1996

Individual Differences in Word Association and Inference Generation From Brief Discourse

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INDIVIDUAL DIFFERENCES IN WORD ASSOCIATION AND INFERENCE GENERATION FROM BRIEF DISCOURSE

by

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A Thesis submitted in partial fulfilment of

the requirements for the degree of

Bachelor of Arts (Psychology) Honours

at the Faculty of Health and Human Sciences,

Edith Cowan University

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Date of Submission: December 2, 1996

USE OF THESIS

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ABSTRACT

When people read a short discourse, both more and less skilled readers make word associations. However, it has also been found that, whereas more skilled readers generate inferences from the text, less skilled readers do not (Long, Oppy, & Seely, 1994). The present study partially replicates and extends the study of Long et al. (1994) by investigating the pattern of word associations and whether less skilled readers may be able to generate inferences if given more time to process the discourse. In particular, the study investigates whether word association are made and inferences are drawn as part of an automatic or an attentional cognitive process. Several models of cognitive processing are compared. The design of the study was a 2 skill level (more skilled/less skilled readers) x 2 target type (associate and inference words) x 2 target congruence (appropriateness or inappropriateness to the context of the discourse) x 3 SOAs (Stimulus Onset Asynchronies or processing time allowed) (400msec, 750msec, and 1500msec). Ninety-six university social sciences students (20 males and 76 females) undertook a lexical decision task, and their performance in terms of response times and error rates was analysed. The pattern of responses found for word associations in Long et al.'s study was not replicated in the present study as the priming effect for word associations did not occur. A priming effect for inferences did not occur and it was found that giving less skilled readers more time to process inference words did not assist them to generate inferences. Both groups of readers were faster in their responses to associate words than to inference words. Future studies could investigate finding an accurate baseline from which to measure priming.

DECLARATION

I certify that this thesis does not incorporate without acknowledgment any material previously submitted for a degree or diploma in any institution of higher education; and that to the best of my knowledge and belief it does not contain any material previously published or written by another person except where due reference is made in the text.

Signature ...

Date ..... 10. 2. 97 .....

ACKNOWLEDGMENTS

Thanks are extended to the following people for their interest and support throughout my honours year.

Thank you to my principal supervisor, Dr Brett Degoldi, and assistant supervisor, Dr Amanda Blackmore, who gave unstintingly of their time. Their interest, support, and encouragement have been exceptional and many times have helped keep me focused and positive.

Many thanks are due to Brett, for the many hours he gave me, the many trips up from Bunbury, emails, faxes, and phone calls, and hundreds of hours spent on DMASTR. His energy and enthusiasm have been nothing short of amazing.

Many thanks also to Amanda, for her availability and help on so many occasions and especially with modifying my passages, and reading my draft. Her reflection, attention to detail, kindness and encouragement are very much appreciated.

It has been a pleasure to get to know and work with both of these lovely people. They have been exceptional supervisors. Thank you both very much.

Thanks are extended to Prof. Don Thomson, for inviting me to participate in his research group. It has been a privilege to be part of this group. Thank you also for insightful comments on my research.

The help of the staff of the Psychology Department was much appreciated during my data collection. Thank you to those whose classes I attended (Neil Drew, Dr Susan Gee, Dr Mark Groves, Dr Adele Hills, Dr Moira O'Connor, Julie-Ann

Pooley, Dr Susan Priest, Dr Daniel Reidpath, and Dr Julie Thacker), and Justice Studies lecturers (Guy Hall and Lloyd White) for welcoming me into their classes and encouraging students to volunteer. Thanks also to their tutors.

To Ho Thuan, thanks are extended for installing my computers, for his expertise, cheerfulness and willingness to assist, and for a very long loan of his stopwatch.

To my husband, Jeff, and sons, Lindsay and Bevan, thank you for help and support on the home front. Thank you especially to Jeff, for his encouragement and his patience with the many thousands of hours he lost me to the gargantuan data collection, the half tonne of journals, the computer (and wonderful laser printer), "Hermie's Hollow" (the study), and the honours room with which I became very acquainted. Without his support, this year would not have been possible.

A big thank you to Wayne Hill, my dear friend, for all his encouragement, his continued interest in my study and many helpful suggestions, his steadfast support and practical help at every stage throughout the year.

To the honours students: Josie Hubble, Santina Tonizzo, Wendy Nicholls, Michael Sheehan, Pam Sullivan, Pam Davies, and Grace Francis, I am very grateful for their encouragement, support, and camaraderie--especially Josie for her friendship, concern and practical help, Santina for her friendship all year, and Wendy for emails of encouragement from afar. They have all made it a year to remember. Also to Di McKillop (who has been there and done that) for her interest and suggestions.

Many thanks are due to my willing participants, a cast of hundreds:

For the pilot studies: thank you to the 3rd year, honours, masters and PhD Psychology students from Edith Cowan University, staff at Wanslea Family Services

and the Centre for Clinical Research in Neuropsychiatry, and friends who willingly gave their time and attention to fill in pilot surveys for my materials.

For the experiment: thank you to one hundred and fifty-five Edith Cowan University students including students from 1st, 2nd, 3rd, 4th years, and the masters programme in Psychology at Joondalup campus, thirty-seven 1st and 2nd year Psychology and School of Nursing students at Bunbury campus, and also several students from Justice Studies, Human Services, Leisure Science, and Education at Joondalup and Mt Lawley campuses. I am thankful for their willingness to give their time for the somewhat daunting reading test, and two-thirds of them for gamely coming back for the experiment. The encouragement and good wishes they often extended towards me were very much appreciated.

Finally, thanks are due to Prof. Robert Till and Prof. Debra Long, the principal authors on whose work my research was based, for prompt responses to my emails, providing the filler passages, and for their good wishes.

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1. INTRODUCTION

1.1. Overview

This thesis investigates a facet of language processing. The focus is on differences in the way people of different reading ability process text. This chapter commences with how people in general read. Several theoretical models of language processing are then outlined. The issue of which processing takes place while a person is reading and which after reading has finished is discussed. The two facets of reading under investigation in this paper, word association and inference generation, are explained. The last section of the chapter covers a review of the literature and includes explanations of the methodologies used in measuring cognitive language processing. The chapter concludes with research involving the way in which more skilled readers and less skilled readers might differ when making word associations and generating inferences from text.

1.2. Reading

Literacy is an important issue in modern society and reading is the major essential component of literacy. The written word is the main interface for communication between the author and the reader. Understanding what is written depends on the reader's ability to glean meaning from the text. This ability varies with individuals. Understanding how individuals process written language can lead to more effective methods of teaching reading.

There are appreciable differences in people's reading ability, even when they have a similar educational grounding. Results from the Longitudinal Survey of Australian Youth showed 30% of their sample of 13,900 Year 9 students in Australian high schools did not possess basic literacy skills (ACER, 1996; Slattery, 1996). The ACER study findings indicate our present methods of teaching reading are not effective for many children (Slattery, 1996).

Reading is a complex skill which involves cognitive and perceptual processes (Barber, 1990). Whereas most people acquire spoken language without specific instruction, reading needs to be systematically taught (Coltheart, 1996, May 20).

In Australian schools a *whole language* approach is widely used. Emphasis is placed on overall experience with language, rather than breaking down the process of learning to read into a set of distinct cognitive procedures. Consequently, when a child who is otherwise intelligent fails to learn to read, it is difficult for teachers to determine exactly where the problem lies (Coltheart, 1996, May 20).

In contrast to the whole language approach, Coltheart (1996, May 20) maintains it is imperative children are taught how letters sound so they are able to sound out words. The ability to recognise the written symbols which make up the word (graphemes) and how they sound (phonemes) is called a grapheme-phoneme correspondence, and this is a basic lexical (or *word in language*) process.

These very different approaches to teaching reading are directly related to cognitive models of language processing. The former equates to a *top-down* approach, and the latter to a *bottom-up* approach, as explained in the following section.

1.3. Models

There is considerable debate amongst theorists who propose the various models as to whether people process language in a top-down manner by firstly recognising themes and topics as proposed by Goodman (1970) and Smith (1971) or a bottom-up manner by recognising individual letters and words as proposed by Becker (1976), Forster (1976), and Till, Mross, and Kintsch (1988). Alternatively, people might use some combination of both of these methods, or quite different processes according to their level of reading ability or the difficulty of the task (Neely, 1977; Posner & Snyder, 1975; Stanovich, 1980).

The initial approach that this project takes is that people have a *language processor* which serves to encode, store, and retrieve written (and spoken) language (Adams & Collins, 1988; Taft, 1991). It is, in a manner of speaking, a storehouse of words, or *mental lexicon* (Oldfield, 1966).

Four major classes of models, covering several psycholinguistic theories, are compared in this paper: bottom-up, top-down, interactive, and dual process models. The first two models are described as *stage models*. Proponents of stage models maintain that language is processed in serial order. It is contended that the language processor is divided into lower and higher cognitive functions. Lower stages in reading involve recognising the graphemes (written symbols) and phonemes (how they sound) and encoding them. Higher functions include analysing how the word is related to the other text (the syntax) and accessing the meaning of the word (the semantics).

1.3.1. Bottom-up models.

According to the proponents of bottom-up models, encoding and processing flow in one direction from the basic cognitive functions to the higher functions. This precludes any feedback mechanism from higher to lower cognitive processes.

The example of a bottom-up model used in the present study is the *activation-selection-elaboration model* proposed by Till et al. (1988) shown in Figure 1.1. When a person reads a word, at first all associated words are accessed in the mental lexicon. For example, if the word *mint* was read, associated words such as *money, candy, new* and *herb* would be accessed. Till et al. describe this as the *sense activation* stage. Next the appropriate meaning for the word in the context in which it is being read is selected over and above the other meanings. This is the *sense selection* stage. The third stage is *contextual elaboration* where further meaning is ascribed to the text. For example, if the text read ... *all the buildings collapsed except the mint,* an inference might be drawn that an earthquake has caused the collapse.

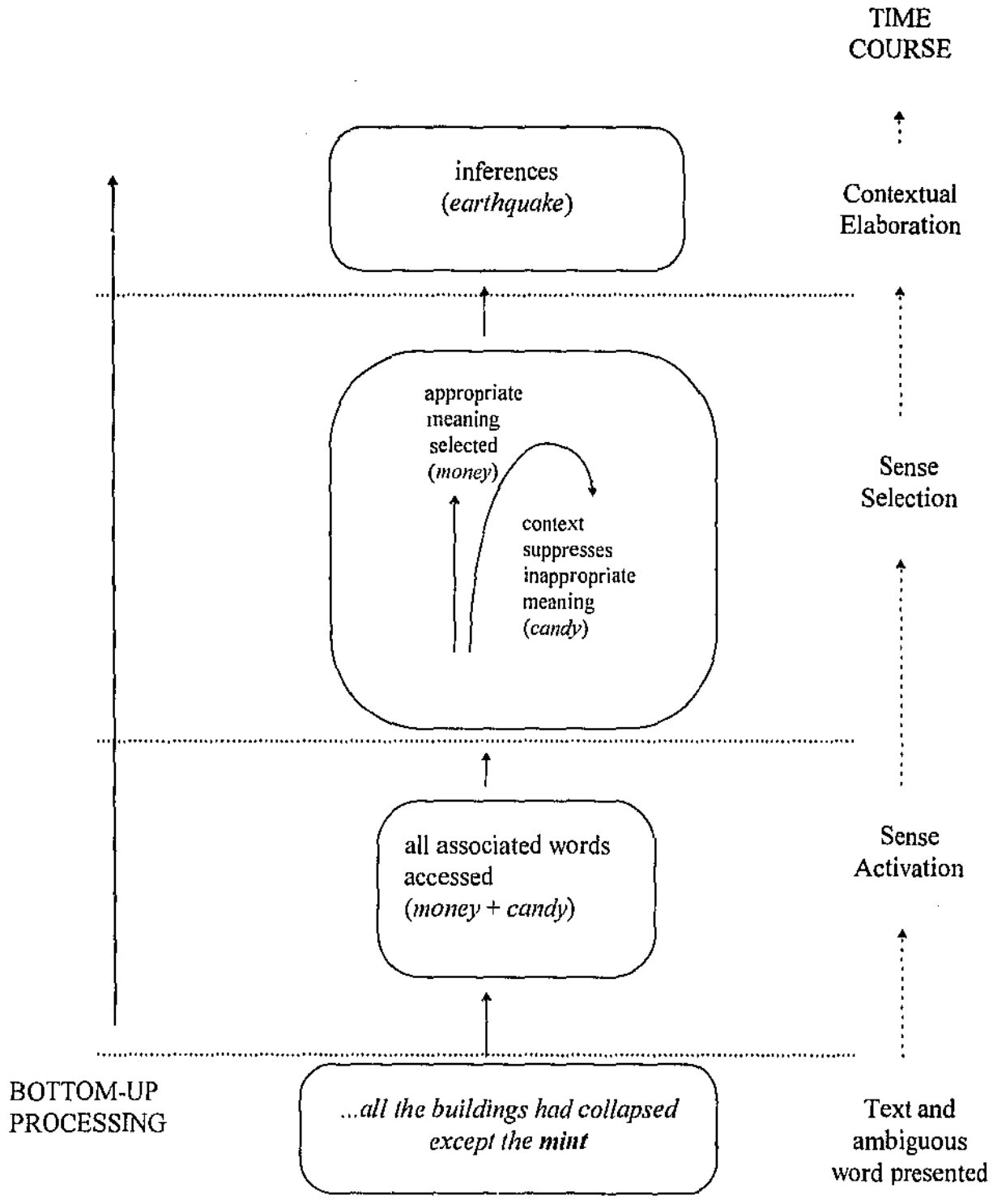

Figure 1.1. Simplified Diagram Representing Activation-Selection-Elaboration Model after Till, Mross, and Kintsch (1988) Showing Bottom-up Processing

A similar bottom-up model is proposed by Forster (1976) and is entitled the *serial search model.* In this model access to the mental lexicon occurs by two routes: reading (orthographic), and hearing (phonetic). When a word (e.g., *house*) is encountered while reading, a group of similar letter strings (e.g., *horse, house, rouse* and *mouse*) is accessed in the mental lexicon, then a serial search is conducted to find a match according to frequency of occurrence in the language (e.g., *horse* would be found before *rouse*). However, when the word has been preceded by another word which is semantically related (e.g., *home*, then *house*), then a different process occurs. A cross-referencing system searches for semantically related words. When two semantically related words are read in proximity to each other (e.g., *home*, then *house*), it has been found that people respond faster to the second word (*house*) than another unrelated word (e.g., *rock*) (Meyer & Schvaneveldt, 1971, 1976). This is called a *semantic priming effect* (Taft, 1991). The first word is called the *prime,* and the second word is called the *target.*

Forster (1976) describes the serial search of the mental lexicon as more like looking for a book in a library, with semantically related topics grouped together, than looking for a word in a dictionary lexicographically.

There are several other bottom-up models, for example, the *verification model* proposed by Becker (1976). However, they look at priming of single words rather than words in the context of sentences. As this thesis is investigating words embedded in passages, such models have not been used as the findings for priming of single words would need to be extrapolated to include sentences and passages. Kleiman (1980) notes these findings cannot automatically be extrapolated to include

priming in sentence contexts because the single word level of investigation does not take into account such constructs as sentence comprehension processes and world knowledge.

1.3.2. Top-down models.

Goodman (1968, 1970, 1985) and Smith (1971), two major proponents of top-down models, maintain that people use an hypothesis-testing process when reading. Goodman likens reading to a psycholinguistic guessing game where the reader does not read each word, but makes a series of intelligent guesses at the meaning of the text.

A top-down model of processing is illustrated in Figure 1.2. Proponents of top-down models contend that higher-order conceptual processes such as goals, world knowledge, and expectations are accessed first. The reader is sampling text and constructing meaning from the gist of the text rather than relying on identifying words from their graphemes (Barber, 1990; Samuels, & Kamil, 1984). This model underlies the whole language approach used in Australian schools (Coltheart, 1996, May 20; Nicholson, 1993).

The model is illustrated without a time-line because, although the model claims processing occurs top-down, logically the reader must see the text before being able to sample it and this would constitute a bottom-up process. This contradiction poses a difficulty in establishing a time-line sequence.

Purely top-down models have been largely discredited because of the abundant evidence for bottom-up processes (Barber, 1990; Daneman, 1991; Mitchell, 1982; Samuels, & Kamil, 1984). Eye movement studies have shown that readers fixate

(pause at) virtually every word, even if the words are short functional words or highly predictable from the context (Stanovich, 1991). The value of top-down models has been in highlighting the role of world knowledge and context in readers' construction of meaning from text. They have led other theorists to propose interactive models which include both bottom-up and top-down processes.

1.3.3. Interactive models.

An example of an *interactive-activation model* proposed by McClelland and Rumelhart (1981) and Rumelhart and McClelland (1982) is shown in Figure 1.3. While proponents of interactive models recognise that there are lower and higher processes involved, they contend there is a feedback mechanism so that processing is interactive rather than unidirectional, that is, higher conceptually-driven processes and lower stimulus-driven processes can affect each other. It can be seen from Figure 1.3 that processing occurs between and within each node (processing site). Timecourse is not illustrated in this model because the interactive processing is proceeding at different levels concurrently. There may be individual differences in the speed of processing, however the model does not predict a deficit in processing in less skilled readers.

An implication of this model is that higher level conceptual processes such as context effects (the effect of context of words within a sentence) feed back to the word recognition level and that this is a normal process for everyone. Rumelhart and McClelland (1982) are not specific about whether other conceptual processes are included in the feedback loop of their model.

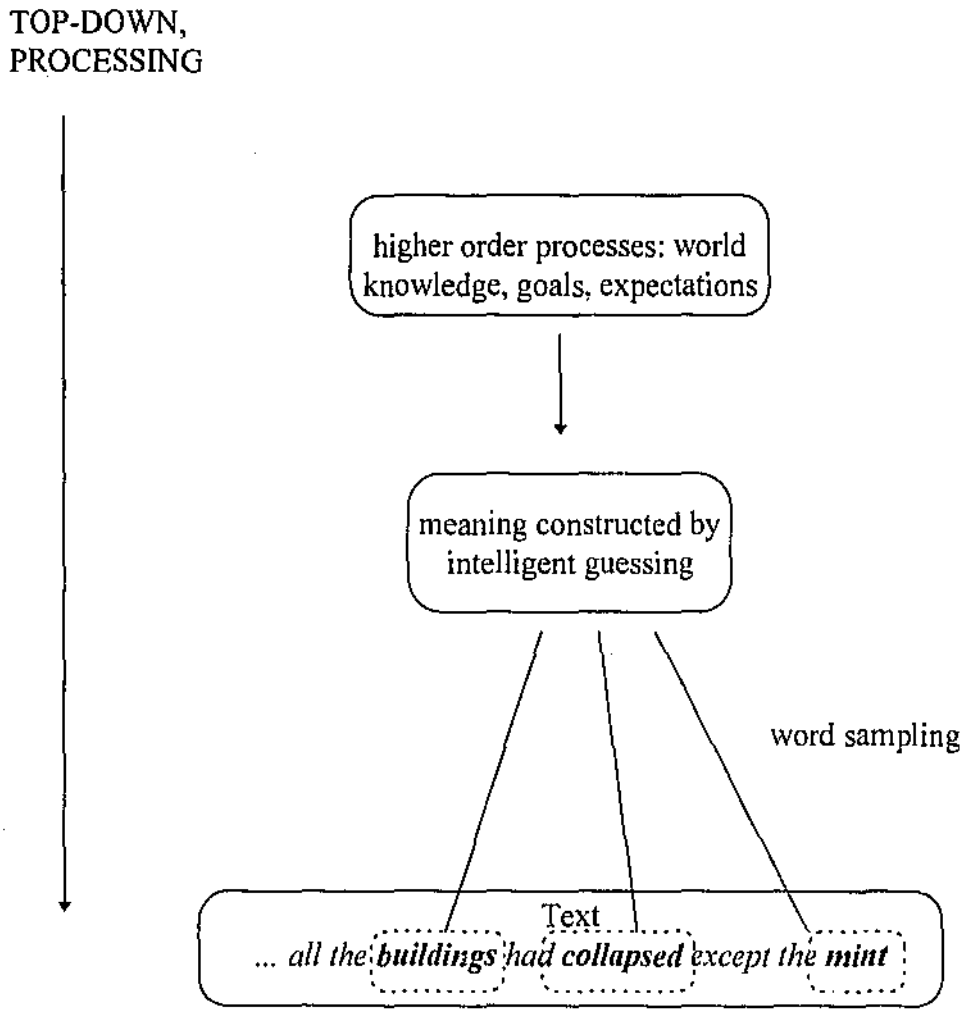

Figure 1.2. Top-down Model Illustrating an Hypothesis Testing Approach to Language Processing (Based on Goodman, 1970)

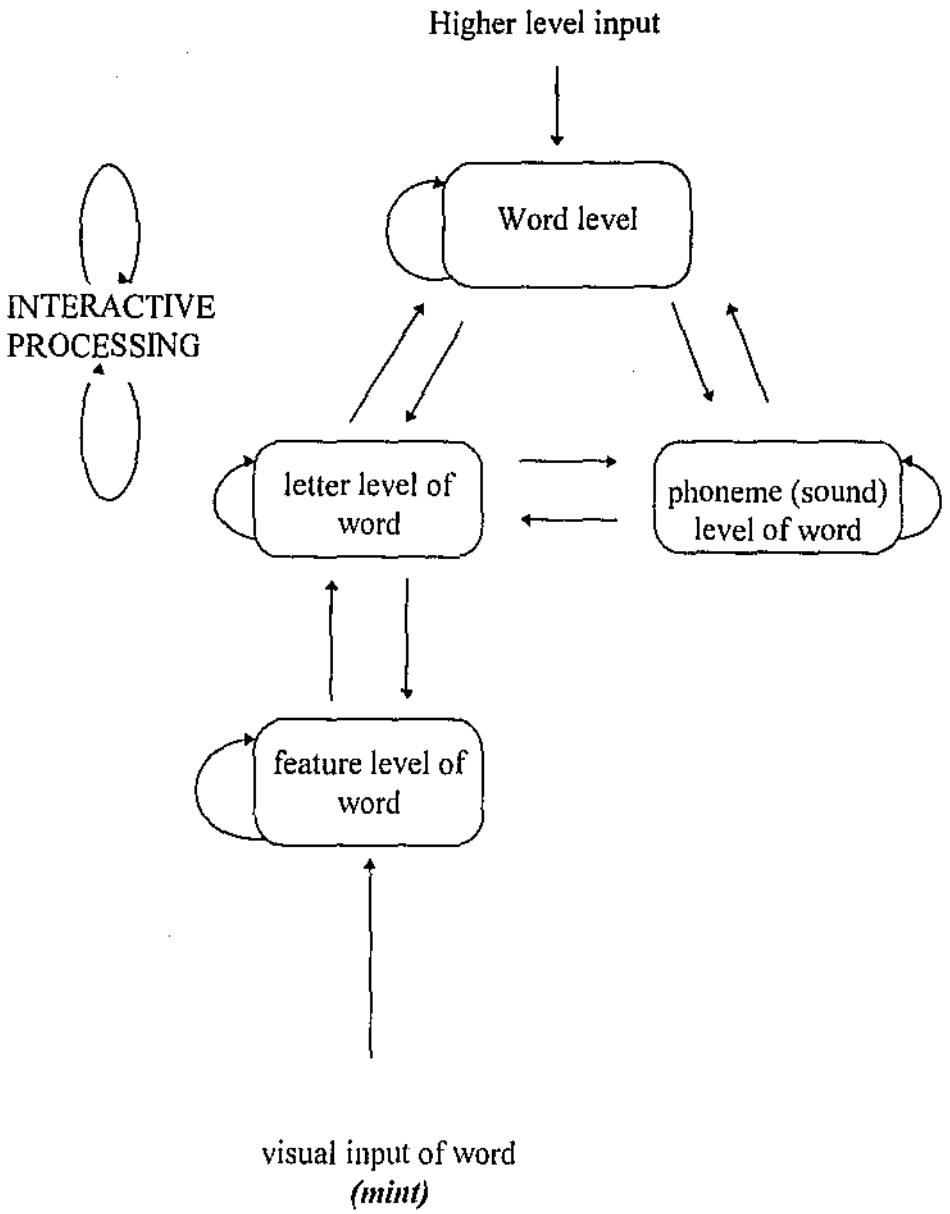

Figure 1.3. Interactive-Activation Model Adapted from McClelland and Rumelhart (1981) Showing Interconnections Providing Interactive Processing

1.3.4. Dual process models

A fourth class of model is described as a dual process model because it is postulated that two different processes are occurring in language processing, either at the same time, or in different individuals. A generic dual process model is illustrated in Figure 1.4.

