern of Type 1 and 2 sentences, Type 3, also contains a transitive verb followed by a direct object target word. In this context though, the verb has semantic features that are not congruent with the target word. For example:

3. She interviewed the bubbles floating in the air.

Words in the direct object argument slot of the verb "interview" are semantically restricted to having features which indicate that they are capable of being interviewed. This might be represented as [+sentient] or at least [+capable of language]. In this type of sentence then, the semantic properties of the verb preceding the target word imposes selection constraints on the items that can fill the verb argument frame. The target words in these contexts do not conform to these constraints. To the extent that the word recognition processes make use of these constraints, the recognition process will be disrupted and reaction time will slow down.

Type 4 sentences, "syntactically anomalous sentences", differ from Types 1 to 3, in that the stimulus word strings contain an intransitive verb and a target word that is located as though it were the direct object of the verb. For example:

4. She crawled the bubbles floating in the air.

"Sentences" such as these set up violations of strict subcategorisation rules. The verb is subcategorised in the lexicon as having no argument frame, but by placing a noun phrase immediately after the verb, it appears that the sentence contains a direct object. Because of this kind of violation, the verb is not able to supply productive constraints
on the target word. As a result the listener is only able to use the phonological representation to recognize the word *bubbles*. Thus, recognition time to target words in this type of sentence should approximate recognition time under a condition where target words are presented in a meaningless context such as a list of unrelated words.
Chapter III. Extending the Model: Hypotheses and Expectations

A. The Roles of Semantic and Syntactic Knowledge in the Word Recognition Process, Materials and Learner Variables

Extending the cohort model of spoken word recognition to second language processing will need to take into account two significant differences between a second language context and the adult, first language context in which the model was developed. One is language-based variability. In any application of the model to a second language there will be an existing first language processing system which may be working in concert or in conflict with the second language processing system. Different first/second language dyads may result in important differences in the way in which the second language is processed. While these potential differences are the main focus for study in cross linguistic research (see competition model references above), they might result in uncontrolled variance if subjects from different linguistic backgrounds were included in a single study. This can be avoided by limiting a study to one first and one second language.

However, even when the research scope is narrowed to a single first language and a single second language, a major difference between contexts remains; namely, that development or learning takes place in the second language and thus there can be major individual differences in language proficiency. The cohort model is a model which was constructed within the context of a fully developed system of adult, first language and, as a result, one can assume stability in the system. Adult second language learning, on the other hand, can encompass states of linguistic development that range from an absolute neophyte through an advanced learner to an expert who
can function effortlessly in a broad range of linguistic situations. By focussing on this
difference, the present study (and future ones) should provide information on both
second language speech processing and second language learning.

To review how this is so, consider two of the salient points of the cohort model.
First, the lexicon and lexical access are central to the cohort model and, according to the
cohort model, lexical entries are defined by bundles "of phonological, morphological,
syntactic, and semantic properties" (Marslen-Wilson, 1989, p. 6). These properties are
learned. Thus, a defining aspect of increased proficiency will be a larger, more
comprehensive lexicon with richer, more complete entries. Second is the function of
these properties in word recognition. During speech comprehension, the first 100-150
ms of an incoming word activates the set of all lexical entries that match its word-initial
phonological form. Prior to word recognition, the syntactic and semantic properties of
all of the members of this cohort become available for assessment as to fit in the higher
level context. As the phonological input continues to arrive and be processed, the
increasing data further restricts the possibilities for membership in the cohort.

When the semantic and/or syntactic properties of a particular member of the
activated cohort fit the higher-level mental representation of the context, that word is
integrated effortlessly into the ongoing discourse, often before the end of the word is
reached and sometimes before enough phonological information has been provided to
distinguish it from other competitors. At this point, the word has been recognized.
However, when the context is disrupted in such a way that there are no contextual
open spaces or locations within the current higher-level representation of the utterance
that match the semantic and syntactic properties of any members of the cohort of
activated word-candidates, the recognition process must wait until sufficient phonological data has arrived to identify the word. Thus, the speed of word recognition slows down.

However, in the case of a person listening to speech in a second language, the syntactic and/or the semantic properties of a spoken word may not be available to the listener because the relevant properties have not yet been learned and included in the "bundles" that constitute the entry in the listener's mental lexicon. In this case, if word recognition takes place at all, it will be based entirely on phonological data. In other words, word-recognition speed in a second language will be a function, in part at least, of the existence or not within the listener's mental lexicon of the particular, context-relevant lexical properties. This has an important implication. If the word recognition speed of a second language user is relatively slow even though syntactic or semantic constraints are available in the message, then the relevant lexical properties must be missing from the pertinent mental lexical entry or entries of that person.

Thus, by looking at the recognition-time profile across sets of contexts where different syntactic and semantic constraints are or are not available, it should be possible to ascertain which types of properties are functioning in the second language recognition process. Also, by comparing recognition-time profiles of different levels of language proficiency, it should be possible to get some idea of how these properties develop functionally, relative to each other. Finally, since highly familiar words will have better defined lexical entries than less familiar ones, an even finer-grained assessment of this functional development should be obtainable by looking at word-recognition time differences within speakers but between selections of familiar and less
familiar words. This will be developed in detail in the next section.

B. Word Familiarity and Word Knowledge

Although early versions of the cohort model (Marslen-Wilson and Welsh, 1978; Marslen-Wilson and Tyler, 1980) made no mention of word frequency or activation, this has changed in later versions (Marslen-Wilson, 1987). Part of the motivation for moving to a strength of activation metaphor was the finding that word-frequency was a functional variable in the recognition process. Marslen-Wilson (1987) reports strong facilitation to lexical decisions on the higher frequency member of pairs of high/low frequency words which were matched according to recognition point (the point in a word where it "can be discriminated from the other members of its word-initial cohort, taking into account both contextual and sensory constraints", Marslen-Wilson, 1987, p. 80). Other evidence from research using lexical decision tasks (Taft & Hambly 1986), cross-modal priming (Marslen-Wilson (1987), and gating tasks (Tyler, 1984) supports the idea that word frequency will have an effect on speed of word recognition. To account for this, it was proposed that high frequency words would initially have a higher relative level of activation than low frequency words (Marslen-Wilson, 1987). More recent studies in printed (Allen, McNeal & Kvak, 1992) and auditory (Connine, Titone, & Wang, 1993) word recognition also indicate that word recognition speed is related to word frequency, and that higher frequency words will be responded to more quickly than lower. There is controversy about whether these frequency effects reflect differences in initial activation levels of lexical entries or post-access bias (Marslen-Wilson, 1990), but Marslen-Wilson reports research findings that suggest these effects

It is reasonable to expect that these activation effects will prevail in the second language context, too, regardless of their temporal location in the word recognition process. That is, second language learners should also respond more quickly to more frequently encountered words than to less frequently encountered ones. This expectation will be referred to as the word familiarity: activation hypothesis to distinguish it from another effect that is predictable from concepts of word familiarity and growth in language proficiency. This effect will be outlined next.

The effect of word frequency on recognition speed has not been directly investigated in the word monitoring experiments conducted within the purview of the cohort model and will need to be assessed, but if the effect is experimentally observable then it can be instrumental in the investigation of second language learning. Usually, word frequency is defined on the basis of data that summarizes a written corpus (e.g. Carroll, Davies & Richman, 1971; Francis, & Kucera, 1982) and can be seen as an estimate of actual frequency of exposure and consequently, of opportunity to learn and become familiar with the word. While this assumption would probably not be accurate for beginning language learners since much of their exposure to the language may take place in restricted contexts such as classrooms or language textbooks, it becomes more reasonable with increased proficiency of the individual and longer immersion in the target language setting. In addition, it seems plausible that ongoing exposure to words in use in the global second language context would result to some extent in increased word knowledge in that language. Because of learning resulting from greater exposure then, entries for high frequency words should have more complex lexical structures
with richer, more complete sets of lexical properties than those for low frequency words. If this is true, then word frequency can also be used as an indirect measure of word knowledge and therefore provide an additional strategy for investigating second language growth. This word familiarity: learning hypothesis proposes that the effect of different levels of language proficiency on word recognition speed should be reflected within a proficiency level by high and low frequency words.

C. Second Language Proficiency

Before the lexical characteristics of second language proficiency are discussed, one other aspect of differences in fluency must be reviewed. In the cohort model, the lexicon is central to the word recognition process, but the cohort model is comprised of a number of sub-functions and assumes processes that are external to the model. With second language learners, it is not necessarily the case that the different processes and structures which underlie or influence the word recognition process will develop at equal rates. In particular, the cohort model divides the process of spoken word-recognition into three basic functions: access, the mapping of the sound signal onto the lexical representation of words; selection, the selection of the word-form that is closest in match to the input; and integration, the process of integrating the syntactic and semantic information of the word being recognized with the higher level representation of the current utterance.

Both access and integration involve processes that are not described in Marslen-Wilson's model. In the case of access, there is the process of transforming the physical input signal to a mental representation appropriate for lexical access, and in the case of integration, there is the process (or processes) of constructing a higher, message-level
representation. In order for the cohort model to be of value in investigating the
development of the second language lexicon, it is important to be able to argue that the
locus of the particular experimental effects that are to be examined is in the lexicon and
not the pre-access or post-integration stages of speech processing. Therefore, before
discussing how the development of the lexicon might impact on word recognition, I
will discuss the relationship of increased proficiency to the access and integration
processes first.

1. Access

Prior to access, the stream of acoustic energy must be received by the ear and be
transformed to some other physical, and ultimately mental, representation of the
original sound image. This new representation must be such that matches can be made
with internally existing mental representations so that a cohort of words can be
activated and eventually a word be recognized. In the early discussions of the cohort
model, this process of taking input in the form of a speech wave and generating some
form of representation usable by the access process was outside the model proper. The
approach was to assume that the peripheral auditory system provided the lexical
processing system with some form of acoustic-phonetic analysis of the speech which is
projected onto the mental lexicon (e.g. Marslen-Wilson, 1989; Zwitserlood, 1989). More
recently, the nature of the representations in the recognition lexicon (Lahiri and
Marslen-Wilson, 1991; Marslen-Wilson, 1993) and of the input to the recognition lexicon
(Marslen-Wilson and Warren, 1994) have been the focus of investigation.

In an ordinary first language context, it is safe to assume that both the processes
operating at the speech input level and the word-form representations stored in the
lexicon have stabilized in the adult. It is not certain when the input processing system stabilizes in native speakers of a language but there is evidence of a reorganization from a ‘universal’ to a ‘language-specific’ phonetic perception occurring between 6 and 12 months (Werker & Lalonde, 1988; Werker, 1993). When, if ever, does the adult second language learner’s peripheral auditory system and segmentation process begin to output consistent representations of the sound structure of the new language? There are indications that at least some new phonological information can be learned by adults in a relatively short time. In two one-hour laboratory sessions, McClaskey, Pisoni & Carrell, (1983) succeeded in training subjects to distinguish a stop intermediate between /p/ and /b/ by using voice onset time stimuli. Furthermore, this discrimination ability was generalized to another new stop category, between /k/ and /g/. On the other hand, the very term ‘foreign accent’ suggests that there are second language learners who never seem to attain the ability to produce the difference between particular phonemes in a second language (or to use certain syntactic structures) consistently. These errors have become fossilized (Selinker, 1972) in their production systems and likely represent lack of discrimination in their auditory coding systems, too. In a review of cross-language speech perception research, Werker (1993) concludes that "...although young infants are equally sensitive to both native and non-native phonetic contrasts, adult perception is modified by language experience, and the impact of experience is more profound for some non-native contrasts than it is for others...." (p. 61). What may be the case is that the output from the emerging auditory coding system becomes internally consistent rather rapidly, fixing on the sub-set of the significant contrasts in the spoken sounds of the new language which are either still
available to the learner or readily re-learned.

I would suggest that, under the cohort model, regardless of whether this coding system develops slowly, and moves toward native-speaker like discrimination, or quickly, and retains lack of discrimination among certain phonological features, the main effect of a less-than-native-like input system would be slower word recognition time and increased variability of these times. This is because of what Marslen-Wilson (1987) calls the contingency of perceptual choice, in which the identification of a word depends not only on what words are present but also on what words are not present. A system which can not discriminate along certain features will retain more words in the cohort longer than one which can. Thus, recognition will take longer. However, since this will only occur in word-cohorts in which a particular feature is functional in discriminating among the members, the slow-down will not be universal and consequently there will be greater variability in recognition times. Furthermore, unless these unmastered distinctive phonological features are correlated with syntactic or semantic lexical features (unlikely in the case of the initial sounds of root words in English), an increasing proficiency in a second language input coding system should not interact with syntactic or semantic information so as to affect word recognition time.

In summary, decreased proficiency in the auditory encoding system should increase word recognition time overall, but should not interact with changes in the syntactic or semantic structure of the lexicon. That is, word recognition will take longer for those who are less proficient. This will be termed the delayed access hypothesis.
2. Integration

In the cohort model, the integration function "concerns the relationship of the recognition process to the higher-level representation of the utterance" (Marslen-Wilson, 1987, p. 72). Because the focus of the cohort model is on word recognition, not a great deal is said about how these higher-level representations are constructed. If they come about as a result of processes that are different from the assessment/integration which originate in the lexicon, then it seems reasonable to ask whether increased proficiency in a second language is primarily related to increased capabilities in these higher-level processes. Relevant to the present study, members of the activated cohort are assessed against these higher level representations during the recognition process. Consequently, more accurate representations of the message, which result from greater proficiency, may also contribute to increased word recognition speed. As a result, an interpretation problem appears to arise if a difference in word recognition speed is observed that is associated with a difference in language proficiency. Can this difference in speed be attributed to differences in lexical structure or differences in capability in the higher level discourse processes?

However, this is not as great a problem as it may seem. First, when Marslen-Wilson and Tyler (1981) discuss higher-level representations, they propose two distinct types of processes that contribute to the construction of these sentential and discourse-level representations. They characterize them as (1) those that are within the model (the automatic and obligatory central processes I have described earlier) and (2) those that are off-line, post-access processes which they say are "idiosyncratic and variable, and not, we believe, central to the normal process of speech understanding" (p. 322). In
addition, relevant to the present study, Tyler (1989) stresses the immediacy with which the lexical representation of a verb imposes constraints on the processing of the subsequent input. The verb becomes the dominant source of contextual constraint. It would appear, then, that the cohort model is at least adequate for explaining the effect of lexical knowledge related to verbs on the recognition of subsequent nouns.

