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MODELS OF MENTAL LEXICON IN BILINGUALS WITH HIGH AND LOW SECOND LANGUAGE EXPERIENCE : AN EXPERIMENTAL STUDY OF LEXICAL ACCESS

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งานวิจัยนี้ประกอบด้วยการศึกษาเชิงทดลอง 5 การทดลองเพื่อศึกษาการนึกรู้คำภาษาที่ 1 และ ภาษาที่ 2 ในผู้พูดทวิภาษาและเพื่อศึกษาความสัมพันธ์ระหว่างประสบการณ์ภาษาที่ 2 กับกระบวนการนึกรู้คำ การทดลองที่ 1 เป็นการทดลองแบบสตรูปในภาษาไทย-ภาษาอังกฤษ ซึ่งผู้ทดลองต้องบอกชื่อสีของหมึกในคำที่เขียนด้วยสีซึ่งขัดแย้งกับความหมายของคำ เช่น ในคำว่า "เขียว" ที่เขียนด้วยหมึกสีแดง ผู้ทดลองจะต้องบอกว่า "แดง" สิ่งเร้าหรือคำจะถูกเขียนเป็นภาษาไทยหรืออังกฤษและผู้ทดลองต้องตอบเป็นภาษาไทยหรืออังกฤษ โดยมีการทดลอง 4 เงื่อนไขคือ คำเรียกสีและการบอกชื่อสีเป็นภาษาที่ 1 (L1-L1) คำเรียกสีเป็นภาษาที่ 1 และการบอกชื่อสีเป็นภาษาที่ 2 (L1-L2) คำเรียกสีเป็นภาษาที่ 2 และการบอกชื่อสีเป็นภาษาที่ 1 (L2-L1) และคำเรียกสีและการบอกชื่อสีเป็นภาษาที่ 2 (L2-L2) การทดลองแสดงว่า ในกรณีของการนึกรู้ภายในภาษาเดียว คือ L1-L1 และ L2-L2 ผู้พูดทวิภาษาที่มีประสบการณ์ทางภาษาที่ 2 สูง (กลุ่มสูง) มีการแทรกแซงจากความหมายของคำสูงกว่าผู้พูดทวิภาษาที่มีประสบการณ์ทางภาษาที่ 2 ต่ำ (กลุ่มต่ำ) ในการนึกรู้คำในภาษาที่ 2 (L2-L2) กลุ่มสูงมีการแทรกแซงของความหมายของคำใกล้เคียงกับการนึกรู้คำในภาษาที่ 1 เมื่อเทียบกับการนึกรู้คำในภาษาที่ 2 ของกลุ่มต่ำ ส่วนในการนึกรู้คำข้ามภาษา (L1-L2 และ L2-L1) การแทรกแซงจากความหมายของคำเกิดขึ้นสูงกว่าในกลุ่มตัวอย่างประสบการณ์ต่ำมากกว่าในกลุ่มสูง

การทดลองที่ 2-5 ศึกษาการนึกรู้คำโดยใช้การทดลองแบบกระตุ้นเร้าความหมายของคำข้ามภาษา ซึ่งผู้ทดลองต้องตอบว่าคำที่เห็นบนจอภาพเป็นคำเรียกญาติหรือไม่ โดยก่อนที่คำจะปรากฏบนจอภาพความหมายของคำจะถูกกระตุ้นด้วยคำซึ่งกำหนดให้ปรากฏเป็นระยะเวลา 150 มิลลิวินาที คำที่ใช้ในการกระตุ้นนี้มีทั้งที่มีความหมายสัมพันธ์กับคำทดลองและไม่สัมพันธ์ กลุ่มตัวอย่างประกอบด้วย 4 กลุ่ม คือ (1) ผู้พูดทวิภาษาไทย-อังกฤษ (2) ผู้พูดทวิภาษาอังกฤษ-ไทย (3) ผู้พูดทวิภาษาจีนกลาง-อังกฤษ และ (4) ผู้พูดทวิภาษาอังกฤษ-จีนกลาง ผลการทดลองแสดงว่าการกระตุ้นเร้าความหมายของคำมีผลต่อการนึกรู้คำทั้งในกลุ่มสูงและต่ำ ความแตกต่างในการนึกรู้คำนี้เป็นผลจากประสบการณ์ทางภาษาซึ่งแสดงให้เห็นชัดด้วยความแตกต่างของอัตราความเร็วในการนึกรู้คำ ซึ่งแตกต่างกันอย่างมีนัยสำคัญทางสถิติ

ผลการทดลองทุกการทดลองสนับสนุนว่าผู้พูดทวิภาษามีระบบคำของภาษาที่ 1 และ ภาษาที่ 2 แยกกัน แต่มีระบบความหมายของภาษาที่ 1 และ 2 ร่วมกัน นอกจากนี้ ผลการทดลองเสนอแนวคิดที่ว่า ผู้พูดทวิภาษาที่มีประสบการณ์ทางภาษาที่ 2 ต่ำ มีการนึกรู้คำภาษาที่ 1 โดยตรงจากระบบความหมายและคำศัพท์แต่มีการนึกรู้คำภาษาที่ 2 ผ่านระบบคำในภาษาที่ 1 อย่างไรก็ตาม ผู้พูดทวิภาษาที่มีประสบการณ์ภาษาที่ 2 สูง มีการนึกรู้คำภาษาที่ 2 โดยตรงจากระบบความหมายไม่ได้นึกรู้ผ่านภาษาที่ 1 เช่นในกลุ่มประสบกลุ่มประสบการณ์ต่ำ

ภาควิชา .....ภาษาศาสตร์.....	**ลายมือชื่อนิสิต**.....พนอเนื่อง สุทัศน์ ณ.....อยุธยา.....
สาขาวิชา ....ภาษาศาสตร์.....	**ลายมือชื่ออาจารย์ที่ปรึกษา**.....ปิยพร ลักษณียนาวิน.....
ปีการศึกษา ....2545.....	**ลายมือชื่ออาจารย์ที่ปรึกษาร่วม**.....Denis R. Burnham.....

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KEY WORD: LEXICAL ACCESS / L2 EXPERIENCE / LEXICAL SYSTEM / CONCEPTUAL SYSTEM /

PANORNUANG SUDASNA NA AYUDHYA: MODELS OF MENTAL LEXICON IN BILINGUALS WITH HIGH AND LOW SECOND LANGUAGE EXPERIENCE: AN EXPERIMENTAL STUDY OF LEXICAL ACCESS, THESIS ADVISOR: ASSIST. PROF. SUDAPORN LUKSANEEYANAWIN, Ph. D. THESIS COADVISOR : PROF. DENIS K. BURNHAM, Ph. D., 257 pp. ISBN 974-17-1440-8

Five experiments are conducted to investigate lexical access in L1 and L2 by bilingual speakers and to explore the relationship between L2 experience and the process of lexical access. Experiment 1 is a Thai-English Stroop interference task in which subjects must name the colour of the ink of a conflicting colour word, e.g. "green" written in red ink. The stimuli were written in Thai or English and the subjects had to respond in either Thai or English, giving rise to four conditions, L1-L1, L1-L2, L2-L1, and L2-L2. This experiment revealed that the L1-L1 effect and the L2-L2 effect in the High experience - High group is higher than in the Low experience –Low group. The L2-L2 effect in the High group is higher and closer to the L1-L1 effect than in the Low group. In the L1-L2 condition, the effect in the Low group is higher than the High group.

Experiments 2-5 investigate lexical access using a cross-language version of the Semantic Priming Tasks in which subjects react to the kinship word on the screen whether it is a kinterm or not, before the word is shown on the screen it will be primed with a related term or unrelated term. Four bilingual groups were tested: (1) Thai-English, (2) English-Thai, (3) Mandarin-English, and (4) English-Mandarin bilinguals. Kinship is used as the semantic conceptual system for these experiments. The results of these four experiments demonstrate cross-language priming effects in both the High and the Low language experience groups. The different patterns of reaction time found in the cross language semantic priming experiments in subjects with high and low L2 experience are statistically significant.

Results from all the experiments support the notion that there are specific L1 and L2 lexical systems, and also a common conceptual system for L1 and L2 words. In addition, the results imply that in bilinguals with low L2 experience, L1 words are retrieved via conceptual links and L2 words are retrieved via lexical links. However, in bilinguals with high L2 experience, accessing L2 words moves to a lexical basis, as a function of L2 ability.

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Academic year .....2002..... **Co-advisor's signature** .....

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CHAPTER 1

INTRODUCTION

1.1 Background

A person hears or reads a word and s/he cannot only understand the word's meaning, but also access other knowledge about the word, for example, spelling, pronunciation, meaning, and syntactic category or part of speech. This knowledge of words is stored in the memory for words - that is, in the 'mental lexicon' (Miller, 1979).

The study of lexical access concerns two aspects of the mental lexicon: first how knowledge of words is stored in the mental lexicon, and second how word knowledge is retrieved from the mental lexicon.

Studies of lexical access suggest that the storage and the retrieval of words occur in three ways. The first is that words with similar pronunciation and spelling are stored close together in the mental lexicon, e.g. the English words "ride" and "rite", or the words "real" and "reel" are stored close together (Grainger and Ferrand, 1994). The second way is that words in the same syntactic category or with related meanings are closely linked in the semantic system of the mental lexicon. For example, the work of Deutsch, Frost, and Forster (1998) demonstrates that verbs and nouns are differently organized and retrieved such that verbs are grouped together and nouns are also grouped together. In addition, the work of Lowe (1999) shows that words with a high degree of semantic relatedness are connected much more closely than words with a low degree of semantic relatedness. The third way is that storage and the retrieval of words in the mental lexicon are determined by the relative frequency of words in the ambient language. High frequency words are retrieved faster than low frequency words (Savage, 1991).

1.1.1 Semantic Organization in the Mental Lexicon

The present study focuses on the organization and the retrieval of semantically related words in the mental lexicon by monolingual and bilingual speakers.

Research on the semantic system in monolingual subjects usually concentrate on the issue of how words of a language are represented in and retrieved from the semantic system. Forster (1976) hypothesized that words belonging to the same semantic category are grouped together in what he referred to as "bins". In other words, the semantic system of a language consists of a set of "bins" or semantic categories. Within each category, semantically related words are grouped together. The implication of this hypothesis is that we can retrieve knowledge associated with words faster if these words follow other words that are related to them in meaning or are in the same semantic category. For example, the word "nurse" is retrieved faster if this word follows other words such as "doctor", "hospital", or "medicine", compared with the case when it follows an unrelated word, such as "table". This hypothesis is presented schematically in Figure 1.

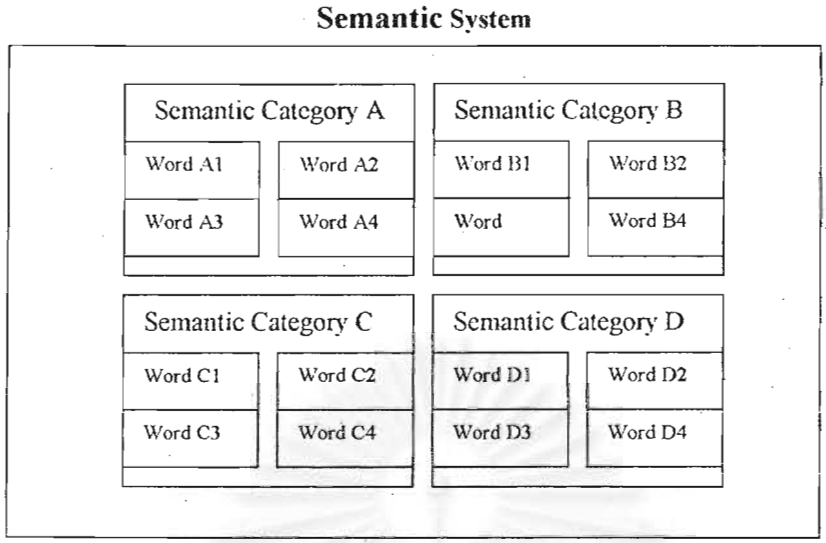


Figure 1: The Semantic System of a language. Semantically related words are stored together in the same semantic category or "bin".

In the present study, the interest is in the semantic systems of first (L1) and second (L2) languages in the bilingual lexicon. According to Kroll and De Groot (1997) there are two important models describing the nature of the bilingual lexicon, the *Word Association Model*, and the *Concept Mediation Model*. The Word Association and Concept Mediation Models are shown in Figure 2.

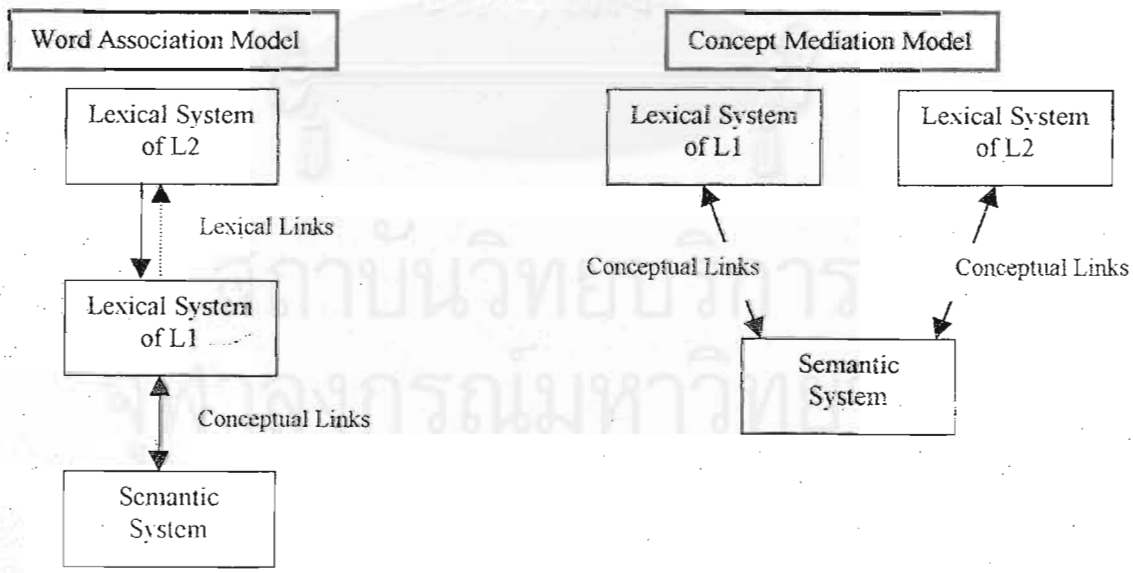


Figure 2: The Word Association and Concept Mediation Models. (The solid lines indicate the direct access and the dotted lines indicate the indirect access) (Adapted from Zakinthinos, 1992)

According to the Word Association Model, words in the lexical system of L1 directly access concepts from the semantic system. On the other hand, words in the lexical system of L2 access concepts from the semantic system only via words with the same meaning in L1 using lexical link between the Lexical Systems of L1 and L2. In contrast to the Word Association Model, in the Concept Mediation Model words in L1 directly access concepts from the semantic system and, also, words in L2 directly access concepts from the semantic system, both via conceptual links.

These models have in common an unspoken assumption that for bilinguals their two languages have separate lexical systems but share the same semantic system. In other words, the entire explanatory power of these two models resides in changes to the level of lexical representations, and takes no account of differences at the level of semantic representations. However, evidence from comparative language studies shows that every language has sets of words or lexical representations, which have no semantic equivalents in other languages (Lipka, 1992). For example, Thai, Mandarin, and English languages have different sets of words representing the "kinship" system.