The *interactive-compensatory model*, was proposed by Stanovich (1980) and was based on Rumelhart (1977). Stanovich maintains that bottom-up processing is more efficient than top-down processing and is the route of processing usually used by more skilled readers. Stanovich has found that, whereas less skilled readers relied on context when they read, more skilled readers did not. Unlike Rumelhart and McClelland's interactive model, Stanovich accounts for deficits. Although processing is interactive, if a deficit in processing occurs at any stage, for example if a word cannot be recognised, the reader compensates by using the top-down process of checking context. Top-down processing is the strategy of second choice.

In another dual process model, the *two-process theory of expectancy* proposed by Posner and Snyder (1975) and further developed by Neely (1977), two processes are occurring at the same time. One process, which is similar to the cross-reference system explained by Forster (1976) is described as spreading activation resulting in associated words being accessed quickly. The words may be from the same semantic group (e.g., *home* and *house*) or, in the case of sentences, from the same topic. This process is automatic, fast, and unconscious. Posner and Snyder call this process *facilitation.* It is as if access to the word has been facilitated by a priming effect.

When a word which is not associated with the preceding text is encountered, a second process comes into operation. The word is unexpected and so no priming effect is experienced. Instead an inhibitory effect occurs. The person is slower in responding to an unexpected word than to a word which is completely neutral. This process of inhibition is attentional, that is, readers give the word their conscious attention. Therefore two separate processes are operating: one that speeds recognition of associated words (facilitation) that is automatic, and one that makes accessing unrelated words slower (inhibition) that is attentional.

Although Stanovich (1980) has adopted Posner and Snyder's (1975) concept of dual process, the emphases in the two models are different. Stanovich is explaining differences between more skilled readers and less skilled readers, whereas Posner and Snyder are emphasising automatic versus attentional processing that is used by all readers (Gough, 1984).

The concepts of automatic and attentional processes are central to the study of higher cognitive processes and have been influenced by the work of Fodor (1983) who introduced the concept of modularity. Fodor distinguishes between the two processes. The first process is described as *modular* and is executed speedily, that is, automatically or *on-line* while the person is reading. It is also domain specific (e.g., one domain might be the language processor) and is termed *encapsulated* (i.e., it is separate from other modules).

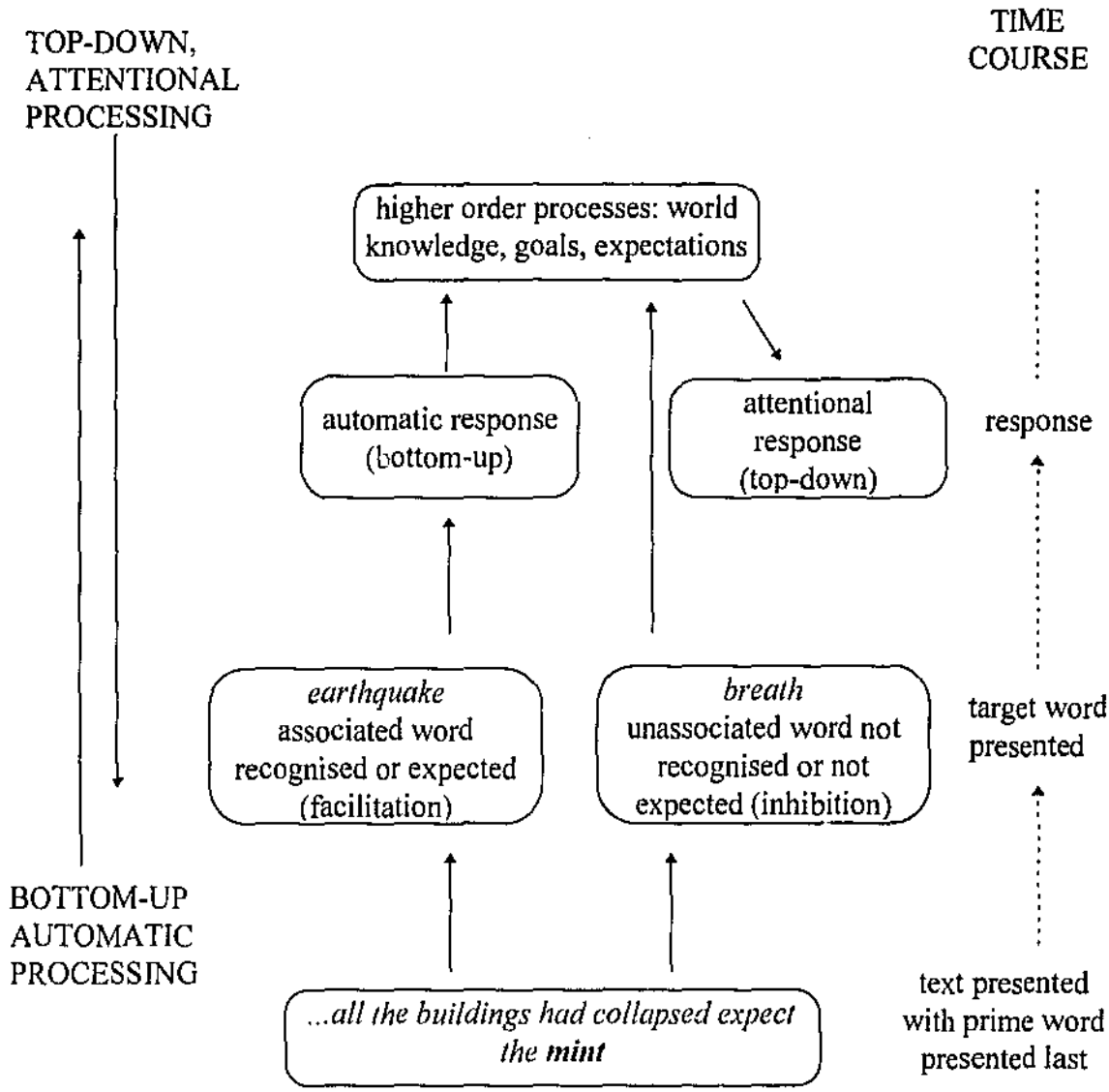

Figure 1.4. Example of a Dual Process Model Showing Bottom-up (Automatic) or Top-down Processing (Attentional) Processing

The second process is nonmodular, occurs in the central system, and calls on prior knowledge which is stored in long term memory. This process is attentional (or strategic) and is said to be carried out *off-line*, that is, after the reading process has been completed (Magliano, Baggett, Johnson, & Graesser, 1993; Perfetti, 1993; Stanovich, 1991). These various terms are listed below in Table 1.1.

Table 1.1

Terms used in the Concept of Automatic and Attentional Processing

Automatic	**Attentional (or Strategic)**
modular	non-modular
occurs in input system module	occurs in central system
encapsulated	generalised
on-line	off-line
fast	slower
independent	calls on knowledge in long term memory
domain specific	domain independent
autonomous	resources shared with other systems

The theories proposed by dual process models underline the importance of studying individual differences in reading. The implication of dual process models for the present study is that there may be different processes occurring for readers with high or low reading abilities. More skilled readers might process language more automatically. Less skilled readers might have to give their attention and use more working memory resources to process the same amount of information. Alternatively, it might be that some of the more fundamental processes, such as

recognising the form of a word or processing associated words, are automatic for all readers, whereas other processes, such as generating inferences, might be automatic for some readers and attentional for others.

The four different models explain language processing in different ways, the stage models in one direction with no feedback loops, and the interactive models with many feedback loops. Dual process models contain alternate explanations for seemingly contradictory findings in language experiments. As language processes such as word association and inference generation occur at different levels of processing, they might each be explained best by different models.

1.4. Word Association and Inference

This study is designed to examine differences between more skilled readers and less skilled readers in two aspects of reading comprehension. Under particular investigation is the differences between more skilled and less skilled readers regarding the higher cognitive functions of *word association* and *inference generation.*

Words are said to be associated when they are often thought about together, for example, *house* and *home,* or *doctor* and *nurse*. Several theorists contend that associated words are stored in close proximity in the mental lexicon according to their semantic relatedness (Collins & Loftus, 1975; Forster, 1976; Meyer & Schvaneveldt, 1976; Posner & Snyder, 1975). This leads to a fast and easy access

between associated words, and often results in a semantic priming effect which will be explained in detail in section 1.5.1.

Inference is defined by Goodman (1985, p. 833) as "a general strategy of guessing." Although people may be provided with only incomplete information, they rely on their existing schemata and knowledge to make inferences, and this weighs the odds that their inferences will be correct. This definition of inferences is very similar to the way in which Goodman describes the whole reading process in his top-down model. Kintsch (1994) describes inferences in a more bottom-up manner. In addition to bringing the important factor of world knowledge to the task, the reader recognises the words, chooses appropriate meanings, and goes through a continual process of construction and integration of meaning while reading.

It could be contended either that inference generation is a contextually specific guessing strategy, as Goodman (1985) suggests, or that it is part of general language processing, as suggested by Till et al.'s (1988) activation-selection-elaboration model.

In terms of Fodor's (1983) concept of modularity, if inference generation is a specific guessing strategy it would be regarded as non-modular and an off-line process. If it is part of the general language processor, inference generation would be regarded as being generated on-line and therefore modular in nature.

It is agreed by most theorists that semantic priming of associated words is an automatic process (Forster, 1976; Neely, 1977; Posner & Snyder, 1975). However, research has shown that inferences can be generated automatically (on-line) or attentionally (off-line) (Garnham, 1982; Magliano et al., 1993; Perfetti, 1993). The

present study uses topical inferences which are asking the question "what is this passage about?" It is expected that this kind of inference is generated on-line, at least for more skilled readers, as understanding the meaning of a topic is a basic requirement for comprehension of the text.

The distinction between automatic and attentional processing is important to reading. If for less skilled readers inferences are generated attentionally, there is a possibility the strategy is trainable (McNamara, Miller, & Bransford, 1991). Neely (1977, p. 227) maintains that "a mental operation that initially demands attention becomes automated with extended training." The advantage of automatic processing is it uses very little cognitive resources, whereas attentional processing uses more resources. These resources are then not available for other processing (Long & Golding, 1993; Spiro & Myers, 1984).

1.5. Language Processing Research

This section on language processing develops the concept of priming which was touched on earlier. Application of the priming effect when studying text representations is covered under the heading of propositions. Different methodologies used in language processing research are then discussed with emphasis on the *lexical decision task* which is the methodology used in the present study. The various methodologies all measure response times and plot the time course of processing. Time course studies and the method of measurement are discussed. Emphasis is placed on differences between more skilled readers and less

skilled readers as the performance of these two groups is compared in the present study.

1.5.1. Priming

One method which is used to investigate cognitive models of lexical processing is *priming*. In a priming task, two words are presented sequentially, the first of which is the *prime* and the second, the *target*. One general finding is that participants respond faster to a target word (e.g., *candy*) when it is preceded by a prime word with which it is associated (e.g., *mint*), than when the two words are not associated (Meyer & Schvaneveldt, 1971, 1976). This is called *semantic priming*. The theoretical explanation is that the target word is accessed by the mental lexicon at the same time as the prime word. Therefore, when the target word is presented, it is recognised and responded to faster than an unassociated word which has not been accessed. This effect is called facilitation because access to the word in the mental lexicon is facilitated by priming (Taft, 1991).

The priming effect has been reliably replicated over many experiments involving letters within the context of words, pairs of associated words, words in the context of sentences, and propositions (ideas embedded in text). Examples of these are briefly described below.

Rumelhart and McClelland (1981, 1982) developed the interactive-activation model while investigating priming effects for local context of letters within isolated words. Other researchers have investigated the priming of associated single words. For example, Meyer and Schvaneveldt's (1976) seminal experiment found a priming effect for a word such as *doctor* when an associated word such as *nurse* was

presented as a target. This effect has been reliably reproduced in many other studies (Becker, 1976; Collins & Loftus, 1975; Fischler & Goodman, 1978; Neely, 1976, 1977).

Another general finding is that responses to target words are facilitated (i.e., they are faster) when the target word is related to a sentence context (as opposed to a single word) (Fischler & Bloom, 1979; Kleiman, 1980; Stanovich & West, 1979; West & Stanovich, 1978). Context effects for words in sentences were investigated by Schuberth and Eimas (1977) who found a facilitation for highly predictable target word endings for brief sentences. For example, the target word *bone* was facilitated after the sentence fragment *The puppy chewed the* .... was presented.

Kleiman (1980) found a large facilitation for target words which provided a best completion for a sentence, and a smaller facilitation effect for other target words which provided a plausible completion. Kleiman accounts for his findings by proposing a system of spreading activation, with most plausible completion words activated first, and less activation of other plausible but less likely completions. This account is similar to Forster's (1976) explanation of spreading activation and serial search through semantically related topics.

1.5.2. Propositions

A major shift in reading research occurred with the development of Kintsch (1974) and Kintsch and van Dijk's (1978) concept of *propositions* (McNamara et al., 1991). McNamara et al. explain that propositions are the "smallest units of knowledge that can stand as separate assertions" for example, *the host mixed a cocktail* would be considered one proposition (p. 491). Kintsch and van Dijk's

theory addressed *text* comprehension rather than *sentence* comprehension. When reading a text, the reader not only comprehends the words, but makes a mental model representing the propositions contained in the text.

The individual's world knowledge contributes to the mental model and to the way the reader draws inferences from the text. A working mental model is constructed and updated as the individual reads the text. Associated propositions are accessed and available in working memory in much the same manner as associated words (Kintsch, 1993). However, whereas words and syntax rely on the identification of symbols, inferences require complex processes (Perfetti 1993). Therefore caution needs to be applied when using models which have only been applied to single words.

Development of Kintsch's and van Dijk's (1978) concept of *propositions* has assisted in the study of higher cognitive functions such as inference generation. Many kinds of different classes of inferences have been investigated. Some are considered to be on-line, for example, bridging inferences which are necessary for local text coherence (McKoon & Ratcliff, 1980, 1992). However, there is debate over whether most other kinds of inferences are generated on-line or off-line (Perfetti, 1993).

Long and Golding (1993) found superordinate inferences (the major inference that answers the question of *why* in a passage) were more likely to be drawn on-line than subordinate inferences (those which were secondary to the text). Magliano et al. (1993) found that causal antecedent inferences (which answer the question of *why* something has happened) were more likely to be generated on-line than causal

consequence inferences (those in which the reader is inferring what might happen next).

The kind of inferences used in the present study are described as thematic or topical inferences (Long, Oppy & Seely, 1994; Till et al., 1988) and reflect the major theme of what is happening in the passage. Whether topical inferences are generated on-line or off-line is debatable, although they resemble most closely Long and Golding's (1993) superordinate inferences which they found were generated on-line. Development of methods of testing the theories has led to advances in understanding the different kinds of word associations and inferences.

1.5.3. Methodologies

Several methodologies incorporate priming: a) In the *naming task* the participant is asked to read the target word out aloud as quickly as possible, b) the *cloze task* requires the participant to provide a target word to complete a sentence, and c) the *lexical decision task* requires the participant to make a decision as quickly as possible as to whether the target word is a genuine word (e.g., *sample*) or a non-word (e.g., *sumple*) (see Taft, 1991).

The last method is used in this study. The participant is asked to read a sentence one word at a time. The last word in the sentence is the prime word. Then the target word is presented and the participant responds as quickly as possible with a button press, one button for *yes* it is a real word, or another button for *no* it is not a real word. The priming effect is measured by presenting different kinds of target words, for example, those which are associated with the prime word and others which are

unrelated. The response speed to all the real word targets is recorded. This is the major dependent variable in lexical decision tasks.

The role of the *nonwords* is to act as a control so that participants have to make a lexical decision. This is usually their only purpose in the task and responses to the non-words do not usually form part of the analysis. The variable of interest is the speed of the participants' response to the *legitimate words*.

1.5.4. Homographs

When studying the effect of word association or sentence context (such as inference generation), one method often used with the lexical decision task is the presentation of an ambiguous word in the form of a *homograph* (a word which has one spelling but two or more meanings, for example, *mint* or *beam*) as the prime word (see Taft, 1991, p. 48). A target word is then presented in the form of an associate or inference word. The associate word can be appropriate or inappropriate to the meaning of the homograph used in the context of the passage. The inference word can be an appropriate or inappropriate inference for the passage. This configuration of associate and inference words and appropriateness and inappropriateness is illustrated in Table 1.2 with an example from Till et al. (1988). Participants might be presented with the target word *money* which would be an appropriate associate of *mint* in the context of the sentence, or the target word might be *candy* which is an inappropriate associate of the meaning of mint presented here. Likewise participants might be presented with the word *earthquake* which is an appropriate inference to draw from the sentence, or the word *breath* which is not an appropriate inference.

Table 1.2

Sample Item with Appropriate and Inappropriate Target Words

	Target Type			
Paragraph	**AA**	**IA**	**AI**	**II**
The townspeople were amazed to find that all the buildings had collapsed except the ***mint***.	money	candy	earthquake	breath

Note 1. AA = appropriate associate, IA = inappropriate associate, AI = appropriate inference, II = inappropriate inference.
Note 2. The homograph, which immediately precedes presentation of the target word, is illustrated in italics and bolded.

Differences in response times to the target words measure whether the participant's response has been primed. If a priming effect is achieved then it is concluded the participant has made the word association or generated the inference.

1.5.5. Time course

Early research in reading used errors as the method of measurement. With the development of computer programs that can accurately measure response times to the nearest milliseconds, the emphasis has moved from measuring errors to measuring response speeds (Meyer & Schvaneveldt, 1976). This application of computer technology to reading experiments provides an accurate and useful tool. It allows the researcher to plot the time course of language processing by manipulating experimental timing in a number of ways.

Research by Till et al. (1988) which found priming effects for word association and inferences, also found that inferences were generated *later* than word associations.

Till et al. investigated the *time course* of lexical processing in adults using a lexical decision task. They plotted the amount of time each stage of processing encompassed after presentation of a homograph that terminated a short passage of one or two sentences. As illustrated in Table 1.2, one passage Till et al. used was *The townspeople were amazed to find that all the buildings had collapsed except the* ***mint***. The time course is illustrated on the right hand side in the more detailed version of the activation-selection-elaboration model shown in Figure 1.5.

In this example the word association task involved the prime word of *mint* as a homograph with two associations: *money* and *candy*. When presented with the associated word of *money*, participants responded faster than when presented with the unassociated word of *candy*, which is associated with a meaning of *mint* not applicable to the sentence. All of the models described in this study can account for this associative priming effect.

Similarly, when presented with a target word which was an inference from a passage, a priming effect occurred. For example, when presented with the passage "*The townspeople were amazed all the buildings had collapsed except the mint*" participants responded faster to the inference word *earthquake* than to the word *breath*, which could not be regarded as an inference for the passage. Responses to the inference words were slower than responses to the associate words. The homograph primed target words associated with the correct sense of the homograph within 300-400 msec, however, inferences were not derived from the text until between 500 and 1000 msec. This finding suggests that inference generation is a higher cognitive function which is elaborated *after* the cognitive function of word association has been processed. This implies serial processing which supports the bottom-up models: the activation-selection-elaboration model and the serial search model.