Let us return to the relationship between the processes involved in word recognition and the processes involved in constructing and interpreting higher-level representations. If language processing can be legitimately modelled as an information processing system (cf. McLaughlin, Rossman & McLeod, 1983), then the likelihood that these two separate sets of processes must take place simultaneously should result in a significant interaction of proficiency with word recognition speed under some circumstances. It is reasonable to suppose that during the development of second language proficiency, the construction of the higher level representation will put a "load" on the processing system. As proficiency develops, this load will decrease. In the case of first language processing, this construction process would generally be effortless. In a comparison, then, of two situations where recognition takes place under different load conditions, native speakers of a language and second language learners (or even fluent second language users) may perform differently.

Consider, for example, the situation when a target word is presented in a random list of words and compare it to Type 4 sentence (syntactically anomalous sentences) above. Under both of these conditions, there are no syntactic or semantic constraints to aid in word recognition. Where they differ, however, is that in Type 4 sentences it is possible to construct a higher level representation right up to the point
where the anomalous noun phrase occurs. In the random list, it is not possible to do this. For native speakers of a language this would make no difference. Word recognition would proceed according to phonological data alone. However, for a less proficient second language user, the effort of constructing the representation may draw resources away from the processing of the phonological data. That is to say, if there is no attempt to construct a meaningful representation when a word is presented in a random list, then target word recognition for the language learner under this condition will be faster than in the Type 4 sentences.

In summary, this review of the integration processes of the cohort model has identified a possible source of interaction of language proficiency with word recognition speed. The information processing hypothesis proposes that, for second language users, because of a reduced load on the processing system, word recognition speed will be faster in the context of a random list than in a sentential context which would cue construction of a higher level representation but not impose syntactic or semantic constraints on the target word. This should not be the case for first language users. Importantly, this effect will not obscure effects on word recognition speed related to lexical structure.

3. Lexicon

On the basis of the above arguments, it is reasonable to proceed with extending the cohort model to the second language context in a preliminary investigation of the structure and development of the second language lexicon. Lexical representations "provide the basic bridge between sound and meaning, linking the phonological properties of word-forms with clusters of syntactic and semantic properties." (Marslen-
Wilson, Brown & Tyler, 1988, p. 2). Also, the lexicon is, if not the central link in language learning as suggested by Carroll (1992), one of the most important components in both first and second language learning, since the lexicon must be learnt by both native speakers and second language speakers.

But what is the nature of this lexical learning in a second language context? Two specific questions arise: (1) What is the nature of the limiting case of the second language (i.e., highly proficient users') lexical structure and word recognition? and, (2) What is the nature of growth toward that limiting case? First, I will sketch out three very general limiting cases toward which the development of the second language lexicon may move. Each of these possibilities predicts a characteristic effect on the use of contextual constraints in the word recognition process. Then I will present a more detailed analysis of how different developmental sequences of lexical verb and noun entries might affect the speed of word recognition in a second language.

The first possibility is that the underlying processes in the cohort model do not function in parallel in even proficient second language users. That is, in a second language, particularly one learned after puberty, phonological coding acts strictly as an address for the meaning of the particular word, and syntactic and semantic information do not become available for processing until after the word has been recognized. There is no mechanism for multiple assessment of candidates against the developing context. The process of integration would take place after a combined recognition/selection process, unlike in the cohort model where selection during normal conversation "becomes a by-product of the primary process of mapping word-senses into higher level representations." (Marslen-Wilson, 1987, p.98-99). The implication of this for word-
recognition under different message-level contextual constraints is that there would be no difference in recognition time. Only the phonological data could be used. The response-time profile for even advanced users would be horizontal.

This seems unlikely as a limiting case for proficiency in a second language. First, it would mean that even highly proficient second language users would always be running a processing deficit that would increase with the length of the continuous discourse. There would be some time needed to integrate a word with the on-going discourse once its semantic and syntactic properties became available for processing. While this may apply to learners, it does not seem to be a realistic characterization of the nature of proficient second language use. Second, Hayashi (1991) appears to have already demonstrated that in second language users there is an effect of context on word recognition speed. Since in Hayashi's experiment the target words were obscured to some extent with white noise, it is possible that their identity was arrived at through some kind of post-perceptual deductive strategy rather than through normal recognition processes. Thus, however unlikely this possibility is, it cannot be ruled out on the basis of prior research.

Another possibility is that the phonological encoding acts strictly as an address, as just described, but that at any particular address there almost always remains, rather than a single candidate, a number of candidates. That is to say, the phonological address and the encoding process never reach such efficiency that words can easily be uniquely identified on the basis of bottom-up data. When a word is heard out of context, the identification process would have to rely on some sort of phonological and situational best-guess procedure to reach any decision. When the word is in a
meaningful context, then the selection process can use syntactic and semantic constraints to make the final choice. In this case, the reaction time profiles of native speakers and fluent second language speakers under different contextual constraints would be parallel but not coincident. In particular, the second language users' profile would lag behind by at least the difference between the native speakers' recognition point, often occurring in the middle of a word, and the offset of the word.

The final, contrasting possibility is that the limiting case of the second language (i.e., highly proficient users') lexical structure may be essentially the same as native speakers. In this case, for highly proficient second language users and native speakers of a language, the profiles of word-recognition times under different conditions of contextual constraints would be parallel, and in fact would coincide.

Of course, defining the limiting case of second language lexical structure does not say anything about the developmental path taken to get there. One plausible hypothesis of integrated lexical development regarding such a path is that the different types of properties, including the phonological, are highly interdependent, and that they 'assemble' uniformly and evenly with no particular property or attribute becoming more well defined or more highly functional in the word recognition process than another at any time. Once a word is 'recognizable' (i.e., has a stable phonological representation), all other properties will be available to the recognition process. An implication of the hypothesis suggests that, as a speaker moved from lesser to greater proficiency, the pattern of recognition would result in a gradually decreasing number of unrecognized words (missed targets), an increasingly significant use of available contextual constraints of all types, and a decreasing variance in word recognition speed.
This hypothesis also predicts that for all target words that are recognized, there will be an effect of contextual constraint.

At first glance, this type of lexical development may seem unlikely in second language learning since one of the jobs of language instruction is teaching new or more precise meaning or usage for words that students already use or recognize. That is to say, second language learners will often have a phonological representation stored in the lexicon but will not have certain aspects of meaning or syntax attached to it. However, if word recognition is specifically understood as the process of fixing the identity of a word through those central processes described by Marslen-Wilson and Tyler (1981) and not as some sort of post-perceptual deductive processes, however quick they may be, then this interdependent model of lexical development should have some validity.

What is more probable, though, is that word recognition processes will make use of whatever lexical properties are available. Furthermore, lexical entries will grow, properties will accumulate, along those dimensions or within those categories which are easiest to infer from the spoken, contextualized presentation of language which the user meets with on a day to day basis. As I will argue below, in terms of syntactic or semantic properties, it is more likely to be the semantic properties that are inferred first and the semantic constraints that become functional soonest.

When Marslen-Wilson et al. (1988) carried out their study on the effect of syntactic and semantic constraints on word recognition speeds, they exploited the "fundamental distinction between the categorial properties of the verb argument frame and the semantic and syntactic properties of the items that can fill these argument slots"
It is possible to outline some fairly strong prerequisites for these specific constraints to function in an identical manner in the second language word recognition process. For an English verb to impose such constraints on a noun phrase that follows it, certain lexical conditions must be in effect. First, rather obviously, the ESL person must know what the verb and the target noun sound like. That is to say, in that person's mental lexicon there must be phonological representations for the entries of both the constraining verb and the target noun. Second, the verb's lexical entry must include the categorial information that it is, indeed, a verb. In addition, that same entry must supply sub-categorial information about what type of verb it is. In particular, the verb will need to supply information that it is a transitive verb, for it is this property that imposes the syntactic constraints on the interpretation of subsequent input. For there to be semantic constraints as well, there must also be a well-constructed semantic representation of the verb's meaning. This semantic information about the verb defines restrictions on the words that can be selected to fill the open verb-frame slot or slots (see Chapter II). Finally, for the syntactic constraints to act upon the noun, the noun, too, must be categorized within the second language lexicon as a noun, and for the semantic constraints to come into play, the noun, too, has to have a well-constructed semantic representation.

This analysis appears to require that for this particular case (recognition of object nouns constrained by the preceding verb), the syntactic properties must be functionally operative before there can be a semantic effect in word recognition. If this apparent logical requirement is also a developmental sequence, then learners of a second language may not show any difference in speed of word recognition when presented
with sentences such as 1 and 3. This would happen if learners can develop

1. She watched the bubbles floating in the air.
3. She interviewed the bubbles floating in the air.

representations of verbs which include categorial and sub-categorial information but do not have well differentiated semantic representations which can select the nouns that semantically fit in the argument slots.

The problem with this analysis is that it is once again based on the fully developed lexicon and does not take into account how lexical entries develop, something that must be done if the cohort model is to be applied to the second language situation. A more plausible hypothesis would be that of semantic dominance. This proposes that initial lexical entries are phonological form representations linked to semantic representations which are syntactically uncategorized. Those that have some sort of predicate argument structure eventually become categorized as verbs or as nouns, adjectives or prepositions that have arguments (Haegeman, 1991). In these relatively immature lexical entries, the syntactic properties of the argument frames are not well specified though there may be semantic constraints on what could fill them.

The verb in sentence 3 can serve as an example. The meaning of the verb *interview* implies two participants, the interviewer and the interviewee. Similarly, the noun *interview* also implies two participants, (e.g. ... the reporter’s interview of the victims...). Where the noun and the verb differ is that when *interview* is a verb, filling both frames is syntactically mandatory whereas when it is a noun they are both optional. Furthermore, with respect to syntax, the verb arguments must be filled with noun phrases, while one of the optional arguments of the noun must be a prepositional
phrase. It is likely the case that syntactic details such as these take longer to sort out and become part of the functional properties of the lexicon than it does to establish a semantic representation of the concept of interview that excludes such things as bubbles as the interviewee. If this is so, then in the case of the second language learner, response time to target words in sentences such as number 3 will be slower than those in normal sentences because of the lack of semantic constraints within the message, but response time to target words in sentences such as number 4 will not differ from that to 4. She crawled the bubbles floating in the air.

number 3, because the learner is unable to make use of the syntactic constraints in those kind of sentences.

4. Summary of Hypotheses and Predictable Outcomes

The foregoing conceptual analysis of the application of the cohort model to second language word recognition allows us to express more clearly the particular questions that were addressed in the present study, and to state some expectations regarding the outcomes. The first question is:

a). How are the word recognition systems of native speakers and fluent second language users different?

Two hypotheses are proposed on particular areas where these systems will differ. First, the delayed access hypothesis proposes that decreased proficiency in the auditory encoding system will increase word recognition time overall. Consequently, even fluent second language users will take longer than native speakers to recognize words presented in any context. Second, the information processing hypothesis proposes that, for second language users, there will be a reduced load on the processing system when word recognition takes place in the context of a random list. Consequently, recognition
time will be shorter than in a sentential context which allows construction of a higher level representation but supplies no recognition aid in the form of syntactic or semantic constraints on the target word. This will not be the case for first language users and may not be the case for fluent second language users, especially with high frequency words.

Although each of the previous hypotheses predicts differences between the processing systems of native speakers and fluent second language speakers, they do not address whether the use of lexical knowledge is similar in both cases. The second research question is then:

b). Is the role of lexical knowledge during the spoken word recognition processes of fluent second language users comparable to that of native speakers?

Broadly speaking, there will be comparability in the two systems in that both will make use of some sort of lexical knowledge. As argued above, for fluent second language users the contrary case seems to impose such a heavy load on listening comprehension as to be unrealistic. The integrated lexical development hypothesis proposes that the different types of properties, including the phonological, are highly interdependent, that they 'assemble' uniformly and evenly with no particular property or attribute becoming more well defined or more highly functional in the word recognition process than another at any time. On the other hand, the semantic dominance hypothesis predicts that novices will, after quickly mastering sufficient phonological code, initially learn semantic properties of a word and that these will play a leading role in the word recognition process. Thus, a learner's systems will not be comparable to an expert's in that the specific types of lexical properties they can make use of during word
recognition will be different. The extent to which a second language word recognition system will converge in functionality on a first language system may depend on age-dependent limits to second language learning. Johnson and Newport (1991) have produced evidence that adult learners of a second language do not master at least some aspects of universal grammar. Possibly, then, this dominance of semantic properties will persist even in fluent users but it will be decreased as word knowledge (and general proficiency) increase.

This interaction of differential use of lexical knowledge with proficiency introduces the final research question.

3. What is the nature of the development of the word recognition system as it moves from learner to fluent user?

Each of the specific hypotheses proposed under a) and b) above can be restated in terms of interaction with different levels of proficiency and with different levels of word knowledge. First, the delayed access hypothesis predicts that word recognition time will be faster across conditions for fluent users than for advanced learners. Similarly, recognition time to high frequency words will be faster than recognition time to lower frequency words. Second, the information processing hypothesis predicts that as proficiency increases, the load on the system from constructing higher level representations will decrease. Consequently, the recognition time difference between the load and no-load conditions will decrease with proficiency and will be smaller for high frequency words than for low frequency words. Finally, as suggested in the preceding paragraph, the semantic dominance hypothesis predicts that learners of a second language will first show effects of semantic constraints on words. As proficiency increases toward fluency (or as word familiarity increases), though, syntactic constraints
will increasingly affect the speed of word recognition.
Chapter IV. Method

A. Subjects and Design

Table 2 presents the basic design of the research. Sixty students, twenty for each of three language proficiency levels participated as subjects for the present study.