As can be seen in Chapter 2, the meaning of the word /phɔ:2/[1] in Thai is identical to the meaning of the words /fu2/ in Mandarin and /faðər/ in English and the meaning of the word /mɛ:2/ in Thai is identical to the meaning of the words /mu 2/ in Mandarin and /mʌðər/in English. However, the meanings of the other words in Thai are not identical to the meanings of other words in English. For example, the meaning of the word /grænd faðər/ (father or mother's father) in English has two separate words in Thai /ta:0/ (mother's father) and /pu:1/ (father's father). Thus different languages represent the same world or things with different sets of lexical representations, which have their own lexical meanings (Ogden and Richard, 1949).

The evidence from comparative linguistics showed that L1 and L2 may have different sets of words representing the same things. For the present study, therefore, it was questioned whether the word meanings in L1 and L2 are stored and retrieved from the same semantic system or from two different semantic systems.

This project aims to explore how the word meanings in L1 and L2 in the bilingual lexicon are stored and retrieved.

1.1.2 The Definitions of the Terms 'Bilingualism' and 'Bilinguals'

It is important to define the terms 'bilingualism' and 'bilinguals' as they will be used here before presenting one specific hypothesis. In previous studies, definitions of the terms 'bilingualism' and 'bilinguals' are numerous. Early works (e.g., Bloomfield, 1935; Haugen, 1935) defined bilingualism as a condition in which any individual can use two languages (their mother tongue or L1 and another language or L2) equally well. Such an individual is called a *bilingual*.

On the other hand, definitions of these terms in later studies (Barkman, 1968; Mackey, 1968; Weinreich, 1968; Beardsmore, 1991) are broader. According to these studies, the term bilingualism is defined as a condition in which an individual can use two or more languages. Such an individual is called a bilingual. Her/His ability in these two languages may or may not be equal. These later works suggested that most

[1] The present study uses the LRU Transcription developed at the Linguistic Research Unit of Chulalongkorn University (Luksaneeyanawin, 1993). For this system, the numbers are used to mark 5 tones, i.e., number 0 for mid tone, number 1 for low tone, number 2 for falling tone, number 3 for high tone, and number 4 for rising tone (Schoknecht, 2000).

bilingual speakers can use one language better than the other and that it is rare to find bilinguals who can use two languages equally well. These works suggested that research on various types of bilinguals is more interesting than attempting to delimit the terms 'bilingualism' and 'bilinguals' to those who can use two languages equally well. In the present study, the terms 'bilingualism' and 'bilinguals' are defined in this latter broader sense. Thus Bilingualism is defined in this research as a condition in which the person can use two or more languages, and their ability in the two languages may not be equal.

Here bilingual subjects with different levels of L2 experience, high and low, will be tested. Past studies (Magiste, 1985) suggest that storage and retrieval in the bilingual lexicon are a reflection of the level of proficiency in L2. Sudasna (1999) and Sudasna, Luksaneeyanawin, and Burnham (2000) found that the proficiency level in L2 can be effectively determined in terms of the language experience with L2: high L2 experience bilinguals have a high level of L2 proficiency and low L2 experience bilinguals have a low level of L2 proficiency.

In this study, L2 experience is measured using the Second Language Experience Questionnaire. This contains questions concerning the subjects' contact hours with L2, (in formal classroom situations, extra curricula activities), including their attitude towards L2 and their exposure time to L2 (see Appendix A).

1.2 Aims of the Thesis and the Experimental Studies

The objectives, the hypotheses, and the scope and the expected outcomes and contributions of this thesis are set out below.

1.2.1 The Objectives

The objectives of this thesis and the associated experimental studies are set out below.

1. To investigate the storage and the retrieval of words in L1 and L2 in bilingual speakers.
   - 1.1. To study the semantic systems of first and second languages in the bilingual lexicon.
   - 1.2. To study lexical access in first and second languages in the bilingual lexicon.
2. To investigate the relationship between degree of second language experience and lexical access in bilingual speakers.
   - 2.1. To study the semantic systems of first and second languages in bilingual speakers with high and low second language experience.
   - 2.2. To study lexical access in first and second languages in bilingual speakers with high and low second language experience.

1.2.2 The Hypothesis

There are two main hypotheses of the experimental series and these are set out below to provide the general orientation of the thesis. More specific detailed hypotheses will be given in Chapter 3.

Hypothesis I: In bilinguals with low L2 proficiency (the Low group hereafter), L2 words access the meanings from the semantic system via L1 words with

identical or similar meanings. For example, the meaning of the word /grænd faðər/ in English is similar to the meanings of words /ta:0/ and /pu:1/ in Thai. Thai-English bilinguals should fully attach the meaning of the word /grænd faðər/ to both the words /ta:0/ and /pu:1/. The phrase 'L1 based semantic system' will be used to refer to this hypothesis.

Hypothesis II: In bilinguals with high L2 proficiency (the High group hereafter), L2 words access meanings from the semantic system of L2, and L1 words access the meanings from the semantic system of L1. For example, the meaning of the word /grænd faðər/ in English is similar to the meanings of the words /ta:0/ and /pu:1/ in Thai. However, the word /grænd faðər/ means "father of parents" but the word /pu:1/ means "father of father" and the word /ta:0/ means "father of mother". Thai-English bilinguals should not fully attach the meaning of the word /grænd faðər/ to both the meanings of words /ta:0/ and /pu:1/ and they should recognize the difference among these three words. The phrase 'language dependent semantic system' will be used to refer to this hypothesis.

These two main hypotheses will be tested in a series of experiments.

1.3 Scope

These studies will encompass the semantic system of L1 and L2 words in the bilingual lexicon. Four groups of subjects will be tested: Thai-English, English-Thai, Mandarin-English, and English-Mandarin bilinguals and in each group, half of the subjects have high L2 experience and the other half-low L2 experience.

1.4 Expected Outcomes and Contribution

This thesis will:

1. Provide knowledge about the nature of the semantic system in the bilingual lexicon.
2. Provide knowledge about the relation between the level of language experience and the level of language proficiency, determined in terms of language experience.

1.5 Research Methods

In this thesis, there are two sets of experimental research. In the first set, to measure the subjects' linguistic proficiency, colour words written with semantically incongruent ink colours will be presented to subjects, who must name the colours of the words in their L1 or L2. Reaction time to name the colour will be recorded. This method is called the 'Stroop Interference Task' (see Section 3.2).

In the second set, a Semantic Priming task will be used. This set of experiments will investigate the hypothesis that there is a common semantic system in low L2 proficient bilinguals and there are L1 semantic system, and L2 semantic system in high L2 proficient bilinguals. To measure the degree of priming and thus the degree of semantic relatedness between prime and target, subjects will be asked to do a Lexical Decision Task, i.e., to decide whether the targets are kinship terms or not.

CHAPTER 2

LITERATURE REVIEW

2.1 Mental Lexicon and Lexical Access

This section will focus on past studies of the mental lexicon and lexical access, with particular emphasis on the organization and the retrieval process in the mental lexicon.

2.1.1 The Concept of 'Mental Lexicon'

From previous psycholinguistics studies, many definitions of the term 'Mental Lexicon' have arisen.

According to the early studies on 'Mental Lexicon', the work of Treisman (1960), who began to study the mental lexicon and listening and reading ability (Henderson, 1982), the concept of 'Mental Lexicon' was compared to 'Dictionary Units'. This is because of the fact that a speaker can perform the function of various types of conventional dictionary, such as speaking, understanding speech, writing, and reading. This concept of 'Mental Lexicon' is quite similar to the concept of 'Mental Lexicon' proposed in the work of Oldfield (1966), who first raised the issue of how word information is stored and retrieved by a speaker (Forster, 1976). According to Oldfield (1966), the concept of 'Mental Lexicon' was defined as a mental dictionary.

However, there are many differences between the conventional dictionary and the 'Mental Lexicon' (Miller, 1976). For example, the mental lexicon can be accessed by the different way in language use or the mental lexicon can acquire the new words. Thus, comparing the concept of 'Mental Lexicon' to the concept of 'Dictionary' may misunderstand and the 'Mental Lexicon' is thought of a fixed dictionary.

In later works, Miller (1976) proposed that in order for a person to be said to have learned a language they must use word knowledge, i.e. pronunciation, spelling, syntactic information, meanings, and pragmatic information, in speaking or listening to speech. Without such word knowledge, the person cannot speak or listen to speech. Miller referred to this word knowledge as the 'Mental Lexicon'.

Taft (1984) proposed that a person can understand the words because s/he has encountered these words before and therefore s/he has the representation for words in long-term memory, that is, in the 'Mental Lexicon'.

For the present purposes, the term 'Mental Lexicon' will be defined in the broadest possible sense. Here, the 'Mental Lexicon' is the memory for words. It is generally assumed that the mental lexicon is an indefinite lexicon, not a fixed corpus because the mental lexicon can acquire new words and it is available to be retrieved by different access cues (Miller, 1976).

2.1.2 The Concept of 'Lexical Access'

For the study of lexical access, it is interested in the fact that a speaker of a language is able to access words of that language so rapidly and so effectively. The study of lexical access (Forster, 1976) proposes that this ability involves a highly structured lexical storage and retrieval system. Understanding how these two systems operate is the important issue in the study of lexical access.

Thus, the study of lexical access concentrates on two issues concerning the mental lexicon:

(a) how word knowledge is stored in the mental lexicon and what units are represented in the mental lexicon, and
(b) how word knowledge is retrieved from the mental lexicon.

In the following section, the concept of lexical items, or "words" will be investigated ahead of a consideration of studies concerning how word knowledge is stored in and retrieved from the mental lexicon.

2.1.3 Theory on the Organization of the Theoretical Lexicon

The word is the basic unit of the mental lexicon. Here three issues will be considered: first, how the term "Word" is defined in linguistics; second, the nature of word meanings; and third, the organization of words in the mental lexicon.

2.1.3.1 What is a word?

"Word" is a basic linguistic concept, and the study of words has a long history. Many well-known linguistic theories have tried to define the term "Word" and develop models of words. However, it is surprising that something as familiar as the term "word" does not have a simple and precise definition. Various definitions of the term are considered below.

Matthews (1981) demonstrated that the term "word" can be used in at least three different senses. First, a word is a sequence of sounds, syllables, or letters. The sequences *Dies* and *died* are two different words in this sense.

Second, a word is the abstract unit or lexeme. Different word forms, which belong to the same lexeme are the same word. So, *dies* and *died* are different word forms but they belong to the same word DIE.

Third, if the same sequence of sounds or letters is used to represent different grammatical functions, then they are different words. For example, *thought*, which is both a noun and in the past tense, are different words.

According to Palmer (1981), there are at least four different ways of defining the term "word".

a) "Word" as a Concept: First, the term word is defined as a linguistic symbol, which represents a single concept (Sapir, 1949). However, while a particular concept may be represented by one word in a particular language, the same concept may be represented by more than one word in another language. Thus, an important problem concerning this definition is how we define "Concept".

Later linguistic theory argued that we cannot define the concept of word in terms of a concept or meaning, and this leads to the structural linguistics definition of "word".

b) "Word" as a Written Form: In structural linguistics, the term "word" is defined as a sequence of letters appearing between spaces. For example, the words *man* and *men* are different sequences of letters. Thus, there are two different words in this definition.

"Word" in this definition is merely a word form. However, there are two problems concerning this definition. First, there are many languages in which words are not separated by spaces, such as in Thai. Despite this, Thai speakers can isolate

words in Thai correctly. Second, there are some languages, which have spoken language or phonological representations but do not have written language or orthographic representations (Miller, 1991).

So, this definition lacks generality across various languages of the world and therefore cannot be used as a universal definition of 'word', especially when cross-linguistic studies are involved, as in the current thesis.

c) "Word" as a Morpheme: Bloomfield (1935) offered a solution to the definition of 'word'. According to Bloomfield, a word is a minimal free form or "morpheme". The concept of morpheme is any meaningful linguistic form that cannot be divided into smaller linguistic forms and can occur in isolation. In other words a morpheme is a minimal free form.

For example, the word *corpus* is one morpheme. This is because when *corpus* is separated into either *cor* and *pus*, or *corp* and *us*, these units have their own meanings but the meaning of *corpus* is not the composition of either the meanings of *cor* and *pus*, or the meanings of *corp* and *us*. Thus, the word *corpus* is one morpheme.

However, there remains a problem with this definition. There are some words, which are meaningful, but cannot occur in isolation, e.g., the words *the*, and *is*. These words must occur with the other words. For example, *the* has to occur with nouns or *is* has to occur with a singular noun and a present continuous verb.

d) "Word" as a Lexeme: There are some sequences of sounds or letters, which are different word forms sharing a common root meaning, such as the words *love* and *loved* or the words *take* and *took*. The sequences *love* and *loved* can be said to belong to the same abstract word *LOVE* and the words *take* and *took* to belong to the same abstract word *TAKE*. The technical term for the variations of these superordinate words is 'lexeme'.

For the present purposes, the term 'word' will be defined as a word form. However, in Thai language, where words are not separated by spaces, we assume that Thai speakers know intuitively, what is a word and where a word boundary is, that is, Thai speakers can isolate words in Thai correctly.

2.1.3.2 Word Meaning

There are two contradictory viewpoints (Aitchison, 1994, 1996) about the nature of word meaning: the "fixed meaning" and the "fuzzy meaning" assumptions.

a) The Fixed Meaning Assumption

According to the fixed meaning assumption, it is possible to assign a firm meaning to any word. The notion of a fixed meaning is accepted mainly by lexicographers because words in a dictionary tend to have lexical information that is definite. There are two theories associated with this notion, the "Snapshot" and the "Checklist" theories.

The Snapshot Theory suggests that the semantic information of any word is stored as a series of Snapshots or mental images in the mind. However, an important problem with the Snapshot Theory is that humans always see any object from a number of angles or points of view. Take, for example, for the word *cat*, we can see a cat, but it may be walking or sleeping, and so on. Furthermore, cats can have different personal characteristics. So, it would seem that people need all of the possible photographs of a cat from every angle and also photographs of all possible cats to define the word *cat*. This problem is more precisely marked in more general terms such as the word *vehicle*. The problem is whether it is necessary to have mental

images of different kinds of vehicles from every angle and how people can label a new vehicle as a vehicle if they do not have the associated mental images. For these reasons, the Snapshot Theory has generally proved unsatisfactory.

In the Checklist Theory, for each word there is an internal list of essential characteristics, and we label a real object, object, event, or concept with a particular word if it possesses the "criterion attributes" (Aitchison, 1994, 1996). For example, the word *square* has four essential characteristics, or criterion attributes.

1. a closed, flat figure
2. having four sides.
3. all sides equal in length.
4. all interior angles equal.

If anything possesses all of these conditions, we will label it as *square*.

The 'Checklist' idea only works well for technical terms because for general words it is difficult to decide what characteristics should go on to the checklist of criterion attributes. For example, it is difficult to define such words as *animal*, and *vehicle*, based on the checklist theory.

For the above reasons, the notion of fixed word meaning, which is presented in the 'Snapshot' and the 'Checklist' theories, is impossible to use in the study of the mental lexicon and psycholinguistics, even though it may be accepted by lexicographers.

b) The Fuzzy Meaning Assumption

In the fuzzy meaning assumption word meanings are fluid, for two reasons : the "family resemblance" phenomenon and the "fuzzy edges" problem.

Take the word *game* as an example of the family resemblance phenomenon, Every game has similarities with some other games: ring-a-roses and tennis are physical activities, tennis and chess involve competition between players, chess and patience are played indoors, however, no one characteristic links them all.

The 'fuzzy edges' problem refers to the semantic issue that there is no clear point at which a word ends and another begins. For example, naming tall containers without handles to be vases and naming low and flat ones to be bowls. However, there is confusion when naming something that was in between the two, and there was also great variability in their answers.

In addition, certain shapes were clear instances of particular containers, but others varied due to their perceived function. Thus a certain object might be labelled as a 'bowl' when full of potatoes, but as a 'vase' when it held flowers. These results show that word meanings are vague. How people cope with these vague boundaries and fuzzy-edged meanings is described in Prototype Theory.