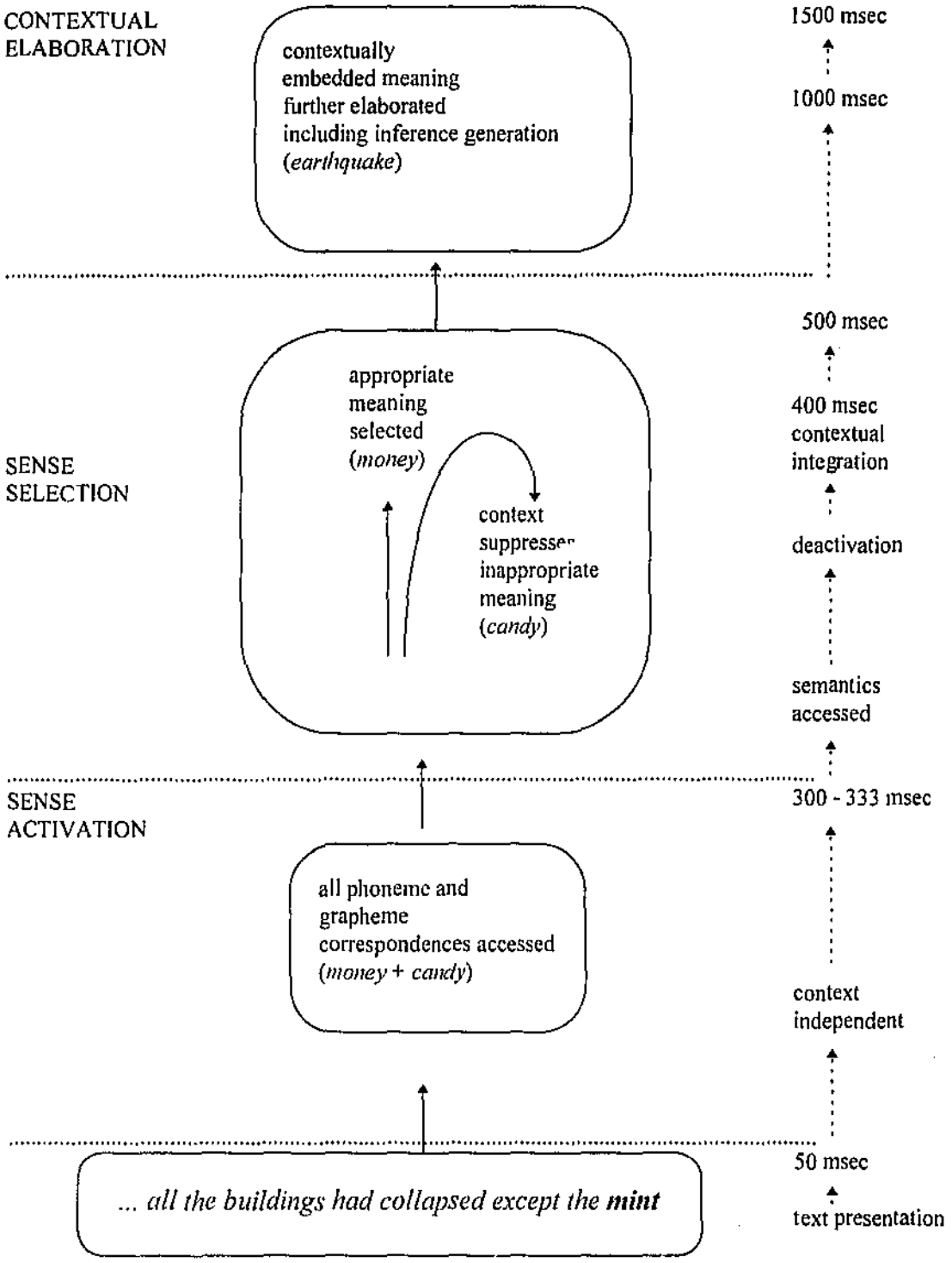

Figure 1.5. Activation-Selection-Elaboration Model after Till, Mross, and Kintsch (1988) Showing Bottom-up Processing.

1.5.6. Stimulus onset asynchrony

When charting the time course of lexical processing, the question of interest is *when* during the time course the priming effect occurs. The time course is investigated by varying the time allowed for the participant to respond to the target word. This time allowed is called the stimulus onset asynchrony (SOA) and is measured from the onset of the prime word to the onset of the target word. By varying the SOA, researchers have found different patterns of response times.

Till et al. (1988), in experiment 1, used two SOAs: 333msecs and 1,000msecs. They found there was no priming effect at 333msecs. This supported the activation-selection-elaboration model which proposes that at short SOAs, both meanings of a homograph are initially accessed (the activation stage of the model). At the longer SOA of 1,000msecs, there was a priming effect (the selection stage of the model). Responses for the longer SOA were also faster, and Till et al.'s explanation for this phenomenon is that it was a preparation effect: participants were anticipating a target word would appear next.

Neely (1976) found a larger priming effect for a 2,000msec SOA than a 360msec SOA. Neely (1977, p. 230) interpreted the longer SOA as allowing the participant time to "engage, focus, and commit limited-capacity attention," whereas the short SOA, would not allow time for attentional processing. That is, Neely is assuming the longer SOA induces the participant to move from automatic to attentional processing as outlined in the dual process model, the two-process theory of expectancy.

Dosher and Corbett (1982) investigated inference generation using a long SOA. They presented short sentences of four to six words for 2.5sec and asked for a Stroop colour response. (The Stroop test requires the participant to name the colour of ink used to the print the target word, for example, name the colour of ink *(red)* when the target word is *blue*). They found no Stroop interference. This equates to no priming effect. McNamara et al., (1991) in critiquing this study, suggest that readers would take no more than 1sec to read the brief sentence, leaving a 1.5sec delay before the appearance of the target word, in which time activation of the inference might have decayed. It could be argued that, not only had the delay in time moved the participants from automatic to strategic processing, but the time of processing had passed altogether.

1.5.7. Individual difference research.

Most of the studies quoted so far have not investigated whether there are differences in language processing according to the individual's reading ability. Reading ability involves many cognitive functions and is possibly made up of several different factors. Studies have covered many aspects of reading abilities: word recognition, speed of lexical access, and fluency (Fleisher, Jenkins, & Pany, 1979), word knowledge (Daneman, 1991), working memory capacity (Daneman & Carpenter, 1980; Miyake, Just, & Carpenter, 1994), world knowledge (Daneman, 1991), flexibility (Shebilske & Fisher, 1983; Spiro & Myers, 1984), use of context (Perfetti, 1985; Stanovich, 1984, 1986). These are described briefly below.

At a basic processing level, it has been found that speed of word recognition is correlated with reading ability. However, this does not mean the two are causally

related. Studies which improved less skilled readers' word recognition skills did not succeed in making gains in reading comprehension levels. Speed of lexical access accounts for only 10% of the variance in reading ability in adults, although it appears to be related to fluency. It appears that reading speed and reading comprehension are fairly independent skills (Daneman, 1991).

To be able to recognise and pronounce a word is one skill. Word knowledge (i.e., knowledge of a word's meaning) is another. Word knowledge is one of the best predictors of reading comprehension. This is understandable as the reader who has a limited vocabulary will lack comprehension of texts when unknown words are often encountered. However, knowing the meanings of individual words may not be sufficient. The reader needs to be able to relate the meaning of the word to the context in which it is embedded (Daneman, 1991).

Several studies have investigated working memory capacity. Daneman and Carpenter (1980) proposed that more skilled readers have larger working memory capacity than less skilled readers. They constructed a test instrument which estimates reading span by measuring the number of sentence endings the participant can hold in working memory. Studies using the *reading span test* have found the results of the test predicted reading comprehension. Daneman and Carpenter concluded that more skilled readers may be faster and their processing may be more automatic so that fewer cognitive resources are being consumed in the limited capacity of working memory. The working memory is therefore free to carry out other processing tasks such as comprehending the text. Reading span was also highly correlated with the ability to relate previous to present information when reading text.

Another correlate of reading ability is world knowledge. In contrast to reading span which uses working memory, world knowledge is stored in long term memory and must be retrieved and utilised in drawing inferences (Daneman, 1991). Daneman makes the point that it may not be readers' world knowledge which is important, but their ability to apply it. Thus flexibility may be a factor. It might be that more skilled readers are more efficient in their use of different processes according to the situation (Shebilske & Fisher, 1983; Spiro & Myers, 1984). For example, Shebilske and Fisher found that more skilled readers speeded up when instructed to read for gist, whereas less skilled readers slowed down.

In a similar manner, it has been found that more skilled readers rely less on context while reading than less skilled readers. More skilled readers are able to recognise the words individually without context whereas less skilled readers need to rely on the context in which the words are embedded when they do not recognise a word (Stanovich, 1991).

These individual differences range from identifying single words to the higher cognitive processes that call on long term memory such as world knowledge. One study which has looked at individual differences on two levels: word association and inference generation is Long et al. (1994). In their study, Long et al. replicated and extended Till et al.'s (1988) research to examine individual differences in selecting the associated meanings of a homographic prime, and the extent to which inferences were generated from short passages. Whereas Till et al. used only one subject group for their research, Long et al. used two groups, more skilled and less skilled adult readers, to see if there was a significant difference in the way each group performed

on these tasks. Lexical processing and response time were measured over several different onset of target times (SOAs) up to 1000msec. They found that both more skilled and less skilled readers selected the appropriate associated meanings of the homographic prime. However, whereas more skilled readers generated inferences from the discourses they read, less skilled readers failed to make the same conceptual connections.

There are two possible explanations for this result: either less skilled readers fail to generate inferences, or they are slower and did not draw inferences within the time allowed by Long et al.'s (1994) study.

1.6. Hypotheses

The present study is a partial replication and extension of Long et al.'s (1994) study. Two of the SOAs used by Long et al.: 400msec and 750msec were used and a longer SOA of 1500msec was added. It is contended that allowing an extra 750msecs of processing time should give sufficient time for less skilled readers to generate inferences on-line if they are capable of so doing. The time of 1500msecs was considered optimal as extending the time any longer, to say 2000msecs, would take the responses beyond on-line automatic processing into off-line attentional processing.

There are five hypotheses proposed for the study, two that address the topic of word association, two that address inferences, and one that compares the pattern over both, as detailed below:

Firstly it is hypothesised that both more skilled and less skilled readers will demonstrate associative priming and that, given more time, both more skilled and less skilled readers will continue with this priming effect. The second word association hypothesis is that more skilled readers' response times for the associate target word responses will be faster than less skilled readers' response times for the associate target word.

Looking at inferences, the third hypothesis has two parts. It is proposed that, for the SOAs of 400msec and 750msec, the more skilled readers will generate inferences whereas the less skilled readers will not, as was found in Long et al.'s (1994) study. However, given more time, the more skilled readers will continue to generate inferences at the same rate, and less skilled readers will begin to make inferences. The fourth hypothesis is that more skilled readers' response times for the inference target word responses will be faster than less skilled readers' response times for the inference target words. The fifth hypothesis proposes that overall the responses to associate target words will be faster than the responses to inference target words, as was found in Till et al.'s (1988) and Long et al.'s studies.

2. Materials Preparation

The materials for the experiment were based on Till et al. (1988) (see Appendix A for experimental paragraphs with associate and inference test words from Till, Mross, and Kintsch, 1988) but were modified to reflect Australian rather than American use of English by testing them with an Australian sample. This was done in two stages: an associate word pilot study and an inference word pilot study. These modifications were deemed necessary as the Australian participants in this study could not be expected to be primed by American target words which are culturally specific and therefore less familiar to Australians. An example is the target word *candy* used as an associate target word in List 2 item 1. It is not a term usually used by Australians. Similarly the inference target word *love* used in List 1 item 22 is not likely to be generated by Australians who do not associate the word *smack* with giving a kiss. Since this study was designed to determine usage of Australian English, only those who regarded themselves as speakers of Australian English were involved.

Participants were also purposefully sought from amongst tertiary students or graduates with a social sciences educational background. The rationale for this purposive sample was that there would be language similarities between the samples for the pilot studies and the experiment, and thus any priming effects would be maximised.

This chapter covers both pilot studies: the first which tested word associations, and the second which investigated inferences generated from short passages.

2.1. Pilot Study 1: Associate Words

The purpose of this study was to determine which words in Australian English would be most likely to be associated with a set of commonly occurring homographs.

2.1.1. Method.

A pilot study was conducted to find the highest scoring words which were associated with a set of homograph primes. For example, it was found that the homograph *order* was associated with five different meanings: *sequence, demand, request* (for a purchase), *religious*, and *award.* In this example the two highest scoring meanings were *sequence* and *demand.*

These highest scoring words were used as the target words for the experiment to maximise any priming effects. Two meanings of approximately equal frequency of occurrence in responses were required so two lists, each containing one meaning of the homograph, could be used interchangeably in the experiment. Using two lists enabled control of the design so that each participant only saw each homograph once during the experiment. This is more fully explained in part 4.1.2 dealing with materials for the experiment.

2.1.1.1.Participants

Forty participants completed the survey.

2.1.1.2.Materials

A list of 45 homographs was prepared comprising the 28 used by Till et al. (1988) and Long et al. (1994), and an additional 17 from an Australian study by Forster (1976). Till et al.'s homographs were sourced from Cramer's (1970) study which used a sample of 109 American university students to determine frequency of

responses to different meanings of 100 homographs. Forster's homographs, which were of equiprobable frequency, were sourced from Kucera & Francis' (1967) analysis of word frequencies for American English. The homographs were listed on three sheets with blank spaces provided for the responses (see Appendix B for associate word pilot study instructions and materials).

2.1.1.3.Procedure

Participants were instructed to respond with two single words which they associated with two different meanings of each homograph. They were prompted to write the first appropriate words which came to mind.

2.1.2. Results.

Responses to the homographs were grouped under their different meanings. The meaning groupings were agreed by the researcher and assistant supervisor. For example, the homograph *swallow* was grouped in three meanings as illustrated in Table 2.1.

A one-way χ^2, using Excel 4, was performed on the highest two responses to each homograph, to determine which of the homographs contained responses of equal occurrence. The analysis revealed there was no significant difference with 38 of the 45 homographs (see Appendix C for summary of chi-square results for associate word pilot study). Seven homographs (*bit, foil, refrain, smack, page* from Till et al.'s, 1988, passages, and *batter* and *crank* from Forster's, 1976, study) showed a significant difference χ^2 (1, $\underline{N}$ = 80) = 4.59, 5.23, 12.56, 7.11, 8.06,

Table 2.1

Example of Meaning Groups for Homograph *Swallow*

Homograph	Meaning 1		Meaning 2		Meaning 3		Total
swallow	bird	37	gulp	12	accept	1	50
	tree martin	1	throat	12			13
			eat	8			8
			food	3			3
			drink	2			2
			digestion	1			1
			choke	1			1
			epiglottis	1			1
			ingest	1			1
		38		41		1	80

4.62, and 4.08 respectively, $p < .05$). The seven words and their corresponding passages were consequently eliminated from the materials and the other 38 were retained.

Of the 38 retained words, 23 were from Till et al.'s study. In most of these cases the pilot study responses were incorporated as the new target words, for example the word *lolly* was substituted for *candy* in List 2 item 1. In three cases, where the top response words had a different meaning to Till et al.'s target words, new passages reflecting the different meanings were devised. See Table 2.2 for details.

Table 2.2

Pilot Study Responses for Homographs used in Till, Mross, and Kintsch (1988)

Category of highest or near highest responses compared to Till's study	**No. of words in category**	**Homograph**	**Action taken**
same word and meaning	5	ball, pupil, club, swallow, mass	original words and passages retained
different word but same meaning	15	mint, rash, dates, second, iron, bill, sage, mole, file, temple, mean, will, bat, limp, beam	new target words substituted, original passages retained
different meaning	3	interest, tip, case	new passage written

The results of the 1st pilot study gave a pool of 38 homographs which could be incorporated in the experiment.

2.2. Pilot Study 2: Inference Words

As well as investigating word association, the experiment explored the way individuals generated inferences from a short passage. As the inference words used in Till et al.'s experiment were drawn from an American population, there may have been cultural differences in the language, so two pilot studies were conducted to

determine the highest occurring response words for Australians when drawing an inference from a short passage. These two studies are referred to as studies A and B.

2.2.1. Inference word pilot study A: Method

2.2.1.1. Participants

Twenty-seven participants filled in the surveys. None had been a participant in the first pilot study.

2.2.1.2. Materials

A list of 76 passages was prepared consisting of 38 pairs of passages using two meanings of 38 homographs (see Appendix D for inference word pilot study instructions and materials). Forty passages were incorporated from Till et al. (1988). Minor alterations were made to four of these items (14, 21, 44, and 48) so they accorded more closely with the Australian culture and language usage. For example in item 21, *drove on the left side* was replaced by *drove on the right hand side* to more closely match Australian driving conditions.

Six passages (12, 15, 18, 49, 51 and 61) were rewritten because the response word resulting from the 1st pilot study did not match Till et al.'s original passage. For example, passage 49 was rewritten to give reference to *sage* as a herb, rather than a bush (*brush*) as used in Till et al.'s passage.

In addition, fifteen of the homographs from Forster's (1976) study were included in the list (items 24-38 and 62-76). Thirty passages were created to resemble Till et al.'s passages. The new passages matched Till et al.'s materials on the following principles: a) the homograph appeared in both pairs of passages, b) only one meaning of the homograph was appropriate for each paragraph pair, c) each

paragraph consisted of two sentences of approximately 22 words in length, d) for half the passages, the homograph appeared at the end of the first sentence and in the other half, at the end of the second sentence, e) the homograph was always the last word in the sentence, f) all homographs were also homophones, and g) each meaning of the homograph pair had approximately equally strong associations to both senses of the word.

The passages were only presented up to the point where the homograph appeared, as this is where the participants for the main experiment must draw the inference. (This is explained more fully in section 4.1.2). Therefore, where the homograph occurred at the end of the second sentence, the whole passage was included, but where the homograph occurred at the end of the first sentence, only the first sentence was presented.

2.2.1.3. Procedure

The instructions explained that the study was investigating how people draw inferences from what they read. Participants were asked to read each passage and write down a word reflecting their understanding of what the passage was about. Two examples with possible responses were given.

2.2.1.4.Preliminary Results

Responses were grouped under meanings in a similar manner to the 1st pilot study. See Table 2.3 for example.

Table 2.3

Example of Response Groupings for Inferences from a Passage

Passage: *The chemistry student knew that this was not a good time to forget how to calculate volume and mass. Again, she tried to recall the formulas.*

Meaning						Associate		Total
1		2		3				
exam	13	failure	1	physics	1	weight	3	18
test	2	anxiety	1	science	1	measurement	1	5
examination	1	panic	1					2
		reassurance	1					1
		danger	1					1
	16		5		2		4	27

A summary of the results for the inference pilot study can be found in Appendix E. As a result of the inference word Pilot Study A, 17 passages were unsatisfactory for a number of reasons. Explanatory notes for the unsatisfactory passages are listed in Appendix F. These 17 passages were deleted from the study.

2.2.2. Inference word pilot study B: Method

As a consequence of having a number of unsatisfactory passages deleted, it was decided to run a second pilot study to increase the pool of passages available for the experiment.

2.2.2.1. Participants

A different sample of 27 respondents completed the survey.

2.2.2.2.Materials

Materials were similar to those used in inference word pilot study A. Fifteen passages were revised or rewritten and tested (see Appendix G for inference pilot word study B instructions and materials).

2.2.2.3.Procedure

The same procedure was adopted as for pilot study A.

2.2.3. Results.

A summary of results from the inference pilot study B are presented in Appendix H. The passages from inference pilot study B were integrated with the retained passages from pilot study A.

As a result of both pilot studies, six pairs of passages (items 4 and 42; 9 and 47; 27 and 65; 32 and 70; 36 and 74, and 34 and 72, containing the homographs *rash, iron, stick, yarn, poach* and *hamper* respectively) were deleted, four pairs because one of the pair contained a high number of associate as opposed to inference responses, one pair because the two meanings were associated with each other (items 36 and 74), and one pair (items 9 and 42) because the inference word for one passage was also a plausible inference for the other passage.

Thirty-two pairs of passages were retained according to adherence to the previous principles plus the following principles: a) strength of main inference responses were equal for both lists (503 responses for List 1 and 505 for List 2), b) different inferences were generated for each paragraph pair, c) inference words rarely appeared as associate words, and d) half of the homographs occurred at the end of the first sentence, and half at end of the second sentence.

The final two sets of 32 passages are presented in Appendix I as List 1 and List 2.

3. Reading Ability Test

3.1. Method

A reading ability test was administered to participants in order to form two groups for the experiment: more skilled and less skilled readers.

3.1.1. Participants.

The participants were social sciences students from Edith Cowan University Joondalup and Bunbury campuses. The majority were Psychology undergraduate students. There were also students from the School of Nursing, Justice Studies, Human Services, Leisure Science, and Education. None had participated in the materials pilot studies. All participants had normal or corrected to normal vision and hearing. One hundred and forty-four participants were administered a reading ability test (see materials section below). Twenty-seven were males and 117 were females, with a mean age of 29.5 years and a *SD* of 10.31 and a range of 17 to 56 years. Participants volunteered to take part in the reading test in their own time. The informed consent form is attached as Appendix J.

3.1.2. Materials.

Reading ability was tested using the Woodcock Language Proficiency Battery-Revised, 1991 (WLPB-R). The test consisted of the university and college student items from the four reading subscales of the WLPB-R. The four subscales measure different components of reading ability as described below.

1. Passage Comprehension (a modified cloze task)

Comprehension tasks measure broad reading abilities including vocabulary knowledge, and skill in using syntactic and semantic cues.

2. Word Attack (non-word pronunciation)

Non-word pronunciation tasks are designed to measure decoding ability. They require individuals to use their knowledge of phonics and language structure.