Table 2

Research Design

<table>
<thead>
<tr>
<th>Familiarity</th>
<th>High Frequency Words</th>
<th>Low Frequency Words</th>
</tr>
</thead>
<tbody>
<tr>
<td>Context Type</td>
<td>N</td>
<td>P</td>
</tr>
<tr>
<td>Language Proficiency Level</td>
<td>Native Eng. Speaker</td>
<td></td>
</tr>
<tr>
<td>Fluent ESL User</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Advanced ESL Learner</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

N: normal context  P: pragmatic anomaly  Se: semantic anomaly  Sy: syntactic anomaly  RO: random order

The overall age range was 17 to 45 years (mean age=24.9) with no significant differences among the language proficiency levels (Means: native English speaker, 25.3 years, a range of 19 to 39 years; fluent ESL user, 26.8 years, a range of 19 to 45 years; advanced ESL learner; 22.6 years, a range of 17 to 32 years). Gender was evenly represented from each language group. No subjects reported any hearing defects. Native English speakers (Native Speakers) were recruited from graduate or undergraduate level educational courses at the University of British Columbia (UBC). All ESL subjects spoke Cantonese as their first language. Subjects in the fluent ESL user (Fluent Users) level of proficiency were UBC students who were fully enrolled in
content courses (i.e. not attending supplementary language courses). Subjects in the
advanced ESL learner (Advanced Learners) level were recruited from college
preparatory English classes, at a local community college. This college has an extensive
in-house language testing program which is used to govern movement from one level
to the next of a ten-level system. Promotion from the highest level confers B.C.
provincial credit for Grade 12 English and Grade 11 Social studies. Subjects were
students in the last two terms of this program.

B. Language Materials

1. Test sentences

Forty nouns were chosen from Francis & Kucera (1982). Because it was
necessary for timing purposes to accurately determine the beginning of each of the
targets, only words beginning with a stop consonant (e.g. /b/, /t/, /d/, etc.) were
chosen for the test sentences. Subject to this constraint, one half of them were
randomly selected from within the adjusted frequency rank range 300 to 1200, and the
other half were selected from the range 3500 to 4500. The mean adjusted frequency of
the high frequency words was 127.7, and the mean of the low frequency words was
13.623, a significant difference, $F(1,39) = 63.8, p < .001$ (MSe=2091.820). Using each of
these as a target repeated over the five different sentence types (see Table 3), forty sets
of stimulus sentences were constructed, resulting in a 200-item corpus (40x5, see
Appendix A). (Strictly speaking, the test items of contexts 3, 4, and 5 are not sentences,
but to simplify discussion they will be referred to as such.) As can be seen in Table 3,
each stimulus sentence pair from contexts 1 to 4 starts with the same lead-in sentence
but ends with a different test sentence. The stimulus string in context 5 is a scrambled set of the words from both the lead-in sentence and test sentence of context 1 of each set.

**Table 3**

**Examples of Test Sentences: Target word *bubbles***

<table>
<thead>
<tr>
<th>Sentential Context</th>
<th>Lead-in Sentence</th>
<th>Test Sentence</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Normal</td>
<td>Lynda was playing in the garden. <strong>She watched the bubbles floating in the air.</strong></td>
<td></td>
</tr>
<tr>
<td>2. Pragmatic Anomaly</td>
<td>Lynda was playing in the garden. <strong>She ate the bubbles floating in the air.</strong></td>
<td></td>
</tr>
<tr>
<td>3. Semantic Anomaly</td>
<td>Lynda was playing in the garden. <strong>She interviewed the bubbles floating in the air.</strong></td>
<td></td>
</tr>
<tr>
<td>4. Syntactic Anomaly</td>
<td>Lynda was playing in the garden. <strong>She crawled the bubbles floating in the air.</strong></td>
<td></td>
</tr>
<tr>
<td>5. Random Order</td>
<td>Floating the Lynda watched the in was she <em>bubbles</em> playing the garden in air</td>
<td></td>
</tr>
</tbody>
</table>

2. Filler material

Except for context 5, the test sentences follow a very regular pattern and this could result in subjects developing conscious or unconscious response sets. For example, the task in all test materials is to monitor for the exact word. In addition, the target words are all nouns beginning with stop consonants and the location of the target word is usually about 9 to 14 words from the beginning of the stimulus. Most important, the target word is always the second word after the main verb in the test sentence. In order to decrease the likelihood of subjects developing guessing strategies based on these regularities, eighty distracter sentences were constructed to add to the
set of test sentences. To divert attention from the use of exact-word monitoring in the test sentences, two other tasks are introduced, category and rhyme monitoring (Marslen-Wilson et al. 1988; Marslen-Wilson & Tyler, 1980) (see Table 4).

### Table 4

**Example Filler Material (target word underlined)**

<table>
<thead>
<tr>
<th>Category: A Kitchen Utensil</th>
</tr>
</thead>
<tbody>
<tr>
<td>The large <em>spoon</em> is often misplaced. It should be kept in the drawer.</td>
</tr>
<tr>
<td>Rhyme: true</td>
</tr>
<tr>
<td>She couldn’t <em>undo</em> the water. She left it on the shelf.</td>
</tr>
</tbody>
</table>

In the category monitoring task, subjects listen for an example of the specified category (e.g. Kitchen Utensil—spoon). The material for this task was taken from Battig & Montague (1969) and 30 items were constructed (see Appendix B). In the Rhyming task, subjects listen for a word which rhymes with the given cue word (eg undo: true). Inspiration for rhyming fillers was from Holofcener (1960), and Johnson (1957) and 30 items were constructed (see Appendix C). Following Marslen-Wilson et al. (1988), word type and word position have also been varied in the distracter sentences. In addition, so has the type of initial sound. As in that research, the target words in three out of the five contexts are anomalous. To conceal this regularity, the distracter sentences contain anomalous words and other oddities that are not targets. Again following Marslen-Wilson et al. (1988), twenty filler items using the exact-word task but otherwise following the above criteria were also constructed (see Appendix D). The sole purpose...
of the filler items was to discourage any guessing strategies on target words. They were not the source of any data.

3. Example and Warm-up Items

In addition to the test sentences and the distracter items, 9 example (see Appendix E) and 18 warm-up items (see Appendix F) were constructed. The example items presented each task three times with the target word appearing in a variety of locations and in a representative set of contexts. The warm-up items were also representative of both the filler and the test material but were presented in a more randomized fashion.

C. Production of Language Stimuli and Computer Program

The materials were recorded on a reel-to-reel tape-recorder at 7 1/2 ips. The speaker was a professional actress who was not aware of the purpose of the experiment. The target words were not indicated in the recording script. The materials were then digitized at 22Khz using Voice Editor II (Creative Labs, 1991) and each stimulus sentence was saved in an individual sound file. For test sentences of types 1 to 4, the target word and all words following it were excised from the file. One of the excised sections was duplicated and appended to each of the truncated test sentences. In this manner presentation of the target word was identical across the members of each set of test sentences.

A display/timing program was developed so as to control the presentation of the stimulus materials and time the subjects' responses. Using a sound-file editor, a digital marker was placed within each test item file at the onset of the target word. This marker was used by the display/timing program to start a counting loop within
the program. On the two 33MHz, 386 DOS computers used in the present study, more than 17,000 iterations of the loop were equal to one second. That is, one iteration was less than 0.1 msec. The two computers were calibrated using 10 different one-second sound clips with flags at the beginning and end of each. The mean number of iterations for the respective computer was used to calibrate reaction latencies in msecs.

D. Procedure

As each subject arrived at the experiment room, s/he was asked to write a 50-item cloze test (see Appendix G) and to fill in a questionnaire form for language background and biographical information. Subjects were allowed a maximum of 40 minutes to complete the cloze test. Cloze tests tend to correlate well with other measures of language proficiency and it was felt that such a measure would be helpful in illustrating the global language ability differences among the three functionally defined language proficiency levels.

Furthermore, the cloze test as a test type is typical of a general class of "off-line", retrospective type of language proficiency measures. If the skills measured in such a type of test are related to the on-line, high speed processes which we wish to measure in the word-recognition paradigm, then scores on this test should allow for a more precise look at relationship between language proficiency and word recognition. On the other hand, if the skills measured in the two tasks (spoken word recognition and the cloze test) are different, then we can not expect to find a significant relationship between the two.

The material used by the display/timing program is cued by a separate data file
containing a list of the stimulus files in the order that they are to be presented. Five of these cue files were created in order to counterbalance presentation of the words over the five sentence contexts. Each file presented all of the example and warm-up material and 40 of the 200 test-sentences in random order mixed with all of the 80 filler items. Each of the cue files presented eight different target words, four high frequency and four low frequency, under each of the five contexts. Target words were heard once and only once by each subject, but were presented under all five contexts. Four subjects, two male and two female, from each of the three language proficiency levels were tested on each of the five cue files for a total of 60 subjects (=4x3x5).

The subjects were tested in a quiet room using a personal computer equipped with a sound-card, and closed-ear headphones. Before each session, subjects were introduced to each task type through the example items. They were told to respond as quickly as possible, to avoid guessing ahead or trying to anticipate the location of the target word and not to push the button more than once during a trial. When they had completed the example items, subjects began the session proper, starting with the warm-up items and then moving through the items as arranged in the cue file.

The computerized display/timing program mentioned earlier was used to display target words and to time responses. Subjects faced the video screen and pressed the space bar to begin a cue sequence. The program displayed the task type (exact, category, or rhyme) in the middle of the screen. Below this, in the same lettering, it displayed the cue word. After a three-second pause, it began playing the voice file containing the appropriate material. If the material was filler, the program played the voice file and then waited for the subject to signal readiness for the next
item. No data were recorded.

If the material was a test item, the program started the voice file, waited for the marker of the target-word onset and then began timing. When the subject pressed the space bar, the timing stopped. If the subject pressed the bar before the onset of the target word, the value for that trial was set at -1. If the subject failed to press the bar at any time during the presentation the sound file, the value was set at -2. This was done in order to make a distinction, if necessary, between missed (unrecognized) target words and over-anticipation of a target word.

At the end of each trial, the program wrote the appropriate data to a file opened for that subject. The data consisted of a code for the particular target word, a code for the context it was presented under, and a value for the reaction time. The latter was -1, -2, or the total number of iterations of the loop from word onset to bar press. When each session task was completed, the subject’s participation was acknowledged with appreciation.

E. Data Screening and Preparation

Periodically during data-gathering, subjects’ response files were reviewed with the intent of finding unusual or unacceptable cases. As a result of this, two atypical cases were identified. In one case, the subject had an exceptionally low score on the cloze test. This subject was in the Fluent User pool but a review of her biographical information revealed that she was a post-doctoral student. There are no language requirements for admission of post-doctoral students in UBC, and it appears that her general language proficiency was probably lower than that of any of the advanced
learners. The second case was a subject who apparently did not understand the instructions or was very tired during the session. This subject did not respond to 11 of the 40 target words. These two subjects were rejected and substitutes were found for them.

Missing values occurred in the data if subjects either pressed the bar before the onset of the target word or not at all during the trial. In the final set of 2400 responses, there were 26 missing values. There was no discernible pattern to these data. They were replaced with the mean of the remaining replications for the subject within the particular cell of Word Frequency by Context.

In order to identify and replace extreme outliers, a series of 40 regressions was run, one for each of the four repetitions within each of the 10 cells of Word Frequency (2) by Sentence Context (5) conditions. In these regressions, the dependent variable was response latency, while language level was a categorical predictor, and target-word length was used as a covariate. All raw data points with studentized residuals greater than 2.5 were replaced with the regression estimates. Thirty-two values were identified in this manner. These procedures resulted in a total of 58 (2.4%) values out of the entire 2400 which were estimated rather than measured.

Subjects responded to four words under each of the ten context by word-frequency conditions. The mean of these four replications was used as the unit of analysis of the response latency data. That is to say, each subject's 40 responses were reduced to 10 mean values, thus reducing the original 2400 responses to 600 mean responses. The research design called for analysis of these means using a multivariate analysis of the 60 subjects' 10 repeated measurements. Consequently, these
measurements were treated as 10 variables and further investigated for outliers and departures from parametric assumptions. Inspection of density plots, maximum and minimum standardized scores, and skewness estimates on each variable by language level indicated that some of the within cell distributions of the Native speakers tended to be slightly positively skewed. However, analyses of the residuals from regressions of each of the 10 latency variables onto language level and word length did not indicate that a transformation of the data would be necessary. The Bartlett's test for homogeneity of group variances did not suggest there were any major violations of this assumption. Mahanalobis distances did not reveal any multivariate outliers. After these screening procedures were completed, analysis of the data in terms of the hypotheses was commenced.
Chapter V. Results

A. Review: The Components of the Extended Model

The present research is concerned with the extension of the cohort model of word recognition to second language comprehension and learning. Two important assumptions of the model as outlined by Marslen-Wilson (1989) are: 1) that syntactic and semantic properties of a mental lexical entry can function to facilitate spoken word recognition and 2) that spoken word recognition is a function of the initial level of activation of a word, which in turn is a function of the frequency of exposure to it in the general language environment. In order to extend the cohort model to account for second language processing, it is necessary to interpret the consequences of these assumptions within the context of differences in language proficiency. Before data analyses are conducted, the assumptions underlying the definition of the language proficiency level of subjects in this research need to be examined.

In this research, language proficiency level was functionally defined and three proficiency groups were investigated: native speakers of English (Native Speakers), fluent ESL users (Fluent Users), and advanced learners of ESL (Advanced Learners).

<table>
<thead>
<tr>
<th>Table 5</th>
<th>Cloze Test Score Means and Standard Deviations by Language Proficiency Group</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Advanced Learners</td>
</tr>
<tr>
<td>Mean</td>
<td>17.471</td>
</tr>
<tr>
<td>Stand. Dev.</td>
<td>3.99</td>
</tr>
</tbody>
</table>

62
The results from the cloze exercise support this functional definition, suggesting the three samples differed significantly in their global or general English proficiency, $F(2,55^1)=41.76, p<.001$ ($\text{MSe} = 24.93$). Although the group means are well separated (see Table 5), there is overlap (see Figure 1) in scores even between the Native Speakers and the Advanced Learners, suggesting the cloze scores may be a fruitful avenue of further investigation into the relationship between language proficiency and word recognition speed.

<table>
<thead>
<tr>
<th>Score</th>
<th>Advanced Learners</th>
<th>Fluent Users</th>
<th>Native Speakers</th>
</tr>
</thead>
<tbody>
<tr>
<td>50</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>40</td>
<td>1</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>30</td>
<td>1</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>25</td>
<td>1</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>20</td>
<td>6</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>15</td>
<td>5</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>10</td>
<td>1</td>
<td>1</td>
<td>2</td>
</tr>
</tbody>
</table>

Numbers indicate frequency of cloze score.

Figure 1. Distribution of Cloze Scores by Proficiency Level

The two ESL groups were also different in the amount of time they reported having spent in an English immersion context. The mean of the Advanced Learners was 14.8 months (range = 33), while the mean of the Fluent Users was 61.6 months (range = 132). There were, however, no significant differences among the mean ages of the three groups, $F(2,57)= 2.62, p > .05$ ($\text{MSe}=4.226$).