The psychologist, Eleanor Rosch (1975) pointed out that within a category, some members are very good exemplars or "Prototypes" of that category and the others are less so. For example, within the category 'bird', robins and blackbirds are good exemplars but penguins are a bad exemplar. For example, Rosch asked subjects to answer classify exemplars such as a penguin or a robin into categories such as 'bird'. She found that the subjects said "Yes" to a statement such as "A penquin is a bird" more slowly than to a statement such as "A robin is a bird". The results implied that it took longer to say "Yes" to a bad exemplar of a category than it did to a good exemplar.

To summarize, Prototype Theory (Rosch, 1975) suggests that when people categorize, they have some idea of the characteristics of the prototype or the best exemplar, and decide on the extent to which an instance is a member of a particular category by matching its features with the features of the prototype. Even if the

exemplar does not match exactly, but it posses sufficient similarities, it is considered to be the member of the category. Prototype theory seems to be functionally appropriate for the study of the mental lexicon. Prototype theory allows for the recognition of a word or sentences or to use a word with slightly different meanings or to generate metaphors.

2.1.4 The Organization of Words in the Mental Lexicon

According to Figure 3, word knowledge is stored and organized in the mental lexicon in four levels: the form or representation level (orthographic and phonological representations), and the morphology, semantic, and syntax levels. Each of these is discussed below, both with regard to language encoding and decoding processes.

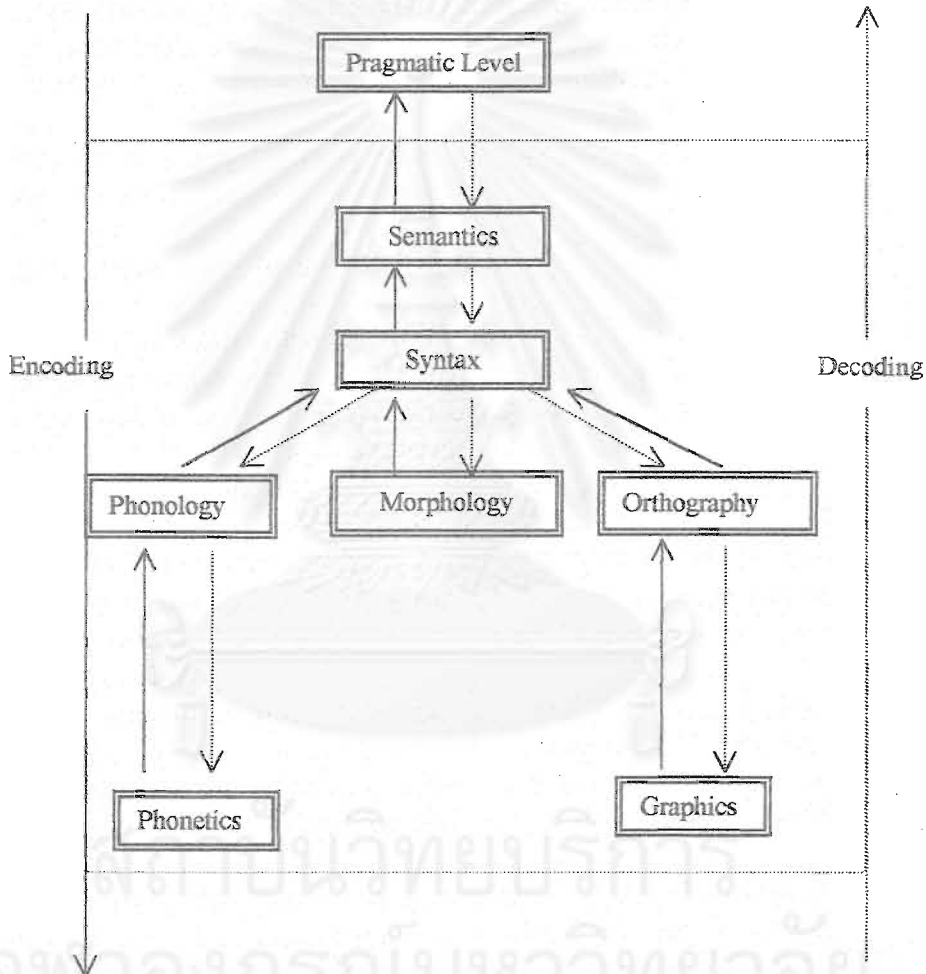


Figure 3: The Model of Encoding and Decoding Process and the Theoretical Grammar and Theoretical Lexicon (Luksaneeyanawin, 1994)

2.1.4.1 The Organization of Words at the Representational Level

a) Orthographic Representations

A large number of studies have demonstrated that words are organized on the basis of their orthographic representations. That is, words with similar orthographic characteristics are stored together in the lexicon. For example, Ferrand and Grainger (1994) tested French monolinguals with a prime that shared letters with

a word target in a lexical decision task[2]. The subjects were asked to decide whether the target words were words in their language. The results showed that orthographically-related prime-target pairs such as *pien-PIED* resulted in faster reaction time (RTs) to targets than unrelated prime-target pairs such as *take-PIED*. The implication is that the words *pien* and *pied* are stored together in a similar location in the lexicon, such that when the word *pien* is presented and accessed, the word *pied* will also be activated, and the RT to say this is a word is thus relatively short. On the other hand, the words *take* and *pied* are stored in separate locations in the lexicon, and when the word *take* is presented and accessed, there is no influence in accessing the word *pied*.

Van Heuvan, Dijkstra, and Grainger (1998) used lexical decision tasks to investigate how the recognition of target words belonging to one language is affected by the existence of orthographic neighbours from the same or another language. In English-Dutch bilinguals they found that increasing the number of orthographic neighbours in English or Dutch language facilitated response time to English target words. These results imply that *orthographic* neighbour words facilitated target word access and that the meaning of words was not important in this priming effect which is at the representational level.

b) Phonological Representations

It should be pointed out that the orthographic representation effects can be related to the phonological representation effects. Since orthographic characteristics or written words are visual representations of phonology or spoken words. Usually, printed words are translated into phonological forms before lexical access, especially in children and low proficiency speakers (e.g. Coltheart, 1978). Thus, two words with similar orthographic representations should be pronounced in an identical way, for example, the word "weak" and the word "week" are pronounced as /wi:k/ and these two words will be stored together in the mental lexicon. This implies that accessing the word "weak" will facilitate accessing the word "week" due to their orthographic and phonological similarity.

It is also suggested that words that are similar phonologically, i.e., have a similar beginning, ending, or rime, are stored together (Aitchison, 1994). For example, words with identical initial syllables such as *pencil*, *penguin*, and *pentagon* are grouped together, and accessing the word *pencil* will facilitate accessing the words *penguin* and *pentagon*. Moreover, the word *pentagon* is linked to the word *dragon* based on the identical ending, so accessing *pentagon* will facilitate accessing the word *dragon*. Furthermore, the word *dragon* links with the other words such as *drama* because they have an identical beginning, and so accessing the word *dragon* will facilitate accessing the word *drama*.

[2] In a lexical decision task, subjects are asked to discriminate words from nonwords. In this task, 'prime' refers to any word which appears before to the target, and 'target' refers to any word which appears after the prime. Subjects are required to press one button if the presented stimulus is a word, and another button if it is not. For the studies in languages with upper and lower case letters such as English, primes and targets are usually printed in different cases (i.e., primes are typically in lower case and targets in upper case). Using primes and targets in different cases is to inhibit the role of letter characteristics in visual word recognition and also, to exclude the effect of episodic memory and to mask the presented primes (Forster and Davis, 1984).

2.1.4.2 The Organization of Words at the Morphological Level

In the psychological literature there is a debate regarding whether morphological features are used to organize the lexicon. There are two main hypotheses regarding the role of morphology in the mental lexicon: the derivational hypothesis, which developed from ideas expressed in linguistic literature, and the independence hypothesis (Mackay, 1968).

The derivation hypothesis proposes that derived and inflected words are not stored separately in the lexicon, but rather under the same base words or lexical entry or stem. For example, the words *reproach* and *approach* will be stored together and retrieved under the same stem *proach*. On the other hand, the independence hypothesis proposes that derived and inflected words have separate and independent lexical representations to their base words. Research on the derivational and independence hypotheses can be seen to be based on the following predictions: if the derivational hypothesis is correct, derived and inflected words will take longer to produce and comprehend, and be more likely to cause errors. If the independence hypothesis is correct, derived and inflected words should take about the same time to produce and comprehend, and should rarely cause errors.

Recent evidence suggests that morphological information does determine the organization of the mental lexicon. Experiments conducted by Deutsch, Frost, and Forster (1998) used lexical decision tasks and naming tasks[3] with Hebrew nouns and verbs. In Hebrew, all verbs and nouns are morphological composition of stems and derivational morphemes (e.g. an English word "unjustly" is a composition of a stem "just" and two derivational morphemes "un-" and "-ly"). In the Hebrew nominal system, there are a large number of nominal derivational morphemes. Thus, the meaning of each morpheme is vague, and there is no explicit meaning for each morpheme. In addition, the meanings of derivational morphemes can be changed depending on the meanings of nominal stems. On the other hand, in the Hebrew verbal system, there are only seven verbal derivational morphemes, each morpheme is used frequently. In addition, the meanings of verbal derivational morphemes are more explicit than those of nominal derivational morphemes and are not changed based on the meanings of verbal stems. Thus, Hebrew speakers access the meanings of verbal derivational morphemes faster than those of nominal derivational morphemes. In the study, Deutsch et al (1998) found that in the nominal system, priming effects were observed when primes and targets shared the same stem but not when the primes and the targets shared the same derivational pattern. In the verbal system, priming effects were observed when the primes and targets shared the same derivational pattern. The implication is that in the nominal system, all derivational words are listed in the lexicon independently of the stems from which they are derived but in the verbal system, it is possible that derivational words are decomposed into their stems and derivational morphemes before they are stored. It is therefore suggested likely that the organization of the mental lexicon depends on the nature of derivational morphemes and their stems.

[3] In a naming task, subjects are simply required to name a word presented clearly in front of them. The latency to pronounce measured by a voice key microphone can be used as an index of how long it takes to access the word (Taft, 1991).

2.1.4.3 The Organization of Words at the Semantic Level

There is evidence that storage in the mental lexicon must also be organized in terms of semantic categories. Grainger and Frenck-Mestre (1998) tested English-French bilinguals on whether semantic categorization and lexical decision tasks were facilitated by prime stimuli that were non-cognate translation equivalents, such as *arbre-tree*, when compared to primes with unrelated meaning such as *balbe-tree*. They found stronger priming effects in semantically related prime-target pairs than in semantically unrelated prime-target pairs. This suggests that words are stored in the mental lexicon of the bilinguals in terms of their shared semantic representations, not only in terms of their lexical representations.

2.1.4.4 The Organization of Words in the Syntactic Level

Linguistic studies also suggest that words that belong to different parts of speech are probably stored separately. For example, Miller (1990) divided the lexicon into five word classes: nouns, verbs, adjectives, adverbs, and function words, and they suggested that there are at least three syntactic categories which are structurally relevant in the organization of the lexicon - nouns, verbs and adverbs, and adjectives. Likewise, Aitchison (1994) proposed that there are at least three different word classes, which are organized separately in the mental lexicon: nouns, verbs, and adjectives.

However, these studies do not provide strong empirical data to report any differences in lexical access (i.e. access time) between nouns, verbs, and adjectives. It should be pointed out that the previous study by the organization of words at the syntactic level has reported only the difference between 'open class' words (nouns, verbs, and adjectives) and 'closed class' words (articles, prepositions, quantifiers, conjunctions, and auxiliaries). It still lacks the demonstration of lexical access difference between main word classes, i.e nouns, verbs, and adjectives.

2.1.4.5 Word Frequency Effect

From a psychological point of view, there is another important factor in the storage and the retrieval processes in the mental lexicon. This factor is *word frequency*.

It has long been known that a word's frequency of occurrence in a language affects the way that the word is stored and retrieved. For instance, in the Search Model (Forster, 1976), which assumes that the mental lexicon is similar to a printed dictionary, a word with a high frequency of occurrence will be stored at the top of the mental lexicon, while a word with a low frequency will be stored at the bottom. This organizational structure of the mental lexicon is based on evidence that in lexical decision tasks, high frequency words are retrieved faster and more automatically than low frequency words (Savage, 1991).

Direct access models such as the logogen (Morton, 1968, 1969, 1970) and interactive-activation (McClelland and Rumelhart, 1981) models (Details will be found in 2.1.5), assume that the lexicon begins with the first letters of the words (A-Z). These first letters are then combined with the second letters such as AN-, and so on until the final letter completes the word. However, not every combination of letters is present in the lexicon. For example, there is no place for a combination beginning PLT-, since there is no English word beginning with these letters.

In these theories, each word is stored in a particular combination node, for example *Split* will be stored in its word node, which is under a group of words beginning SP- or SPL-. According to this view, a word group beginning with SP- or SPL- will be composed of many word nodes, i.e. the node *split*, *splash*, and *splay*. Moreover, each word node will have its word frequency. These models account for the word frequency effect by assuming that the threshold levels of activation or accessing of high frequency words are lower than the low frequency words. So, it takes a longer time to access low frequency words.

It can be seen that the frequency effect is an important factor in accessing the mental lexicon, and should always be taken into account in experimental studies performed to investigate the mental lexicon (Savage, 1991).

An important rider on the word frequency effect concerns the frequency of stems in affixed words, which have been shown to be independent of the frequency of whole affixed words. Taft (1979) examined this using pairs of words with the same whole word frequency such as *reproach* and *dissuade*, but with different stem frequency, i.e., the stem *"proach"* in "reproach" is of higher frequency than the stem *"suade"* in "dissuade". Taft (1979) found that subjects responded more quickly to *reproach* than *dissuade* thus showing that the mental lexicon is organized in terms of stem frequencies as well as word frequencies.

Furthermore, Taft and Forster (1976) proposed the notion of how a visually presented word can be syllabified without considering its pronunciation. In the BOSS, a word must be segmented as the first part of the first stem morpheme of a word up to and including all consonants following its first vowel, but it does not include an illegal consonant cluster in final position. For example, the BOSS of the word "thunder" is "thund", the BOSS of a word "yesterday" is "yest" and the BOSS of words "fine", "infinite", "final", and "fin" is "fin". In this notion, words are accessed via a representation of their BOSS (Taft, 1979). The BOSS was also supported by the findings of Taft (1979, 1984) that word access time was faster when the words were accessed via their BOSS than when they were accessed via their phonological first syllable. So, what is being proposed here is that the research on frequency effects should be more focused on the frequency of the BOSSes as well as the frequency of words and stems.

2.1.5 The Retrieval Process of the Mental Lexicon

The foregoing discussion has shown that there are many factors involved in the storage and retrieval of information in the mental lexicon. In order to account for these variables a number of models have been posited.

There are four important models in the retrieval process of the mental lexicon, a) the search model, b) the logogen model, c) the interactive-activation model, and d) the verification model. These models are described and discussed below.

a) The Search Model

According to Forster (1976), the mental lexicon can be represented as a system of files: a master file containing information (syntactic, semantic, phonological, orthographic) relating to each word, and there are three peripheral files containing "pointers" to the master file (see Figure 4).