3. Letter-word Identification (word pronunciation)

Word pronunciation tasks, while measuring decoding ability, additionally test orthographic access to the mental lexicon.

4. Reading Vocabulary (synonyms and antonyms)

Reading vocabulary tasks test isolated word knowledge, and skill at supplying a meaning without the benefit of contextual facilitation (Cunningham, Stanovich, & Wilson, 1990; Woodcock, 1991).

The WLPB-R has been developed according to American Psychological Association *Standards for educational and psychological testing* (1985) using stringent criteria for standardisation and item selection (Woodcock, 1991). Internal consistency reliability using a split-half technique for the cluster of the four subscales is 0.94 at 18 years of age, and 0. 94 for 30-39 years of age. Validity has been tested against other tests of reading and verbal ability including the Wechsler Adult Intelligence Scale-Revised Verbal Scales and the reading scales in the Wide Range Achievement Test-Revised.

3.1.3. Procedure.

The passage comprehension and reading vocabulary subscales were adapted for group administration as a pencil and paper task. The items from these subscales were reproduced onto clear overheads using the same type-face and spacing as in the WLPB-R Testing Book and administered to small groups mainly comprising two to four people.

The materials were presented either by overhead projector or, in the case of an individual testee, on the overhead sheet placed on the desk in front of the person. Items in the comprehension subscale were presented for 30 seconds each and items in the reading vocabulary subscale were presented for 15 seconds each. A stopwatch was used for accuracy of timing.

The letter-word identification and word attack subscales were individually administered using the WLPB-R easel Testing Book. Administering the four subscales took approximately 30 minutes. At the conclusion of the test, participants were thanked and offered a Mars® bar as a token of appreciation.

3.2. Results

Responses were scored according to the criteria in the WLPB-R Examiner's Manual (1991). Response words for the passage comprehension and vocabulary subscales that were not listed in the WLPB-R marking key were independently categorised by the researcher and her assistant supervisor with an inter-rater reliability of 92%.

Participants who scored in the highest third (N=48) and lowest third (N=48) were selected for the computer experiment. They became the more skilled and less skilled reader groups respectively in the main experiment. The range of scores out of a possible 116 was 61-83 for the less skilled readers (M = 77.2, SD 4.98) and 89-105 for the more skilled readers (M = 95.22, SD 4.33).

4. Main Study

The main aim of the experiment was to investigate the way in which people make word associations and draw inferences from a brief passage.

4.1. Method

4.1.1. Participants.

Ninety-six participants undertook the computer experiment. They were all university students who had done the reading test and, as described in section 3.2, they were chosen from the highest 48 and lowest 48 of the 144 scores. The more skilled reader group consisted of 35 females and 13 males with a mean age of 32 years, with a *SD* of 10.31 and a range of 17 to 56 years. The less skilled reader group consisted of 41 females and 7 males with a mean age of 27 years, with a *SD* of 9.29 and a range of 17 to 49 years. All participants had English as their first language, and had normal or corrected to normal vision and hearing. No participant had been diagnosed with dyslexia or a reading disability. Participants volunteered to take part in the experiment in their own time.

4.1.2. Materials.

There are several elements to the experimental materials and these are discussed in detail in this section. In order to follow this section, the reader may find it useful to refer to an example of a complete experiment from List 1 which can be found in Appendix K . In summary the materials consisted of the following:

Passages
- instructions and eight practice items
- 64 experimental passages (32 for List 1 and 32 for List 2)
- 32 filler passages
- eight comprehension passages and eight comprehension questions

Target words and non-words
- eight target words and non-words for practice items
- 64 associate target words and 64 inference target words for experimental passages
- 32 target non-words for filler passages
- eight target words and nonwords for practice passages and eight target words and nonwords for comprehension passages

Each of these will be described in the order given above:

A set of *instructions* and eight *practice items* were placed at the beginning of the experiment. The practice items were constructed to resemble the experimental passages and were paired with four target words (one appropriate associate, one inappropriate associate, one appropriate inference, and one inappropriate inference) and four target non-words.

The materials contained 64 *experimental passages* consisting of pairs of short passages each of two sentences long. Each passage was approximately 22 words in length. The pairs of passages were divided into two lists (List 1 and List 2) so that each list presented one meaning of the 32 homographic prime words. Each participant was given only one list and therefore saw each homograph only once.

The sentences were constructed so that the prime word was always the last word in the sentence. Half of the prime words appeared at the end of the first sentence and half appeared at the end of the second sentence. The target word, which could be either an associate or inference word, always followed immediately after the prime word. For example, the target word *money*, appeared after the prime word *mint* at the

end of the first sentence in item 011 of Appendix K, whereas the target word *skin* appeared after the prime word *mole* at the end of the second sentence in item 021 of Appendix K.

In addition to the experimental passage, 32 *filler passages* were used. The filler passages were followed by target non-words. There were the same number of filler passages as experimental passages so that there was an equal chance of the participant encountering either a target word or nonword. Participants could not therefore predict which they would encounter at the onset of each target.

The same filler passages appeared in each list. They were of similar construction to the experimental passages used in Till et al.'s study. Seventeen were supplied by the principal author (R. E. Till, personal communication, 15 April, 1996) and three were from fillers supplied by the principal author of Long, Oppy and Seely (1994) (D. L. Long, personal communication, 9 April, 1996). In additional, 12 passages, which were rejected as experimental passages, were incorporated as fillers. The passages were organised in blocks of eight consisting of four experimental passages and four filler passages.

Eight *comprehension passages* were constructed for a comprehension task. They resembled the experimental passages and were paired with four target words (one appropriate associate, one inappropriate associate, one appropriate inference, and one inappropriate inference) and four target non-words.

A comprehension passage followed each block of eight experimental and filler passages and was paired with a *comprehension question* to ensure participants were reading the sentences rather than merely waiting for the target word to appear. The comprehension questions appeared on the screen as a single sentence and stayed on

the screen while participants circled a yes/no response on a questionnaire sheet provided. Appendix L shows the comprehension passages, questions, and response sheet.

Thus each participant responded to eight practice items, 32 experimental passages, 32 filler passages, and eight comprehension passages. This totalled 80 passages.

The *target words* took five forms: appropriate associate (AA), inappropriate associate (IA), appropriate inference (AI), inappropriate inference (II), and nonwords, and they always appeared immediately after the prime word. The target words which were appropriate for one list were used as inappropriate targets for the other list. In Table 4.1, for example, *money* is the appropriate associate for List 1 item 1 and the inappropriate associate for List 2 item 1.

The *target nonwords* were presented as targets only to the 32 filler passages. They were similar in orthographic structure to legitimate English words, so that they were pronounceable, for example, *pruckets* and *chittle,* but they did not sound like existing words of English. Like the real target words, they consisted of one, two, or three syllables. They were sourced from Degoldi (1989, Appendix A-2).

Each participant was presented with eight appropriate associate target words, eight inappropriate associate target words, eight appropriate inference target words, and eight inappropriate inference target words occurring after the experimental passages, as well as 32 target nonwords occurring after the filler passages. The target words were rotated so that each word was seen by an equal number of participants (see Table 4.2).

Table 4.1

Sample Items with Appropriate and Inappropriate Target Words

List, Item No.	Paragraph	Target Type			
		AA	IA	AI	II
1.1	The townspeople were amazed to find that all the buildings had collapsed except the *mint*. Obviously, it had been built to withstand natural disasters.	money	lolly	earthquake	breath
2.1	Thinking of the amount of garlic in his dinner, the guest asked for a *mint*. He soon felt more comfortable socializing with the others.	lolly	money	breath	earthquake

Note. AA = appropriate associate, IA = inappropriate associate, AI = appropriate inference, II = inappropriate inference.

Target words for the eight *practice items* and eight *comprehension items* were constructed to resemble the rest of the experiment. That is, each set of eight comprised one appropriate associate target word, one inappropriate associate target word, one appropriate inference target word and one inappropriate inference target word, as well as four target nonwords.

Table 4.2 describes the design of the experiment including rotation of the item numbers through the different versions for one list. Because of the requirements of the computer program, items were numbered to relate to each experimental condition. For example in condition one, there were 8 items numbered from 11

through to 18 where the 10 equated to the condition number (condition No. 1) and the 1 equated to the item number (item No. 1).

Responses were not recorded for the practice items, but were recorded for the comprehension items, therefore giving nine separate conditions as shown in Table 4.2.

Table 4.2

Experimental Design Showing Item Numbers for Each Version

Experimental Condition	**Passage Type**	**Type of Target**	**Version**			
			A	**B**	**C**	**D**
			Items			
1	Experimental	Appropriate Associate (AA)	1-8	25-32	17-24	9-16
2	Experimental	Inappropriate Associate (IA)	9-16	1-8	25-32	17-24
3	Experimental	Appropriate Inference (AI)	17-24	9-16	1-8	25-32
4	Experimental	Inappropriate Inference (II)	25-32	17-24	9-16	1-8
5	Filler	Non-word	33-40	33-40	33-40	33-40
6	Filler	Non-word	41-48	41-48	41-48	41-48
7	Filler	Non-word	49-56	49-56	49-56	49-56
8	Filler	Non-word	57-64	57-64	57-64	57-64
9	Comprehension	1 AA, 1 IA, 1 AI, 1 II, 4 Non-words	65-72	65-72	65-72	65-72

4.1.3. DMASTR computer program

The DMASTR computer program was used to run the experiment. Five IBM-compatible 486 DECpc 433dxLP computers were programmed with the DMASTR software. The program interleaved the first eight conditions into blocks of eight so

that each block contained one item from each condition, for example block 1 contained items 11, 21, 31, 41, 51, 61, 71, and 81 as shown in the Appendix K example of a complete experiment.

The DMASTR program scrambles the order of presentation of the blocks of eight passages, and also scrambles the order of presentation of passages within each block, so they are randomly presented each time the program is run. Instructions, practice items, and comprehension passages and questions, are maintained in fixed positions.

The sentences were presented by Rapid Serial Visualisation Process (RSVP) so that they appeared one word at a time in the centre of the screen. The RSVP rate, which is the rate of presentation of words on the screen, was set at 400msecs per frame. This time course is illustrated in Figure 4.1. The instructions and comprehension questions are presented as one sentence per frame and are maintained on the screen until the spacebar is pressed.

When the participant makes a response, the DMASTR program records it and displays on the screen whether the response was correct or incorrect. If the response is correct, the program also displays the recorded response speed in milliseconds.

The SOA (Stimulus Onset Asynchrony) is a measure of the time from the onset of the prime word (i.e., from when the prime word appears) to the onset of the target word. This is the amount of time the participant has to process the prime word and the preceding sentence/s before the appearance of the target word/non-word.

The time course of the SOA is illustrated in Figure 4.1. Three different SOAs were used in this experiment: 400msecs, 750msecs, and 1500msecs. The SOA is

equal to the 400msec presentation time of the prime word, plus the presentation time of the blank frame. That is, when the SOA is 400msecs, there is no blank frame. The prime word is presented for 400msecs, then the target word appears immediately. When the SOA is 750msecs, the blank frame is presented for 350msecs, and when the SOA is 1500msecs, the blank frame is presented for 1100msecs. Each participant was given only one SOA.

Order of Presentation	Length of Presentation (msecs)	SOA Duration	Term
word ↓	400		RSVP rate
⋮			
word ↓	400		RSVP rate
↓			
last word in ↓	400	↓	prime
sentence ↓		↓	
↓		↓	SOA
blank ↓	0, 350	↓	(400, 750
frame ↓	or 1100	↓	or
↓		↓	1500msecs)
↓			
Target ↓	400		target
=== WORD === ↓			word/ nonword

Figure 4.1. Time Course of Sentence Presentation.

4.1.4. Design.

The design was fully crossed so that each participant encountered an equal number of words and nonwords targets (32 of each), including an equal number of appropriate and inappropriate associate word targets (8 of each), and appropriate and

inappropriate inference word targets (8 of each). Only one meaning of the homographic prime was used per participant, that is, each participant was given either List 1 or List 2. Equal numbers of more skilled and less skilled readers were given each version of the two lists. Four versions of each list were devised so that each experimental passage was presented with each of the four target words an equal number of times. The four versions (A, B, C, and D) were used in each list and were run at three different SOAs. There were 24 different variations of the design in the experiment, with two more skilled and two less skilled readers per variation. The design was fully counterbalanced so that results from the different versions could be combined and averaged (Degoldi, 1994).

The experiment was a 2 skill level (more skilled/less skilled readers) x 2 target type (associate/inference) x 2 target congruence (appropriate/ inappropriate) x 3 SOA (400msec, 750msec, 1500msec) x 4 version (A,B,C,D) x 2 list (1, 2), fully crossed design, where skill and SOA were between subjects variables, and type and appropriateness were within subjects variables. The independent variables were the skill of the readers, the type of target word, the appropriateness of the target word, and the SOA. The dependent variable was participants' response time on the lexical decision task. Errors were also analysed as a dependent variable.

The four versions (A, B, C, and D) and the two lists (1 and 2) were dummy variables that were analysed to ensure that no interactions with versions and lists had occurred. Table 4.3 shows the design of the experiment with four versions of each list in each cell per SOA. Given that there were no interactions between the lists and versions, this design provided 32 participants per cell.

Table 4.3

Design for Cells of Experiment with Two More Skilled and Two Less Skilled Reader per Version per Cell

SOAs	List and Version
1 (450msecs)	1A1,1B1,1C1,1D1, 2A1,2B1,2C1,2D1 (n = 32)
2 (750msecs)	1A2,1B2,1C2,1D2, 2A2,2B2,2C2,2D2 (n = 32)
3 (1500msecs)	1A3,1B3,1C3,1D3, 2A3,2B3,2C3,2D3 (n = 32)

4.1.5. Procedure.

Participants were randomly assigned to List 1 or List 2, one of the three SOAs, and one of the four versions. Five IBM-compatible DECpc 433dxLP computers programmed with DMASTR software were used to run the experiment. Before commencement, verbal and written instructions were provided and these are shown in Appendix M. The passages were presented by rapid serial visual procedure (RSVP). The target words appeared in uppercase with a space and three equals signs on either side of the word.

Participants were requested to make a lexical decision response to the target word by pressing the right shift key marked with a green sticker for *yes* if the target word was a real English word, or the left shift key marked with a red sticker for *no*, if the target was a non-word. Participants were instructed to respond as quickly and accurately as possible. The computer program measured response times in milliseconds, and the experiment took 20 minutes to complete. After completing the experiment, participants were thanked for their participation and offered a Mars® bar as a token of appreciation.

4.2. Results

This section covers treatment of the data. Firstly, treatment of univariate outliers is discussed. Several assumptions of Analysis of Variance (ANOVA) are then covered. Several analyses were performed on the data. The first of these deals with the dummy variables of *lists* and *versions*. Then the major analyses are reported. Several statistical features unique to language experiments are also explained.

4.2.1. Univariate outliers

The following steps were taken to reduce the effect any outliers might have on the sampling distribution.

The grand means for responses to all nine conditions (shown in Table 4.2) were examined and possible outliers were detected by converting the grand mean scores to *z*-scores using the two skill levels as separate groups. The *z*-scores for two participants were above 3 *SDs* from the mean, and these two participants were

eliminated from the study and replaced by enlisting two new participants. Equal cell sizes were maintained (Tabachnick & Fidell, 1989).

Upper and lower cut-offs for individual response scores were set at 200msecs minimum and 2000msec maximum. A response under 200msecs is attributed to chance or equipment malfunction as the human response mechanism cannot function at faster than 200msecs. Responses below 200msecs were eliminated from the data as outliers. There were 3 responses eliminated. Response times longer than 2000msec are attributed to the participant failing to respond to the target. The computer program automatically replaced any response greater than 2000msecs with a value of 2000msecs. Any scores more than 2*SD*s from the mean were also regarded as outliers. A 2*SD* cut-off was set and any scores above or below these parameters were brought back to 2*SD*s (Degoldi, 1994; User's guide to the DMASTR display system, 1986).

4.2.2. Assumptions of ANOVA

All cells in the design were independent. The tests for normality, and homogeneity of variances were performed (Edwards, 1993; Keppel, 1991).

Visual inspection of the distribution of the variables showed that four out of 24 cells were skewed. It was decided not to transform the variables because all cells would need to be transformed, and meaningfulness of the scales of measurement, which are a msec response time and an error percentage response rate, would be lost. It was also considered that the *F* statistic would not be critically affected by the skewness as all cells are equal and $n > 12$ (Keppel, 1991).

The statistic for homogeneity of variance was significant. However, Keppel (1991) suggests that the *F* statistic is not critically affected so long as the largest within-group variance divided by the smallest within-group variance is not greater than nine. The statistic thus generated in the present study is much less ($F_{max} = 2$). Violations of the assumptions will be taken into account when drawing conclusions about the analysis (Keppel, 1991).

4.2.3. Main analyses

The major analyses were performed using the Perlman ANOVA program from the DMASTR suite of programs. DMASTR records response times only when responses are correct. Separate analyses were performed for response times and for errors. Non-word target responses and responses to the comprehension items were not analysed.

The conventional way of using Analysis of Variance (ANOVA) in research is to use subjects (i.e., the participants) to obtain an *F* value. This value gives an indication of the reliability of the findings and the likelihood of getting the same effects with another similar population of people. In language experiments, in addition to analyses using *subjects* as the major variable of interest (F_1), an analysis of *items* (F_2) is used. In item analysis, instead of subjects being the unit of sampling, the experimental item set is treated as the unit of sampling. In the present study the items are a sample of a population of homographs within sentences. The value of F_2 indicates the reliability of findings about the items, and the likelihood of getting the same effects with another similar population of items.

In language experiments, when a significant effect is found in both the subject and item analyses at the conventional $p = .05$, a third analysis is used that generalises across subjects and items simultaneously. This statistic is called *min F'* and, as it is a conservative statistic, $p = .10$ is adopted as the significance level. It has been suggested that this has the effect of guarding against a Type 1 error (Clark, 1973; Forster & Dickinson, 1976). When either F_1 or F_2, is not significant at $p = .05$, *min F'* is not performed and the null hypothesis is accepted. The *min F'* value indicates the reliability of the findings and the likelihood of getting the same effects with another similar population of people using another similar set of items. For all analyses the most significant level is reported.

The complete experiment was a split-plot factorial design with 2 lists (1, 2) x 4 versions (A,B,C,D) x 2 skill levels (more skilled/less skilled readers) x 2 target types (associate/inference) x 2 target congruence (appropriate/ inappropriate) x 3 SOAs (400msec, 750msec, 1500msec). Response times and error rates were dependent variables.

4.2.4. Effects for lists and versions

As lists and versions were dummy variables, the first analyses investigated whether there were any interactions between them and any other variables so they could be safely eliminated from any further analyses. As long as there were no substantial differences between them, they would have no influence on the other analyses. The lists and versions were not important to the research questions. If an analysis were to show there were no interactions, the lists and version could be collapsed with confidence. Two five-way ANOVAs were performed separately on

each SOA, one on response times and one on error rates. The design was a 2 (lists) x 4 (versions) x 2 (skill level) x 2 (target) x 2 (congruence) split-plot. The lists, versions, and skill level were between-subjects variables, and target type and congruence were within-subjects variables. Response time (msecs) was the main dependent variable.

In addition, error rate (*%E*) was used as a dependent variable. In language experiments that require a fast response, the main dependent variable of interest is the response time. However, a problem occurs if response time is at the expense of accuracy. This is called a speed-accuracy trade-off (Jonides & Mack, 1984). For example, a participant with a fast mean response rate of 600msecs who makes no errors would not be equivalent to a participant with the same mean response rate (600msecs) who makes, say, 15% errors. As a result of this potential confound, errors are also analysed in order to match findings and ensure there are no speed-accuracy trade-offs. The results for the five-way ANOVAs showed there were no speed-accuracy trade-offs as either errors decreased as response times decreased or error rates did not change across response speeds.

There were no significant interactions for lists or versions for subject or item response times in the first SOA. However, in the second SOA there was a significant interaction between lists, versions, and congruence in the analyses for subject errors ($F_1(3,16) = 5.30, p < .05$) and items errors ($F_2(3,56) = 3.20, p < .05$). This result was not significant when analysed by combined subjects and items with $minF'(3,63) = 1.99, p > .10$.

In the third SOA there was a significant interaction between versions, targets and congruence in the analyses for subject response ($F_1(3,16) = 4.12, p = < .05$) and items response ($F_2(3,56) = 6.75, p = .001$). This result just reached significance for $minF'(3,37) = 2.56, p < .10$. There were no significant interactions between lists and versions for error rates in the third SOA.

Over the whole five-way analysis for response times and error rates across both subjects and items, the result of one significant interaction was not considered problematic, and lists and versions were collapsed into one. The variables *lists* and *versions* formed no further part in the analyses.

4.2.5. Effects for main variables of skill, target, and congruence

The main focus of the study is to look for differences between the two groups, more skilled readers and less skilled readers. Two three-way ANOVAs were performed separately on each SOA, one on response times and one on error rates. The design was a 2 (skill level) x 2 (target) x 2 (congruence) split-plot. Skill level was a between-subjects variable, and target type and congruence were within-subjects variables. Response time (msecs) and error rate (*%E*) were the dependent variables.

The main areas of interest are any priming effects which are indicated by the variable *congruence* (appropriate and inappropriate), any differences in response speeds between the more skilled readers and less skilled readers indicated by the

variable *group* (skill level) and any differences between associate target words and inference target words indicated by the variable *target* (associates and inference).

There was a significant main effect for *target* in all three SOAs for subject and item responses. The results for *minF'* for these three main effects are shown in Table 4.4. The *minF'*s for responses were significant showing that responses to associate target words were faster than responses to inference target words.

There was a significant main effect for *target* in the first and second SOAs for subject and item errors as shown in Table 4.4. The two *minF'*s for errors were not significant so there was no difference in the error rate between associate target words and inference target words. There were no other main effects or interactions for response rates or errors. The results for the three-way ANOVAs showed there were no speed-accuracy trade-offs.