1 Two cloze scores were missing from the data set.
B. Analyses

1. Analysis of Response Latency

The means of subjects' responses to the replications within cell were analyzed using a multivariate analysis of the 60 subjects' 10 repeated measurements. The between-subjects factor was language proficiency level and the two within-subjects factors were word frequency and sentence context. Table 6 presents a summary of the mean response latencies under all conditions.

**Table 6**

**Mean Response Latencies of Three Proficiency Levels in High and Low Frequency Word Conditions**

<table>
<thead>
<tr>
<th>Language Group</th>
<th>Word Frequency</th>
<th>CONTEXT</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Normal</td>
</tr>
<tr>
<td>Advanced Learner</td>
<td>Low</td>
<td>393.2</td>
</tr>
<tr>
<td></td>
<td>High</td>
<td>356.8</td>
</tr>
<tr>
<td>Fluent User</td>
<td>Low</td>
<td>420.9</td>
</tr>
<tr>
<td></td>
<td>High</td>
<td>337.3</td>
</tr>
<tr>
<td>Native Speaker</td>
<td>Low</td>
<td>278.3</td>
</tr>
<tr>
<td></td>
<td>High</td>
<td>267.9</td>
</tr>
</tbody>
</table>

Note: Times rounded to nearest .1 msec.

a. Differences among the Language Proficiency Groups

The *delayed access hypothesis* predicts that word recognition will take longer for subjects who are less proficient. In the present study, that would suggest that Native Speakers should respond more quickly to target words than ESL subjects in general,
Figure 2. Mean Response Latencies of Language Proficiency Levels

and that Fluent Users should recognize spoken words more quickly than Advanced Learners. Figure 2 summarizes the data related to this hypothesis. A contrast of means made between the mean of the Native Speakers ($M = 315.5$) and the combined means of the ESL groups (Fluent Users, $M = 413.7$; Advanced Learners, $M = 412.8$; combined, $M = 413.3$) was significant, $F(1,57)=29.55, p<.001, MSe=43,159.05$. However, as might be expected from looking at Figure 2, the contrast between the means of the Fluent Users and Advanced Learners was not significant. The delayed access hypothesis predicts results that would be analogous to those of the Cloze test, where the distinct differences between each of the three proficiency groups reflected the differences in functional proficiency of the groups. The results here do not completely conform to this, since the two ESL groups showed no reliable difference in response latency. This suggests that either the hypothesis itself is incorrect or that the cloze task and the word recognition
task assess two quite different aspects of language proficiency.

b. Word Familiarity

The cohort model predicts that high frequency words will be recognized faster than low frequency words because the higher frequency ones are at higher state of initial activation. For the purpose of the present research this prediction has been labelled the *word familiarity: activation hypothesis*. The difference in response times between the high \((M=358.0)\) and low \((M=403.4)\) frequency word conditions (see Figure 3) was significant, \(F(1,57)= 144.32\ p < .001\ (MSe=2142.98)\), which provides tentative support to the extension of the cohort model from the population of first language users to the larger, combined population of both first and second language users.

![Figure 3. Mean Response Latencies to High and Low Frequency Words](image)

However, further analysis of the data revealed a source of variation in response latency that was not directly related to the fundamental cohort model, but which could
influence the interpretation of results. This was the length of the spoken target word (as measured from onset to offset in hundredths of a second).

Although it may not necessarily be the case that longer words will take longer to recognize than shorter words, in this data set there was a positive relationship between the length of each of the 41 recorded words and the mean response time of all the subjects to that word, $r_{(m=41)} = .79, p < .001$. This effect of word length has been reported in previous research (Grosjean, 1980; Marslen-Wilson and Welsh, 1978; Marslen-Wilson and Tyler, 1980). Furthermore, it was found that the length of the spoken target words in the high frequency group of words ($M = 367$ ms) was significantly different from the length of the low frequency words ($M = 435$ ms), $F(1,39) = 7.523, p < .01$. The potential effect of this difference in spoken target word length is in the same direction as the difference predicted by the word frequency effect, and therefore in this research context, the effect of word frequency is inherently contingent on spoken word length.

To investigate the word length effect further, an additional analysis was undertaken. Individual regressions were run for each subject’s 40 responses, with word length as a predictor. The ten within-cell means of the residuals from these 60 regressions were then calculated and analyzed using the same repeated measures model as described above. In this analysis, the effect of word frequency on response latency remained significant, $F(1,57)=15.05, p<.001, MSe=1,541.98$, supplying additional support for the word familiarity: activation hypothesis.

As a result of the finding that target-word length appeared to influence response latencies, the remaining analyses used word length as a covariate to achieve a statistical control over word length when assessing the effect of word frequency.
c. Context

The cohort model predicts that increased word recognition time will result from decreasing the amount of pragmatic, semantic, and syntactic lexical information in the spoken message that links a target word to the preceding context. The profile presented in Figure 4 tends to support this. The test of the within-subjects factor of sentence context was significant, univ. $F(4, 227) = 33.24, p < .001, \text{MSe}=2028.75$; Pillai Trace $= 0.77501$, multiv. $F(4,50) = 43.058, p < .001$, indicating differing use of contextual information during the recognition process.

A more fine-grained analysis of the effect of context can be achieved by looking

![Figure 4. Mean Response Latencies of All Subjects across Sentence Contexts](image)

Figure 4. Mean Response Latencies of All Subjects across Sentence Contexts at how progressively increasing contextual information in the spoken message affects the recognition time. Target words in both the syntactically anomalous context and the random list context have no contextual information which can facilitate the recognition

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process. Thus, there should be no real difference between them in recognition time. This is borne out in the analysis, there being no significant difference between the mean responses in these contexts, \( F(1,53) = 3.238, p > .05, MSe = 2379.720 \).

While the syntactically anomalous context and the random list context have no contextual links to the target word, the semantically anomalous context does impose syntactic constraints on the target. Adding this syntactic constraint to the message should decrease response time. When the mean response under the semantically anomalous context is compared to the mean of the combined syntactically anomalous context and the random list context, there is, as predicted, a significant difference (estimated to be 13.48 ms, \( F(1,53) = 7.845, p < .01, MSe = 1849.775 \)). Similarly, adding the semantic constraint which is inherent in the pragmatically anomalous context should also reduce response time. When the mean of the pragmatically anomalous context is compared to the mean of combined semantic, syntactic and random contexts, there is another significant drop in response time (estimated to be 17.69 ms, \( F(1,53) = 15.820, p < .001, MSe = 1779.680 \)). The most significant difference in mean response times, though, is between the mean of those in normal conditions and the mean of those in the combined anomalous contexts (estimated to be 47.80 ms, \( F(1,53) = 143.355, p < .001, MSe = 1529.849 \)). These results supply further support to the contention that the explanatory scope of the cohort model can be broadened to include word recognition in a second language.

d. Language Proficiency and Context, Interaction

It was hypothesized that, when the cohort model is extended to the second language context, language proficiency will interact with sentence context to affect word
Figure 5. Mean Response Latencies of Language Proficiency Levels across Sentence Contexts

recognition time. Specifically, the semantic dominance hypothesis and the information processing hypothesis predict that certain sections of the different groups’ profiles across the contexts will not be parallel. The semantic dominance hypothesis proposes that semantic aspects of lexical attributes will be learned more quickly by second language learners than syntactic aspects. This would result in the semantic attributes becoming functional more quickly than syntactic ones in the word recognition processes of second language learners. The information processing hypothesis proposes that the extra load put on novice word recognition systems when constructing high level representations of the spoken message will interfere with word recognition. Indeed, Figure 5 suggests there are some differences in the way the language groups make use of available contextual information, particularly between the Native Speakers and the ESL subjects as a whole.
However, neither a comparison of the ESL subjects with the Native Speakers nor a comparison of the Fluent Users with the Advanced Learners was significant. This finding supports neither the semantic dominance hypothesis nor the information processing hypothesis. It does, however, concur with the integrated lexical development hypothesis.

e. Language Proficiency and Word Frequency, Interaction

The word familiarity: activation hypothesis predicts that all three language proficiency groups will recognize higher frequency words faster than low frequency words because in all cases greater exposure to words leads to a higher initial level of activation. This has already been supported in the above analysis. The word familiarity: learning hypothesis, on the other hand, argues that at lower levels of language proficiency, the lexical entries for low frequency items are not as likely to be as fully developed as those for high frequency items. At higher levels of proficiency, even lower frequency words are more or less completely learned. Consequently, this hypothesis predicts that the difference between mean response time to high and low frequency words will be greater for subjects with lower proficiency.

In Figure 6, the relative slopes of the three lines present a graphical method of assessing this hypothesis. Apparently, the two ESL groups are almost identical in the way word frequency affects their word recognition times, there being no significant difference between the differences between response times in the high and low word-frequency contexts of these two groups, $F(1,57)<.01$, $p>.9$, MSe=2142.98. On the other hand, as can be seen by comparing, in Figure 6, the slope of the Native Speakers with the almost coincident slopes of the ESL speakers, there was a difference between the way the ESL speakers and the Native Speakers were affected by differences in target
word frequency, $F(1,57)=9.50$, $p<.004$, MSe=2142.98. These results indicate that exposure to different levels of word frequency results in differential word recognition speeds between the ESL subjects and Native Speakers. It does not, however, lend support to the word familiarity: learning hypothesis, since, despite an almost four-year difference in immersion time (i.e. learning time), the two ESL groups show no overall difference in effect of word frequency.

f. Context by Word Frequency

The word familiarity: activation hypothesis predicts that there will be no interaction of context and word frequency. The initial level of activation of a word is a function of a subject's general exposure to it, and this initial level of activation defines a base or mean which context effects will add on to or subtract from. On the other hand, word
familiarity: learning predicts that there will be an interaction. This hypothesis states that, to some extent, learning of a word is facilitated by exposure to it. The pragmatic, semantic and semantic attributes of low frequency words are therefore less likely to be fully developed than those of high frequency words. Consequently, low frequency words are less likely to show a context effect since subjects will not be able to use contextual information to recognize a word as they will not have the relevant attributes well defined in their lexical entry for that word. The data do not support the learning hypothesis (see Figure 7), as there was no significant difference in segment slopes along the two lines.

g. Three-way Interaction: Word Frequency by Context by Language Proficiency

The three-way interaction term is of particular interest because it relates to both
the semantic dominance hypothesis and the information processing hypothesis. Both of these predict three-way interaction. However, inspection of Figure 8 does not support either of these specific hypotheses.

In the syntactically anomalous items, there are no syntactic contextual links to the target word. In the semantically anomalous items there are, but according to the semantic dominance hypothesis, novice ESL speakers will not have learned enough of a low frequency word's syntactic attributes to make use of them during the recognition process. Thus, this hypothesis predicts that the semantic to syntactic segment of the Advanced Learner low frequency profile will be flat or relatively so. On the other hand, Native Speakers will "lose" functional syntactic information when faced with the syntactically anomalous items as compared with the semantically anomalous items and
so this segment of the Native Speaker high frequency profile should show a slope which rises from *semantic* to *syntactic*. In the present research, these two segments are actually reversed from these hypothesized aspects.

The *information processing hypothesis* states that construction of higher level representations will draw on limited processing resources. In the case of items in the syntactic anomaly context, it is possible to construct a meaningful message, at least up to the target word which is not linked at all to the prior context. In the case of items in the random list, there is no message and so no processing resources will be expended in an attempt to build one. The *information processing hypothesis* predicts that low proficiency ESL subjects will have slower recognition times in the syntactically anomalous items than in the random list because of this "drain" of processing resources. Higher proficiency ESL users and native speakers will not experience this because their language processes are more highly automatized. As a result, the *information processing hypothesis* predicts that the slope of *all* syntactic to random-list segments would either be falling (for subjects with lower proficiency) or flat (for subjects with greater proficiency). All but the Native-Speaker, low-frequency segments rise, and this one falls, which is contrary to its hypothesized flatness.

However, there is a significant three-way interaction present. While a comparison between the combined ESL speakers and Native Speakers shows no differences in the four slopes (see Figure 9), a comparison between the two ESL groups does (see Figure 10), Pillai Trace = 0.30589, multiv. $F(4,50) = 5.51, p < .002$. Inspection of Figure 10 indicates that the centre of this interaction appears to be the change in context from a condition where there is at least some syntactic contextual link to the
target word (semantic anomaly) to one where there is none (syntactic anomaly and random list). When the syntactic anomaly and random list contexts are combined into a single category, defined as items having no syntactic link between the prior context and the target ('No Context', see Figure 11), this becomes more apparent. This
interaction effect appears to be as follows. When there is any prior contextual link at all to the target word, the effect of word frequency is greater on the Fluent Users than on the Advanced Learners. When there is no such contextual link, this is reversed. A post hoc test comparing the semantically anomalous items and the combined "No Syntax" items was significant, univ. $F(1,56) = 6.37, p < .02$. This kind of interaction seems to suggest more of a re-structuring of rules or knowledge than a learning of new knowledge.

![Figure 11. Mean Response Latencies of ESL Learners & Users to High and Low Frequency Words across Sentence Contexts (Syntactic and Random Combined)](image)

2. Supplementary Analyses

The three language proficiency subject groups differed by design on the nature of their language proficiency. The Native Speakers spoke English as their first
language. The two ESL groups differed on the functional academic use to which they were applying their English. The Advanced Learners were in full- or half-time ESL classes. The Fluent Users were attending university classes taught in English. These three groups incidentally differed on two other characteristics, their mean cloze test score and, in the case of the ESL groups, on the amount of time they had spent in an English immersion context. Further analyses were carried out to determine whether these particular aspects of the groups were related in any significant manner to their word recognition processes.

a. Cloze Score

All three language proficiency groups were included in the series of analyses which looked at the relationship between cloze score and word recognition latency. Adding syntactic and semantic contextual information to the cues decreased subjects' response time to target words (see above). Syntactic and semantic knowledge also play a part in deducing answers to the cloze exercise. It would seem likely, therefore, that if there is a relationship between the cloze score and response latency it should be strongest in the contexts where the context is richest. That is to say, in the normal, pragmatic and perhaps semantic contexts. However, for the purpose of comparing the results, the analysis was repeated in each of the contexts. The first analysis tested to see if the regression lines of the cloze score were parallel in the language groups. There was some evidence that this may not be the case. In the normal context and the syntactically anomalous context, the interaction terms were marginally significant \((F(2,54)=3.334, p<.05, MSe=14,953\) and \(F(2,54)=3.014, p<.06, MSe=16,710,\) respectively). To investigate this further, Pearson correlation coefficients between cloze score and
response latency were calculated within each level, across each of the contexts (see Table 7).