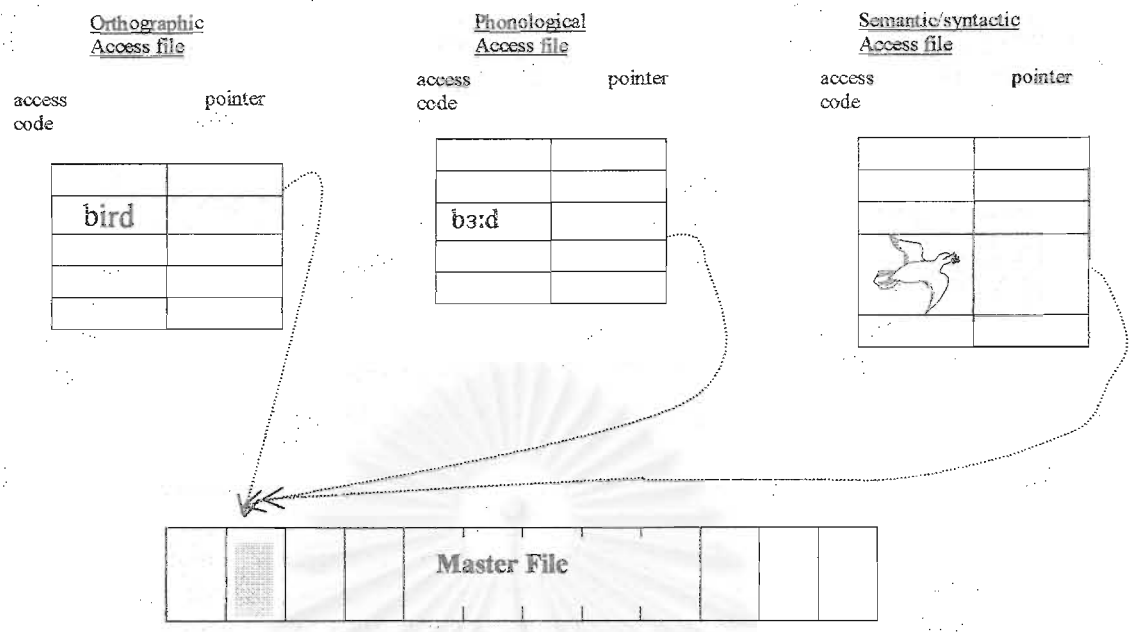


Figure 4: The Search Model (Adapted from Forster, 1976)

The first of these peripheral files contains the "entries" corresponding to the orthographic forms of words and is used in orthographic word processing. The second contains the phonological forms of words and is used in speech processing. The third contains the concepts of words and is used in language production.

For each peripheral file, the entries are organized into "bins" or word categories, classified in accordance with their frequency. Words with high frequency will be placed at the top of the bin, while words with low frequency will be placed at the bottom of the bin. Speakers use linguistic information, for example, orthographic and phonological information, to limit their search to a particular "bin". Then, they must work through until they find the word corresponding to the linguistic information, which they perceived. A pointer is then used to access the master file, which contains word knowledge. At this point access is complete.

For example, if the word *henchman* is presented, the visual input will be converted into a format that is compatible with the access codes - in this case the characteristics of letters *h-e-n-c-h-m-a-n*. Then, the decision of which "bin" to which the input word is likely to belong is made and the input *h-e-n-c-h-m-a-n* is compared with the access code in each entry. When the similarity between the input and the access code exceeds some criterion, the search is successful. Finally, the pointer will direct attention to the relevant entry in the master file.

In the *Master File*, all information for all words in the lexicon, i.e., phonological, orthographic, syntactic, and semantic information, is stored and retrieved. When access is complete, the information in the master file is available for every possible kind of response, speaking, listening, reading, and writing. However, if the linguistic information does not correspond to any word in the peripheral files, the search must continue to the end of the bin. Thus, a non-word will take longer time to be rejected as a candidate lexical entry.

In conclusion, the important characteristic of this model is that there are many means of accessing but only one mean of storage: whether we read, or hear, or understand a word, it is the same word we are accessing from the master file. In

addition, this is a point of difference between the search model and the later models, and is the weak point of the search model.

b) The Logogen Model

The logogen model was initially proposed by Morton (1968, 1969, 1970). The first version is shown in Figure 5a. In this version, there is a set of elements called logogens, one for each of the words or morphemes in the lexicon. Logogens are evidence-collecting devices with thresholds. Evidence is collected from visual or auditory input, and when the amount of evidence collected by a word's logogen exceeds the logogen's threshold, word information in the cognitive system is accessed. Then the word becomes available as a response in the response buffer. Higher frequency words require less evidence to be collected before the threshold is reached. This is because each logogen has a resting level of activation, and this level is proportional to the frequency of words in a language.

The original logogen model has been developed through many revisions because data was found which could not be explained by the original model. Thus new models were added with new components and the model became more complex.

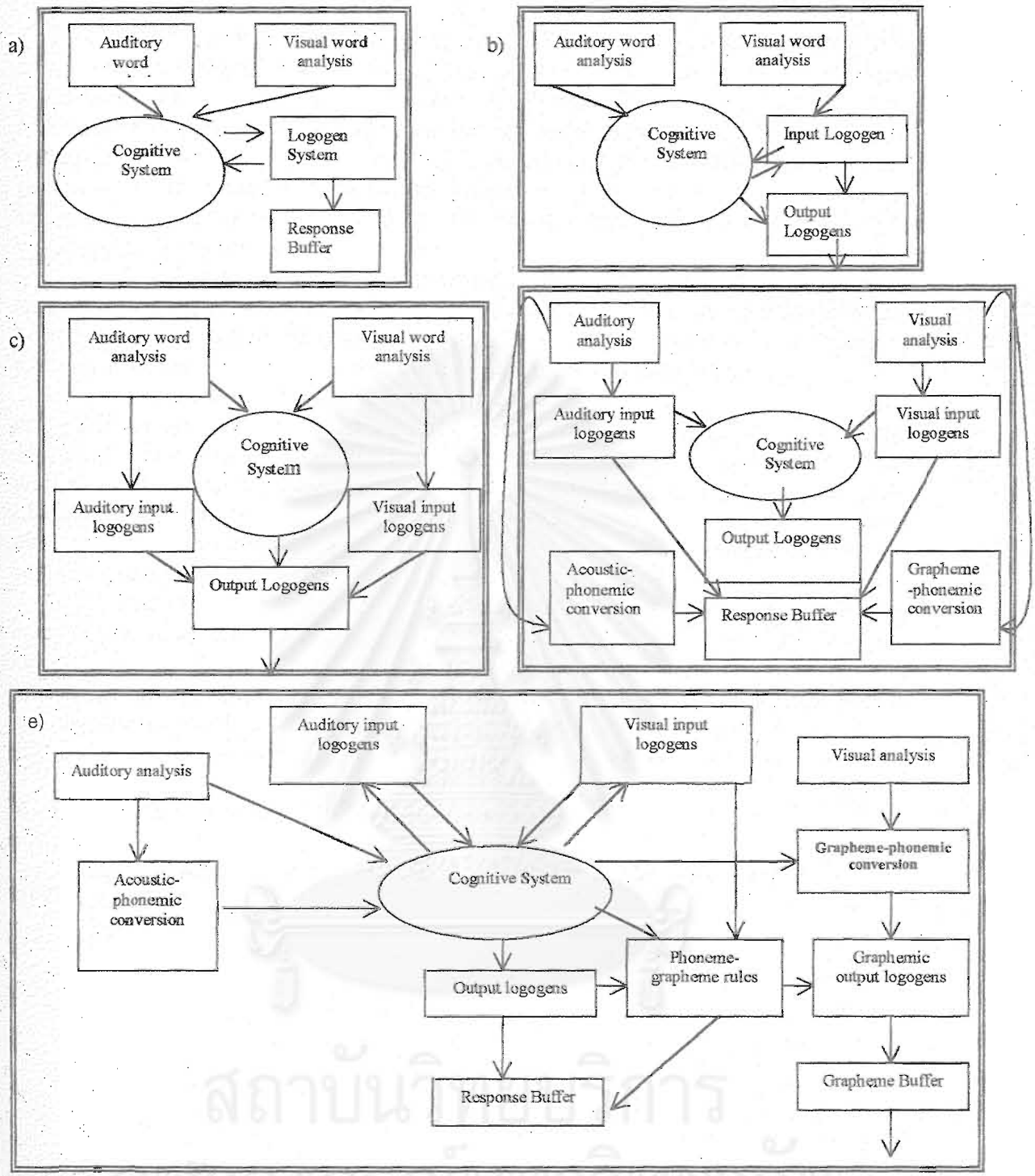


Figure 5: The Five Versions of the Logogen Model of Lexical Access: a) Morton (1968, 1969, 1970); b) Morton (1979); c) Morton (1979); d) Morton (1980); e) Morton (1980)

We will now consider the four later versions of the logogen model in brief, focusing on the additional components of each version.

The second version (see Figure 5b) was proposed by Morton in 1979. In this version, Morton made the distinction between the input and the output logogen system. The input logogen system is responsible for word perception and the output logogen system is responsible for word production.

The third version was proposed by Morton (1979) (see Figure 5c). There is some experimental evidence, suggesting that spoken and written words are accessed by different systems. For example, Howard and Frankin (1988) showed that the deaf could understand and read printed words but not understand spoken words. Opposite results came from a study by Colheart (1998), in which it was found that an alexic patient could understand spoken but not written words. In this third version of the logogen system, Morton made a distinction between the input logogen systems of visual and auditory words.

The third version can explain the distinction between accessing written and spoken words but it cannot explain how humans can write or read non-words. Thus, Morton (1980), added grapheme-phoneme and acoustic-phonemic conversion modules which can explain how we can produce non-words (see Figure 5d).

In the final version of the logogen model (see Figure 5e) Morton (1980) made a distinction between the output logogen systems of visual and auditory words. There are two output logogen systems, one for speaking and another for writing/spelling. This modification is supported by data from previous studies such as Lhermitte and Derouesné (1974) and Basso, Taborelli, and Vignolo (1978) who found that brain damaged people could produce written words but not spoken words, whereas some could produce spoken words but not written words.

One important difference between the search model and the logogen model is the cognitive system component. In the search model, all of the word information, i.e. semantic, syntactic, phonological and orthographic information is stored in the master file. In the logogen model, the cognitive system is the storage unit for semantic and syntactic word information, whereas the phonological and orthographic information is stored in the auditory and the visual output logogen systems.

c) The Interactive-Activation Model

The Interactive-Activation Model was proposed by McClelland and Rumelhart (1981) and is shown in Figure 6.

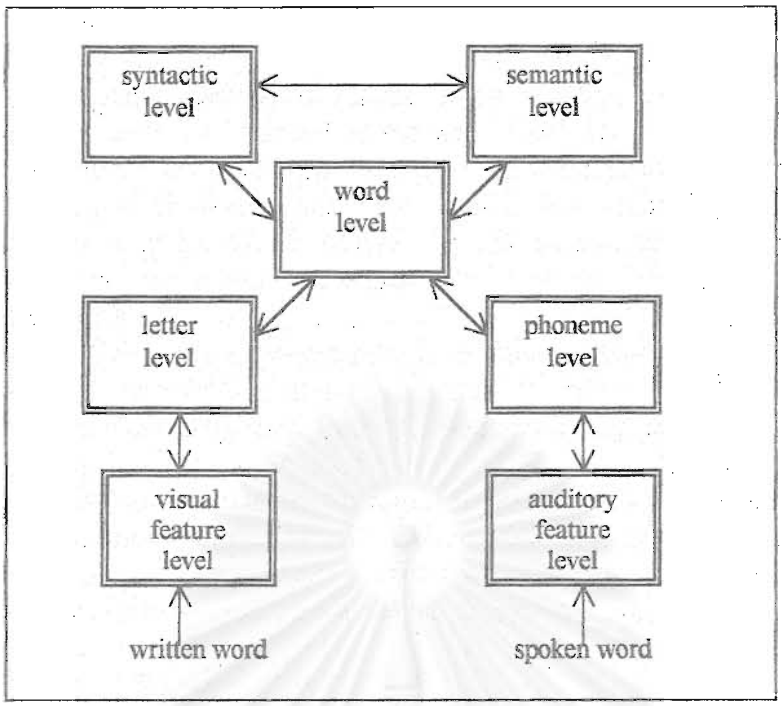


Figure 6: The Interactive-Activation Model of Lexical Access (McClelland and Rumelhart, 1981)

The Interactive-Activation Model is an extension of the logogen approach. It includes a set of elements, which behave in the same way as logogens. These sets are at three levels - the visual feature level, the auditory feature level, and the word level. For example, when a word is visually presented, the appropriate visual feature units will be activated, which will continuously activate appropriate letter units. Then, the word unit at the word level will be activated.

There are two important features of this model. The first is that there is not only activation from lower levels to higher levels as in the search and logogen models, but also activation from higher to lower levels. Thus, this model is interactive. The second is that the activation of an appropriate unit will inhibit the activation of all other units at the same level. For example, when the sequence of letters BOAT is presented, the visual features of this sequence will activate the units of B, O, A and T at the letter level. Then, the units of B, O, A and T will activate the word unit BOAT, as well as other units, in which the visual features are similar to BOAT, e.g., the word unit BOOT, etc. This activation at the word level will feed back to the letter and visual feature levels. Activation of the appropriate feature at the feature level will be increased as well as the activation of B, O, A and T at the letter level. The activation at these lower levels will increase the activation of the word unit *BOAT*, and inhibit the activation of the other word units. Thus, the appropriate word unit is accessed.

The interactive-activation model is similar to the search model but different from the logogen model in one aspect: the interactive-activation model has only one set of word knowledge for accessing both written and spoken words. Thus this model ignores evidence that accessing written words is different from accessing spoken words.

d) The Verification Model

In the Interactive-Activation model, there is only one activated word unit because other word units are inhibited at the word level. However, in the verification model, there are many words activated and there is a verification mechanism to select the appropriate word from the activated words. For example, when *BOAT* is presented, the word units for *BOAT*, *BOOT*, etc. will be activated equally, and then at the verification stage, the appropriate word *BOAT* will be selected by checking back to the presented word.

The point of difference between the interactive-activation and the verification models is that the output of the interactive-activation model is an appropriate word that is isolated from a set of active candidated words by means of an inhibitory mechanism, which deactivates the candidate words at the word level. Whereas, the output of the verification model is an appropriate word that is checked back and matched to the representation of word's characteristics at any level lower than the word level. For example, an appropriate visual word is checked back and matched to the presented letter string at the letter or the visual feature level.

2.2 Bilingualism and Bilingual Speakers

Bilingualism has been studied in a variety of disciplines, e.g. sociology, anthopology, education, psychology and linguistics, and for various reasons. In this section, one of the most important issues is how to define and categorize bilingual speakers, which bears on the issue of how the degree of bilinguality is measured. Once these definitional and measurement issues are bedded down, the study of lexical access in bilinguals, which is the primary focus of this thesis, will be addressed.

2.2.1 Definitions of 'Bilingualism' and 'Bilingual Speakers'

Definitions of the words 'Bilingualism' and 'Bilingual Speakers' in the literature are numerous. Beardsmore (1991) listed 35 definitions of the terms 'Bilingualism' and 'Bilingual Speakers'. For the current purposes, we will divide these definitions into two groups, narrow and broad definitions.

Early writers defined the words 'bilingualism' and 'bilingual speakers' in a narrow sense. For example, Bloomfield (1935 : p 56) defined 'bilingualism' as the native-like control of two languages. Haugen (1935) defined a 'bilingual' as a person who is able to complete meaningful utterances in two languages. According to these works, 'bilingualism' is defined as any condition in which any individual can use two languages (their mother language or L1 and a second language or L2) equally well. A person who can do this is called the bilingual speaker.

In contradistinction to these narrow definitions, later studies provide broader definitions. These later works point to a number of theoretical and methodological problems inherent in the early definitions. First, what is meant by the concept of 'native-like competence' and how do we know whether a bilingual speaker can use two languages equally well? Second, the early definitions are unrealistic, since no bilingual speakers have linguistic repertoires sufficient for all aspects in both mother and second languages. Finally, the later works suggest that research in different types of bilinguals is more interesting than attempting to delimit the terms 'bilingualism' and 'bilingual speakers' by narrow definitions.