Table 4.4

MinF' Results for Main Effects of Target

SOA	DV	Analysis
1	Responses	$F_1(1,24) = 19.80, p < .001$; $F_2(1,60) = 16.93, p < .001$ $minF'(1,73) = 9.13, p < .01$
2		$F_1(1,24) = 10.80, p < .01$; $F_2(1,60) = 14.50, p < .001$ $minF'(1,59) = 6.19, p < .05$
3		$F_1(1,24) = 48.70, p < .001$; $F_2(1,60) = 8.42, p < .01$ $minF'(1,76) = 7.18, p < .01$
1	Errors	$F_1(1,24) = 4.74, p < .05$; $F_2(1,60) = 4.86, p < .05$ $minF'(1,67) = 2.40, p > .10$
2		$F_1(1,24) = 5.27, p < .05$; $F_2(1,60) = 6.32, p < .05$ $minF'(1,63) = 2.87, p = .10$

4.2.6. Associates and inferences

Given that the present study plans to look at how associate and inference priming effects pattern with different skill levels, the two types of target words were analysed separately. Two two-way ANOVAs with 2 (skill) x 2 (congruence) as the factors were conducted, measuring each SOA separately. For inferences there was a significant main effect for *skill* in the third SOA for both subject and item responses. *MinF'* also reached significance (F_1 (1,24) = 5.99, $p < .05$; F_2 (1,120) = 41.13 , $p < .001$; *minF'* (1,31) = 5.23, $p < .05$). More skilled readers (M = 703.56, SD = 108.16) were faster in responses to inference word targets than less skilled readers (M = 844.09, SD = 224.5). Results for these last analyses are shown in Figures 4.2 and 4.3 and the full tables of means can be found in Appendix N. There were no other significant main effects or interactions for any of these analyses for either response times or error rates. The results for the two-way ANOVAs showed there were no speed-accuracy trade-offs.

4.2.7. Comprehension and error rates

Participants were asked eight comprehension questions during the experiment and these were scored to check that participants were actually reading the passages and not just looking for the target words. Percentage of correct responses for comprehension questions was high for both groups at M = 87.24, SD = 13.52 for the more skilled reader group, and M = 82, SD = 15.97 for the less skilled reader group. Scores ranged from 50% to 100% correct for both groups. These results indicate that participants had read the passages.

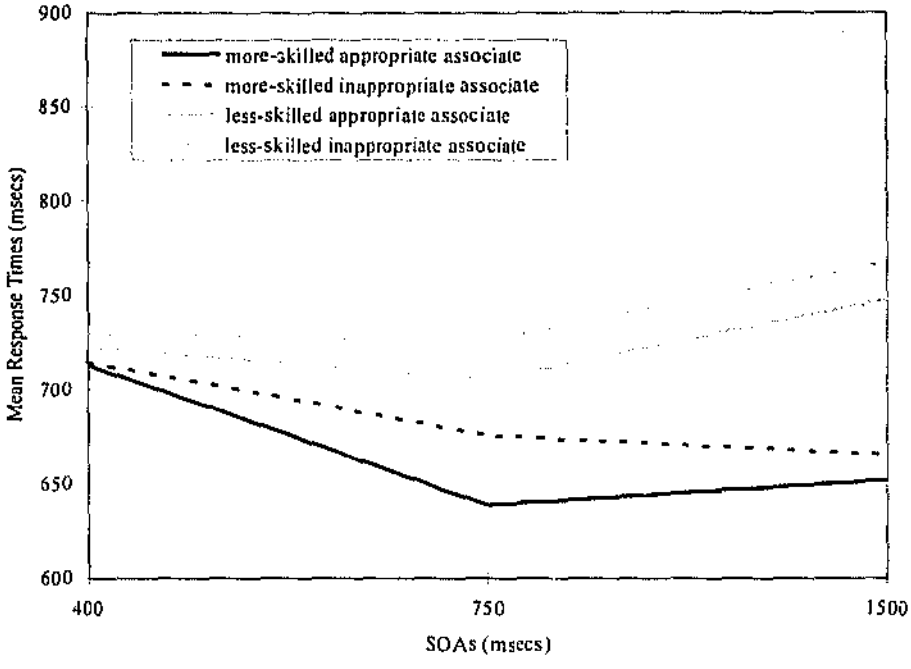

Figure 4.2. Means for Associate Responses.

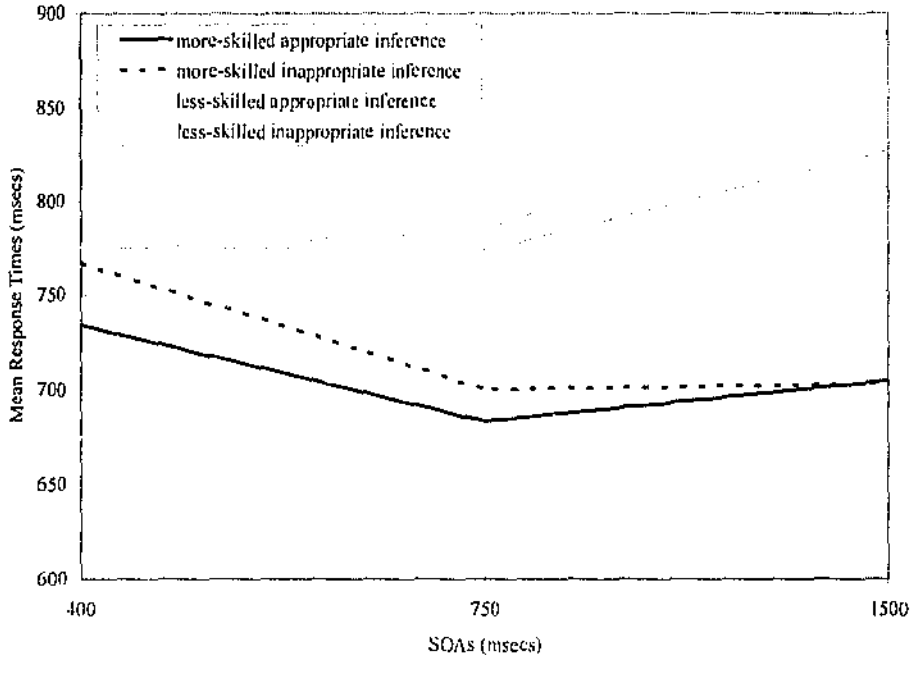

Figure 4.3. Means for Inference Responses

The percentage error rate for incorrect responses to the target words and non-words in the experiment was small for both groups with $M = 4\%$, $SD = 3.29$ and range 0% to 13% for more skilled readers, and $M = 5\%$, $SD = 4.18$ and range 0% to 16% for less skilled readers. These results indicate that participants understood the instructions for the task.

5. Discussion and Conclusions

The results of the analyses showed several significant findings which will be discussed in this section. Partial support was gained for two of the hypotheses. The study was a partial replication of Long et al.'s (1994) study and the findings are compared to the results of their study. There were several differences in design and results between the two studies and the implications of these will be discussed. The models will be examined in light of the findings. Suggestions for future research are proposed.

Two of the hypotheses proposed in this study addressed the effects of associate words. The first hypothesis, that both more skilled and less skilled readers would demonstrate associative priming, was not supported. The associate priming effect, measured by the variable *congruence,* was not significant either for more skilled readers or less skilled readers at any of the SOAs. In addition, for the second hypothesis, the two groups' response times for the associate target words were not different.

The pattern for priming for inference words did not occur either. Therefore, neither the replication nor the extension part of the third hypothesis is supported. That is, there was no priming effect at the 400msec or 750msec SOAs or the extended SOA of 1500msecs.

The fourth hypothesis investigated response times for inference target words. There was no difference between the two groups' response times on the first two SOAs. However, more skilled readers' response times were faster than less skilled

readers' response times at the third SOA. This provided support for the fourth hypothesis, but only at the third SOA.

The last hypothesis compared the effects of the two types of target words concerned with word association and inferences as Till et al. (1988) had shown. The hypothesis proposed that overall responses to associate target words would be faster than responses to inference target words. This was supported as there was a main effect for the variable *target* for subjects' responses on all three SOAs.

5.1. Comparisons with Long et al.'s (1994) Study

Of the results from all the analyses the most surprising result is the failure of the priming effect to occur (as measured by *congruence* in the analysis). Long et al. (1994) found priming effects at both 400sec and 750msec. There are several possible explanations as to why the priming effect did not occur in this study.

Kleiman's (1980) study, reported in the introduction, found a large facilitation for target words that provided a best completion for a sentence and a smaller facilitation effect for other target words that provided a plausible completion. This finding was a rationale for conducting the word association pilot study to maximise any possible priming effects. However, perhaps despite this precaution there was just not a strong enough association between the resulting primes and targets used in the materials to capture the priming effect.

Stanovich (1991, p. 432), commenting on earlier studies such as Neely (1977), Meyer and Schvaneveldt (1971) and some of his own work (Stanovich & West, 1979, 1981), observes that they used "materials that were highly predictable and

loaded with semantic associates." Stanovich argues that, although these materials served their purpose in the experiments to test cognitive reading models, the results cannot be generalised to typical texts read by fluent adult readers. Such texts are not as highly predictable, and experiments using more representative texts have failed to find the same large context effects. In fact, context effects have been reduced to a few milliseconds, which is the magnitude found in the present study. The sentences used in the present study might be more like this latter type.

Differences in results between the two studies amount to a failure to replicate. This prompts two questions: Did the sample of participants come from the same population of people, and was the sample of passages from the same population of items?

Participants for both studies were mainly university psychology undergraduates. However, sample selection was different. Long et al.'s (1994) participants took part for course credits. The participants for the present study were volunteers. It is possible that less skilled readers might have been unwilling to take part in an experiment which assessed reading ability. The resulting sample might not have had as wide a range of reading ability as Long et al.'s. A lack of differences could have reduced the possibility of capturing any differences in the dependent variables.

Even though there might not have been large differences in the groups in the present study, there was still a significant difference for skill in the third SOA for inferences. Future research could investigate whether larger differences in reading ability might spread these differences further apart.

Another noticeable difference between the studies is that response times for the present study for both groups were much faster. For example, for appropriate associate responses for more skilled readers at the 400msecs and 750msecs SOAs the means for Long et al.'s (1994) study were approximately 730msecs, whereas for the present study the means for more skilled readers were 712msecs and 638msecs. This is an unexpected result as virtually all of the participants for the present study were novices to the lexical decision task.

The original materials were not satisfactory to use because of the influence of American language and culture that contribute to people's world knowledge and word knowledge. There is a possibility that the passages were qualitatively different somehow. However, the materials were tested by pilot studies in the same way as Till et al. (1988) did when formulating the original studies.

Long et al.'s (1994) study used more participants ($N = 168$), compared to $N = 96$ for the present study. However, as they tested six SOAs, this would have given a smaller cell size of eight, as compared to a cell size of 16 in the present study. Although the sample and cell size was considered adequate, perhaps a larger study in the future could incorporate greater numbers in order to detect smaller effect sizes.

5.2. Models

All of the models discussed in this paper rely on priming effects to explain cognitive processing and as these effects were not found in the present study, it is difficult to draw any conclusions about the processes which took place. However,

the models can be considered with regard to response times to the two different types of targets.

Proponents of bottom-up models would contend that there is a bottom-up process occurring because, despite there being no priming effect, associate responses were still faster than inferences. Till et al. (1988) take this view with the selection-activation-elaboration model. The strict interpretation of the bottom-up model does not allow for the influence of higher order effects like context effects. It has no mechanism for resolving ambiguity in a homograph before passing on the input to a higher level. The bottom up model would say both meanings of the homograph are accessed more on the basis of their word frequency in the language than their context in the sentence. In the present study, the ambiguity of the homograph was not resolved in the time allowed, as the results indicate both meanings of the homograph were accessed equally and it appears that readers did not rely on the context of the sentence. The lack of context effects is difficult to interpret in terms of top-down processing. It appears the processing occurred in more of a bottom-up manner.

Proponents of the interactive models, such as McClelland and Rumelhart (1981) who developed the interactive-activation model, would say both groups of readers are still processing associates and inferences but less skilled readers are just slower than more skilled readers. A limitation of the interactive-activation model is that it deals only with word level context and therefore does not explain the difference in response time to inferences as opposed to associates. Perfetti (1993) makes the point that inferences need complex computations whereas more basic lexical processes, such as syntactic procedures, use symbols, which is a different process. Comparisons cannot be made automatically from word context to sentence context findings.

However, the interactive models would expect interaction from higher levels of processing and this has not occurred in the present study.

Two dual process models were included in this study. Posner and Snyder (1975), who developed the two-process theory of expectancy model, would say that associate words were processed more automatically because responses to them were faster. Responses to inference words were so much slower, they would be off-line, especially at the third SOA.

The other dual process model discussed in this study, the interactive-compensatory model, looked at the possibility that language processing is different for more skilled and less skilled readers. Stanovich (1980) would say more skilled readers are faster because their processing is more bottom-up. Not only are they faster than less skilled readers but they are faster at associate words than at inference words which indicates they are using a bottom-up process. However, there is no evidence that less skilled readers are using a top-down process, rather they appear to be slower at using the bottom-up process.

5.3. Conclusions: Warnings and Baselines

There was a difference in response times between the two groups of readers on the third SOA of 1500msecs. It is possible to anticipate that the target word is about to appear with this longest SOA because of the pause between prime and target word presentation, whereas at the shortest SOA, there is no pause, and with the middle SOA the pause is so brief, it is not noticeable. Jonides and Mack (1984) call this anticipation a warning effect, and they maintain it might have the effect of

heightening the participant's attention to the task. However, from the results for the last SOA in the present study, it appears that less skilled readers did not anticipate the onset of the target words as their means have increased for appropriate inference target words from $M = 773.56$ at the second SOA to $M = 827.19$ at the third SOA, and the more skilled readers' means stayed the same ($M = 652.00$ and $M = 665.38$ respectively).

Although there was no significant effect for congruency between the appropriate and inappropriate target words, another way to look at the results is to regard the inappropriate target words as control conditions that provide a baseline for the appropriate target words. Researchers in cognitive language processing have been debating different baseline measures. Some include in their studies a neutral baseline by presenting rows of Xs instead of words before the onset of the target word. Jonides and Mack (1984) criticise this method. They maintain that responding to rows of Xs is a different task requiring different processing, therefore the baseline is not neutral. As it is necessary that the baseline tests the same cognitive language processes, perhaps the conditions usually used in lexical decision tasks provide legitimate control measures.

Till et al. (1988) found that although both meanings of the homograph are selected initially, the contextual bias suppressed the inappropriate meaning within 400msecs. This would indicate that, with SOAs of over 400msecs, the decayed inappropriate meaning should provide a baseline measurement against the primed appropriate meaning. However, in the present study there was no difference between the responses to the appropriate and inappropriate associate words. It appears that

the participants accessed both meanings of the homograph equally at all three SOAs. Even after 1500msecs the inappropriate meaning of the homograph had not decayed. As the inappropriate meaning was equally accessed, the inappropriate associate target words did not provide a legitimate control condition.

The longest response times were for the inappropriate inference target words. Because these words were related to the meaning of a passage from the list each participant did not see, they would have no relationship to the prime word or the passage. Therefore they are more promising as a neutral baseline. As there was no difference in response times to the appropriate or inappropriate inference target words for either group, it can be concluded the participants did not draw inferences from the passages. When they responded to the inference target word, the only part of the passage accessed by the language processor was the prime word. There was no evidence of the effect of *context* selecting the appropriate meaning of the homograph for either group. Identical results could have been expected if the participants had only been presented with the prime word, then the target word, without any sentence context being shown. This indicates participants might have only been attending to the last word read before the target, the homograph prime in a similar manner to the word association task.

It appears that if inferences are going to be drawn at all, it is after 1500msecs and they would not be considered automatic after such a delay. There is no evidence in the present study that inferences required for local text coherence were made on-line, as was the case in McKoon and Ratcliff's studies (1980, 1992). Inference generation as an off-line process seems more likely.

5.4. Recommendations for Further Research

It is felt that there is little point in extending the SOA time any further as a 2000msec SOA was trialed for this study and was found to be an inordinately long time to wait for the target word to appear. Looking more carefully at other aspects of the design might prove more fruitful.

The main objective of including the comprehension questions was to prompt participants to read all the passages rather than looking for the target words. However, the comprehension scores proved to be helpful in determining whether participants had attended to the task. There were eight forced-choice questions. Scores ranged from 50% to 100% in both groups indicating that they were some measure of attending to the task. However, with forced-choice, participants have a 50% chance of selecting the correct answer even if they do not know it. Future studies might employ other forms of response such as multiple-choice. This would place more emphasis on the comprehension aspect of the research design in order to differentiate attentiveness to the task.

Till et al.'s (1988) study has been criticised by Magliano et al. (1993) for not distinguishing between different types of inference, such as bridging inferences that are said to be processed on line, and more elaborative inferences that are more likely to be drawn off-line. This was not considered a problem for the present study because the majority of passages used by Till et al. involved global inferences about the topic. However, four passages possibly asked a "what might happen next" question which would be considered an elaborative inference. Magliano et al. argue that, when testing inference generation, passages requiring elaboration might wash

out any effects from other more on-line inference passages. Future research might address this issue by categorising the different types of inferences and testing them separately.

In conclusion, attention of future researchers could focus more on the changing demands placed on readers by the technological age. The ability to process large amounts of information is becoming more important. The results of the present study gave no support to the contention of top-down processing, which is the current approach emphasised in the Australian education system. Rather, speed and accuracy of identification of single words appear to be associated with reading skill. The results of the present study support the need for teaching basic literacy skills which use a bottom-up process and require clear grounding in the rules of language such as grapheme-phoneme correspondences.

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List of Appendices

Appendix A

Experimental Paragraphs with Associate and Inference Test Words from Till, Mross, and Kintsch (1988)

LIST 1

item No.	paragraph	*prime word*	target 1 appropriate associate	target 2 inappropriate associate	target 3 appropriate inference	target 4 inappropriate inference
1.	The townspeople were amazed to find that all the buildings had collapsed except the *mint*. Obviously, it had been built to withstand natural disasters.	*mint*	money	candy	earthquake	breath
2.	For the third time, the worried player swung but missed the *ball*. He knew what the coach would say.	*ball*	bat	dance	out	marriage
3.	The jockey was happy to receive the trophy. However, he said the secret was his use of a new kind of harness and *bit*.	*bit*	horse	piece	race	salt
4.	The doctor became very nervous as he watched the patient's *pupils*. He had seen this kind of problem only once or twice before.	*pupils*	eyes	student	sick	prank
5.	When the boy was sent to bed without supper, the mother worried that her husband was too *rash*. He had not asked for the boy's side of the story.	*rash*	harsh	hives	punishment	medicine
6.	The lawyer read the document to the entire group. Then the witness signed at the bottom and filled in the *dates*.	*dates*	year	fruit	court	shipwreck

7.	Round after round, the visitor tried to find his opponent's weakness. When the fencing instructor blew his whistle, the visitor grudgingly lowered his *foil*.	*foil*	sword	tin	defeat	barbecue
8.	The millionaire jumped from the window when he heard about the new rate of *interest*. His entire fortune was at stake.	*interest*	money	hobby	suicide	affair
9.	Jim became the first to win the contest from his *club*. He viewed the challenge as a patriotic duty.	*club*	group	hit	proud	tired
10.	The students wrote as fast as they could while the professor covered one board and went on to a *second*. It seemed like every class period was like this.	*second*	first	minute	notes	chess
11.	When the maid turned away from the laundry, the baby grabbed the *iron*. Later that day, the maid started looking for a new job.	*iron*	clothes	steel	burn	dead
12.	The waiter left quickly as he saw the angry customer tear up the *bill*. He did not want to risk getting in a fight.	*bill*	check	duck	fear	zoo
13.	The host raised his glass in honour of the *sage*. His timeless advice was helpful to all.	*sage*	wise	brush	toast	deserted
14.	The gardener pulled the hose around to the holes in the yard. Perhaps the water would solve his problem with the *mole*.	*mole*	ground	face	drown	cancer
15.	The fighter pilot scanned the waters until he located it. All that could be seen above water was the *tip*.	*tip*	end	money	submarine	date
16.	The architect displayed his final version of the plans. He had used all the available information from the *file*.	*file*	papers	nail	blueprint	burglar

17.	The audience stood and continued to clap loudly after the last *refrain*. The performance was easily the best of the concert season.	*refrain*	song	stop	encore	gamble
18.	The rabbi looked for something to use in putting up his announcement. Finally, he used his shoe to tack it to the door of the *temple*.	*temple*	church	head	hammer	boxing
19.	The sparrow loved to compete with the others. But no matter how hard he worked, he could not keep up with the *swallow*.	*swallow*	bird	gulp	flying	birthday
20.	The sailors felt that they had no choice. They could no longer tolerate a captain so *mean*.	*mean*	cruel	average	mutiny	correct
21.	The parents worried about their son's way of life. His troubles with the police were made worse by his temper and stubborn *will*.	*will*	mind	testament	jail	insurance
22.	The little girl was very happy with the new doll from her grandmother. She reached up to hug her and give her a little *smack*.	*smack*	kiss	hit	love	pain
23.	It was dark as the young woman passed the graveyard. Having seen too many movies, she was afraid of the sudden appearance of a *bat*.	*bat*	fly	ball	vampire	broken
24.	After desperately holding the rope for hours, the climber felt his arms begin to go *limp*. Still, he had hopes that he would be rescued.	*limp*	soft	leg	fall	miracle
25.	Everyone drove on the left side. At night, they seemed quite courteous and used only the low *beam*.	*beam*	light	ceiling	England	repair

26.	The old man sat with his head down and did not hear a word of the sermon during *mass*. Nevertheless, he felt better after the service.	*mass*	church	weight	sleep	test
27.	The scribbling on the paper was hard to read but was apparently of great importance. It was carried to the king by a young *page*.	*page*	boy	book	message	car
28.	The evidence was very convincing. Although the judge thought it was useless, he agreed to review the *case*.	*case*	history	box	guilty	drunk