Table 7

<table>
<thead>
<tr>
<th></th>
<th>Advanced Learners (n=20*)</th>
<th>Fluent Users (n=20)</th>
<th>Native Speakers (n=20)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal</td>
<td>-0.377</td>
<td>0.297</td>
<td>0.414</td>
</tr>
<tr>
<td>Pragmatic</td>
<td>-0.223</td>
<td>0.413</td>
<td>0.175</td>
</tr>
<tr>
<td>Semantic</td>
<td>-0.441</td>
<td>0.172</td>
<td>0.242</td>
</tr>
<tr>
<td>Syntactic</td>
<td>-0.345</td>
<td>0.358</td>
<td>0.015</td>
</tr>
<tr>
<td>Random</td>
<td>-0.207</td>
<td>0.302</td>
<td>0.015</td>
</tr>
</tbody>
</table>

* 2 missing scores were replaced with group mean

None of the individual coefficients in Table 7 is reliably different from zero. However, the pattern of negative and positive coefficients suggests that the relationship between the cloze test scores and response latency may be different in the Advanced Learners than in the Fluent Users and Native Speakers. It may be the case that, within the Advanced Learners, low scores on the cloze are more indicative of generally low proficiency than low scores in the other two groups. These low scores would be associated with higher latency times and thus account for the negative correlations. Such an explanation is speculative of course.

**b. Time in an English Immersion Context**

Time spent in an English immersion context is, of course, relevant only to the ESL groups so the investigation of the relation of this measure to spoken word recognition was limited to the Advanced Learners and the Fluent Users. The initial
analysis strategy was similar to that used for the cloze score. First, the analysis looked at a repeated measures model which included language level, time in the immersion context, and a term for the interaction between these two. In this analysis, the parameter for this interaction term was significantly different from zero $F(1,36)=7.510$, $p<.01$, MSe=38,195. The implication of this is that the regression slopes of the "time in" variable are different in the two groups.

In order to determine the nature of these unequal regression slopes, the data was re-analyzed. From the range and the variance of each of the two groups (Users: range=132, var=1422.45; Learners: range=33, var= 93.139), it is fairly apparent that the two groups differ a great deal in their dispersion. A test of this confirmed that the variances were not homogenous (Bartlett’s Chi-sq(1, N=40) = 27.151, $p<.001$). Before continuing, the time-in-an-immersion-context variable was log transformed and the result used in subsequent analyses. Using the overall mean response latency for each subject as the dependent variable and log time in an English immersion context as the independent variable, linear regressions were done within each of the two language levels. The slopes in these regressions differed in aspect (Fluent Users: $b=-62.273$, $t(19)=-2.697$, $p<.02$; Advanced Learners: $b=42.102$, $t(19)=2.220$, $p<.04$), with word recognition time for Advanced Learners apparently increasing the longer they have been immersed, and decreasing under the same conditions for Fluent Users.

This suggests a curvilinear relationship with an inflection point somewhere within the middle of the combined group. For illustrative purposes, a distance weighted least squares smoothing algorithm was used to determine a curve which passed through the data points. This was first done for the Advanced Learners and the
Fluent Users separately, then applied to the combined data set. The results are displayed in Figure 12.

Figure 12. Distance Weighted Least Squares Smoothing for Mean Latency Time, Separately for Learners and Users, and Combined.
Chapter VI. Discussion

In order to facilitate discussion of the results and their implications, it will be useful to present a brief review of the study. The primary objective of the present study was to assess the usefulness of the cohort model of spoken (first language) word recognition as a method of explaining the processes involved in recognizing spoken words during the comprehension of a spoken second language. The strategies used to achieve this objective were 1) to attempt to demarcate differences in the spoken word recognition systems of native English speakers and second language users, 2) to compare the role of lexical knowledge during the spoken word recognition processes of native English speakers and second language users, and 3) to investigate the nature of the development of the word recognition system as it moves from learner to fluent user. Two groups of ESL subjects and one group of native speakers of English (Native Speakers) served as subjects for the present study. The ESL subjects were characterized as Advanced Learners, who were studying ESL at a local community college in preparation for entrance to higher education courses and Fluent Users, who were attending full-time academic classes taught in English at the University of British Columbia. The performance of these three groups was compared on a reading cloze test and a spoken-word recognition task in which there were five different levels of contextual richness prior to a target word. In order to find how the different subject groups handle recognition materials of different familiarity, two levels of target word frequency were presented.

A. Summary of Results

The main findings can be summarized briefly by looking at 1) the overall results,
2) the results from a comparison of the two ESL groups, and 3) the results from a comparison of the Native Speakers with the ESL speakers. Overall, the three groups differed significantly in the way they performed on the cloze test. The results were congruent with the assumption that the Advanced Learners were not as proficient in English as the Fluent Users, who in turn were not as proficient as the Native Speakers.

Second, as the extended cohort model predicts, there was a significant overall effect of sentence context on word recognition latency. Cues with greater contextual linkage to the target word resulted in faster recognition latencies. Finally, again in accordance with the predictions of the extended cohort model, there was a significant overall effect of word frequency on recognition latency. Higher frequency words were responded to more quickly than lower frequency words, as expected.

Between the two ESL groups, there were no significant differences in recognition latencies or recognition latency profiles across sentence contexts or across word frequency. This finding does not conform to the delayed access hypothesis, which predicted a difference in recognition time because of the putative overall difference in language proficiency between the two ESL groups. The basis for the attribution of an overall language proficiency difference was, in addition to their statistically different mean scores on the 50 item cloze test, the difference in their academic use of English.

There was a three-way interaction of ESL group, word frequency, and sentence context. The pattern of this interaction did not conform to the patterns predicted by the semantic dominance hypothesis or the information processing hypothesis. It did indicate that the effect of word frequency on ESL group changed, depending on whether contextual links to target words were available or not. In addition, there was a very interesting curvilinear
interaction of recognition latency with time spent in an immersion context. This interaction clearly indicates that spoken word recognition speed actually decreases for a period of time, after the immersion experience begins, and then begins to increase with further exposure.

Between the Native English speakers and the ESL subjects there was a significant difference in overall mean recognition latency. This is in accord with the delayed access hypothesis. There were no significant differences in the recognition profiles of the Native English speakers and the ESL subjects across sentence contexts. This finding does not support the semantic dominance hypothesis, which was based on the argument that semantic lexical attributes would be learned in a second language faster than syntactic lexical attributes. Nor does it support the information processing hypothesis which argued that Advanced Learners would have different recognition profiles across Contexts four (Syntactic anomaly) and five (Random list) than Native Speakers (and perhaps the Users) because of the higher processing load (up to the target) in the syntactically anomalous context as opposed to the random list context. In contrast with the comparison across the five sentential contexts, there was a significant difference in the recognition profiles of the Native English speakers and the ESL subjects across word frequency.

B. Discussion

An examination of these individual findings in light of their theoretical implications, and the aims and strategies of the study itself is in order. First, the results will be interpreted with respect to their theoretical implications regarding the development of second language proficiency. Following that, the apparent differences
between the ESL and the native speaker word recognition systems will be considered.

1. Developmental differences between Users and Learners

One of the strategies used in this study was to attempt to investigate the nature of the development of the word recognition system as it moves from learners to fluent users. In this respect, the similarity of the performance of the two ESL groups on the word recognition task was remarkable. There was less than 1 msec difference between those groups' respective overall mean response latencies. In addition, their response profiles across word frequencies and across sentence contexts were almost coincident. On the assumption that these groups represented different language proficiency levels and thus had lexicons at different stages of development, the delayed access hypothesis predicted there would be a significant difference between the two groups. If these were the only data available for analysis, one would be tempted to conclude that they were samples from the same population and that they did not represent different proficiency groups, to say the least, in terms of recognizing incoming spoken words.

However, they do come from distinct subject pools. One group was still involved in studying ESL, while the members of the other group were using their English to pursue higher educational academic goals. Furthermore, as groups, they differed significantly on the cloze exercise. Finally, the Advanced Learners, for the most part, had not been immersed in the ESL context for as long as the Fluent Users. Only two Advanced Learners reported having lived in an immersion context longer than the minimum time reported by the Fluent Users. Thus it would not be a valid interpretation to suggest that the two groups are from the same population.

What the data clearly show is that, compared to the Native Speakers, the
Advanced Learners have a pervading inefficiency in their spoken-word recognition processes, and that, despite almost four years of further second language immersion and experience, the Fluent Users have not perceptibly improved their word recognition speed, either overall or within the contexts.

At the same time, though, it is not possible to say that the two groups have identical word recognition processes or strategies. The reason is that the two ESL groups did differ in two respects, although their overall word recognition latencies, and word recognition latency profiles across word frequencies and across sentence contexts were very similar. In the analysis of the relationship between recognition latency and length of time in an English immersion context, it was found that the regression slopes of the two groups had different aspects. By combining the two groups into one, and using a non-linear method of analysis, it became clear that there was a curvilinear relationship between these two variables. Word recognition latency apparently increases for the first two to three years of immersion and decreases after that. One possible explanation for this is found in Ellis's (1994) discussion of *U-shaped behaviour*:

Learners may sometimes pass through an early stage of development where they manifest correct use of a target-language feature if this feature corresponds to an L1 feature and then, subsequently, replace it with a developmental L2 feature before finally returning to the correct target-language feature. In such a case, the facilitative effect is evident in the early stages of acquisition, before the learner is 'read' to construct a developmental rule. The 're-learning' of the correct target-language rule occurs when learners abandon the developmental rule as they come to notice that it is incompatible with the input.

While the data seem to fit this pattern, it is difficult to know what the 'feature' is that is undergoing this re-structuring. Looking at the other difference between the two ESL groups sheds some light on this.

In the analysis of the three-way interaction of ESL level, sentence context and
word frequency, it was found that the location of the interaction appeared to be where the sentential context changes from containing at least some syntactic contextual link to the target word (semantic anomaly) to one where there was none (syntactic anomaly and random list). Ellis' U-shaped behaviour can be simplified to three stages, 1) application of L1 principle to L2, 2) development of an interlanguage principle, 3) mastery of L2 principle. Under this simplification, performance in stage one would be similar to that in stage three, while stage two would be different from both. If the Advanced Learners are indeed at a lower developmental level than the Fluent Users, then a logical progression in terms of ESL level, and high and low frequency words would be for Advanced Learners to be in stage one for the low frequency words, and stage two for the high frequency words. The Fluent Users would be at stage two in the low frequency and stage three in the high frequency words. If this is correct, we would expect the performance of the Advanced Learners in low frequency words (stage one) to be similar to Fluent Users in high frequency words (stage three), and the performance of Advanced Learners in high frequency words to be similar to Fluent Users in low frequency words (both stage 2). This indeed seems to describe the results. Thus, it appears that the use of both phonological and contextual information in the speech signal is undergoing some kind of transition or restructuring over the developmental period encompassed by these two groups.

In summary, the data from the present research suggests three points about the relative development of the two ESL groups, Advanced Learners and Fluent Users. First, despite almost four years difference in immersion experience, there are no overall differences in spoken-word recognition speed between the groups. Second, from the
Advanced Learner to the Fluent User there appears to be a re-organization of the way in which the incoming data, both phonological and contextual, is actually used during the recognition process. Third, there appears to be, in the Advanced Learner group, an initial decrease in overall recognition speed with the passage of time, which is reversed in the Fluent Users by a gradual increase in overall recognition speed. The data do not allow extrapolation to a period of second language development prior to that of the Advanced Learners or subsequent to that of the Fluent Users. In fact it may be quite misleading to conceive of word recognition speed as being a continuous function that can be extrapolated much in either direction. Clearly, a word cannot be recognized until adequate phonological data have been received and processed (see 3. Processing Differences... below, for further discussion of this point). It may also be the case that, if a word has not been recognized by the time most of its phonological data has arrived, it will not be recognized at all. In other words, aside from variation due to individual differences in processing speed and attention, it may be that the time needed to recognize any particular word is constrained by specific "endpoint" parameters, and the primary learning job of the system, once it is capable of actually recognizing words, is to increase efficiency within those parameters.

2. Developmental differences between ESL and Native speakers.

In addition to emphasizing differences between the Fluent Users and the Advanced Learners, the use of high and low frequency target words revealed a difference between the ESL groups and native speakers. The present study took an approach to the word frequency effect that was different from that of the original cohort model. For the second language learner, word frequency was hypothesized to
produce two effects. The first one, which was subsumed under the word familiarity: activation hypothesis, is equivalent to the effect of activation attributed to word frequency under the cohort model. In this case, increased exposure to words raises either the initial level of their activation in the lexicon or else their susceptibility to activation. This heightened activation is not related to the completeness of the lexical entry. In a sense, this effect can be thought of as a result of differences in language-based environmental priming of words. The second word frequency effect was predicted by the word familiarity: learning hypothesis. Under this hypothesis, increased exposure to words will result in the lexical information becoming more complete through learning. This learning should affect all properties of a lexical entry. Interestingly, Marslen-Wilson (1990) touches on the relationship between learning and activation, saying "in this era of learning models it becomes increasingly implausible to suppose that frequency of experience is not somehow reflected in the basic organization of the way the system responds to sensory inputs..." (p. 149). It does not appear, though, that a similar learning vs. activation distinction is made by him.

In the present study, no strong evidence was found to support this distinction. The difference in frequency of the two sets of words had a greater effect on the mean response latency of the ESL subjects than on that of the native speakers by an estimated 25 msec. Under a combined activation/learning model, this difference would be explained by attributing the relatively slower word recognition speed of the ESL subjects within the low frequency context to less-well defined lexical entries for these words. However the activation/learning model also predicts a difference between the two ESL groups (Fluent Users and Advanced Learners), as well as a difference between
the ESL speakers and the Native speakers and there was none. Unless some third factor is introduced, such as a relation between on-going word exposure level and retention of word knowledge, the model does not fit the data of the present study.

Even a simple activation model is inadequate, though, without an additional explanation as to why the "language-based environmental priming" of low frequency words is not as effective for ESL speakers as it is for Native Speakers of English. Two broad categories of such explanations would be learner-internal or learner-external. In the first category, the explanation must appeal to inherent differences in the actual process of activation of words within speakers of first and second languages. In the second category, an environmental factor is appealed to. One such explanation is that people who speak a second language are in general faced with different word frequency levels than native speakers simply because, as second language users, they evoke different speech uses and patterns with their native language speaking interlocutors. The *input frequency hypothesis* (Ellis, 1994) invokes a similar concept to explain the acquisition orders of grammatical morphemes and syntactic structures. Deciding among these various solutions will have to be left for future research.