As an example of the latter, broader approach, Weinreich (1961a) simply defined 'bilingualism' as the practice of alternately using two languages, with the persons involved being 'bilinguals'. At about the same time, Macnamara (1968) proposed that a bilingual is anyone who posses minimal competence in one of the four language skills, i.e., listening comprehension, speaking, reading, and writing in a language other than their mother language. In conclusion, the earlier definitions tended to restrict the concept of 'bilingualism' and 'bilingual speakers' to "equal competence in two languages", whereas, later studies allow variation of L2 competence. Here, the broader definitions are used.: 'Bilingualism' is defined as a condition in which individuals can use two or more languages, and ability in these languages may or may not be equal. Such individuals are called 'bilinguals'. These broad definitions allow studies that need to differentiate degrees and types of bilinguality, and such differences are discussed in the next sections.

2.2.2 Typologies of Bilinguality

There are many types of bilingual speakers. Bilinguals can be categorized based on six dimensions (Hamers and Blance, 1983) as shown in Table 1. Each of these typologies is discussed in turn below.

Table 1: The Typologies of Bilingualism

Dimension	Types
1) Linguistic Competence	1) Balanced Bilinguals 2) Pseudo Bilinguals
2) Cognitive Organization	1) Coordinate Bilinguals 2) Compound Bilinguals 3) Subordinative Bilinguals
3) Age of Acquisition	1) Early Bilinguals (a) Simultaneous (b) Consecutive 2) Late Bilinguals
4) The Status of L1 and L2	1) Additive Bilinguals 2) Subtractive Bilinguals
5) Group Membership and Cultural Identity	1) Bicultural Bilinguals 2) L1 Monocultural Bilinguals 3) L2 Acculturated Bilinguals 4) Deculturated Bilinguals

2.2.2.1 Balanced and Pseudo Bilinguals

Hamers and Blanc (1983) made the distinction between balanced and pseudo-(non-balanced) bilinguals. According to Hamers and Blanc, a 'balanced bilingual' is anyone who has equivalent competence in both L1 and L2 and can function equally

well in either L1 or L2 in all situations and contexts. In addition, it is thought that there is no interference between L1 and L2 when using either. Other terms applied to balanced bilinguals are 'ambilinguals' and 'equibilinguals' (Edwards, 1994).

In contrast to a balanced bilingual, a pseudo-bilingual is anyone whose competence in one language, more often L1, is superior to their competence in the other, more often L2. Other terms applied to pseudo bilinguals are 'non-balanced' and 'dominant bilinguals' (Edward, 1994).

Despite these definitions, previous studies of bilingualism (Edwards, 1994) suggest that it is almost impossible to find balanced bilinguals, and that most bilinguals are in fact pseudo-bilinguals. The study of pseudo-bilinguals is interesting because it can reflect the importance of factors such as age of acquisition, and language experience, in the development of bilinguality.

2.2.2.2 Coordinate, Compound, and Subordinate Bilinguals

According to Weinreich (1968), coordinate bilinguals maintain separate semantic systems for L1 and L2 in the mental lexicon. In contrast, compound bilinguals have L1 and L2 semantic systems, which are fused and stored together in the mental lexicon. Thus, a single concept will have different orthographic and phonological forms for L1 and L2 attached to them, and words in L1 and L2 independently access the same concept from the lexicon. Subordinate bilinguals have L1 and L2 semantic systems, which are fused and stored together in the mental lexicon, with the addition that words in L2 access the concept via words with similar meanings in L1. The difference between compound and subordinate bilinguals is that in subordinate bilinguals, words in L2 access the concept via words with similar meanings in L1.

Another way to classify these three types of bilinguals is in terms of the lexical and semantic systems: two languages of the coordinate bilinguals are independent in both the semantic and lexical systems; in the compound bilinguals, the two languages are independent in the lexical system, but interdependent in the semantic system; and in the subordinate bilinguals, the two languages are interdependent in both the semantic and the lexical systems.

In models of lexical access, mainly two of these three are mentioned, compound and subordinate bilinguals. The coordinate hypothesis receives little attention. Models of bilingual lexical access are concentrated in section 2.2.4.

2.2.2.3 Early and Late Bilinguals

Age of acquisition is an important factor in the development of bilinguals. A distinction must first be made between early and late bilinguals. In early bilinguals, the experience in the two languages occurs at the same time before the critical age of 11 years (Beardsmore, 1986). Early bilinguals can be further sub-divided into (a) simultaneous bilinguals and (b) consecutive bilinguals. A simultaneous bilingual is a person, who acquires two languages at the same time. For example, a child whose father uses one language and the mother uses another may acquire the two languages at the same time. A consecutive bilingual is a person who acquires a second language early in childhood, after s/he has already acquired the first language. As opposed to these two types of early bilinguals, late bilinguals acquire their first language before the age of 11 years and the second language after the age of 11 years.

2.2.2.4 Additive and Subtractive Bilinguals

Additive and subtractive bilinguals are defined in relation to the relative status of the first and second languages in the community. Additive bilinguality is any condition in which the first and the second languages are equally valued in the community. On the other hand, subtractive bilinguality is any condition in which the first language is devalued in the community (Beardsmore, 1991).

2.2.2.5 Bicultural, L1 Monocultural, L2 Acculturated, and Deculturated Bilinguals

In respect of cultural identity, bilinguals can be separated into bicultural, L1 monocultural, L2 acculturated, and deculturated bilinguals (Beardsmore, 1991). In the first of these distinctions, a 'bicultural' bilingual is a person who identifies positively with cultural groups speaking his first and second languages and s/he is recognized by both cultural groups as a member. Second, an 'L1 monocultural' bilingual is a person who identifies positively with one cultural group, usually with the cultural group speaking his/her first language. Third, the cultural development can also lead a bilingual to renounce the cultural identity of first language group and adopt the cultural identity of the second language group. In this case, s/he would be called an 'L2 acculturated' bilingual. Finally, a 'deculturated' bilingual is a person who has given up her/his first language cultural identity but at the same time, s/he also fails to identify with the second language cultural group. As a result, this person becomes a deculturated bilingual.

2.2.3 The Measurement of L1 and L2 Proficiency in Bilingual Speakers

There are a number of tests commonly employed to measure bilinguality. These can be divided into two types – direct and indirect measurement (Mackey 1968; Macnamara, 1968, 1976).

2.2.3.1 Direct Measurement of Bilinguality

According to Finocchiaro and Sako (1983), there are three types of direct language testing. All these tests are designed to measure proficiency levels in comprehension skills (listening and reading), production skills (speaking and writing) and comprehension and production skills.

The most popular second language tests for English as an L2 are TOEFL (The Test of English as a Foreign Language), and TOEIC (The Test of English for International Communication). Furthermore, the other second language tests for the other languages are also developed by a number of testing scholars. For example, the American Council on the Teaching of Foreign Languages developed second language testing for 37 languages, including Thai and Mandarin (American Council on the Teaching of Foreign Languages, 2002).

2.2.3.2 Indirect Measurement of Bilinguality

a) Rating Scales

The two most popular types of rating scales are language behaviour questionnaires, in which subjects are asked to rate what language they use at home and in various situations; and scales in which subjects are asked to rate their proficiency in either L1 or L2. These types of testing are based on the subjects' own perception of their ability (Macnamara, 1968).

b) Fluency Test

Common examples of fluency tests are "word naming" and "word association" tasks (Macnamara, 1968). Word naming is a task in which subjects are asked to name, in a limited time period, as many different words referring to a specific category as they can. For example, subjects might be asked to name things, which can be found in a kitchen. In word association tasks, subjects are asked to give, in a limited time period, as many continuous associations as possible to a particular word. For example, they are asked to say words that come to mind when they hear the word 'home'.

c) Flexibility Test

A common flexibility test is the richness of vocabulary test, in which the subjects are presented with a word or a sentence in either L1 or L2, and are asked to write or say words or sentences, which are synonymous with the stimulus word or sentence (Macnamara, 1968).

d) Dominance Test

For the Dominance test, bilinguals are presented with an ambiguous word and are asked to interpret this word. The response will indicate which language the subjects prefer to use (Macnamara, 1968).

2.2.3.3 Scoring

Direct and indirect measurement both typically use a single difference score, computed by subtracting a score obtained in L1 from a score obtained in L2. A subject who obtains the same score in L1 and L2 will thus acquire zero score and will be treated as a balanced bilingual. The difference between the score of L1 and L2 is treated as an index of the difference between L1 and L2 competence (Macnamara, 1968).

2.2.4 Organization of Word Knowledge in the Bilingual Lexicon

One basic issue in bilingualism is whether bilinguals have one or two language systems. In this regard Kolers (1966) raised two important hypotheses concerning the bilingual lexicon: (a) the Independence hypothesis and (b) the Interdependence hypotheses.

a) The Independence Hypothesis

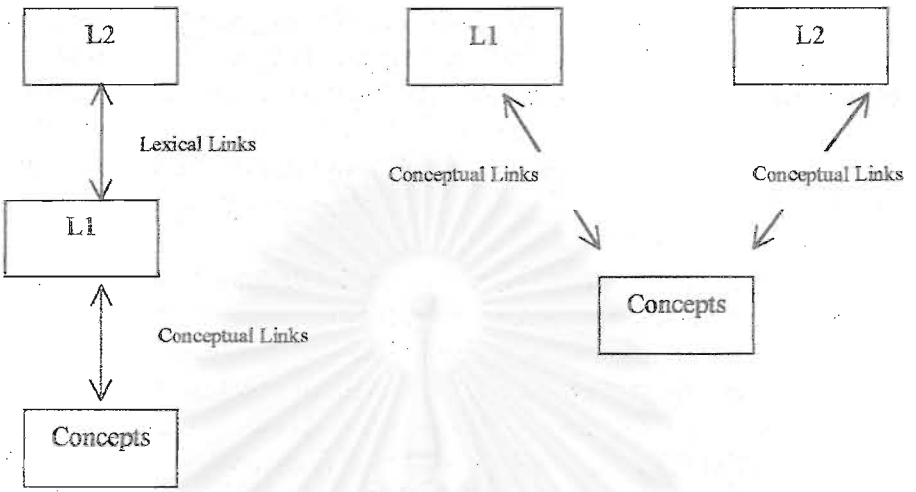
The independence hypothesis assumes that words within L1 or L2 form stronger associations than words with the same or corresponding meaning between L1 and L2 do. For example, Kolers (1966) found that English-French bilinguals took less time to read passages that were written in either of their two languages, than passages that were written in both languages, mixing with each other (where some words were written in English and some in French). In addition, Kintsch (1970) reported better recognition memory when subjects were tested on the same word list that they were familiarized with, than when they were tested on translated versions of the familiarized list.

b) The Interdependence Hypothesis

The interdependence hypothesis assumes that the corresponding words in two languages are closely stored in terms of their word forms. Supporting evidence for the interdependence hypothesis in bilinguals is derived from experiments demonstrating cross-language Stroop interference effects (e.g. Sudasna, Luksaneeyanawin, and Burnham, 2000). The traditional Stroop effect (Stroop, 1935) is the demonstration that the spoken response "red" to the word "BLUE" written in red colour is generally slower than the same response to the word "RED" written in red colour. In other words, if the to-be-ignored aspect of the stimulus (e.g., word meaning) is incongruent with the appropriate response, the reaction time is delayed. The cross-language Stroop interference task is the demonstration that a coloured word in a stimulus language, which is different from the response language, produces interference (Zakinthinos, 1992). Such findings are assumed to indicate the interdependence hypothesis in the bilingual lexicon (see details in Chapter 4).

2.2.5 The Retrieval of Word Knowledge in the Bilingual Lexicon: "Word Association" and "Concept Mediation" Hypotheses

Potter et al. (1984) proposed two hypotheses of the bilingual mental lexicon, the Word Association, and the Concept Mediation hypotheses as shown in Figure 7.



(a) Word Association (b) Concept Mediation

Figure 7: The Word Association (a) and Concept Mediation Hypotheses (b) (adapted from Potter et al. 1984)

According to the Word Association hypothesis, words and concepts in L1 and L2 are stored in and retrieved from a single interlingual lexical and semantic system. That is, words in L1 and L2 share the same lexical and semantic system, whereas words presented in L1 can directly access concepts from the semantic system, words presented in L2 can only access concepts from the semantic system via words with the same meaning in L1.

In contrast to the Word Association hypothesis, under the Concept mediation hypothesis words in L1 and L2 are stored in and retrieved from two intralingual lexical systems. Thus, concepts in L1 and L2 are stored in and retrieved from the same semantic system. So, words in L1 can directly access concepts from the language general semantic system and words in L2 can also directly access concepts from the same semantic system. The concept mediation model proposes that word forms in L1 and L2 independently occur in the same semantic system.

Research work in lexical access supports both the word association model (Dalrymple-Alford, 1968; Rosenberg and Simon, 1977) and the concept mediation model (Kintsch, 1970; Gerard and Scarborough, 1989). To examine the word association and concept mediation hypotheses, Talamas, Kroll, and Dufour (1995) asked more and less fluent English-Spanish bilinguals to perform a translation recognition task in which they had to decide whether two words, one in each language, were translation equivalents. The conditions of interest in this study were the tasks on which the two words were not translation equivalents, including cases in which the Spanish translation of the English word (e.g. *"friend"*) was incorrect but similar in form to the correct translation (e.g., "*hambre*" versus the correct "*hombre*"),

or unrelated. They found longer reaction time in both form-related and meaning-related pairs than in unrelated word pairs. They also found that the less fluent bilinguals produced longer reaction time in the form-related word pairs than in the meaning-related word pairs, suggesting that in less fluent bilinguals, the lexicon is structured somewhat like the word association model. On the other hand, more fluent bilinguals produced longer reaction time in the meaning-related than in the form-related word pairs suggesting a closer match of their lexicon with the concept mediation hypothesis. The implication is that fluency in L2 determines whether the lexicon is organized in terms of the word association or concept mediation hypothesis.

2.2.6 Lexical Access in Bilingual Speakers with Different L2 Proficiency: The Revised Hierarchical Hypothesis

Previous works (Chen and Ho, 1986; Chen and Leung, 1989; Kroll and Curleg, 1988; Potter et al., 1984) studied bilinguals with differing L2 proficiency. Results of these studies suggest that for bilinguals with low L2 proficiency, words in L2 access the meanings through words in L1, that is, in terms of the word association hypothesis. For bilinguals with high L2 proficiency, words in L2 directly access the meanings. On the basis of these studies, a third hypothesis of the bilingual lexicon has been proposed, the Revised Hierarchical Hypothesis (Kroll and Stewart, 1994), as shown in Figure 8.

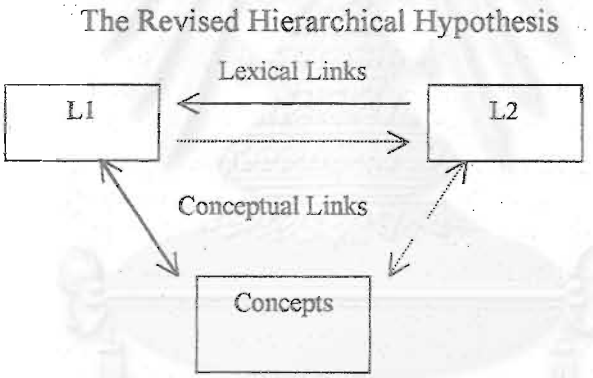


Figure 8: The Revised Model of the Bilingual Lexicon (adapted from Kroll and Stewart, 1994)

According to the Revised Hierarchical Hypothesis, words in L1 and L2 are interconnected via lexical links. However, lexical links from words in L2 to words in L1 are stronger than those from words in L1 to words in L2. Thus, accessing the meanings of words in L2 via words with the same meanings in L1 is faster than accessing the meanings of words in L1 via words with the same meanings in L2. In addition, this hypothesis assumes that words in both L1 and L2 directly access concepts from the semantic system. However, the conceptual links from words in L1 to the semantic system are stronger than those from words in L2. Thus, words in L1 are retrieved from the semantic system faster than words in L2.