LIST 2

item No.	paragraph	*prime word*	target 1 appropriate associate	target 2 inappropriate associate	target 3 appropriate inference	target 4 inappropriate inference
1.	Thinking of the amount of garlic in his dinner, the guest asked for a *mint*. He soon felt more comfortable socializing with the others.	*mint*	candy	money	breath	earthquake
2.	The lonely maiden had great hopes as she dressed to go to the *ball*. This was her only opportunity to meet people.	*ball*	dance	bat	marriage	out
3.	All afternoon the chef monitored the food preparations for the party. He tasted the soup, then added a little *bit*.	*bit*	piece	horse	salt	race
4.	The thumbtack was carefully positioned on the chair by one of the *pupils*. Everyone watched as the newcomer went to his					

	assigned desk.	*pupils*	students	eye	prank	sick
5.	The hiker reached in his pack when he realized he had a *rash.* There must be something that would stop the itch.	*rash*	hives	harsh	medicine	punishment
6.	Despite the storm, the lightening and the 50-foot waves, a few survivors held tightly to the mast. Eventually they reached a desert island and began to feast on *dates.*	*dates*	fruit	year	shipwreck	court
7.	The servant lit the fire and then prepared the meat. He seasoned it and wrapped it in *foil.*	*foil*	tin	sword	barbecue	defeat
8.	The husband was afraid that his jealous wife would discover his new *interest.* He kept looking for clever ways to account for his time.	*interest*	hobby	money	affair	suicide
9.	The caveman had been searching so long that when he finally came upon a small animal, he was not able to swing his *club.* He was frustrated, to say the least.	*club*	hit	group	tired	proud
10.	The master was ready and moved the piece in less than a *second.* His opponent would have to try a new strategy.	*second*	minute	first	chess	notes
11.	The worker was struck by a gigantic, falling chunk of *iron.* Everyone was seriously upset by the accident.	*iron*	steel	clothes	dead	burn
12.	The parents helped the little boy toss food through the fence in the direction of the bird's *bill.* Then they all walked on to see the other animals.	*bill*	duck	check	zoo	fear
13.	The buildings were run down, the windows were boarded up, and the only traffic was the blowing tumbleweed and *sage.* Still, one					

	could sense the importance the town once had.	*sage*	brush	wise	deserted	toast
14.	The patient sensed that this was not a routine visit. The doctor hinted that there was serious reason to remove the *mole*.	*mole*	face	ground	cancer	drown
15.	The waitress smiled and said she would get off work soon. The young man decided to wait and left a big *tip*.	*tip*	money	end	date	submarine
16.	The old woman awoke to a sound from downstairs. She reached in her purse but found only a *file*.	*file*	nail	papers	burglar	blueprint
17.	Dave played his chips quickly and went for more; he seemed unable to *refrain*. His whole life revolved around the game.	*refrain*	stop	song	gamble	encore
18.	Mike rehearsed his moves mentally. At the signal, he planned to go for his opponent's left ear and *temple*.	*temple*	head	church	boxing	hammer
19.	The big moment arrived and the boy was very excited. He blew out the candles and then bit into more cake than he could possibly *swallow*.	*swallow*	gulp	bird	birthday	flying
20.	The proofreader checked each chapter. Then he added some numbers, and filled in the *mean*.	*mean*	average	cruel	correct	mutiny
21.	Several policies were found and processed. The relatives received the money from the company long before the settlement of the *will*.	*will*	testament	mind	insurance	jail
22.	Danny had a lot to learn about riding bicycles. Going too fast and looking the other way, he rode into the wall with a *smack*.	*smack*	hit	kiss	pain	love
23.	The teammates heard the loud crack. That was the last time					

	anyone would be able to use that *bat*.	*bat*	ball	fly	broken	vampire
24.	After touching Christ, the beggar found that he no longer walked with a *limp*. He had been rewarded for his faith.	*limp*	leg	soft	miracle	fall
25.	The restaurant manager started to panic. He had looked up and noticed a huge crack in the *beam*.	*beam*	ceiling	light	repair	England
26.	The chemistry student knew that this was not a good time to forget how to calculate volume and *mass*. Again, she tried to recall the formulas.	*mass*	weight	church	test	sleep
27.	He rarely had to perform a job of this sort. Thus, the mechanic followed carefully the directions on each *page*.	*page*	book	boy	car	message
28.	The fraternity party finally came to an end. There were several examples of what happens when one tries to consume a *case*.	*case*	box	history	drunk	guilty

Appendix B

Associate Word Pilot Study Instructions and Materials

Dear student

My name is Alison Clark. I am a psychology (honours) student and I am doing my research in the area of adult literacy. As part of my test instrument I am using a list of homographs (words which have the same spelling but have more than one meaning, for example, *bank* which can mean the side of a river, or a place to deposit money). As the test instrument is American, there may be some language differences, so I am asking for your assistance in testing the list with an Australian sample. Filling in the list should take you about 15 minutes and you are free to withdraw at any time. Thank you for assisting me.

Instructions

On the following two pages are the lists of words. Please read each word and write down two **single words** which are **associated with two different meanings** of the word. The words you write can be a synonym (for example, cordial....friendly, or jumper....pullover) or an associated word (for example, cordial....raspberry, or jumper....warm). Try to use **the first appropriate word** which comes to mind. Please don't feel you must spend a lot of time deliberating over each one. If you can't think of a word, leave a blank and proceed to the next. Here are two further examples:

scales	1.	.....weigh.....	2.	.....fish.....
crest	1.	.....top.....	2.	.....cockatoo.....

If you are not sure of what to do, please ask me for clarification. If you understand the instructions, please proceed.

mint	1.	2. .....
ball	1.	2. .....
bit	1.	2. .....
pupils	1.	2. .....
rash	1.	2. .....
dates	1.	2. .....
foil	1.	2. .....
interest	1.	2. .....
club	1.	2. .....
second	1.	2. .....
iron	1.	2. .....
bill	1.	2. .....
sage	1.	2. .....
mole	1.	2. .....
tip	1.	2. .....
file	1.	2. .....
refrain	1.	2. .....
temple	1.	2. .....
swallow	1.	2. .....
mean	1.	2. .....
will	1.	2. .....
smack	1.	2. .....
bat	1.	2. .....
limp	1.	2. .....

beam	1.	2. .....
mass	1.	2. .....
page	1.	2. .....
case	1.	2. .....
coach	1.	2. .....
park	1.	2. .....
patient	1.	2. .....
stick	1.	2. .....
order	1.	2. .....
stern	1.	2. .....
express	1.	2. .....
batter	1.	2. .....
scrub	1.	2. .....
yarn	1.	2. .....
clog	1.	2. .....
resort	1.	2. .....
hamper	1.	2. .....
bark	1.	2. .....
crank	1.	2. .....
poach	1.	2. .....
poker	1.	2. .....
yard	1.	2. .....

Thank you very much for your assistance.

Appendix C

Summary of Chi-square Results for Associate Word Pilot Study

Score sheet N=40								CHI SQ	TEST				
prime word	meaning 1		meaning 2		meaning 3		others	score 1	score 2	mean	Xsq crit= 3.84	source	deleted
mint	herb	23	!olly	20	money	19	18	23	19	21	0.38	Till	
								19	20	19.5	0.03		
								23	20	21.5	0.21		
ball	bat	23	round	24	dance/ing	22	11	23	22	22.5	0.02	Till	
								24	22	23	0.09		
								23	24	23.5	0.02		
bit	small	32	horse	17			31	32	17	24.5	4.59	Till	deleted
pupils	students	43	eyes	36			1	43	36	39.5	0.62	Till	
rash	skin	42	hasty	36			2	42	36	39	0.46	Till	
dates	fruit	37	calendar	28			15	37	28	32.5	1.25	Till	
foil	aluminium	40	stop	22			18	40	22	31	5.23	Till	deleted
interest	attention	36	money	34			10	36	34	35	0.06	Till	
club	bat/hit	31	group	29			20	31	29	30	0.07	Till	
second	first	40	time	29			11	40	29	34.5	1.75	Till	
iron	clothes/ing	34	metal	28			18	34	28	31	0.58	Till	
bill	money	38	duck	23			19	38	23	30.5	3.69	Till	
sage	herb	37	wise	31			12	37	31	34	0.53	Till	

Appendix C

Summary of Chi-square Results for Associate Word Pilot Study

Score sheet N=40								CHI SQ	TEST				
prime word	meaning 1		meaning 2		meaning 3		others	score 1	score 2	mean	Xsq crit= 3.84	source	deleted
moie	animal	36	skin	35			9	36	35	35.5	0.01	Till	
tip	top	25	money	13	rubbish	21	21	25	13	19	3.79	Till	
								25	21	23	0.17		
								13	21	17	0.94		
file	cabinet	38	nail/s	30			12	38	30	34	0.94	Till	
refrain	stop	48	music	19			13	48	19	33.5	12.55	Till	deleted
temple	religion/ious	41	head	37			2	41	37	39	0.21	Till	
swaliow	gulp/throat	41	bird	38			1	41	38	39.5	0.11	Till	
mean	nasty	34	average	23			23	34	23	28.5	2.12	Till	
will	death/testament	38	power/willpower	38			4	38	38	38	0.00	Till	
smack	hit	45	drug/s	23	lips	9	3	45	23	34	7.12	Till	deleted
bat	ball	43	animal	36			1	43	36	39.5	0.62	Till	
limp	walk	40	floppy	37			3	40	37	38.5	0.12	Till	
beam	wood/en	33	light	25			22	33	25	29	1.10	Till	
mass	weight	29	church	26	large	24	1	29	26	27.5	0.16	Till	
								26	24	25	0.08		
								29	24	26.5	0.47		

Appendix C

Summary of Chi-square Results for Associate Word Pilot Study

Score sheet N=40								CHI SQ	TEST				
prime word	meaning 1		meaning 2		meaning 3		others	score 1	score 2	mean	Xsq crit= 3.84	source	deleted
page	book/s	41	boy	19			20	41	19	30	8.07	Till	deleted
case	law	39	bag	27			14	39	27	33	2.18	Till	
coach	teach	44	bus	35			1	44	35	39.5	1.03	Forster	
park	garden/s/trees	42	car	37			1	42	37	39.5	0.32	Forster	
patient	hospital	41	wait/ing	34			5	41	34	37.5	0.65	Forster	
stick	wood	39	glue	28			13	39	28	33.5	1.81	Forster	
order	demand	28	sequence	25			27	28	25	26.5	0.17	Forster	
stern	strict	41	boat/s	37			2	41	37	39	0.21	Forster	
express	fast/train	36	say	33			11	36	33	34.5	0.13	Forster	
batter	fish	44	hit (abuse)	26			10	44	26	35	4.63	Forster	deleted
scrub	clean	42	bush	33			5	42	33	37.5	1.08	Forster	
yarn	story	40	wool	38			2	40	38	39	0.05	Forster	
clog	block/ed	40	shoe/s	38			2	40	38	39	0.05	Forster	
resort	holiday	45	last	31			4	45	31	38	2.58	Forster	
hamper	picnic	40	hinder	36			4	40	36	38	0.21	Forster	

Appendix C

Summary of Chi-square Results for Associate Word Pilot Study

Score sheet N=40								CHI SQ	TEST				
prime word	meaning 1		meaning 2		meaning 3		others	score 1	score 2	mean	Xsq crit= 3.84	source	deleted
bark	dog	41	tree	39			0	41	39	40	0.05	Forster	
crank	wind	31	joke	17			32	31	17	24	4.08	Forster	deleted
poach	steal	40	egg/s	38			2	40	38	39	0.05	Forster	
poker	card/s	42	fire	38			0	42	38	40	0.20	Forster	
yard	measure	42	garden	38			0	42	38	40	0.20	Forster	

Appendix D

Inference Word Pilot Study A Instructions and Materials

Hi! My name is Alison Clark. I am a psychology (honours) student and I am doing my research in the area of adult literacy. In particular, I am interested in **how people make inferences** from what they read. As the test instrument I am using is American, there may be some language differences, so I am asking for your assistance in testing the passages with an Australian sample. Filling in your responses should take you about 20 minutes and you are free to withdraw at any time. Thank you for assisting me.

Instructions
Please read each passage and write down **a word reflecting your understanding of what the passage is about**.

Here is an example: If you read the passage "He stood on the cliff, palette and brush in hand, surveying the scene before him." you might infer that he was about to paint a picture of the scene, so your response might be "artist" or "painting."

Here is another example: If you read the passage "The jockey was happy to receive the trophy." you might infer that he had just won a horse race, so your response might be "race" or "winner."

Please proceed with the passages.

1. The townspeople were amazed to find that all the buildings had collapsed except the mint. .....

2. For the third time, the worried player swung but missed the ball. .....

3. The doctor became very nervous as he watched the patient's pupils. .....

4. When the boy was sent to bed without supper, the mother worried that her husband was too rash. .....

5. The lawyer read the document to the entire group. Then the witness signed at the bottom and filled in the dates. .....

6. The millionaire jumped from the window when he heard about the new rate of interest. .....

7. Jim became the first to win the contest from his club. .....

8. The students wrote as fast as they could while the professor covered one board and went on to a second. .....

9. When the maid turned away from the laundry, the baby grabbed the iron. .....

10. The waiter left quickly as he saw the angry customer tear up the bill. .....

11. The host raised his glass in honour of the sage. .....

12. A number of mysterious holes kept appearing in the lawn near the hedgerow. Then the gardener realized he might have a problem with a mole. .....

13. The fighter pilot scanned the waters until he located it. All that could be seen above water was the tip. .....

14. The architect displayed his final version of the plans. He had used all the available information from the file. .....

15. He shaved his head and put on the orange robe. This was the first time he would take part in the ceremony in the temple. .....

16. The sparrow loved to compete with the others. But no matter how hard he worked, he could not keep up with the swallow. .....

17. The sailors felt that they had no choice. They could no longer tolerate a captain so mean. .....

18. The parents worried about their son's health. The number of hours he studied seemed too many, but he had a very strong will. .....

19. It was dark as the young woman passed the graveyard. Having seen too many movies, she was afraid of the sudden appearance of a bat. .....

20. After desperately holding the rope for hours, the climber felt his arms begin to go limp. .....

21. Everyone drove on the right hand side. At night, they seemed quite courteous and used only the low beam. .....

22. The old man sat with his head down and did not hear a word of the sermon during mass. .....

23. The evidence was very convincing. Although the judge thought it was useless, he agreed to review the case. .....

24. The passengers were frightened when the men stopped the coach. .....

25. The friends knew tickets for the last game had sold out. They would be lucky to find somewhere to park. .....

26. When Sally saw the room was decorated with balloons, she found it difficult to be patient. .....

27. The soles of the cheap shoes began to come apart. She tried to find something to make them stick. .....

28. By the time the group of friends reached the restaurant they were ready to order. .....

29. Well into the dark and stormy night, the frightened passengers felt a sudden thump. There was sure to be some damage to the stern. .....

30. After his alarm clock failed to ring, he was lucky to catch the express. .....

31. After working on it all day, he was covered in grease and oil. His overalls needed a good scrub. .....

32. When the day's mustering was over they liked to sit around, relax and have a good yarn. .....

33. After a day of watching the big mammals frolic in the water, the launch returned them to the resort. .....

34. When he came upon the scene he did not know if his efforts would only hamper. .....

35. She was surprised to find out this well-known spice was made from ground bark. .....

36. He couldn't find work in the village. As he crossed the lord of the manor's land, he hoped there would be a rabbit to poach. .....

37. By midnight it had nearly gone out. He threw on more wood and gave it a jab with the poker. .....

38. She watched as the assistant cut off a metre of material. She remembered the days when it would have been a yard. .....

39. Thinking of the amount of garlic in his dinner, the guest asked for a mint. .....

40. The lonely maiden had great hopes as she dressed to go to the ball. .....

41. The thumbtack was carefully positioned on the chair by one of the pupils. .....

42. The hiker reached in his pack when he realized he had a rash. .....

43. Despite the storm, the lightening and the 50-foot waves, a few survivors held tightly to the mast. Eventually they reached a desert island and began to feast on dates. .....

44. The husband was afraid that his suspicious wife would discover his new interest. .....

45. The caveman had been searching so long that when he finally came upon a small animal, he was not able to swing his club. .....

46. The master was ready and moved the piece in less than a second. .....

47. The worker was struck by a gigantic, falling chunk of iron. .....

48. The parents helped the little boy toss food through the fence in the direction of the bird's bill. Then they all walked on to see the other animals. .....

49. Ken laid aside the duck while he mixed the breadcrumbs, onion, thyme and sage. .....

50. The patient sensed that this was not a routine visit. The doctor hinted that there was serious reason to remove the mole. .....

51. After asking him for the millionth time, Sue waited until he was out, then she cleaned out the shed. She took all the boxes to the tip. .....

52. The old woman awoke to a sound from downstairs. She reached in her purse but found only a file. .....

53. Mike rehearsed his moves mentally. At the signal, he planned to go for his opponent's left ear and temple. .....

54. The big moment arrived and the boy was very excited. He blew out the candles and then bit into more cake than he could possibly swallow. .....

55. The proofreader checked each chapter. Then he added some numbers, and filled in the mean. .....

56. Several policies were found and processed. The relatives received the money from the company long before the settlement of the will. .....

57. The teammates heard the loud crack. That was the last time anyone would be able to use that bat. .....

58. After touching Christ, the beggar found that he no longer had a limp. .....

59. The restaurant manager started to panic. He had looked up and noticed a huge crack in the beam. .....

60. The chemistry student knew that this was not a good time to forget how to calculate volume and mass. .....

61. Next time he travelled he would use some bright stickers. He was the last one to find his case. .....

62. All the team rallied around after the game and cheered the coach. .....

63. The rangers started sampling the water. This year there didn't seem to be many hatchlings in the park. .....

64. At least twice a week the doctor would visit this particular patient. .....

65. Rusty, the dog, could still beg and heel. Sadly, he was no longer able to fetch a stick. .....

66. In the days of the Charge of the Light Brigade they were all prepared to accept an order. .....

67. After finding the bedraggled kitten in the toilet bowl, Billy's father was stern. .....

68. When she found the spare tyre had air in it, her relief was more than she could express. .....

69. He gazed up at the bright stars. After the noise and bustle of the city, it was good to get out into the scrub. .....

70. They watched in fascination as she deftly gathered the fibres and made them into yarn. .....

71. They had tried everything else they could to right the yacht, and this was their last resort. .....

72. They thought about how lucky they were with the weather as they packed the hamper. .....

73. It was two o'clock in the morning when suddenly he leaped up and began to bark. .....

74. Look for them in the nests while you are in their pen. If you are lucky, you might find some you can scramble or poach. .....

75. He waited desperately for the next round to be dealt. All he needed was just one good hand of poker. .....

76. The thought of cooking for the visitors outside made them rethink their plans. They raced around and cleaned up the yard. .....

Thank you very much for your assistance.