3. Processing Differences between the ESL and Native Speakers

Characterizing the nature of differences in the spoken word recognition systems of ESL and Native speakers was one of the goals of the present study. Chapter III outlined three hypothetical limiting cases toward which the development of the second language lexicon may move. The first proposed limiting case was that there would be no access to non-phonological lexical knowledge during word recognition, and that
word recognition times would be the same under the different contexts. This can be rejected on the basis of the results found in this study. Increasing the strength of the link between the prior context and the target word by supplying syntactic, semantic or pragmatic relationships between the two resulted in decreased mean word-recognition latencies. Similarly, a strict interpretation of the third proposal can also be rejected because it predicted both parallel and coincident profiles for the ESL and native subjects. While the profiles were not significantly different in shape, the mean response for the ESL groups was almost 98 msec. slower than that of the Native Speakers, indicating some inefficiency in the ESL system.

This strongly suggests that the ESL subjects were making use of the pragmatic, semantic, and syntactic cues in the context but leaves open the question of where, in the recognition process, those properties of a word candidate become accessible for assessment against the higher level representation. In second language processing, do these properties become available for assessment against the higher level representation as soon as a lexical entry becomes a member of the cohort of word candidates, as in the cohort model? Or, do the word recognition processes exhaust all phonological input before relying, if necessary, on other lexical properties to recognize a word? The difference between the two cases, as mentioned, is where in the temporal presentation of the word the recognition takes place. This, however, introduces the question of what "where" means in relation to the general concept of word.

One possibility is word offset, in which case, we are comparing response latency to spoken word length. It is important to note that spoken word length is not a theoretical concept. It is the actual, measured length (in msec., for example) from word
onset to word offset. In the present study, this value was held constant for each word across the five different contexts by excerpting a single sound segment containing the word from one of the five recordings and then splicing it in the appropriate place in the remaining four cues. Word length varied from word to word, of course; however, under other experimental conditions, it would be possible to vary the length of individual spoken words using either speech compression (Conrad, 1989) or increasing the rate of speech, (Griffiths, 1990).

Another instance of the "where" of word recognition is the concept of recognition point which Marslen-Wilson (1987) defines as the point in a word where it "can be discriminated from the other members of its word-initial cohort, taking into account both contextual and sensory constraints". He notes that this point can "occur well before the end of the word", (p.80). The recognition point can be estimated through word monitoring and gating tasks. A third, related location, in the word recognition process is the uniqueness point (Marslen-Wilson, 1990) or isolation point (Grosjean, 1980) which Grosjean defines within the gating task as:

the point at which the listener has isolated a candidate but may still feel quite unsure about it. He or she will therefore continue to monitor the acoustic-phonetic information until some criterion level of confidence is reached and the word is accepted or recognized." (Grosjean, 1980, p.273).

The difference between the recognition point and isolation point is the level of certainty in the mind of the person who is monitoring the word. Marslen-Wilson (1984) also discusses an optimal discrimination point which "can be defined, for spoken words heard in isolation, as the point at which a particular word becomes uniquely distinguishable from any other word in the language beginning with the same sound sequence." (p. 141). Lists of phonetically transcribed words are necessary to determine such a point,
the issue of which goes beyond the present data.

For the purpose of the present study, which is to compare the systems of native and second language speakers of English, it is instructive to look at several of these points within the two distinct groups (ESL, Native English). The mean response latency of the ESL group under the fully contextualized (normal) cues was estimated at approximately 377 msec. The mean spoken word length in this study, as measured from word on-set to word off-set, was estimated to be about 399 msec. If it is assumed that there is some finite amount of time that passes between when a subject makes a decision that the present word is the target word and when that subject actually presses the button to indicate recognition (Marslen-Wilson and Tyler, 1980, estimate response execution takes about 50-75 msec), then the ESL speakers' recognition points are, under the fully contextualized cues, somewhat before target word offset.

However, the mean response latency of the Native Speakers in the two uncontextualized cue conditions (syntactic anomaly and random list) was estimated to be about 335 msec. This can be taken as an estimate of the mean recognition point for the word-list in the present study, under conditions where it could reasonably be assumed to be a direct function of the individual optimal discrimination points of the target words. We can see that the ESL group as a whole is recognizing words generally before word offset but after the point in the words where there is adequate phonological data (for the native speakers) to distinguish the target word from the rest of the competitors in the cohort. On the other hand, 30% (12 out of 40) of the ESL subjects recorded mean response latencies in the normal context that were faster than the 335 msec mentioned above. This seems to indicate that, at least in some cases, second
language word recognition processes can, like first language word recognition processes, make rapid use of relevant lexical knowledge that is activated *while* a word is being heard. Also, it seems to indicate that the observed limiting point of efficiency in the ESL groups' second language spoken word recognition processes is at least consistent with the multiple access and multiple assessment processes that are fundamental to the cohort model (Marslen-Wilson, 1987).

While it may be true that the ESL word recognition system can be effectively modelled by the cohort model, it is also true that the word recognition systems of these ESL subjects are not as efficient as those of native speakers. The cohort model may also help explain this, at least to the extent of suggesting where the greatest inefficiency lies in the word recognition process. The major problem does not appear to be in the construction of that part of the higher level representation of the discourse upon which the assessment process relies to facilitate integration. If the problem resided here, we would expect to see a difference in the recognition latency profiles of the two language groups across Normal speech and Random list, but we don’t. In other words, the major source of the relative ’slowdown’ of the ESL group recognition latencies appears to be independent of the process(es) involved in constructing the higher level representations against which lexical information is compared during recognition. This suggests that the selection process is slowed down in the ESL word recognition process, perhaps because more phonological data is needed by the ESL subjects.

The cohort model can be used to make a more specific analysis of what might be going on here. As Marslen-Wilson (1993) points out, "Listeners know what the words in their language sound like. This knowledge, constituting what we can call the
recognition lexicon, defines the perceptual targets of the access process." (p.187). Prior to lexical access, the physical sound is analyzed and transformed to create the input to this recognition lexicon. This input representation and the representation of lexical form in the recognition lexicon may be central to the relative inefficiency of the second language listener. As mentioned in Chapter II, the input to the word-recognition processes is not conceptualized as a string of phonemic labels, but rather as a set of feature values. Furthermore, in the cohort model, it is assumed "that the representations of lexical form in the mental recognition lexicon are structured arrays of features, where the specification of the lexical item abstracts away from the detailed phonetic properties of the surface form of the word." (Marslen-Wilson & Warren, 1994, p. 653). Warren and Marslen-Wilson (1987, 1988) showed that these features play an important role in narrowing the choices of potential target words. These features, and other modulations of the speech signal, are "tracked in detail by the processes responsible for lexical access and selection." (Lahiri & Marslen-Wilson, 1991, p. 256). For example, the nasalisation of a vowel, which for a language like English indicates that the following consonant will be nasal, has an early effect on lexical choice, limiting the selection of potential words to those that fit this cue (Warren & Marslen-Wilson, 1987).

Of particular relevance to the efficiency problem of the ESL subjects is the study by Lahiri and Marslen-Wilson (1991). They exploited the fact that in Bengali both vowels and consonants contrast in nasality whereas in English, only consonants do so. They were able to show that English subjects listening to English language cues were able to anticipate an upcoming nasal consonant on the basis of its nasalising effect on the preceding vowel. In contrast, Bengali subjects listening to Bengali cues interpreted
nasalised vowels which preceded nasal consonants as nasal vowels, and consequently
did not begin to constrain the word choices until the beginning of the consonant. In
the Lahiri and Marslen-Wilson cross-linguistic study, there was no investigation of first
language/second language recognition interaction. That is, native Bengali speakers
were not tested with English cues, or vice versa for the native English speakers.
However, it is reasonable to conjecture that, given the correct cue material, a differential
use of the nasalized vowel cue could be found in native Bengali and English speakers
recognizing English and Bengali second language words. It is also reasonable to
conjecture that, in the present study, the Cantonese speaking ESL subjects may also
have been using a variety of word recognition cue strategies that were transferred from
their first language (see also B, part 1 above). Such speculation should be brought to
empirical verification of course, but the point of making such a conjecture is to
demonstrate the inherent value of adopting the cohort model of spoken word
recognition as a method of generating hypotheses about spoken second language
processing and, eventually, second language acquisition.

C. Factors Affecting Generalizability

A number of factors affect the generalizability and interpretability of the findings
of this study. Perhaps the most important is the educational background of the ESL
subjects. In order to avoid variation that might have arisen because of differences in
first language, only speakers of the Cantonese dialect of Chinese were invited to join
the study. As a result, most of the ESL subjects had taken their early schooling (K-12)
in Hong Kong, where most of the local Cantonese-speaking immigrant population
comes from. Many Hong Kong schools have an English as-a-foreign-language component, and, in fact, all of the subjects had studied English for at least a few hours a week for two or three years, and many had studied it from kindergarten through to Form six (Grade 12-13). A few even reported attending classes where it was used as the language of instruction. This background in English study may explain why the performance of the two ESL groups on the word recognition task tended to be so similar despite the difference in their length of time in the immersion context. The two ESL groups did differ from each other in one aspect of their educational background. While several of the Fluent Users reported having attended two to three years of high school in Canada, none of the Advanced Learners did. This may be related to the two significant interactions (ESL group by context by word frequency and ESL group by time in immersion context) found in the comparison of these two groups, since otherwise the performance of the two groups seemed almost identical.

The syntactic anomaly word monitoring results in this study were not consistent with results from previous research. Marslen-Wilson, Brown, and Tyler (1988) reported the successive differences in mean response for their normal, pragmatic, semantic and syntactic items to be -28 msec, -22 msec, and -29 msec, respectively. In the present study, for the native speakers, the comparable estimated values were -31 msec, -26 msec, and -3 msec respectively. The first two values in the two studies correspond well, but the difference between response latencies of the semantic and syntactic material in the present study is not comparable to that in the Marslen-Wilson et al. study. The importance of this is that the present research results did not really allow for an assessment of the semantic dominance hypothesis. In order to do that, it will be
necessary to show that the supposed differences between the items in the semantic and syntactic categories consistently produce response differences in native speakers over a wide range of materials which conform to the criteria which define them.

D. Implications for ESL Education and Directions for Future Research

The results of the present study brought forth some implications for ESL education and establish a starting point and a number of routes for future research. The study implicated input representation and the representation of lexical form as possible sources of inefficiency in the word recognition process. This suggests that there is potential for improvement in word recognition speed, and consequently comprehension, by somehow overcoming these inefficiencies. The cohort model assumes that the lexicon is accessed through structured arrays of features (Marslen-Wilson & Warren, 1994). Although the model is not specific about the nature of these features, possible examples of contrasting features would be voiced or unvoiced consonants, and nasal or non-nasal vowels etc. Research has shown that first language experience modifies adult perception and that the ability to perceive these contrasts in a second language is decreased and, in some cases, lost (Clifton, 1993; Werker, 1993). In the cohort model it is assumed that these features are abstracted from the surface form. If adult learners are to regain, or redefine the relevant features and contrasts, they must be supplied with adequate data to do so. It is important to point out that this does not mean pronunciation instruction on a word by word, or phoneme by phoneme basis. The surface representations of sounds of words vary a great deal, depending on numerous factors ranging from the shape of the vocal tract, through dialect, to the
specific phonological contexts under which they are uttered (Lahiri & Marslen-Wilson, 1991). Unless this variation is well exemplified in second language instructional situations by dealing with words in spoken discourse context and by presenting a variety of speakers dealing with the same material, it will not be possible for the student decide which aspects and variations of the surface sounds are idiosyncratic and irrelevant or redundant, and which are not. Without such instructional material, it is unlikely that students would ever be able to construct an efficient and fast word recognition system.

It is also clear from both the cohort model and the results of the present study that fully developed mental lexical entries include a variety of pragmatic, semantic and syntactic information, which can be made available for exploitation by the word recognition system even before the word is identified. Unless all of these aspects of words are addressed during instruction, the ESL learner will not be able to develop comprehensive entries, and word recognition will not be as fast as it should be for easy, on-line comprehension of speech. Again, in order to allow students to extract the relationships among the various lexical features of different words, learning new words should involve hearing them in meaningful context. The study also seems to suggest that increased exposure to words has a positive effect on their learning and recognition. The message here is that students have to be encouraged to truly immerse themselves in the spoken (and perhaps the written) language in order to actually become functional in it.

The present study suggests diverse routes for future research. One direction will be the on-going study of word recognition processes and the fit of the cohort model to
the second language context. One particular study will be another look at the *semantic dominance hypothesis*. The present study did not support the semantic-syntactic distinction found by Marslen-Wilson et al (1988) in the response patterns of the native speakers. Unless such differences can be consistently found in materials which conform to their criteria, it is difficult to judge whether this hypothesis is tenable or not.

The study should also be extended to lower levels of second language proficiency. The main reason that this was not done in the present study was that the distracter items proved rather difficult for the less advanced learners on whom the material was pilot tested. For one thing, many students were unfamiliar with the meaning of the word "rhyme". It should be possible, though, to precede the actual testing session with a training program that presented both the category and rhyme tasks more completely. It would be feasible to set a mastery criterion in this program so that subjects demonstrate a full grasp of the tasks before moving into the testing phase. In addition, a future study would profit greatly if more complete data (response latencies, errors, number of trials to criterion, etc.) were gathered on the distracter items. Through graded selection of the category targets, it should be possible to get some estimate of the size of subjects' passive, listening vocabulary. Such a study should be expanded to include other types of tests, particularly listening comprehension tests, in order to lay ground-work for the development of a much-needed theory of listening comprehension (Buck, 1992).

The present study was concerned with a very specific aspect of speech processing in a second language, *word recognition*. Other studies have also been interested in the speed of processing in a second language (e.g. Conrad, 1989; Griffiths,
1990) but have focussed more on *listening comprehension* in a second language. It is not possible to compare the level of English proficiency of the subjects in these studies with that of the subjects in the present study. However, it is possible to make a rough comparison of the speech rates. Based on the mean length of the spoken target word (399 msec), the mean speech rate would be approximately 150 wpm. As estimated by a sample of ten of the cue sentences, it would be about 180 wpm. Both of these are within the range looked at by the Conrad and Griffiths studies. Comparing all three studies helps focus on a major difference among them and suggests a fruitful avenue for research on the relationship between spoken word recognition and listening comprehension.