Experimental support for this hypothesis comes from the studies using cross-language Stroop tasks (see section 3.2). For example, Chen and Ho (1986) demonstrated that when the bilinguals were less proficient in L2, they show more

interference from L1 words than from L2 words when they were asked to respond in L2. However, when they became more proficient in L2, they showed more interference from L2 words to L1 responses and less interference from L1 words to L2 responses.

2.2.7 Intra- and Interlingual Interference

Any theory of bilinguals' retrieval processes has to address the issue of interference. For example, a bilingual may choose to use a word from another language in the middle of a sentence because the correct item is unknown or the attitude is not expressed well in the language being spoken.

In addition, a bilingual may use the accent of another language, while s/he is speaking a sentence. Such events are commonly labeled interference. Interference occurs at all levels of language: phonological, orthographic, syntactic, and semantic. Interference effects can be categorized in many ways, for example as involuntary versus voluntary, or intra- versus interlingual interference. Involuntary and voluntary interference will not be mentioned further here, however, we will take time to focus on intra- and interlingual interference because it is widely discussed in studies of the mental lexicon.

Research efforts have demonstrated the existence of both within-language or intralingual interference and between-language or interlingual interference. In intralingual interference , language processing is interfered with by the processing of the same language. Whereas in interlingual interference, language processing is interfered with by processing in the other language. In the Stroop colour word task (see section 3.2), the general finding is that colour-naming interference is greater in the intralingual condition than in the interlingual condition (Fang, Tzeng, and Alva, 1981; Zakinthinos, 1992). For example, in the intralingual condition, Zakinthinos (1992) asked Greek-English bilinguals to respond with 'blau' meaning 'blue' to the Greek colour word 'KOKINO' ('red') printed in blue ink and in the interlingual condition, to respond with 'blau'to the English word 'GREEN"printed in blue ink or with 'blue'to the Greek word 'KOKINO". The results showed that the reaction time in the intralingual conditions was longer than in the interlingual condition.

Magiste (1985) found that the main determinant of different patterns of intra- and interlingual interference is language proficiency. Magiste investigated how Stroop interference patterns changed in immigrant children acquiring a new language. The usual pattern for these bilinguals was development from clear proficiency in L1, to L1-L2 balance, to clear proficiency in L2. German-Swedish bilinguals subjects were divided in terms of duration of residence in Sweden (1-16 years). The results showed that words in the more proficient speakers produced greater Stroop interference than did words in the less proficient speakers. The German immigrants showed the largest degree of intralingual interference in German, when they were in their first year in Sweden. However, with increased length of residence in Sweden, the subjects showed more intralingual interference in Swedish and correspondingly less marked differences between intra- and interlingual interference.

The implication from this study is that when second language proficiency increases, the degree of interlingual interference increases, and that in more balanced bilinguals, the degree of intra- and interlingual interference are not as different. This is because words in both L1 and L2 can directly access the lexicon. Thus, L1 and L2 words can produce an equal degree of interferfence.

2.3 Summary of the Literature Review and and Plan of the Present Study

In this chapter, we have attempted to review the important issues for the study of 'mental lexicon' and 'bilingualism'. In the first part we concentrated on the storage and retrieval of word knowledge in the mental lexicon. We pointed out some of the problems arising from the definitions and the characteristics of 'words' and 'word meaning' in a variety of disciplines: psychology, linguistics, and psycholinguistics. We then reviewed the psycholinguistic models of lexical storage and retrieval processes and discussed stressing more specifically the relevant models for this thesis.

In the second part of this chapter, we gave an overview of definitions, typologies, and measurements of bilinguality and bilingualism. We also explained the organization and the retrieval process of word knowledge in the study of bilingual lexical access. Finally, we pointed out the relation between L2 proficiency and the study of bilingual lexical access in the attempt to claim that degree of second language proficiency affects the storage and the retrieval process of word knowledge in the first and the second languages.

In order to give an overview of this thesis, the plan of the following chapters will be stated here:

In Chapter 3, we will propose a number of experimental methods for studying lexical access in bilinguals. Next, we will explain and propose the general hypotheses of two important methods, which we use in this thesis. They are the Stroop Interference task and the Priming task.

In Chapter 4, we will present the experimental design and the results of the present study using the Cross-language Stroop interference tasks conducted in Thai-English bilinguals with high and low English language experience.

The next two chapters deal with the study of the cross-language Semantic Priming task in four groups of bilinguals. These are Thai-English, English-Thai, Mandarin-English, and English-Mandarin bilinguals.

Chapter 5 addresses the second part of the present study including a plan of cross-language Semantic Priming tasks conducted in four experimental sets. These are the sets for Thai-English, English-Thai, Mandarin-English, and English-Mandarin bilinguals. Furthermore, we will stress the importance of linguistic analysis on the stimulus items used in the psycholinguistic study. To end the chapter, we will describe the analysis method and the systems of Thai, English, and Mandarin kinship terms, which are used as the stimulus items in the study.

In Chapter 6, the experimental design and the results of the four sets of cross-language Semantic Priming tasks will be presented. Then, we will summarize the results of all four experimental sets.

Finally, the general discussion and conclusion of the present thesis will be addressed in Chapter 7.

CHAPTER 3

EXPERIMENTAL METHODS FOR STUDYING LEXICAL ACCESS IN BILINGUALS

3.1 Introduction

In the study of lexical access, various experimental methods have been employed, for example, free recall (Kolers, 1966a), word association (Kolers, 1963), lexical decision (Taft, 1991), the Stroop interference tasks (Magiste, 1985; Chen and Ho, 1986), and Priming tasks (Forster and Davis, 1984), etc.

In this chapter, we will explain the ways in which these methods are used and what information they can give us about lexical access in bilinguals. In Section 3.1, free recall, word association and lexical decision tasks are briefly reviewed. Later in this chapter, we will consider the "Stroop Interference" and the "Semantic Priming" tasks in details as these two tasks will be used in the present study.

3.2 Experimental Methods for Studying Lexical Access in Bilinguals

There are several methods for the study of lexical access in bilinguals as presented belows.

a) Free Recall (Kolers, 1966a) In free recall, subjects are asked to recall words with a particular characteristic. For example, subjects are asked to recall any English words beginning with the letter "B" within one minute. The number of correct words, which subjects recall are recorded. It would be expected that in such a task, high L2 proficiency bilinguals should recall more words than low L2 proficiency bilinguals.

b) Word Association (Kolers, 1963) Subjects are asked to name any words, which are semantically related to the presented word within a limited time. For example, subjects are asked to name any words, which are semantically related to the word "Teacher" within one minute. It would be expected that in such a task, high L2 proficiency bilinguals should name more words than low L2 proficiency bilinguals.

c) Lexical Decision (Taft, 1991) In this task, subjects see or listen to words and they are asked to make a decision whether these words are words or non-words in a particular language. The reaction time for correct responses is recorded. It would be expected that in such a task, in high L2 proficiency bilinguals the reaction time should be faster than in low L2 proficiency bilinguals.

3.3 The Study Using the Stroop Interference Task

In the original Stroop Task (Stroop, 1935), colour words written in a semantically incongruent ink colour, for example, the word "RED" written in blue ink, and the word "GREEN" written in red ink, etc were presented and subjects were asked to name the ink colours, not the written words. For example, the partcipants named the word "RED" written in blue ink as "blue". Reaction time was measured and recorded.

It is hypothesized that if the form has no meaning (e.g. XXX), subjects should be able to name the colour of forms without any interference. If the form is a lexical item (represented by a written word), there will be some interference proportional to the linguistic competence, which can be measured by the subjects' reaction time in naming the colour of the ink of the word form. It was found that the reaction time was longer when the subjects named the ink colour of colour words as compared to the ink colour of non linguistic word forms. These results showed that adults read and semantically process written words even when the task at hand does not require reading. Thus in proficient readers, it appears that reading and semantic analysis of what is read are automatic processes. Thus, it is hypothesized that in high proficiency subjects, linguistic interference should be stronger than in low proficiency subjects. As a result, reaction time in colour naming for the high proficiency subjects should be slower than for the low proficiency subjects.

In bilingual Stroop tasks, three experimental conditions are required. The first is non-linguistic (i.e. XXX) in which there should be no interference due to linguistic competence in colour naming and thus relatively short naming reaction time. In the second condition, the colour words and the required response by the subjects' naming of colour are in the same language, either L1 or L2. The inhibition due to incongruent colour words in this condition is called 'intralingual interference'. The final condition is when the colour words and the subjects' naming of colour are in different languages, i.e., the colour words in L1 and the colour naming is required in L2, the colour words are in L2 and the colour naming is in L1. The inhibition due to incongruent colour words in this condition is called 'interlingual interference'.

In both the intralingual and interlingual Stroop Tasks, there are two levels of processing, the perception and the production levels. In the intralingual task, it is hypothesized that the reaction time in L1 naming is slower than in L2 naming because L1 linguistic competence should be better than L2 linguistic competence, resulting in the faster perceptual processing of L1 word forms than the perceptual processing of L2 word forms and more interference in L1 production processing than in L2 production processing. In the interlingual task, it is hypothesized that the reaction time in L1 perception and L2 production should be slower than in L2 perception and L1 production.

XXX	BLUE
XXX	GREEN
XXX	YELLOW
XXX	BLUE
XXX	BLACK
XXX	RED

a) b)

Figure 9: The Monolingual Stroop Task. Subjects name the colour of forms without any interference from colour words in a). Subjects name the colour of these forms with the interference from colour words in b)

Table 2: Non-linguistic, Intralingual, and Interlingual Conditions in Bilingual Stroop Tasks

Non-Linguistic Stroop Task		Intralingual Stroop Task		Interlingual Stroop Task	
Perception of Non Linguistic Forms and Colour Concepts	Naming of Colour Concepts using Colour Words	Perception of Word Forms and Colour Concepts	Naming of Colour Concepts using Colour Words	Perception of Word Forms and Colour Concepts	Naming of Colour Concepts using Colour Words
XXX	L1	L1	L1	L1	L2
XXX	L2	L2	L2	L2	L1

The bilingual Stroop task will be used in this thesis to investigate semantic processing in bilingual speakers.

3.4 The Study Using the Priming Task

An effective way to investigate both the monolingual and the bilingual lexicons is to use the Priming task. Previous studies (e.g. Bijeljac-Babic, Biardeau, and Grainger, 1997; Grainger and Ferrand, 1994) have shown that Priming tasks are an important source of evidence for the mechanics of lexical access.

The Priming tasks are different from the Stroop Interference tasks in at least two aspects. First, the priming tasks can be designed to use different words as stimulus items; whereas, the Stroop tasks are limited to use only colour terms. Second, the Priming tasks can be conducted to test more complicated experiments than the Stroop tasks, i.e., more interrelated factors can be added, both the reaction time and errors can be quantified accurately.

In a Priming task, subjects are presented briefly with a sequence of stimulus items, as shown in Figure 10. A sequence consists of a briefly-presented word or "prime" for 100 to150 ms., followed by another word or "target" for 500 ms. Subjects are asked to make a certain response to the target. In this procedure, subjects are concious of the target but cannot report the prime.

There are various response methods that have been used to indicate priming effects. One of the most frequently used is the lexical decision task, in which subjects are required to decide whether the target is a word or not, with word and non-word targets being equally probable on each trial.

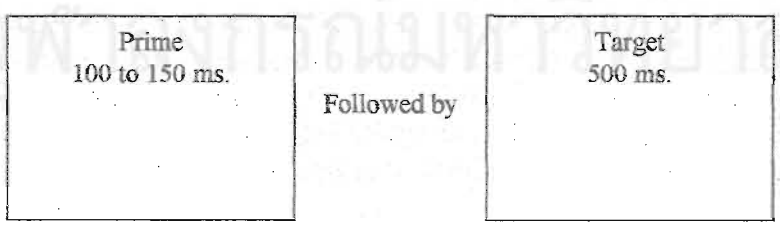


Figure 10: The Sequence of Stimulus Items in Priming Tasks

Previous studies have shown that priming effects are stronger when the primes and the targets are related (phonologically, orthographically, semantically, or syntactically related) than when they are unrelated, even when the subjects are unaware of the primes. This suggests that some of the properties of the primes overlap

with those of the targets such that processing of the primes facilitates the processing of the targets. It is this property of primes that is useful in delineating the relationships between words. For instance, priming effects can be found using primes and targets that are phonologically related, e.g. "real" and "reel", or syntactically and semantically related e.g. "boy" and "girl".

In this thesis, the semantic priming tasks, where the primes and the targets are semantically related, will be used. So the review of literature here will concentrate upon studies which use this method.

Recent studies on the monolingual lexicon (Lowe, 1999; Taft, 1991) show that priming effects are stronger if the targets following primes are in the same semantic category. For example, the target "man" is retrieved faster if this target follows a prime such as "boy", compared to the case when it follows an unrelated prime "car". This is because when the subjects see the primes, they retrieve semantic information about the primes. If the primes and the targets are semantically related, then the semantic properties of the targets, which overlap with the semantic properties of the primes have already been accessed before the subjects see the target. As a result, when the subjects see the targets, they can retrieve and respond to them faster. In this way it can be seen that the priming effect, as measured by the reaction time in responding to a target, is inversely related to the semantic relatedness of that word and its prime. Thus priming effects can be used to measure the nature of the semantic system in the mental lexicon.

However, many recent studies have pointed to problems with the use of lexical decision as a measure of lexical access (Kroll, 1993; Taft, 1991). The problem is that as lexical decision is a binary choice task, there are a variety of post-access decision mechanisms, which come into play such as the familiarity of the targets to the subjects. Thus if a word is familiar, it is more likely that subjects will decide that a target is a "word" then if a target is unfamiliar to the subjects. In this way, results of lexical decision tasks may arise from post-access decision mechanisms rather than from lexical access mechanisms.

Another method to investigate semantic priming effects is the 'semantic categorization' task, in which the subjects are asked to decide whether the target is a member of a particular semantic class. For example, subjects may be required to decide whether the word "apple" is a member of the semantic field "fruit". In this thesis, we will use the semantic categorization task to measure priming effects.

3.5 The General Hypotheses of the Study Using the Stroop Interference

In this part, the general hypotheses of the experimental study using cross-language Stroop interference tasks in the present study will be presented. The important issue of this study concerns whether the lexical and the semantic systems of the two languages are different in bilinguals with different L2 experiences. There are two groups of subjects involved in this study: first, Thai-English (TE) bilinguals with high English language experience, and second, those TE with low English language experience.

There are two general hypotheses in this study.

Hypothesis I: In the intralingual condition, the degree of interference from L1 linguistic competence should be higher than the interference from L2 linguistic competence in both the high and the low English experience groups (From now on these will be referred to as the High and the Low groups).

Hypothesis II: In the interlingual condition, the degree of interference from L2 linguistic competence should be higher in the High group than in the Low group, whereas the degree of interference from L1 linguistic competence should not differ between the High and the Low groups.

3.6 The General Hypotheses of the Study Using the Cross-Language Semantic Priming Task

For the present study, four sets of semantic priming experiments will be conducted. In the first set, Thai-English bilinguals with high and low English language experience will participate in four experimental conditions: within Thai (L1) language, within English (L2) language, between Thai-English (L1-L2) languages, and between English-Thai (L2-L1) languages.