Appendix E
Summary of Results for Inference Pilot Study A

Item	N=27			* Top scoring word in **bold**			* Till's inference word in *italics*							
No.	Item	prime	inf 1	score	inf 2	score	inf 3	score	inf 4	score	assoc	score	no res	total
1	townspeople/building	mint	***earthquake***	24	surprise	1	structure	1			money	1		27
2	player/swung	ball	**baseball**	15	golf/sport/etc	12								27
3	doctor/nervous	pupils	**emergency/injur**	15	depression	2	worried	2	examination	3	eyes	5		27
4	boy/sent/bed	rash	***punishment***	16	naughty	4	sad	2	angry	3	hastyquick	2		27
5	lawyer/document	dates	**will**	16	legalities	10	finished	1						27
6	millionaire/jump	interest	***suicide***	15	bankrupt	7	rate	3	excitement	1	money	1		27
7	Jim/win/contest	club	**winner**	12	sport	7	new club	4	violence	1	organisation	3		27
8	students/professor	second	**lecture**	23	examination	1	panic	2			time	1		27
9	maid/baby/	iron	***burn***	18	housework	4	quick	1			clothes/washir	4		27
10	waiter/angry/custom	bill	**dissatisfied**	10	restaurant	8	price	9						27
11	host/glass/honour	sage	***toast***	21	communion	1	medieval	1	dinner	1	wise man	2	1	27
12	holes/lawn	mole	**pest/s**	9	English	7	burrowing	3	decease	3	animal/rodent	4	1	27
13	pilot/water/scan	tip	***submarine***	11	iceberg	8	target	6			rubbish	1	1	27
14	architect/plans	file	**building**	15	*blueprint*	3	big effort	7			cabinet	2		27
15	shaved head/robe	temple	**monk**	14	Buddhist/Hari Kri	8	initiation	3			church/religior	2		27
16	sparrow/compete	swallow	competition	6	slow/er	5	*flying*	3	nest	3	**birds**	9	1	27
17	sailors/tolerate/capt.	mean	***mutiny***	22	ship	1	angry	1			bad/unfair	3		27
18	parents/worried/son	will	exams	10	concern/ed	5					**determinatio**	12		27

Appendix E
Summary of Results for Inference Pilot Study A

Item	N=27			* Top scoring word in **bold**			* Till's inference word in *italics*							
No.	Item	prime	inf 1	score	inf 2	score	inf 3	score	inf 4	score	assoc	score	no res	total
19	dark/woman/graveya	bat	***vampire***	10	fear	12	cemetry	1			animal	3	1	27
20	holding/rope/climber	limp	***fall***	9	fatigue	7	mountain	8	tied (tired?)	1	saggy/soft	2		27
21	drove/rhs/night	beam	**America**	8	traffic	6	police	7			light/s/headlig	5	1	27
22	old man/head down	mass	depression	6	*sleep*	5	preoccupation	3	deaf	2	**church**	11		27
23	evidence/judge/revie	case	**appeal**	16	court	7	situation	3					1	27
24	passengers/frightene	coach	**robbery**	15	riot	4	travel	1	wondering	1	bus	6		27
25	friends/tickets/game	park	**football/footy**	13	crowded	8	optimism	2			car	4		27
26	Sally/balloons	patient	**party**	16	excited	6	irritation	1			wait	4		27
27	soles/ cheap shoes	stick	poverty	6	quality	2	walk	2	favourite	2	**glue**	13	2	27
28	friends/restaurant	order	**hunger**	12	dinner	9	late	2			ask/decision	4		27
29	dark/stormy/passeng	stern	shipwreck	8	gails	2	voyage	3			**back/ship**	14		27
30	alarm clock/ring	express	late	10	work	1	hurried	2	morning	1	**train/coach/t**	13		27
31	working/grease/over	scrub	**mechanic/s**	20	dirty	1					clean/ing/was	6		27
32	mustering/sit around	yarn	**cowboy/s**	12	camping	8	work	1	drink	1	talk	5		27
33	mammals/water/laur	resort	**whales**	15	tourists	5	boat ride	1			holiday/motel	6		27
34	scene/efforts	hamper	**accident**	14	unconfident	5	waste	1	consideratio	3	hinder	4		27
35	surprised/ground ba	bark	**cinnamon**	10	cooking	3	witchdoctor/yuc	2	knowledge	1	tree/bush	4	1	27

Appendix E
Summary of Results for Inference Pilot Study A

Item No.	Item N=27	prime	inf 1	* Top scoring word in **bold** score	inf 2	score	* Till's inference word in *italics* inf 3	score	inf 4	score	assoc	score	no res	total
36	work/village/manor	**poach**	**hunger**	8	hunter	7	estate	2	destination	2	**steal**	8		27
37	midnight/wood/jab	**poker**	warm	2	fireplace	1	camping	2			**fire**	22		27
38	assistant/metre/mate	**yard**	**old/er**	9	progress	5	dressmaker/ing	8			measurement	4	1	27
39	garlic/dinner/guest	**mint**	***breath***	16	freshener	3	regard	1	date	1	lolly/sweet	6		27
40	lonely maiden/hopes	**ball**	**excitement**	8	Cinderella	7	partner	4			**dance/ing/pa**	8		27
41	thumbtack/chair	**pupils**	***prank***	15	ouch	1	schoolprimary s	3	glue	1	students	7		27
42	hiker/pack	**rash**	**cream**	11	hiking	2	mosquitos	1	pain	2	**allergy/ies**	11		27
43	storm/waves/survivo	**dates**	***shipwreck***	19	ravenous	1	coconut	3			fruit	4		27
44	husband/suspicious	**interest**	***affair***	13	girlfriend	6	fear/jealous	7	crossdressin	1				27
45	caveman/search/ani	**club**	**fatigue**	15	hunting	7					stick/wood/ba	5		27
46	master/move/piece	**second**	***chess***	22	fast	3	wood	2						27
47	worker/struck/chunk	**iron**	**accident**	12	building site	7	bar	4			steel	4		27
48	parents/boy/toss/foo	**bill**	**zoo**	25	teaching	1	catch	1						27
49	Ken/duck/onion/thym	**sage**	**stuffing**	15	cooking	9	chef	3						27
50	patient/visit/doctor	**mole**	***cancer***	23	urgency	2	treatment	1			spot	1		27
51	millionth time/Sue/sh	**tip**	**spring clean**	11	devious	5	exasperation	5	Playboy mag	2	rubbish	3	1	27
52	old woman/sound/pu	**file**	**intruder**	17	frightened	3	strike	2			nail/s	5		27
53	Mike/opponent's ear	**temple**	***boxing***	23	hit	2	preparation	1			side of head	1		27

Appendix E
Summary of Results for Inference Pilot Study A

Item	N=27			* Top scoring word in **bold**			* Till's inference word in *italics*							
No.	Item	prime	inf 1	score	inf 2	score	inf 3	score	inf 4	score	assoc	score	no res	total
54	moment/boy/excited	swallow	***birthday***	22	greed/y	4	choked	1						27
55	proofreader/checked	mean	**statistics**	12	editor	6	finish	3	work	1	average	3	2	27
56	policies/relatives/mo	will	***insurance***	16	death	8	fortunate	2					1	27
57	teammates/loud cra	bat	**cricket**	14	*broken*	11	fast ball	1			stick	1		27
58	Christ/beggar	limp	***miracle***	21	fallacy	1	cripple	5						27
59	restaurant manager/	beam	**disaster**	10	safety	3	earthquake	7			rafter/ceiling	7		27
60	chemistry student/ca	mass	**exam**	16	failure	5	physics	2			weight	4		27
61	travelled/stickers	case	**airport**	14	frustrated	3	cave	1			luggage/suit	9		27
62	team rallied around	coach	**win**	15	sport	6	loss	2	clapped	1	leader	3		27
63	rangers sample wate	park	**pollution**	8	fish	6	conservationist	5	drought	4	forest	2	2	27
64	twice week doctor vi	patient	**illness**	11	kidney	7	over servicing	1	worried	1	hospital	7		27
65	Rusty, dog, fetch	stick	**old**	15	disabled	5	dog	2	trained	1	log/wood	2	2	27
66	Charge of Light Brid	order	**army**	11	obedience	8	redhats	3			command	5		27
67	bedraggled kitten/Bil	stern	**mischief**	11	responsibility	4	couldn't stay	2	drowning	3	angry	7		27
68	spare tyre/air/relief	express	**flat**	16	hurry	3	offer	1	dumb	1	say	5	1	27
69	gazed/bright stars	scrub	**camping**	15							bush/country	12		27
70	fascination/fibres	yarn	**spinning**	12	artisan	5	clever	1			wool/material	8	1	27

Appendix E
Summary of Results for Inference Pilot Study A

Item	N=27			* Top scoring word in **bold**			* Till's inference word in *italics*							
No.	Item	prime	inf 1	score	inf 2	score	inf 3	score	inf 4	score	assoc	score	no res	total
71	tried everything/yach	resort	**capsize/d**	12	storm	5	heave	4			effort	6		27
72	lucky/weather/	hamper	fine weather	3	camping	1					**picnic**	23		27
73	two o'clock/morning	bark	intruder	8							**dog/guard-dc**	19		27
74	nests/pen	poach	chickens	5	pinch	1					**eggs**	21		27
75	desperately/round/de	poker	gambler	14	bluff	1					**cards**	12		27
76	cooking/visitors/outsi	yard	**barbecue/barbie**	16	mess	4	hostel	1	surprise	2	garden/backy	2	2	27

Appendix F

Explanatory Notes for the Unsatisfactory Inference Passages

Item 15: the passage contained the inappropriate associate word (*head*) and this may have acted as a cross-priming source.

Item 28 used the wrong meaning of the homograph (*order--request,* the second scoring meaning, rather than *order--sequence*, the highest score meaning).

Items 36 and 74 (the homograph *poach*): both meanings were associated with each other (*poach*--cook food and *poach*--steal food) and this could have caused cross-priming. This pair of passages was deleted from the study.

Item 48 included both sentences, instead of just the first. This could have caused a different inference to be drawn.

Item 51: the highest response was a two word rather than one word answer, and was directly referred to in the passage, rather than an inference (*spring-cleaning*).

With responses for 12 other items (item 16, 18, 21, 22, 29, 30, 37, 64, 72, 73, 75), responses of the associate meanings were higher than, or nearly as high as, the highest inference word or meaning. They therefore lacked a clear distinction between the associate words and inferences from the passages.

Appendix G

Inference Word Pilot Study B Instructions and Materials

Hi! My name is Alison Clark. I am a psychology (honours) student at Edith Cowan University and I am doing my research in the area of adult literacy. In particular, I am interested in **how people make inferences** from what they read. As the test instrument I am using is American, there are some language differences, so I have changed some of the passages. I am asking for your assistance in testing the passages with an Australian sample. Filling in your responses should take you about 5 minutes and you are free to withdraw at any time. Thank you for assisting me.

Instructions
Please read each passage and write down **ONE WORD reflecting your understanding of what the passage is about.**

Here is an example: If you read the passage "He stood on the cliff, palette and brush in hand, surveying the scene before him." you might infer that he was about to paint a picture of the scene, so your response might be "artist" or "painting."

Here is another example: If you read the passage "The jockey was happy to receive the trophy." you might infer that he had just won a horse race, so your response might be "race" or "winner."

Please proceed with the passages.

1. He put on the orange robe and lit some incense sticks. This was the first time he would take part in the ceremony in the temple. .....

2. The children loved to search all the hideaways in the swamp nearby. Under one bush they found a lizard and in a small nesting burrow there was a swallow. .....

3. Scruffy would always come when called and wait patiently at the edge of the road. Ever since she was three months old she had been taught to obey her master's will. .....

4. For years the little town stood empty in darkness. Occasionally a car passed through and cast an eerie beam. .....

5. The old man sat with his eyes downcast and his head in his hands and did not hear a word during mass. .....

6. They tipped all the ballot papers on the table and started putting them in order. .....

7. The frightened passengers saw porthole lights pass very close and then they felt a sudden thump. There was sure to be some damage to the stern. .....

8. After two days in the hills, walking and carrying all their gear, they were pleased to catch an express. .....

9. By midnight the weather had set in and Bill was shivering. He threw on more wood and gave a jab with the poker. .....

10. The parents helped the little boy toss food through the fence in the direction of the bird's bill. .....

11. The old one didn't have much memory, while the new one had half a gigabyte. Not knowing what to do with the old one, they took it to the tip. .....

12. Fortunately, this was the last time the doctor would need to call on this particular patient. .....

13. Jim could smell the smoke from the coal furnace and heard the whistle blow as they heaved the children into the carriage and threw in the hamper. .....

14. It was two o'clock in the morning when Jill and Tom heard scraping noises at the window and Rusty began to bark. .....

15. The friends enjoyed a sing-song around the piano and watched a video. After supper they finished the evening with a few games of drafts and poker. .....

Appendix H
Summary of Results from Inference Pilot Study B

Item No.	Item N=27	prime	* Top scoring word in **bold** inf 1	score	inf 2	score	inf 3	score	inf 4	score	assoc	score	no respons	total
15	robe/incense	**temple**	**monk**	11	Buddhism	6	magician	2	initiation	3	religion	4	1	27
16	swamp/lizard/spar	**swallow**	**adventure**	18	nature	6	bush kids	2					1	27
18	Scruffy/obey/mast	**will**	**dog**	16	obedient/ce	11								27
21	town/empty/car	**beam**	**ghost-town**	23	old gold towr	2	fog	1	progress	1				27
22	old man/head in h	**mass**	**grief**	21	deaf	1	prayer	1	tired	1	catholic	1	2	27
28	ballot papers	**order**	**election**	25	co-operation	1	station	1						27
29	passengers/dama	**stern**	**collision**	20	anxiety	2	shipping	1			ship	4		27
30	hills/walking/gear	**express**	**hikers**	15	exhaustion	7	civilisation	1	school cam	1	train	2	1	27
37	midnight/wood/jab	**poker**	**winter**	13	tramper	5	inside	1	lost	1	fire	7		27
48	parents/boy/toss/f	**bill**	**zoo**	16	guidance	7	feeding	3	against rule	1				27
51	memory/gigabyte	**tip**	**computer/s**	20	obsolescenc	5	yes, exactly	1					1	27
64	twice week doctor	**patient**	**recovery**	14	death	9	house visit	1	medicine	2	hospital	1		27
72	smoke/furnace/wh	**hamper**	**train**	13	leaving	5	storyline	1			picnic	8		27
73	scraping/window/t	**bark**	**burglar**	16	uncertainty	5	cat	2	assignatior	1	dog/watch	2	1	27
75	friends/video/gam	**poker**	**socialising**	11	party	10	family	4	corny	1			1	27

Appendix I

Final Sets of 32 Passages--List 1 and List 2

LIST 1

item No.	paragraph	*prime*	target 1 appropriate associate	target 2 inappropriate associate	target 3 appropriate inference	target 4 inappropriate inference
1.	The townspeople were amazed to find that all the buildings had collapsed except the *mint*. Obviously, it had been built to withstand natural disasters.	*mint*	money	lolly	earthquake	breath
2.	For the third time, the worried player swung but missed the *ball*. He knew what the coach would say.	*ball*	bat	dance	baseball	Cinderella
3.	The doctor became very nervous as he watched the patient's *pupils*. He had seen this kind of problem only once or twice before.	*pupils*	eyes	students	emergency	prank
4.	The lawyer read the document to the entire group. Then the witness signed at the bottom and filled in the *dates*.	*dates*	calendar	fruit	will	shipwreck
5.	The millionaire jumped from the window when he heard about the new rate of *interest*. His entire fortune was at stake.	*interest*	money	attention	suicide	affair
6.	Jim became the first to win the contest from his *club*. He viewed the challenge as a patriotic duty.	*club*	group	hit	winner	fatigue

7.	The students wrote as fast as they could while the professor covered one board and went on to a *second*. It seemed that every class period was like this.	*second*	first	time	lecture	chess
8.	The waiter left quickly as he saw the angry customer tear up the *bill*. He did not want to risk getting in a fight.	*bill*	money	duck	dissatisfied	zoo
9.	The host raised his glass in honour of the *sage*. His timeless advice was helpful to all.	*sage*	wise	herb	toast	stuffing
10.	A number of mysterious holes kept appearing in the lawn near the hedgerow. Then the gardener realized he might have a problem with a *mole*.	*mole*	animal	skin	pest	cancer
11.	The fighter pilot scanned the waters until he located it. All that could be seen above water was the *tip*.	*tip*	top	rubbish	submarine	computer
12.	The architect displayed his final version of the plans. He had used all the available information from the *file*.	*file*	cabinet	nail	building	intruder
13.	He put on the orange robe and lit some incense sticks. This was the first time he would take part in the ceremony in the *temple*.	*temple*	religious	head	monk	boxing
14.	The children loved to search all the hideaways in the swamp nearby. Under one bush they found a lizard and in a small nesting burrow there was a *swallow*.	*swallow*	bird	gulp	adventure	birthday
15.	The sailors felt that they had no choice. They could no longer tolerate a captain so *mean*.	*mean*	nasty	average	mutiny	statistics

16.	Scruffy would always come when called and wait patiently at the edge of the road. Ever since she was three months old she had been taught to obey her master's *will.*	*will*	power	testament	dog	insurance
17.	It was dark as the young woman passed the graveyard. Having seen too many movies, she was afraid of the sudden appearance of a *bat.*	*bat*	animal	ball	vampire	broken
18.	After desperately holding the rope for hours, the climber felt his arms begin to go *limp.* Still, he had hopes that he would be rescued.	*limp*	floppy	walk	fall	miracle
19.	For years the little town stood empty in darkness. Occasionally a car passed through and cast an eerie *beam.*	*beam*	light	wooden	ghost-town	disaster
20.	The old man sat with his eyes downcast and his head in his hands and did not hear a word during *mass.* Nevertheless, he felt better after the service.	*mass*	church	weight	grief	exam
21.	The evidence was very convincing. Although the judge thought it was useless, he agreed to review the *case.*	*case*	law	bag	appeal	airport
22.	The passengers were frightened when the men stopped the *coach.* It was a dangerous road to travel at night.	*coach*	bus	teach	robbery	win
23.	The friends knew tickets for the last game had sold out. They would be lucky to find somewhere to *park.*	*park*	car	trees	football	pollution
24.	When Sally saw the room was decorated with balloons, she found it difficult to be *patient.* She had waited so long for her birthday.	*patient*	waiting	hospital	party	recovery
25.	They tipped all the ballot papers on the table and started putting them in *order.* There would be a long night of counting ahead.	*order*	sequence	demand	election	army

26.	The frightened passengers saw porthole lights pass very close and then they felt a sudden thump. There was sure to be some damage to the *stern.*	*stern*	boat	strict	collision	mischief
27.	After two days in the hills, walking and carrying all their gear, they were pleased to catch an *express.* Soon they would be home.	*express*	train	say	hikers	flat
28.	After working on it all day, he was covered in grease and oil. His overalls needed a good *scrub.*	*scrub*	clean	bush	mechanic	camping
29.	After a day of watching the big mammals frolic in the water, the launch returned them to the *resort.* They were tired but happy to be on the island.	*resort*	holiday	last	whales	capsized
30.	She was surprised to find out this well-known spice was made from ground *bark.* It is often used in cooking.	*bark*	tree	dog	cinnamon	burglar
31.	By midnight the weather had set in and Bill was shivering. He threw on more wood and gave a jab with the *poker.*	*poker*	fire	cards	winter	socialising
32.	She watched as the assistant cut off a metre of material. She remembered the days when it would have been a *yard.*	*yard*	measure	garden	old	barbeque

LIST 2

item No.	paragraph	*prime*	target 1 appropriate associate	target 2 inappropriate associate	target 3 appropriate inference	target 4 inappropriate inference
1.	Thinking of the amount of garlic in his dinner, the guest asked for a *mint*. He soon felt more comfortable socializing with the others.	*mint*	lolly	money	breath	earthquake
2.	The lonely maiden had great hopes as she dressed to go to the *ball*. This was her only opportunity to meet people.	*ball*	dance	bat	Cinderella	baseball
3.	The thumbtack was carefully positioned on the chair by one of the *pupils*. Everyone watched as the newcomer went to his assigned desk.	*pupils*	students	eyes	prank	emergency
4.	Despite the storm, the lightening and the 50-foot waves, a few survivors held tightly to the mast. Eventually they reached a desert island and began to feast on *dates*.	*dates*	fruit	calendar	shipwreck	will
5.	The husband was afraid that his suspicious wife would discover his new *interest*. He kept looking for clever ways to account for his time.	*interest*	attention	money	affair	suicide
6.	The caveman had been searching so long that when he finally came upon a small animal, he was not able to swing his *club*. He was frustrated, to say the least.	*club*	hit	group	fatigue	winner
7.	The master was ready and moved the piece in less than a *second*. His opponent would have to try a new strategy.	*second*	time	first	chess	lecture

8.	The parents helped the little boy toss food through the fence in the direction of the bird's *bill*. Then they all walked on to see the other animals.	*bill*	duck	money	zoo	dissatisfied
9.	Ken laid aside the duck while he mixed the breadcrumbs, onion, thyme and *sage*. He was an expert at baking a roast dinner.	*sage*	herb	wise	stuffing	toast
10.	The patient sensed that this was not a routine visit. The doctor hinted that there was serious reason to remove the *mole*.	*mole*	skin	animal	cancer	pest
11.	The old one didn't have much memory, while the new one had half a gigabyte. Not knowing what to do with the old one, they took it to the *tip*.	*tip*	rubbish	top	computer	submarine
12.	The old woman awoke to a sound from downstairs. She reached in her purse but found only a *file*.	*file*	nail	cabinet	intruder	building
13.	Mike rehearsed his moves mentally. At the signal, he planned to go for his opponent's left ear and *temple*.	*temple*	head	religious	boxing	monk
14.	The big moment arrived and the boy was very excited. He blew out the candles and then bit into more cake than he could possibly *swallow*.	*swallow*	gulp	bird	birthday	adventure
15.	The proofreader checked each chapter. Then he added some numbers, and filled in the *mean*.	*mean*	average	nasty	statistics	mutiny
16.	Several policies were found and processed. The relatives received the money from the company long before the settlement of the *will*.	*will*	testament	power	insurance	dog

17.	The teammates heard the loud crack. That was the last time anyone would be able to use that *bat*.	*bat*	ball	animal	broken	vampire
18.	After touching Christ, the beggar found that he no longer had a *limp*. He had been rewarded for his faith.	*limp*	walk	floppy	miracle	fall
19.	The restaurant manager started to panic. He had looked up and noticed a huge crack in the *beam*.	*beam*	wooden	light	disaster	ghost-town
20.	The chemistry student knew that this was not a good time to forget how to calculate volume and *mass*. Again, she tried to recall the formulas.	*mass*	weight	church	exam	grief
21.	Next time he travelled he would use some bright stickers. He was the last one to find his case.	*case*	bag	law	airport	appeal
22.	All the team rallied around after the game and cheered the *coach*. They all deserved to celebrate.	*coach*	teach	bus	win	robbery
23.	The rangers started sampling the water. This year there didn't seem to be many hatchlings in the *park*.	*park*	trees	car	pollution	football
24.	Fortunately, this was the last time the doctor would need to call on this particular *patient*. She was much improved after the operation.	*patient*	hospital	waiting	recovery	party
25.	In the days of the Charge of the Light Brigade they were all prepared to accept an *order*. Most went to their deaths.	*order*	demand	sequence	army	election
26.	Billy knew this had been the wrong way to bath the kitten. After finding the bedraggled kitten in the toilet bowl, Billy's father was *stern*.	*stern*	strict	boat	mischief	collision

27.	When she found the spare tyre had air in it, her relief was more than she could *express*. She was able to change it herself.	*express*	say	train	flat	hikers
28.	He gazed up at the bright stars. After the noise and bustle of the city, it was good to get out into the *scrub*.	*scrub*	bush	clean	camping	mechanic
29.	They had tried everything else they could to right the yacht, and this was their last *resort*. They desperately hoped it would work.	*resort*	last	holiday	capsized	whales
30.	It was two o'clock in the morning when Jill and Tom heard scraping noises at the window and Rusty began to *bark*. They were sure they'd locked that window.	*bark*	dog	tree	burglar	cinnamon
31.	The friends enjoyed a sing-song around the piano and watched a video. After supper they finished the evening with a few games of drafts and *poker*.	*poker*	cards	fire	socialising	winter
32.	The thought of cooking for the visitors outside made them rethink their plans. They raced around and cleaned up the *yard*.	*yard*	garden	measure	barbeque	old

Appendix J

Informed Consent Form

Dear student,

My name is Alison Clark, and I am an honours student in psychology. I am conducting research into adult reading. Thank you for coming here today to help me with my research.