On the basis of the analysis of the data from the present study (see above), increasing speech rate (either through compression or through an actual increase in speaking rate) should not change the relative word recognition latencies of native and non-native speakers. According to the analysis, non-native speakers need more data, not necessarily more time, in order to recognize words. That is, increasing the rate of flow of the speech input data should increase the rate with which the data arrives at lexical access, and therefore decrease recognition latency proportionally for both native and non-native speakers. Based on her analysis of patterns of missed words, Conrad (1989) attributed the low comprehension rates of the non-native speakers to the fact that their processing capacities were overloaded "beyond where these participants’ syntactic expectations could operate" (p.13). In the context of the present study, this might be equivalent to locating the major inefficiency in second language spoken-word processing at the *integration* stage of the cohort model or even beyond this, within the
processes involved in constructing higher level representations, rather than at the access stage.

While Conrad’s conclusion appears to be at odds with an analysis made on the basis of word recognition data, it is not in fact. There is an inherent feedback between access and comprehension under conditions of increased speech rate. If, for some reason, words are not identified properly because of increased speech rate, then comprehension will suffer. When comprehension breaks down, the mental representation of the message will be disrupted and, as for example, in the case of target words in the pragmatic anomaly context, there will be a need during access for more data for word identification. However, since the precipitating problem in this sequence of events was lack of time for processing, the entire system will undergo even further disruption, and in all likelihood become dysfunctional. Similarly, if the process of constructing higher level representations can not keep up with the speech rate, it will take longer to integrate the accessed words. The higher level representation will be further disrupted, requiring even more time at the access stage and once again the speech processing system will break down.

The analysis under the present data suggests that the breakdown of the system is not precipitated from within the word recognition side of the process, but from the comprehension side. It is possible, of course, that adult second language learners, because of maturational constraints on their language development (Johnson & Newport, 1989; Long 1990), have an inherently, and pervasively sluggish second language processing 'platform'. Regardless, the source of the collapse of the system could be readily be located by combining a speech-compressed word recognition study.
with a speech-compressed listening comprehension study.

E. Conclusion

The purpose of the present study was to evaluate the feasibility of extending of Marslen-Wilson's (1989, 1987; Marslen-Wilson & Welsh, 1978) cohort model of spoken (first language) word recognition to a second language context. This model is a theoretical description of the fundamental, high-speed processes involved in spoken word-recognition. The study was motivated by the belief that such a model would provide a useful foundation for theoretical and practical research in the areas of second language learning and instruction. This expectation has been fully upheld by the results of the study.

One of the most significant substantive findings was the similarity in overall response latency times and response latency patterns across context and word frequency between the two ESL groups in this study. Despite an almost four year difference in second-language immersion experience, these two groups showed little difference in these areas. When this is combined with the finding that the ESL groups were, on average 98 msec. slower than the Native speakers, the implication of the data is that there is a performance limit on word recognition speed in a second language that is below that of native speakers and which is not responsive to extended exposure to the language. Related to this is the finding that differences in rate of exposure, as estimated by different levels of word frequency, did result in differences in word recognition speed in both of the ESL groups as well as the Native speakers.

The study also revealed fundamental similarities between first and second language processing systems. In both first and second language word recognition,
increasing contextual information that is linked to a target word will increase the speed with which that spoken word is recognized. Furthermore, there do not appear to be major differences in the way different types of contextual information is used. In other words, during spoken language processing, second language speakers can make use of a variety of types of stored lexical knowledge in a high-speed, online manner similar to a native speaker.

The findings of this study demonstrate clearly the validity of extending the cohort model to the second language processing context. The similarities between first and second language processing systems that have been brought out in the present study indicate that the model itself can be fitted to the processes involved in recognizing words spoken in a second language. Furthermore, where differences have been identified, the model has supplied enough analytic power to suggest specific sources of the differences. Overall, the present study has demonstrated that the cohort model and its associated research paradigms, are useful, powerful tools for formulating and testing hypotheses regarding the word recognition processes of second language learners, and by extension, the process of comprehending speech in a second language.
References


Appendices

Appendix A: Targets, lead-in sentences, and test sentences for EXACT monitoring task.

Codes: Cue group and frequency level, sequence number, target word, actual frequency, adjusted frequency.

TG1.1H  1144  bridge  117  76.71

The light on the shore was fading.
C1 John quietly faced the bridge then walked away.
C2 John quietly grabbed the bridge then walked away.
C3 John quietly delighted the bridge then walked away.
C4 John quietly hesitated the bridge then walked away.
C5 shore walked away then on John fading the light the bridge the was faced quietly

TG1.1L  3507  bubbles  25  15.44

Lynda was playing in the garden.
C1 She chased the bubbles floating in the air.
C2 She ate the bubbles floating in the air.
C3 She interviewed the bubbles floating in the air.
C4 She crawled the bubbles floating in the air.
C5 the garden Lynda the in playing she floating the bubbles was in chased air

TG1.2H  344  book  292  256.92

The office was very quiet.
C1 The secretary placed the book on the desk.
C2 The secretary twisted the book on the desk.
C3 The secretary cured the book on the desk.
C4 The secretary consented the book on the desk.
C5 quiet the was office very the book placed secretary the on desk the

TG1.2L  3577  prisoner  31  14.79

The sky over the building was dark.
C1 No-one saw the prisoner when he left.
C2 No-one obeyed the prisoner when he left.
C3 No-one postponed the prisoner when he left.
C4 No-one happened the prisoner when he left.
C5 building the saw sky was he no-one the prisoner over the dark when left
Appendix A, Continued

Several workmen were tidying up the site.
C1 One of them washed the columns of the building.
C2 One of them buried the columns of the building.
C3 One of them swam the columns of the building.
C4 One of them ambled the columns of the building.
C5 of several up site the tidying washed were them the columns of building the workmen one

Audrey had practically finished decorating.
C1 She took a candle from the centre of the mantlepiece.
C2 She swallowed a candle from the centre of the mantlepiece.
C3 She unified a candle from the centre of the mantlepiece.
C4 She aspired a candle from the centre of the mantlepiece.
C5 decorating Audrey the practically mantlepiece centre a candle took the from she had of finished

The truck drove up to the front of the house.
C1 Two men set the bed on the lawn.
C2 Two men chopped up the bed on the lawn.
C3 Two men wore the bed on the lawn.
C4 Two men vanished the bed on the lawn.
C5 the house of two the front up set men the bed the drove to truck lawn on the

Edward was enjoying shopping.
C1 The salesman held the boot in his hand.
C2 The salesman tasted the boot in his hand.
C3 The salesman sipped the boot in his hand.
C4 The salesman chuckled the boot in his hand.
C5 salesman was held Edward hand the boot in the shopping his enjoying
Appendix A, Continued

TG2.1H 703 tree 160 125.26

The students often walk to school.
C1 On the way, they pass the tree in front of the library.
C2 On the way, they kiss the tree in front of the library.
C3 On the way, they breathe the tree in front of the library.
C4 On the way, they appear the tree in front of the library.
C5 the front of the on walk often they school pass way library the tree to in the students

TG2.1L 3557 blade 26 14.98

The machinery came to a stop.
C1 Paul detached the blade carefully.
C2 Paul licked the blade carefully.
C3 Paul astonished the blade carefully.
C4 Paul proceeded the blade carefully.
C5 to detached came carefully a Paul the stop machinery the blade

TG2.2H 699 price 164 125.89

The small store was busy.
C1 Mary liked the price of the blue dress.
C2 Mary drew the price of the blue dress.
C3 Mary operated the price of the blue dress.
C4 Mary abstained the price of the blue dress.
C5 the small was blue the price Mary dress store busy the of liked

TG2.2L 3753 drum 26 13.46

The audience was very noisy.
C1 A young boy moved the drum on the stage.
C2 A young boy smashed the drum on the stage.
C3 A young boy surprised the drum on the stage.
C4 A young boy behaved the drum on the stage.
C5 very the audience was a moved young boy the on noisy stage the drum
There were many interesting items in the room.
C1 Louise removed the gun on the wall.
C2 Louise bounced the gun on the wall.
C3 Louise toasted the gun on the wall.
C4 Louise yawned the gun on the wall.
C5 items the wall there interesting on removed room the gun Louise were the many in

Children often play on the beach.
C1 They roll the tire on the sand.
C2 They polish the tire on the sand.
C3 They frighten the tire on the sand.
C4 They sleep the tire on the sand.
C5 beach sand roll on play the they the on children the tire often

The Smiths walk to the hill every evening.
C1 They frequently take the dog with them.
C2 They frequently carry the dog with them.
C3 They frequently quote the dog with them.
C4 They frequently gossip the dog with them.
C5 the them with they to hill frequently Smiths the dog take evening walk the every

Religious tourists enjoy visiting that part of town.
C1 Most of them enjoy the chapel by the river.
C2 Most of them clean the chapel by the river.
C3 Most of them amaze the chapel by the river.
C4 Most of them ache the chapel by the river.
C5 of enjoy most them visiting that town enjoy tourists of by the river the chapel part
Appendix A, Continued

TG3.1H  949  page  102  93.57

The magazine was open on the shelf.
C1  Sandra touched the page that faced her.
C2  Sandra sketched the page that faced her.
C3  Sandra stimulated the page that faced her.
C4  Sandra blushed the page that faced her.
C5  Sandra that on open magazine was the shelf touched her the faced the page

TG3.1L  3579  cook  22  14.77

The customers were talking noisily.
C1  A woman waved at the cook in the kitchen.
C2  A woman woke the cook in the kitchen.
C3  A woman mixed the cook in the kitchen.
C4  A woman coughed the cook in the kitchen.
C5  kitchen woman customers the cook in a talking waved noisily the at the were

TG3.2H  373  door  384  240.33

Most of the students were in the class.
C1  The teacher shut the door quietly.
C2  The teacher painted the door quietly.
C3  The teacher attracted the door quietly.
C4  The teacher arose the door quietly.
C5  the class were of the shut teacher the students in quietly the door most

TG3.2L  3851  tickets  30  12.78

The buses run every hour.
C1  Most people get the tickets ahead of time.
C2  Most people borrow the tickets ahead of time.
C3  Most people pour the tickets ahead of time.
C4  Most people faint the tickets ahead of time.
C5  every ahead the people most get of hour time buses the tickets run
Appendix A, Continued

TG3.3H 411 table 242 215.50

The display is very charming.
C1 Lots of people admire the table near the pool.
C2 Lots of people scratch the table near the pool.
C3 Lots of people wake the table near the pool.
C4 Lots of people come the table near the pool.
C5 is the people lots display admire the table the pool very near charming of.

TG3.3L 3894 dome 25 12.54

The morning view is spectacular.
C1 The sunlight catches the dome at the very top.
C2 The sunlight melts the dome at the very top.
C3 The sunlight prolongs the dome at the very top.
C4 The sunlight occurs the dome at the very top.
C5 morning is view sunlight catches top the dome spectacular the very the at the.

TG3.4H 309 doctor 349 285.99

John visits his mother every day.
C1 He often meets the doctor in the room.
C2 He often tickles the doctor in the room.
C3 He often sharpens the doctor in the room.
C4 He often competes the doctor in the room.
C5 John room his mother meets the day he every in the doctor visits often

TG3.4L 3698 battery 22 13.90

The engine stopped suddenly.
C1 Anne pulled the battery away from the stand.
C2 Anne chewed the battery away from the stand.
C3 Anne tempted the battery away from the stand.
C4 Anne chatted the battery away from the stand.
C5 Anne away engine the battery the pulled from stand stopped the suddenly

116
Appendix A, Continued

TG4.1H 1131 ball 123 77.53

The game lasted over an hour.
C1 The players put the ball in the bag.
C2 The players slit the ball in the bag.
C3 The players quantified the ball in the bag.
C4 The players shivered the ball in the bag.
C5 the hour lasted the put players in over an bag the game the ball

TG4.1L 3591 dawn 26 14.66

It was still very early.
C1 Joan watched the dawn from her window.
C2 Joan cursed the dawn from her window.
C3 Joan raided the dawn from her window.
C4 Joan quarrelled the dawn from her window.
C5 watched still window the dawn it Joan from was early very her

TG4.2H 942 poet 144 93.92

The atmosphere was electric.
C1 The audience cheered the poet when he stepped on stage.
C2 The audience fed the poet when he stepped on stage.
C3 The audience steamed the poet when he stepped on stage.
C4 The audience progressed the poet when he stepped on stage.
C5 cheered the audience the on he stage when was stepped the poet electric atmosphere

TG4.2L 759 dollar 144 121.43

The small shop wasn’t busy.
C1 John deposited the dollar on the counter.
C2 John bent the dollar on the counter.
C3 John quickened the dollar on the counter.
C4 John arrived the dollar on the counter.
C5 the John busy shop on the dollar small counter the deposited wasn’t
Appendix A, Continued

TG4.3H 731 corner 134 120.34

Traffic was not very heavy.
C1 Louise regarded the corner of the street.
C2 Louise sprayed the corner of the street.
C3 Louise separated the corner of the street.
C4 Louise sneezed the corner of the street.
C5 traffic not Louise the heavy the street corner of regarded very was

TG4.3L 3973 peak 24 12.06

The mountain is beautiful on rainy days
C1 Everyone loves the peak in the mist.
C2 Everyone dries the peak in the mist.
C3 Everyone invites the peak in the mist.
C4 Everyone seems the peak in the mist.
C5 days the in mountain mist the rainy the peak on beautiful loves is everyone

TG4.4H 825 blood 122 107.90

The clinic was great success.
C1 The technicians saved the blood in plastic bags.
C2 The technicians served the blood in plastic bags.
C3 The technicians rattled the blood in plastic bags.
C4 The technicians chattered the blood in plastic bags.
C5 bags the in saved plastic the blood was clinic technicians great the success

TG4.4L 3854 bear 24 12.76

The tourists stood taking pictures of the animals.
C1 Two children eyed the bear in the meadow.
C2 Two children squirted the bear in the meadow.
C3 Two children repeated the bear in the meadow.
C4 Two children dozed the bear in the meadow.
C5 in children eyed tourists pictures taking of meadow the stood the two animals the bear the sleep
Appendix A, Continued