In the second set, English-Thai bilinguals with high and low Thai language experience will be studied in four experimental conditions: within English (L1) language, within Thai (L2) language, between English-Thai (L1-L2) languages, and between Thai-English (L2-L1) languages.

In addition, to test whether there is the difference between lexical access in alphabetic writing system (Thai and English) and logographic system (Mandarin). The third and the fourth experiments will be conducted in Mandarin-English and English-Mandarin bilinguals.

In the third set, Mandarin-English bilinguals with high and low English language experience will participate in four experimental conditions: within Mandarin (L1) language, within English (L2) language, between Mandarin-English (L1-L2) languages, and between English-Mandarin (L2-L1) languages.

In the fourth set, English-Mandarin bilinguals with high and low Mandarin language experience will participate in four experimental conditions: within English (L1) language, within Mandarin (L2) language, between English-Mandarin (L1-L2) languages, and between Mandarin-English (L2-L1) languages

In what follows, the general hypotheses will be presented.

Hypothesis I: In the bilinguals with high L2 experience, the meanings of L1 words are stored in the semantic system of L1 and the meanings of L2 words are stored in the semantic system of L2. As a result, there will be no interference from L1 words in accessing L2 words.

Hypothesis II: In the bilinguals with high L2 experience, L2 word meanings will be directly accessed from the L2 semantic system, which is separated from the L1 semantic system. As a result, the reaction time and the error rates in accessing L2 words will not be statistically significant.

Hypothesis III: In the bilinguals with low L2 experience, the meanings of L1 and L2 words are stored in the same semantic system. As a result, there is the interference from L1 words in accessing L2 words.

Hypothesis IV: In the bilinguals with low L2 experience, L2 word meanings will be accessed from the semantic system via the L1 words with the same or similar meanings.

CHAPTER 4

BILINGUAL LEXICAL ACCESS USING THE STROOP INTERFERENCE TASK

4.1 Introduction

In this chapter, we use the cross-language Stroop Interference tasks to explore whether the lexical and the semantic systems of L1 and L2 languages are different in bilinguals with different L2 experiences. We test the lexical and the semantic systems of L1 and L2 by examining the Stroop interference effects in Thai-English bilinguals with high and low English language experience in four conditions. These are: (1) the intralingual condition in Thai, (2) the intralingual condition in English, (3) the interlingual condition in Thai-English, (4) the interlingual condition in English-Thai.

4.2 Experimental Design

4.2.1 Subjects

Subjects in this experiment were 100 Thai-English non-balanced pseudo-bilingual speakers. They were grouped into 2 groups on the basis of their L2 language experience. L2 language experience was measured with the "English Language Experience Questionnaire" concerning the subjects' contact hours with English, i.e., in formal classroom situations, extra curricula activities, their language attitude towards English and their exposure time to English (see Appendix A). For the present study, the subjects were split into two groups using the median score as the dividing point. Fifty subjects whose scores in the questionnaires were higher than the median score were designated the high language experience group (hereafter, the High group) and the other fifty subjects whose scores were lower than the median score were designated the low language experience group (hereafter, the Low group).

4.2.2 Stimuli and Design

In the Non-Linguistic Stroop Task, the stimulus items were XXX, written in red, blue, green and black ink, and the subjects were asked to name the colour concepts using colour words in L1 and L2.

For the Intralingual Stroop Task of L1, the stimulus items were four Thai colour words, i.e. "แดง", "เขียว", "ฟ้า", and "ดำ" written in mismatching colours - either red, blue, green or black, and the subjects were asked to name the colour of the ink using colour words in Thai. For the Intralingual Stroop Task of L2, the stimuli were four English colour words, i.e. "Red", "Green", "Blue", and "Black", again written in mismatching colours, and the subjects were asked to name the colour of the ink using English colour words.

For the Interlingual Stroop Task, when the stimulus items were Thai colour words, the subjects were asked to name the ink colour in English, and when the stimulus items were English colour words, the subjects were asked to name the ink colour in Thai.

4.2.3 Procedure

Each stimulus item appeared three times at random to prevent any practice effect of pairing colour words to the naming of colour concepts. Thus there was a total of 36 items consisting of 3 conditions (non-linguistic forms, L1 word forms or L2 word forms) x 4 colour items (red, green, blue, and black) x 3 test tokens. The subjects were asked to name the colours of the form as accurately and as quickly as possible. Their reaction time was recorded with a stopwatch.

Table 3: Examples of the Task in Non-linguistic, Intralingual, and Interlingual Conditions

Non-Linguistic Stroop Task		Intralingual Stroop Task		Interlingual Stroop Task	
XXX written in blue ink	Expected naming is /fa:3/(L1)	"แดง" written in blue ink	Expected naming is /fa/ (L1)	"แดง" written in blue ink	Expected naming is /blu/ (L2)
XXX written in blue ink	Expected naming is /blu/ (L2)	"Red"written in blue ink	Expected naming is /blu/ (L2)	"Red" written in blue ink	Expected naming is /fa:3/ (L1)

XXX	แดง	BLUE
XXX	ฟ้า	GREEN
XXX	เหลือง	YELLOW
XXX	แดง	BLUE
XXX	ฟ้า	BLACK
XXX	ดำ	RED

a) b) c)

Figure 11: The Bilingual Stroop Task. Subjects name the colour of forms without any interference in a). Subjects name the colour of forms in Thai (Intralingual Interference) or English (Interlingual Interference) with interference from Thai colour words in b). Subjects name the colour of forms in English (Intralingual Interference) or Thai (Interlingual Interference) with interference from English colour words in c).

The mean reaction time (RT, hereafter) in milliseconds (ms) is the average RT that each group of subjects used to name the colour of the test tokens in a particular condition either the non-linguistic, the intralingual, and the interlingual conditions.

The RT data were analyzed using a three-way analysis of variance (ANOVA) considering language proficiency group (High and Low groups), experimental condition (Non-Linguistic, Intralingual, and Interlingual Stroop Task), and response language (Thai and English).

For the present study, the degree of interference is represented by an 'Interference Index Score' (IIS). IIS is calculated from the mean reaction time (in milliseconds) of the test condition (intralingual or interlingual) minus the mean

reaction time of the control non-linguistic condition in the naming task of the same language (Stroop, 1935). That is, IIS = Mean RT of the Test Condition – Mean RT of the Control Condition with Colour Naming of the Same Language.

4.2.4 Results and Discussion

4.2.4.1 The Mean RT for the Intralingual and the Interlingual Stroop Tasks

Table 4: The Mean Reaction Time (in ms.) in the Non-Linguistic, the Intralingual, and the Interlingual Stroop Tasks for the High and the Low Subject Groups

RT in Non-Linguistic Stroop Task			RT in Intralingual Stroop Task			RT in Interlingual Stroop Task		
Perception - Non-Linguistic Forms; Naming - L1 Colour Words	High	472	Perception - L1; Naming - L1 Colour Words	High	741	Perception - L2; Naming – L1 Colour Words	High	606
	Low	369		Low	595		Low	375
	Mean	420.5		Mean	668		Mean	707
Perception - Non-Linguistic Forms; Naming – L2 Colour Words	High	526	Perception - L2; Naming – L2 Colour Words	High	704	Perception - L1; Naming – L2 Colour Words	High	706
	Low	395		Low	432		Low	708
	Mean	460.5		Mean	568		Mean	490.5

As can be seen in Table 4, the mean RT for the non-linguistic Stroop task is relatively short (420.5 ms in the naming of colour concepts using L1 colour words and 460.5 ms in the naming using L2 colour words) as compared to the RT found in the intralingual and the interlingual Stroop tasks. This is presumably because in the non-linguistic condition, the form has no meaning. Thus the subjects can name the colour of the form without any interference due to linguistic competence (Stroop, 1935). In contrast, in the intralingual and the interlingual conditions, the forms are written words. Hence, there is an interference of linguistic competence in colour naming resulting in slower RT both in the intralingual and the interlingual conditions as compared to the non-linguistic condition. However, the RT for the non-linguistic Stroop Task when using colour words in L2 is slower than in L1. This may be due to the interference from the L2 linguistic production process.

In the intralingual condition, the RT for processing of L1 (668 ms) is slower than in processing of L2 (568 ms). The results imply that there is more interference

from L1 than L2 in Intralingual Stroop Task. However, the difference between the RT in L1 processing and L2 processing is not significant [F (1, 28) = 2.224 p< .01].

In the interlingual condition, the RT in the perception of L1 word forms and L2 colour naming was found to be significantly slower than in the condition when subjects access word with the perception of L2 word forms and L1 colour naming [F (1,28) = 4.648 p< .01]. These results imply that linguistic perception of L1 of the subjects in this experiment is better than their linguistic perception of L2, thus resulting in more interference due to L1 linguistic perception and L2 production than to L2 linguistic perception and L1 production.

4.2.4.2 Interference of L2 in Speakers with Different Language Experience

It is expected that in the control non-linguistic condition, there will be no interference due to linguistic competence. In contrast, in the test condition, there should be an interference due to linguistic competence. IIS, the difference between RT of the test condition and of the control condition, is taken to represent the degree of linguistic interference.

IIS scores in the non-linguistic, intralingual, and interlingual conditions are derived from Table 4, and presented in Figure 12 for the intralingual condition and Figure 13 for the interlingual condition.

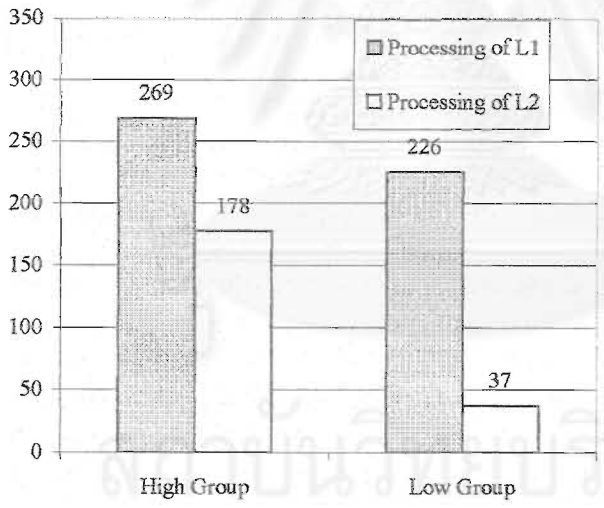


Figure 12: The IIS of the Intralingual Conditions Comparing the Processing of L1 and L2

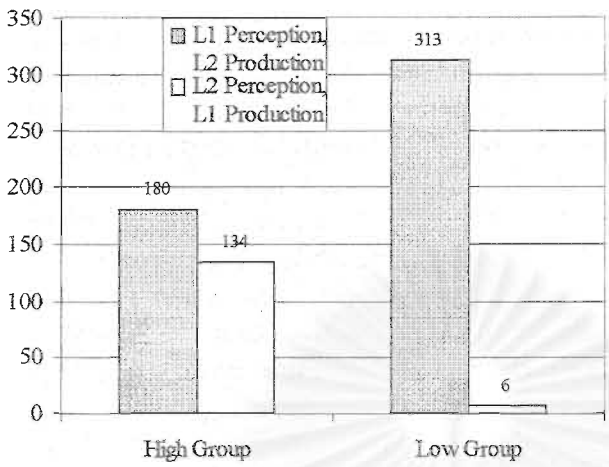


Figure 13: The IIS of the Interlingual Conditions Comparing L1 Perception, L2 Production and L2 Perception and L1 Production

In the intralingual condition (see Table 4 and Figure 12), the IIS found in L1 processing is significantly higher than that found in L2 processing in both the High group [$F(1, 28) = 10.01$ $p < .01$] and the Low group [$F(1, 28) = 12.21$ $p < .01$]. However, the result is more pronounced in the Low group than in the High group. The IIS found in L1 processing in the High group (269) is slightly higher than in the Low group (226). However, in the processing of L2, the IIS found in the High group (178) is markedly higher than in the Low group (37) [$F(1, 28) = 94.9$ $p < .01$]. These results imply that the interference within L1 is higher than the interference within L2 in both the High and the Low groups. Additionally, in the High group, the IIS for L2 processing is more similar to the IIS for L1 processing than in the Low group. These results show that language proficiency, as measured indirectly by the Questionnaire, related to Stroop task performance. Thus, we suggest that the language experience questionnaire used in this experiment is a good means of determining the language proficiency levels of subjects, without using other language tests, for example, standardized reading tests.

In the interlingual condition (see Table 4 and Figure 13), in L1 perception and L2 production, the interference in the Low group is significantly higher than in the High group [$F(1, 28) = 9.57$ $p < .01$]. In contrast, in L2 perception and L1 production, the interference in both the High and the Low groups is lower than in L1 perception and L2 production. These results imply that the degree of interference found in L1 perception is higher than that found in L2 perception in both the High and the Low groups but the interference of L1 perception to L2 production is clearer in the Low group than in the High group. This is presumably because the proficiency level of L2 production in the Low group is lower than in the High group.

In addition, in L2 perception and L1 production, the IIS in the Low group is extremely low (6ms) as compared to the High group (134ms). These results suggest that the interference of L2 perception to L1 production found in the Low group is minimal compared to the High group.

As can be seen in Figure 12, it can be seen that the IIS for processing within L1 is significantly higher than that found for processing within L2 in both the High and the Low groups. The results suggest that the language proficiency level of L1 is better than L2 in both the High and the Low groups. However, the difference between the IIS in the processing of L1 and L2 in the Low group is greater than in the High group. These results imply that, as expected, the language proficiency level of L2 in the High group is closer to the proficiency level of L1 than in the Low group. The present results further indicate that the language proficiency levels can be determined by means of language experience, measured in terms of contact hours to L2. The subjects with low language experience of L2 will have the low proficiency level of L2 and also, the subjects with high language experience of L2 will have high proficiency levels for L2.

As can be seen in Figure 13, the IIS of L2 perception and L1 production in the High group is significantly higher [$F(1, 28) = 76.12$ $p < .01$] than in the Low group. The results suggest that the interference of the perception process of L2 in the High group is greater than in the Low group. The IIS of L2 perception and L1 production in the Low group is extremely low (6ms) as compared to the IIS of the High group (134ms). This implies that the L2 language proficiency of the Low group is lower than in the High group. The perception process of L2 in the Low group is slower than that of the High group. As a result, there is very little interference of the L2 perception process in the naming of colour concepts in L1 as compared to the interference found in the High group.

However, the IIS of L1 perception and L2 production in the High group is significantly [$F(1, 28) = 67.5$ $p < .01$] lower than the Low group. The results suggest that production in L2 may involve more complex processes than in perception. Thus, the Low group has greater difficulty with speech production in the naming of colour concepts in L2 than the High group does.

4.2.5 Conclusion

In the intralingual condition, the interference of L1 processing in the High group is slightly higher than in the Low group. However, the interference of L2 processing in the High group is remarkably higher and closer to the interference of L1 processing than in the Low group. The results suggest that the proficiency level of L2 can be inferred from language experience, without the use of language tests. In addition, the results suggest that the closer the interference of L2 processing to L1 processing the more near native (L1) proficiency is the level of L2. In the interlingual condition, the interference of L1 perception and L2 production in the Low group is substantially higher than the High group. However, the interference of L2 perception and L1 production in the Low group is much lower than the High group. These results suggest that the interference in the interlingual condition is affected by both linguistic perception and production. Thus, we can examine L2 proficiency level in both perception and production processes using Interlingual Stroop Task.

Interpreting the results in terms of the two alternative hypotheses of lexical access, the *Word Association Model* and the *Concept Mediation Model*, in the intralingual condition, it seems that in the High group, there are two intralingual

lexical and semantic systems. This conclusion is supported by the difference between the interference in the processing of L1 and L2 in the High group (269/178msec) being closer to each other than in the Low group (226/37msec). In the interlingual condition, it is very clear that in the Low group, the interference in L2 production is extremely high (313 msec), whereas the interference in L1 production is extremely low (6 msec). The difference in the interference from L1 and L2 production is very clear between the High and the Low groups. The interference from L2 production and L1 perception is higher than in L1 production and L2 perception in the Low group (313/6 msec) as compared to the High group (180/134msec) The results suggest that there is a strong interference from the production process in the Low group compared to the High group. Further research should be designed to examine the interference in the production process of bilingual speakers with different levels of L2 proficiency.