Any questions concerning my project can be directed to my principal supervisor, Dr Brett Degoldi, of the Psychology Department, Edith Cowan University, Bunbury Campus, on telephone 097 80 7729.

This is a reading task which tests comprehension, knowledge of synonyms and antonyms, and pronunciation. The aim is simply to measure the reading ability of adults, in this case university students. The results will have no bearing on any assessments in your units of study.

Your participation is entirely voluntary and you are free to withdraw at any time. Initially your name will be recorded on a slip along with an allocated subject number so that results from the tests can be collated. After data collection is completed, your name slip will be removed from your response sheets and destroyed so that your data cannot be individually identified.

This consent form will be kept separately from any data collected.

Do you have any questions?

CONSENT

I, ..., have read the information above and any questions I have asked have been answered to my satisfaction. I agree to participate in this project. I understand that I am free to withdraw at any stage without any consequences.

I agree that the research data gathered for this study may be published provided I am not identifiable.

Participant's signature .....

Date .....

Appendix K

Example of Complete Experiment from List 1

Instructions

You will see sentences one word at a time on the screen.
Your task is to decide if the item in UPPER CASE is a WORD.
If it is a word press the RIGHT shift key, if it is NOT a word press the LEFT shift key.
Remember to respond as quickly and accurately as possible.
Here are some items for practice. Please start when ready.

Practice Items

+250 The model knew she couldn't have lost five kilos in a week. She decided it must have been the scale. === WEIGH === **appropriate associate**
-250 The little craft tried several times to enter the open sea. Ultimately, the skipper was driven back by the rain and hail. === VERTREY === **non word**
+250 The bird sat quietly on its perch. === FISH === Meanwhile the children cleaned the cage and added food and water. **inappropriate associate**
+250 The old janitor really couldn't hear very well. === DEAF === He asked the child to speak up and talk more clearly. **appropriate inference**
-250 The jockey was sure victory was his. He felt the young filly surge ahead as they entered the final lap. === CADE === **non word**
-250 The vineyard produced an excellent port. === BIRNDER === It was the first time they had won a medal at the show. **non word**
+250 The jogger had been running at a quick pace but did not feel winded. Then all of a sudden he felt a muscle tighten in his calf. === MILK === **inappropriate inference**

That's the end of the practice items. Go on when ready...
-250 Jill asked the owners again to fix the laundry tap. === CHUD === It had been leaking for weeks. **non word (extra practice item)**

Block 1: Experimental Items and Filler Items

+011 The townspeople were amazed to find that all the buildings had collapsed except the mint. === MONEY === Obviously it had been built to withstand natural disasters. **appropriate associate**
+021 A number of mysterious holes kept appearing in the lawn near the hedgerow. Then the gardener realized he might have a problem with a mole. === SKIN === **inappropriate associate**
+031 She was surprised to find out this well-known spice was made from ground bark. === CINNAMON === It is often used in cooking. **appropriate inference**
+041 It was dark as the young woman passed the graveyard. Having seen too many movies, she was afraid of the sudden appearance of a bat. === BROKEN === **inappropriate inference**
-051 The clerk finished his task and took a little rest. === HONDLING === He would finish the other assignment later. **non word**

-061 Joe was upset when he saw his report card. He didn't think the grade he got was fair === EBLET === **non word**
-071 The sound of cannon fire woke the deck hands with a start. === MORPISE === Pirates had been spotted off the port bow. **non word**
-081 All afternoon the chef monitored the food preparations for the party. He tasted the soup then added a little bit. === LIND === **non word**

Comprehension Item and Question 1

-091 They fought their way through the crowd to get to the punch. === LIRST === It was worth the wait. **non word**
QUESTION 1: Were the partygoers looking for the food?

Block 2: Experimental Items and Filler Items

+012 She watched as the assistant cut off a metre of material. She remembered the days when it would have been a yard. === MEASURE === **appropriate associate**
+022 After a day of watching the big mammals frolic in the water, the launch returned them to the resort. === LAST === They were tired but happy to be on the island. **inappropriate associate**
+032 He put on the orange robe and lit some incense sticks. This was the first time he would take part in the ceremony in the temple. === MONK === **appropriate inference**
+042 After desperately holding the rope for hours, the climber felt his arms begin to go limp. === MIRACLE === Still, he had hopes that he would be rescued. **inappropriate inference**
-052 The salad was made and the steaks were fresh off the grill. The wine had been poured and all that was left was to make the corn. === CHITTLE === **non word**
-062 The climbers waited impatiently for the water to boil. === SASTING === They had not eaten a bite all day. **non word**
-072 The salesman brought out several pairs of shoes but none of them fit. Soon Tom began to wonder if there was something wrong with his feet. === RONDS === **non word**
-082 The hiker reached in his pack when he realised he had a rash. === MALIPANT === There must be something that would stop the itch. **non word**

Comprehension Item and Question 2

+092 Bob could see the traffic jam ahead. He had forgotten that before crossing the bridge he would have to pay a toll. === BELL === **inappropriate associate**
QUESTION 2: Are the cars having to wait in a queue to pay a fee?

Block 3: Experimental Items and Filler Items

+013 The doctor became very nervous as he watched the patient's pupils. === EYES === He had seen this kind of problem only once or twice before. **appropriate associate**
+023 The fighter pilot scanned the waters until he located it. All that could be seen above water was the tip. === RUBBISH === **inappropriate associate**
+033 For the third time, the worried player swung but missed the ball. === BASEBALL === He knew what the coach would say. **appropriate inference**
+043 For years the little town stood empty in darkness. Occasionally a car passed through and cast an eerie beam. === DISASTER === **inappropriate inference**

-053 The overweight musician liked playing in the band except when he had to march. === TOMICON === He'd rather sit and play jazz. **non word**
-063 This time the executive was tired of being given the wrong information. He decided to take his idea right to the top. === GOMPRISSONY === **non word**
-073 The repairman tightened some screws in the clock and adjusted a spring. === BRIND === Then he waited to see if the clock would run. **non word**
-083 The servant lit the fire and then prepared the meat. He seasoned it and wrapped it in foil. === ANDISE === **non word**

Comprehension Item and Question 3

+093 After the builders had finished they noticed the building was on a slight lean. === ANGLE === They hoped the owners would not notice. **appropriate associate**
QUESTION 3: Were the building's walls all vertical?

Block 4: Experimental Items and Filler Items

+014 The lawyer read the document to the entire group. Then the witness signed at the bottom and filled in the dates. === CALENDAR === **appropriate associate**
+024 The waiter left quickly as he saw the angry customer tear up the bill. === DUCK === He did not want to risk getting in a fight. **inappropriate associate**
+034 The children loved to search all the hideaways in the swamp nearby. Under one bush they found a lizard and in a small nesting burrow there was a swallow. === ADVENTURE === **appropriate inference**
+044 The old man sat with his eyes downcast and his head in his hands and did not hear a word during mass. === EXAM === Nevertheless, he felt better after the service. **inappropriate inference**
-054 Jill's books had been overdue for weeks and she had done nothing about it. She knew when she returned them she would have to pay a stiff fine. === PRUCKETS === **non word**
-064 The athlete couldn't decide if he wanted to attend school in a different state. === SORP === Most of his friends were staying close to home. **non word**
-074 Rusty, the dog, could still beg and heel. Sadly he was no longer able to fetch a stick === ERBOLANTS === **non word**
-084 When the maid turned away from the laundry, the baby grabbed the iron. === RESTONIA === Later that day, the maid started looking for a new job. **non word**

Comprehension Item and Question 4

-094 The soldiers swept the metal detector ahead of them very carefully. They needed to find every mine. === WONSANT === **non word**
QUESTION 4: Were the soldiers engaged in a dangerous task?

Block 5: Experimental Items and Filler Items

+015 The millionaire jumped from the window when he heard about the new rate of interest. === MONEY === His entire fortune was at stake. **appropriate associate**
+025 The frightened passengers saw porthole lights pass very close and then they felt a sudden thump. There was sure to be some damage to the stern. === STRICT === **inappropriate associate**

+035 After two days in the hills, walking and carrying all their gear, they were pleased to catch an express. === HIKERS === Soon they would be home. **appropriate inference**
+045 The evidence was very convincing. Although the judge thought it was useless, he agreed to review the case. === AIRPORT === **inappropriate inference**
-055 The little boys decided to put all the marbles they had found in a box. === INDOCTANTS === They searched for a long time before they found one the right size. **non word**
-065 The cat leaped into the bushes. She would not be caught by the neighbourhood hound. === TEPPING === **non word**
-075 The two kids watched in amazement as the egg began to hatch. === TARK === After only a minute, the small ball of feathers emerged. **non word**
-085 The scribbling on the paper was hard to read but was apparently of great importance. It was carried to the king by a young page. === ENDEN === **non word**

Comprehension Item and Question 5

-095 The fishermen spent many hours mending the net. === MORAP === It was time they couldn't spend fishing. **non word**
QUESTION 5: Did the fishermen lose time repairing equipment?

You are now half way through the items

Block 6: Experimental Items and Filler Items

+016 By midnight the weather had set in and Bill was shivering. He threw on more wood and gave a jab with the poker. === FIRE === **appropriate associate**
+026 The host raised his glass in honour of the sage. === HERB === His timeless advice was helpful to all. **inappropriate associate**
+036 The sailors felt that they had no choice. They could no longer tolerate a captain so mean === MUTINY === **appropriate inference**
+046 The passengers were frightened when the men stopped the coach. === WIN === It was a dangerous road to travel at night. **inappropriate inference**
-056 The acting and the scenery of the play were very good. All that was needed was a plot === PODAT === **non word**
-066 Kim couldn't decide what vegetable to plant. === ENIT === With carrots peas and beans that still left room for one more row. **non word**
-076 He couldn't find work in the village. As he crossed the lord of the manor's land, he hoped there would be a rabbit to poach. === SHARDONTING === **non word**
-086 Dave played his chips quickly and went for more; he seemed unable to refrain. === TEPPING === His whole life revolved around the game. **non word**

Comprehension Item and Question 6

+096 It was a long, demanding race. === MARATHON === All the competitors were exhausted afterwards. **appropriate inference**
QUESTION 6: Did the runners find the race easy?

Block 7: Experimental Items and Filler Items

+017 Jim became the first to win the contest from his club. === GROUP === He viewed the challenge as a patriotic duty. **appropriate associate**
+027 The architect displayed his final version of the plans. He had used all the available information on file. === NAIL === **inappropriate associate**
+037 They tipped all the ballot papers on the table and started putting them in order. === ELECTION === There would be a long night of counting ahead. **appropriate inference**
+047 The friends knew tickets for the last game had sold out. They would be lucky to find somewhere to park. === POLLUTION === **inappropriate inference**
-057 Billy's pet frog died so he dug a grave. === SCENGLE === He had become very attached to it in the short time he had it. **non word**
-067 Students could be seen hurrying to their classes. The school bell had just rung. === ILLANET === **non word**
-077 When the day's mustering was over they liked to sit around, relax and have a good yarn. === GROAD === The cattle settled quietly for the night. **non word**
-087 There were strange noises on the end of the phone. Sarah decided it must be a crank. === PLIM === **non word**

Comprehension Item and Question 7

-097 Dad would be home soon and would discover the broken bike. Jimmy was frightened of a scolding so he tried to run away and hide. === ROG === **non word**
QUESTION 7: Had Jimmy broken his pedal car?

Block 8: Experimental Items and Filler Items

+018 After working on it all day, he was covered in grease and oil. His overalls needed a good scrub. === CLEAN === **appropriate associate**
+028 The students wrote as fast as they could while the professor covered one board and went on to a second. === TIME === It seemed that every class period was like this. **inappropriate associate**
+038 Scruffy would always come when called and wait patiently at the edge of the road. Ever since she was three months old she had been taught to obey her master's will. === DOG === **appropriate inference**
+048 When Sally saw the room was decorated with balloons, she found it difficult to be patient. === RECOVERY === She had waited so long for her birthday. **inappropriate inference**
-058 With so many exams and papers coming up Jim knew he'd be in trouble. The end of the semester was taking its toll. === CISP === **non word**
-068 This time the mover had the heavy end of the couch and held it until he had to let it drop. === AUDONERIUM === He had been moving furniture all day and was very tired. **non word**
-078 Jim could smell the smoke from the coal furnace and heard the whistle blow. They heaved the children aboard and threw in the hamper. === CHANGLE === **non word**
-088 At the last minute Pat decided to put the fish in batter. === CRIMINE === She worked quickly to mix the flour and water. **non word**

Comprehension Item and Question 8

+098 Once it had been popular to wear fur coats. However, public opinion had reduced the value of the pelt. === RAINING === **inappropriate inference**
QUESTION 8: Has wearing genuine fur become less fashionable?

End Note and Version/Variation Note

THANK YOU. That's the END. <ACEXP1A1>

Appendix L

Comprehension Passages and Questions, and Response Sheet

1. They fought their way through the crowd to get to the punch. === LIRST === It was worth the wait.
QUESTION 1: Were the partygoers looking for the food?

2. Bob could see the traffic jam ahead. He had forgotten that before crossing the bridge he would have to pay a toll. === BELL ===
QUESTION 2: Are the cars having to wait in a queue to pay a fee?

3. After the builders had finished they noticed the building was on a slight lean. === ANGLE === They hoped the owners would not notice.
QUESTION 3: Were the building's walls all vertical?

4. The soldiers swept the metal detector ahead of them very carefully. They needed to find every mine. === WONSANT ===
QUESTION 4: Were the soldiers engaged in a dangerous task?

5. The fishermen spent many hours mending the net. === MORAP === It was time they couldn't spend fishing.
QUESTION 5: Did the fishermen lose time repairing equipment?

6. It was a long, demanding race. === MARATHON === All the competitors were exhausted afterwards.
QUESTION 6: Did the runners find the race easy?

7. Dad would be home soon and would discover the broken bike. Jimmy was frightened of a scolding so he tried to run away and hide. === ROG ===
QUESTION 7: Had Jimmy broken his pedal car?

8. Once it had been popular to wear fur coats. However, public opinion had reduced the value of the pelt. === RAINING ===
QUESTION 8: Has wearing genuine fur become less fashionable?

S. No. .....

Comprehension Answer Sheet

There are eight comprehension questions during the experiment. When prompted, please circle "Yes" or "No", then press the <Spacebar> to resume the experiment.

Question 1	Yes/No
Question 2	Yes/No
Question 3	Yes/No
Question 4	Yes/No
Question 5	Yes/No
Question 6	Yes/No
Question 7	Yes/No
Question 8	Yes/No

Appendix M

Written and Verbal Instructions for Experiment

Written Instructions

In this experiment you will be presented with sentences, one word at a time. The words will flash onto the centre of the screen, one after the other. At some point, a word will flash up in UPPER CASE between equals signs. It will look like this:

=== WORD ===

Your task is to decide whether the word in UPPER CASE is a word of English, eg === **STAR** === or a made up word, eg === **STORP** ===.

- **If it is a word, press the RIGHT <Shift> key: YES**
- **If it is not a word, press the LEFT <Shift> key: NO**

Keep a finger on each shift key so that when you see the UPPER CASE === WORD ===, you can respond as QUICKLY and ACCURATELY as possible.

There are some practice items first, which are then followed by the experimental items.

There will be some comprehension questions throughout the experiment.
Answer them on the sheet of paper provided
There is no need to hurry the comprehension questions.

Remember, respond as quickly and accurately as you can to the UPPER CASE words.

DO YOU HAVE ANY QUESTIONS?

The computer will be saying EXPERIMENT READY
Please commence when you are ready, by pressing the <Spacebar>.

Dmastr Verbal Instructions

The experiment takes about **20** minutes
You will read **sentences one word at a time** in the centre of the screen.

This is a **speeded** task
Your response to the **words in UPPER CASE** will be measured (show the example on the written instructions: === WORD ===)
Is the word in UPPER CASE a real word or a made-up word?

- If it is a **real word** press the **RIGHT** shift key (YES)
- If it is a **nonword** word press the **LEFT** shift key (NO)

Keep a finger on each shift key so you can respond as **fast** and **accurately** possible

Go as **FAST** as you can so you make only occasional errors
If making too many, slow down. If not making any, speed up
When you make a response the computer will flash up "correct" or "wrong" so you'll know how accurate you are.
The number that flashes up is your speed in msecs, so see how fast you can go

At the end of each passage you will see <**Spacebar**>
Press <Spacebar> when ready to go on to next passage

You only need to be fast on your response to the UPPER CASE words which have the === signs on either side
(If more than one person in session) You are not competing against others--only competing against self

You do need to **READ** the passages
There are some **comprehension questions** dotted in amongst the passages
Make sure you read the sentences rather than just look for the UPPER CASE words
When you see a question on the screen, **circle** the **YES** or **NO** on this sheet of paper (comprehension sheet) then press <Spacebar> to continue with the computer experiment

There is a slight **BUG** in the program. Occasionally a word, usually <Spacebar>, gets stuck on the screen and stays there for the duration of the experiment
This is a bug in the program, not something you have done
The experiment continues to run underneath the stuck word
Others have said it only surprises them momentarily--they have been able to continue with the experiment, so please continue if it doesn't bother you

When you come to the end the computer will say "That's the end. Thank you" and go "beep".
(If more than one person in session) Would you please wait quietly while the others finish--everyone will finish within about a minute of each other.

Remember to respond as **quickly** and **accurately** as possible.
Here are some written instructions. Press the <**Spacebar**> when you are ready to begin.
There are some practice items first.

Appendix N

Table N.1

Means, Standard Deviations, and Standard Errors for Subject Responses on SOA 1

Associate			
	M	*SD*	*SE*
More skilled/ Appropriate	712.88	112.38	28.10
More skilled/ Inappropriate	714.75	95.25	23.81
Less skilled/ Appropriate	722.75	93.31	23.33
Less skilled/ Inappropriate	730.13	110.66	27.66

Table N.2

Means, Standard Deviations, and Standard Errors for Subject Responses on SOA 1

Inference			
	M	*SD*	*SE*
More skilled/ Appropriate	733.88	104.09	26.02
More skilled/ Inappropriate	767.00	113.52	28.38
Less skilled/ Appropriate	775.50	148.38	37.10
Less skilled/ Inappropriate	773.75	117.56	29.39

Table N.3

Means, Standard Deviations, and Standard Errors for Subject Responses on SOA 2

Associate			
	M	*SD*	*SE*
More skilled/ Appropriate	638.69	138.01	34.50
More skilled/ Inappropriate	675.50	144.53	36.13
Less skilled/ Appropriate	704.88	192.50	48.12
Less skilled/ Inappropriate	725.75	232.00	58.00

Table N.4

Means, Standard Deviations, and Standard Errors for Subject Responses on SOA 2

Inference			
	M	*SD*	*SE*
More skilled/ Appropriate	683.25	143.36	35.84
More skilled/ Inappropriate	700.00	158.62	39.65
Less skilled/ Appropriate	773.56	207.38	51.85
Less skilled/ Inappropriate	784.06	219.34	54.83

Table N.5

Means, Standard Deviations, and Standard Errors for Subject Responses on SOA 3

Associate			
	M	*SD*	*SE*
More skilled/ Appropriate	652.00	106.03	26.51
More skilled/ Inappropriate	665.38	99.63	24.91
Less skilled/ Appropriate	747.75	201.77	50.44
Less skilled/ Inappropriate	767.63	176.69	44.17

Table N.6

Means, Standard Deviations, and Standard Errors for Subject Responses on SOA 3

Inference			
	M	*SD*	*SE*
More skilled/ Appropriate	704.38	109.91	27.48
More skilled/ Inappropriate	702.75	106.41	26.60
Less skilled/ Appropriate	827.19	234.82	58.71
Less skilled/ Inappropriate	861.00	214.24	53.56

Table N.7

Means, Standard Deviations, and Standard Errors for Subject Errors on SOA 1

	Associate		
	M	*SD*	*SE*
More skilled/ Appropriate	1.88	4.33	1.08
More skilled/ Inappropriate	2.34	5.04	1.26
Less skilled/ Appropriate	2.19	6.32	1.58
Less skilled/ Inappropriate	6.25	9.13	2.28

Table N.8

Means, Standard Deviations, and Standard Errors for Subject Errors on SOA 1

	Inference		
	M	*SD*	*SE*
More skilled/ Appropriate	7.03	13.67	3.42
More skilled/ Inappropriate	7.03	9.09	2.27
Less skilled/ Appropriate	9.38	10.70	2.68
Less skilled/ Inappropriate	6.25	9.13	2.28

Table N.9

Means, Standard Deviations, and Standard Errors for Subject Errors on SOA 2

Associate			
	M	*SD*	*SE*
More skilled/ Appropriate	3.13	7.22	1.80
More skilled/ Inappropriate	7.03	11.15	2.79
Less skilled/ Appropriate	1.56	4.27	1.07
Less skilled/ Inappropriate	1.56	4.27	1.07

Table N.10

Means, Standard Deviations, and Standard Errors for Subject Errors on SOA 2

Inference			
	M	*SD*	*SE*
More skilled/ Appropriate	7.81	10.08	2.52
More skilled/ Inappropriate	7.03	11.15	2.79
Less skilled/ Appropriate	5.47	10.17	2.54
Less skilled/ Inappropriate	9.38	17.97	4.50

Table N.11

Means, Standard Deviations, and Standard Errors for Subject Errors on SOA 3

	Associate		
	M	*SD*	*SE*
More skilled/ Appropriate	0.00	0.00	0.00
More skilled/ Inappropriate	2.34	5.04	1.26
Less skilled/ Appropriate	3.13	5.60	1.40
Less skilled/ Inappropriate	4.69	8.98	2.25

Table N.12

Means, Standard Deviations, and Standard Errors for Subject Errors on SOA 3

	Inference		
	M	*SD*	*SE*
More skilled/ Appropriate	4.69	10.08	2.52
More skilled/ Inappropriate	4.69	7.74	1.93
Less skilled/ Appropriate	3.91	7.53	1.88
Less skilled/ Inappropriate	5.47	10.17	2.54