TG5.1H  1100  park  111  79.59

The workers are always busy.
C1 Two men sweep the park every morning.
C2 Two men burn the park every morning.
C3 Two men drink the park every morning.
C4 Two men disappear the park every morning.
C5 morning two every always the park are busy men the workers sweep

TG5.1L  3528  cafe  25  15.23

John and Fred wanted a new business.
C1 They opened the cafe on East Broadway.
C2 They flooded the cafe on East Broadway.
C3 They embarrassed the cafe on East Broadway.
C4 They relied the cafe on East Broadway.
C5 a Fred business wanted John opened Broadway the cafe and on new East they

TG5.2H  1153  boat  123  75.92

The waves were not large.
C1 Sheila shoved the boat away from the dock.
C2 Sheila blew the boat away from the dock.
C3 Sheila shamed the boat away from the dock.
C4 Sheila commented the boat away from the dock.
C5 the away shoved large the boat sheila dock were not from the waves

TG5.2L  3956  treaty  24  12.15

Delegates from both countries were very happy.
C1 They accepted the treaty quickly.
C2 They rinsed the treaty quickly.
C3 They payed the treaty quickly.
C4 They coexisted the treaty quickly.
C5 both country very delegates happy they quickly from were the treaty accepted
Appendix A, Continued

TG5.3H 819 truth 130 108.37

The two scientists were excited.
C1 They had found the truth about the strange event.
C2 They had obscured the truth about the strange event.
C3 They had filled the truth about the strange event.
C4 They had collaborated the truth about the strange event.
C5 excited strange the scientists the truth were they about event found the two had

TG5.3L 3925 patrol 24 12.31

The soldiers moved carefully.
C1 They heard the patrol in the dark.
C2 They vacuumed the patrol in the dark.
C3 They edited the patrol in the dark.
C4 They brooded the patrol in the dark.
C5 the heard soldiers dark in carefully the patrol moved the they

TG5.4H 1083 block 98 81.17

The sculpture would be large.
C1 John and Louise pushed the block into place.
C2 John and Louise ran the block into place.
C3 John and Louise argued the block into place.
C4 John and Louise marvelling the block into place.
C5 Louise into be John the would large pushed and the block sculpture place

TG5.4L 3778 costume 28 13.30

After the party, Maggie undressed.
C1 She draped the costume over a chair.
C2 She squeezed the costume over a chair.
C3 She resumed the costume over a chair.
C4 She emerged the costume over a chair.
C5 after she party the costume a the undressed Maggie draped over chair
Appendix B: Category based filler items

1. A Precious Stone
   changing the on **RUBY** light was road ran Fred quietly looked beach the then away

2. A Relative
   office the was quiet **UNCLE** very the secretary comic the on desk the dreamed

3. A Kind of Cloth
   the parked the side the **WOOL** put refrigerator men the disk on road at of the truck two

4. A Type of Reading Material
   surgeons twelve jogging up were **MAGAZINE** the site of them the washed wall of the few

5. A Colour
   was drinking he the chopping held **YELLOW** in hand pianist his the

6. A Four-Footed Animal
   over had centre searching almost she a **HORSE** the Andrew of the took from train

7. A Metal
   the saw dark bus over the someone was the when he left **STEEL** building

8. A Unit of Time
   was meadow playing Lynda the stared she in the rising wind **SECOND** woods drain

9. A Kitchen Utensil
   The large **SPOON** is often misplaced. It should be kept in the drawer.

10. A Part of Speech
    The second **VERB** comes too soon. Move it to the end of the sentence.

11. A Fruit
    The meal was not very good. The **APPLE** pie was delicious, however.

12. A Part of the Human Body
    The little restaurant was quiet. Mary’s **LEG** was very itchy.

13. A Weapon
    The valuable **SWORD** danced in the display case. John watched it carefully.
14. A Type of Human Dwelling
Climbing the APARTMENT stairs was difficult. Bill hopped up the slope.

15. An Alcoholic Beverage
Apparently the dinner was full. WINE was the beverage of choice.

16. A Crime
The newspaper report rambles the news. THEFT is being hit by inflation.

17. A Substance for Flavoring Food
Making SALT pork is easy if you have all the correct parts.

18. A Type of Fuel
The old OIL stoves were good but contributed to pollution.

19. A Sport
Although SWIMMING uses a lot of strangeness, it is still a very good exercise.

20. (A Name Applied to a Person to Indicate His) Occupation or Profession
When the new LAWYER coughed the bible, the members of the jury laughed.

21. A Carpenter’s Tool
Jim dropped his HAMMER and began to recite his toolbox.

22. A Natural Earth Formation
Not far behind the MOUNTAIN there is a small town.

23. A Weather Phenomenon
In northern Canada, SNOW starts falling in early Autumn.

24. A Girl’s First Name
After she had raged the poster, MARY sat down to eat a large dinner.

25. A Musical Instrument
Ed replaced the window blind with a new VIOLIN that he had stolen.

26. A Bird
The work in the fields is boring. A SPARROW sings incessantly.

27. A Nonalcoholic Beverage
The menu was dreaming under the counter. MILK was the cheapest drink.

28. An Article of Clothing
Getting dressed wasn’t exactly a dance. His SHIRT was the easiest thing to find.
29. A Flower
The plants and shrubbery scurried the shade. A ROSE grew near the edge of the garden.

30. A disease
The young nurse scolded the hospital blanket. Ben's MEASLES were very itchy.
Appendix C: Rhyming based fillers

1. ablaze
crowd the *appraise* active very an was old the moved lady microphone on square the

2. fierce
the under floor *pierce* the was ceiling everyone dark the helped mechanic he when worked

3. face
women several the up were the *race* walking all road of them window car of the

4. navigate
some there the unusual were on *liberate* thing the Margaret roof drawer took beater from

5. match
der came nearly of the Wendy completed a she *hatch* vacuuming candy had from removed
   couch the

6. strict
transcribed had the Joan nearly revisions *predict* she a from tape the machine old
   removed

7. half
departed the train one from east the two of girls village *laugh* the delivered drain on
   speaker

8. aim
improving waved was coach the Richard running the flag in *blame* the

9. need
sleep kittens often on rug they the string throw *proceed* the in

10. screen
Johnsons along the every run the afternoon trail them cat with they often *green* bring the

11. chance
The people *dance* a lot. It is part of the culture of that area.

12. good
Lots of people *stood* near the gateway. The restaurant was full.

13. cheeky
Kay was surprised at the mess. The *leaky* pot had dripped on the floor.
14. creamy  
The room was very uncomfortable. It was hot and steamy inside.

15. horses  
If he forces the soldiers to leave, he will be in trouble.

16. true  
She couldn’t undo the water. She left it on the shelf.

17. coin  
It is a wonderful athletic club. To join is very easy, also.

18. moved  
Martha did not fill the cloud. Her friends approved but the teacher didn’t.

19. mesh  
The fresh peaches tasted very good with cream.

20. dangerous  
A day ago, a curious event occurred near the drugstore. No one actually saw it.

21. ladder  
The little boy was sadder than he could dream.

22. mud  
Each spring, rains flood the river valley and several houses are damaged.

23. hunt  
John didn’t concern the murder. A blunt instrument had been used.

24. dignify  
I can’t smirk the last part. Please clarify what you mean there.

25. paint  
The village remains several houses. The quaint one belongs to an old man.

26. hour  
In the forest, the old moose wandered, nibbling sour berries and munching old roots.

27. born  
He looked carefully at the map. The paper was torn the pamphlet.

28. neglected  
The bandits had sneezed the bank. The young policeman inspected the damage.

29. presume  
Pick up the world, my friend. There are still many things to consume before we go.
At seven o'clock, the bar closes all the people and the customers stagger to their cars.
Appendix D: Exact Fillers

The material for the Exact Fillers was constructed according to the following general criteria:

<table>
<thead>
<tr>
<th>Gerund</th>
<th>Modal</th>
<th>Verbs</th>
<th>Adj</th>
<th>Adv</th>
</tr>
</thead>
<tbody>
<tr>
<td>List</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Other</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
</tbody>
</table>

**Exact, List, Filler**

1. standing
   two **standing** the men the division from down the were slope technical

2. narrow
   his on buildings **narrow** was street a long mainly old apartment with

3. handed
   the man bushes in little **handed** subway boy a would the stub he go the away so

4. hardly
   needed it any complicated with calculations wind drift of force or tide and anyone charts **hardly** race to convince that.

5. mostly
   other the half of the was window hidden tall **mostly** pot by plants

**Exact, Sentence, Filler**

6. next
   He was standing there in the evening but not the next day.

7. hurt
   She had a bad cut in her leg. It **hurt** so she couldn’t walk.

8. quietly
   Armed with a weapon, she felt better. She **quietly** checked the bolts on the front entrance.

9. afraid
   He was supposed to work in a machine shop but he was **afraid** to go in.
10. from
It was a wonderful evening. Janet gazed at the moon from her porch.

11. strange
The small engine wasn’t drinking. John tossed the wrench on the strange counter.

12. almost
The investigation was almost finished, and very successfully, too, the detectives decided.

13. could
Sky-diving could be dangerous. Especially on days like today.

14. large
Humour doesn’t go through. The large movie will be interrogated.

15. sifted
The plants looked good. He knelt again and gently sifted the soil with his gloved hands.

16. fearfully
The creatures persisted the forest. They would live fearfully in the dark undergrowth.

17. swiftly
Edwind swiftly hid his old friends. They persevered the jam on toast.

18. small
The computer card didn’t fit. The salesman lurked the small part into place.

19. sweet
The box of candy pleased Joan. Sweet things were her favorite stigma.

20. near
His complaint about the truck landed near the feet of the driver.
Appendix E: Example items

Exact

1. bucket
   lowered farmer the into well bucket he up the brought the some water

2. shoved
   The shoppers were very angry. Several shoved their way into the store.

3. refrigerator
   The incident coincided the dinner. John went to the refrigerator to get some beer.

Rhyme

4. stank
   George the although a lot had of he wanted go to still bank to money

5. think
   The dress will shrink if you wash it in hot water, I am sure.

6. floor
   The boy cried the flute. More music didn’t help at all.

Category

7. A Tree
   the near oak road an spread provided branches and it’s pedestrians shade for the

8. A fish
   The lack of rain made the river shallow. The salmon would not enter to spawn.

9. A Type of Footgear
   Private Smith felt uncomfortable. The rifle misfired the sandals on his feet.
Appendix F: Warm-up items

Exact

1. lamp
turned Elizabeth the sleep to lamp and out went

2. wore
bought Brenda new a skirt and it to with the wore her movie friend

3. because
They are going to go to California because they want to visit a warm place.

4. jello
For dessert, the guests were surprised by jello in an ice-cream bucket.

5. radical
The golfers militated the radical elements from the club before they could take-over

6. sour
The cherry cobbler misfired the waiter. The result was a group of sour-faced customers.

Category

1. A relative
while himself father to talking Ed's away the put camping carefully equipment

2. A kind of cloth
suit Frank not wanted had a could but he mind up his he went wool so make home

3. Religious building
Sunday morning was warm and clear. Most of the church members arrived early.

4. An Elected position, president
Several other presidents had run the meetings in the same way that Sean had.

5. A country
My niece spent last summer bicycling her feet through France.

6. A member of clergy
As the sermon digressed the priest, the congregation became more tolerant.
Rhyme

1. fend
   I please need lend some dollars me five help

2. make
   moonlight off the was reflecting beautiful and very lake the romantic

3. investigator
   We will need a navigator for our sailing trip to the Bahamas.

4. teacher
   Interested spectators gathered around and speculated as to what the creature might be.

5. compare
   Despite the excellent repair work, the ship couldn’t swim as well as before.

6. grumble
   Don’t stumble. The ground is pretty heavy around here.
Appendix G: 50-Item Cloze Test

FULL NAME ___________________

Read the following passage and fill in each blank with one word which fits both the meaning of the whole passage and the grammar of the sentence that it is in.

Please Print neatly.

There are several ways of shortening words and phrases to create new words for old ones. **Acronyms** are the result of forming a word from **the** first letter or letters of each word in **a** phrase, often the title of an organization. The American Society of Composers, Authors, and Publishers is usually **referred** to as ASCAP; the United Nations Children’s Fund **is** called UNICEF; a soldier who is **absent without** leave is AWOL; and the Students Opposed to Grading Systems very likely selected the name of their organization **carefully**, so that it would yield the memorable acronym **SOGS**. Most acronyms are temporary lexical items, going out **of** use quickly, as do the organizations or situations **which** they describe, but a few become permanent entries **in** the lexicon of a language. **Scuba** is an **acronym** for **self-contained underwater breathing apparatus**.

Closely related to **acronyms** is another type of shortening commonly used in **English** -- the use of the initial letters of the **words** in a phrase, with the letters pronounced individually, **rather** than as a single word. These strings of **letters** are words, not just abbreviations; we often use **them** without even knowing the phrase that led to **their** creation. For example, the GOP is the Republican **Party** and the source of the letters apparently was Grand Old Party. But many people use the word **GOP** long before
they learn the full phrase. Other examples of this type of word creation
are HEW (Health Education, and Welfare), TLC (tender loving care), and
LSD (in the United States, usually the hallucinogenic drug lysergic
acid diethylamide; in Great Britain, librae, solidi, denarii a Latin
phrase meaning ‘pounds, shilling, pence’; and the military phrase landing
ship dock).

Shortening is also at work in the creation of words by back
formation, a popular formative analysis of long words. In back
formation, a short word is created from a longer one on the
basis of similarities between the longer word and other words in the
language. For example, the word editor existed in the lexicon of
English long before the word edit. Comparing their word editor
to other words such as writer, singer and worker, speakers
of English assumed that, just as writer, singer, and worker consisted
of two formatives each, editor must also have two formatives -- a
suffix or (in pronunciation identical to the suffix er), meaning ‘one who
performs the action described by the verb’, and a verb
edit. Thus, the new word edit entered the lexicon of
English. At first, some speakers objected that "there was no such
word," but today edit is completely acceptable. In more recent times, back
formation has resulted in the creation of enthuse from an earlier
form, enthusiasm. Enthuse provokes strong negative reactions from some
speakers who object that "it isn't a word." In one
sense, such people are correct, for enthuse is a relatively new
word. But, on the other hand, back formation is a perfectly proper, normal
process for creating words. Making such objections, in an attempt to
keep the language from changing, will most likely have no more
effect than earlier objections to the word edit, or to the words televise and donate, also
created by back formation.