Overall, using the Stroop Interference task established that the high and the low L2 experience bilinguals do in fact have differences in their semantic systems and in the retrieval process in lexical access. Thus the L2 Experience Questionnaire is effective in differentiating high and low L2 experience individuals and this is reflected in the pattern of results in the Stroop Interference task. Therefore, the "Cross-Language Semantic Priming task will be used to further explore the semantic systems and the retrieval process in L1 and L2 by various bilingual samples of subjects. This is because the Semantic Priming task is a more analytical task than the Stroop Interference task. In the Semantic Priming task, we can examine many factors concerning bilingual lexical access, such as the factors of L1 and L2 access, and degree of semantic relatedness in L1 and L2. In addition, we can quantify these factors using the L2 experience questionnaires and the semantic analysis of L1 and L2 words.

CHAPTER 5

BILINGUAL LEXICAL ACCESS USING CROSS-LANGUAGE SEMANTIC PRIMING TASK

5.1 Introduction

In this chapter, we will examine two main issues of bilingual lexical access. First, whether L1 and L2 word meanings are stored in separate L1 and L2 semantic systems or in one common semantic system of L1 and L2. Second, whether L2 word meanings are accessed directly or indirectly from the semantic system. Furthermore, we will examine the effects of different L2 experience on these two issues.

In order to investigate these issues, the four experimental sets using the cross-language Semantic Priming tasks are reported here: Experiment 1 for Thai-English bilinguals, Experiment 2 for English-Thai bilinguals, Experiment 3 for Mandarin-English bilinguals, and Experiment 4 for English-Mandarin bilinguals. Each experimental set consists of four language conditions: (1) the intralingual condition in L1 (L1 primes-L1 targets), (2) the intralingual condition in L2 (L2 primes-L2 targets), (3) the interlingual condition in L1-L2 (L1 primes-L2 targets), and (4) the interlingual condition in L2-L1 (L2 primes-L1 targets).

In order to test the degree of priming effect, a restricted set of stimuli is required in which there are definite degrees of semantic overlap or non-overlap and quantifiable semantic features. Thus, before we construct the stimulus sets, a category of words is selected and analysed in terms of semantic feature analysis. For the present study, the kinship terms in Thai, English, and Mandarin are selected because of two issues. First, the kinship terms are words, which represent the same things among different languages but different languages have different set of kinship terms to refer to these same things. Second, the meanings of kinship terms can be obviously analyzed in terms of binary semantic features.

In what follows, the detailed analysis of Thai, English, and Mandarin kinship terms will be presented in Section 5.2. Then, the specific purposes and hypotheses of the present study will be proposed in Section 5.3.

In addition, it is of interest to test whether the difference between writing systems will influence lexical access. Thai and English languages, which have alphabetic writing systems and Mandarin language, which has logographic writing system will be used. The priming effects in accessing Thai, English and Mandarin words in the intralingual conditions will be compared in the subjects using these three languages as L1.

5.2 The Detailed Analysis of Thai, English, and Mandarin Kinship Terms

The study of kinship systems and structures is one of the most studied topics in anthropology, sociology, and linguistics. This is because it helps us to understand the power structure and the interpersonal communication patterns of a society as well as the system, the structure, and the functions of a family in a society.

Research works on kinship systems and structures can be divided into two approaches: the anthropological/ sociological approach and the linguistic approach.

5.2.1 The Study of Kinship Terms in Anthropology and Sociology

In the anthropological and sociological approach, researchers observe and collect a large quantity of information concerning the kinship system and structure of a family in a particular culture. Thus, anthropological and sociological studies on the kinship system and structure can present the characteristics of kinship system and structure in a culture for a particular period from a direct long-term observation of the researchers in this area.

Moreover, studies with this approach are quite dynamic because they can show the change of kinship systems and structures based on social, cultural, and economic factors during a period of time.

5.2.2 The Study of Kinship Terms in Linguistics

Another approach to the study of kinship is the linguistic approach. The linguistic study of kinship focuses on the linguistic properties of kinship terms. Linguists believe that the systems of kinship terms may be different in different cultures. The studies on linguistic properties and systems of kinship terms in different cultures can reflect the systems and structures of kinship in those cultures. The results of linguistic study of kinship terms will reflect the particular characteristics of a kinship system and structure, at a particular time. As kinship structure is quite static then the results of this linguistic analysis will not reflect how the system and structure change between periods of times or how related factors, i.e., social and cultural factors, influence the kinship system and structure.

The kinship system and structure of a society do, in fact, change gradually and are always influenced by temporal change and the social environment. Nevertheless a linguistic study of kinship may present different aspects of the dynamic characteristics of kinship system and structure in a culture from either a comparative and historical approach or a study and a lexical access approach.

5.2.2.1 The Study of Kinship Terms in Comparative and Historical Linguistics

In comparative and historical linguistics, researchers can study and compare systems of kinship terms in a particular culture at different time periods. For example, in Thai kinship terms, it has been found that before the thirteenth century, the father's younger brothers and younger sisters were assigned different terms. The father's younger brothers were called /a:w/ and the father's younger sisters were called /a:/. On the other hand, the mother's younger brothers and younger sisters were assigned the same term /na:/ . However, around the thirteenth century, the terms /a:/ and /a:w/ were merged and a single term /a:/ emerged. The study implies that in the past, the Thai kinship system emphasized the paternal side more than the maternal side (Soontornpasuch, 1963).

Thus it can be seen that comparative and historical study can show the change in kinship terms due to language change and language contact.

5.2.2.2 The Study of Kinship Terms in Lexical Access

Another method for studying kinship terms is the lexical access method. This focuses on how subjects access their lexical knowledge of kinship terms from their mental lexicon - that is, from their memory for words (Miller, 1979). The lexical

access study in this thesis will focus on the change in kinship terms, due to the influence of language contact. For example, people who use more than one language will have more than one system of kinship terms. Here the emphasis is on bilingual speakers, who will have two systems of kinship terms. With two kinship systems it is possible that bilingual speakers' knowledge of kinship system and structure will be different and more complex than the knowledge of monolingual speakers. In addition, there may be interference between the two kinship systems in bilingual speakers.

Whereas comparative researchers must spend a period of time collecting kinship terms in different periods, lexical access researchers may study kinship system and structure from experiments conducted at a particular point in time. In such experiments, kinship terms in a particular culture can be used as stimulus items, and subjects are asked to access their lexical knowledge concerning the kinship terms. For example, they may be asked to categorize the meanings of kinship terms. The results of such studies will allow conclusions to be drawn about the systems of kinship terms in subjects' mental lexicons. Moreover, it will reflect the subjects' knowledge concerning the kinship systems and structures.

For the present purposes, we will describe and compare the systems of Thai, Chinese (in this case, Mandarin[4] is chosen), and English kinship terms. This is because in the later lexical access study, we will use Thai, Mandarin, and English kinship terms as stimulus items and Thai-English, English-Thai, Mandarin-English, and English-Mandarin subjects will be tested. Details of this will be presented in Chapter 6.

5.2.3 Analysis Method

In what follows, the distinctive features which will be used to analyse the system of kinship terms will be described (Prasithrathsint, 2001). There are two main types of features. First, a "Binary" feature is a feature, which can employ a positive (+) or a negative (-) value to show whether this feature is present as a property of a kinship term. For example, kinship terms may be male (+Male) or female (-Male). Second, a "Scalar" feature is a feature, which has values, which can be presented along a scale. For example, there could be up to seven generations in describing the meanings of kinship terms.

5.2.3.1 Distinctive Features in Describing Kinship Terms

The kinship terms of Thai, Mandarin, and English will be described using seven distinctive features, six semantic features and one morphological feature, as presented below.

a) Semantic Features of Kinship terms

1) Generation Differences

For the present purposes, the semantic feature of "generation differences" is a scalar feature. There are seven generations used to describe kinship systems.

[4] Chinese language has six dialects. Mandarin dialect is the standard official dialect of Chinese and it is used in the People's Republic of China and the Republic of China (Peiros, 1998)

- Generation 0 is Ego's generation or the beginning point of view in describing a system of kinship terms. Relatives in this generation are the same generation as Ego. For example, the meaning of the Thai term /phi:2/ "Ego's older siblings" is in Generation 0.
- Generation +1 is the first generation above Ego's generation. For example, the meaning of Thai term /phɔ:2/ "Ego's father" is in Generation +1.
- Generation +2 is the second generation above Ego's generation. For example, the meaning of Thai term /pu:1/ "Ego's father's father" is in Generation +2.
- Generation +3 is the third generation above Ego's generation. For example, the meaning of Thai term /pu:1 thuat2/ "Ego's father's father's father " is in Generation +3.
- Generation -1 is the first generation below Ego's generation. For example, the meaning of Thai term /lu:k2/ "Ego's children" is in Generation -1.
- Generation -2 is the second generation below Ego's generation. For example, the meaning of Thai term /la:n4/ "Ego's children's children" is in Generation –2.
- Generation -3 is the third generation below Ego's generation. For example, the meaning of Thai term /le:n4/ "Ego's children's children's children" is in Generation –3.

2) Lineality

In the present study, "lineality" is defined as "Ego's direct relatives[5] and their descendants" (Keesing, 1975). The feature of "lineality" is a binary feature. There are the kinship terms meaning lineal relatives (+Lineal) and the kinship terms meaning non-lineal relatives (-Lineal). For example, Thai term /phɔ:2/ "Ego's father" is (+Lineal) but the term /nɔ:ŋ3/ "Ego's father's younger sibling" can be both (+Lineal) and (-Lineal).

3) Sex

The semantic feature of "sex" is binary. There are the kinship terms meaning male relatives (+Male) and the kinship terms meaning female relatives (-Male). For example, Thai term /phɔ:2/ "Ego's father" is (+Male) but the term /me:2/ "Ego's mother" is (-Male).

4) Paternal Side

The semantic feature of "Paternal side" is binary. There are kinship terms meaning relatives related to the father's side (+Paternal) and kinship terms meaning relatives related to the mother side (-Paternal). For example, Thai term /pu:1/ "Ego's father's father" is (+Paternal) but /ta:0/ "Ego's mother's father" is (-Paternal).

[5] Direct relatives and their descendants involve anyone born within a group of relatives; this group is intimate and provides certain rights and obligations. There is a distinction between blood relatives and relatives connected by marriage and this distinction can be patrilineal, matrilineal, or bilateral.

5) Relative Age

The semantic feature of "relative age" is binary. Relatives, who are older than the person at the beginning point in describing kinship terms in a generation are (+Old) whereas than who are younger are (-Old). For example, Thai term /phi:2/ "Ego's older sibling" is (+Old) but /nɔ:ŋ3/ "Ego's younger sibling" is (-Old).

6) Relation to Paternal Side

The semantic feature of "relation to Paternal side" is binary. Relatives, who are related to the Paternal side through male lines are (+Male Line). Relatives who are related to the Paternal side through female line, are (-Male Line). For example, the Mandarin term /taŋ ge/ "Ego's father's brother's older son" is (+Male Line) but the term /gu bie ge/"Ego's father's sister's older son" is (-Male Line).

b) The Morphological Feature in Kinship Terms – the Root Term

For the present study, kinship terms can be divided into two types according to morphological characteristics. There are the elementary and the derivational kinship terms. The term "elementary kinship term" is defined as a term that cannot be reduced into component elements, e.g., the terms "father" and "niece" are elementary terms in English. Alternatively, a "derivational kinship term" is one that is a compound of an elementary kinship term and other words, e.g., the words "great aunt" and "great grand father" in English. In the present study, the morphological feature of "root term " is a binary feature. There are root (+Root) and compound (-Root) kinship terms.

5.2.3.2 Values in Describing Kinship Terms

The systems of kinship terms will now be presented in tables using the above features. The distinctive features will be presented in the columns and the kinship terms will be presented in the rows. In the cells, the binary features will be given values. Five values will be used in describing kinship terms, as follows.

1) *Plus Value (+)* means that a kinship term possesses this feature. For example, the Thai term /phɔ:2/ "Ego's father" is (+Root), meaning that this term is a root term.
2) *Minus Value (-)* means that a kinship term does not possess this feature. For example, the Thai term /pu:1 thuat2/ "Ego's father's father' s father" is (-Root) meaning that this term is not a root term.
3) *Plus and Minus Values (±)* means that a kinship term can possess both (+) and (-). For example, the Thai term /a:0/ "Ego's father's younger sibling" is (±Male) meaning that /a:0/ can be either (+Male) or (-Male).
4) *Redundant Value* ⊕ means that the value of a feature can be implied from the values of other features. For example, the Mandarin term /taŋ ge/ "Ego's father's brother's older son" is (+Paternal), (+Male Line), and (+Lineal). However, (+Lineal) can be implied from

(+Paternal), and (+Male Line). Thus, the feature of lineality will be(⊕ Lineal) for /taŋ ge/.

5) *Blank Value* means that a particular feature does not play a role in describing a term. For example, the feature of relation to paternal side does not play role in describing the meaning of Thai term /thuat2/ "Ego's parents' parents' parents". Thus, this feature will be blank for /a:0/.

5.2.4 Important Issues in Describing and Comparing the Systems of Thai, Mandarin, and English Kinship Terms

We will compare the systems of Thai, Mandarin, and English kinship terms in five areas, which relate to the hypotheses of the present study (see Chapter 6). These issues are presented and discussed below:

5.2.4.1 Complexity of Kinship Systems

The complexity of the systems of kinship terms depends on three factors. First, there are a number of distinctive features involved in describing and distinguishing the meanings of kinship terms in each language. For example, if the number of distinctive features in Mandarin is larger than in Thai and English, then the system of Mandarin is more complex than that of Thai and English. Second, there are a particular number of kinship terms in a particular language. For example, in both Thai and English there are six root and compound kinship terms in Ego's generation, whereas there are twenty root and compound kinship terms in Mandarin. Thus, in this generation, the system of Mandarin kinship terms is more complex than the systems of Thai and English kinship terms. Third, there are a number of related words between two languages. For example, in Generation +1 one English term /ʌŋklə/ relates to three Thai terms /luŋ0/, /na:3/, and /a:0/. Thus, the system of Thai kinship terms in Generation +1 is more complex than the system in English.

The complexity of the system of kinship terms is important in lexical access studies for two reasons (Morton, 1969). First, if the number of words in a system is large, a subject will take longer to access the meaning of a word, compared to if the number of words in the system is small. For example, in Ego's generation, in Thai, when the word /phi:2/ is presented to a subject, the terms /phi:2/ and /no:ŋ3/ will be activated in the mental lexicon. Then, there is a checking process, in which the activated words will be checked to determine whether they are appropriate terms. Finally, /phi:2/ will be accessed from the lexicon. Alternatively, in Mandarin, when the term /ge1/ is presented, the terms /ge1/, /di4/, /jie3/, and /mei4/ will be activated before the appropriate term can be accessed. The reaction time in accessing /ge1/ should be longer than in accessing /phi:2/. This is because the checking process in Mandarin will take longer than in Thai.

Second, if the number of related words in a language is larger than in another language, a subject will take longer to access the meaning of a related word in this language, compared to the case when the number of related words in the language is smaller than another language. For example, the reaction time when a Mandarin-Thai bilingual accesses the meaning of the Mandarin term /ge1/ should be longer than when a Thai-Mandarin bilingual accesses the meaning of the Thai term /phi:2/. This is because in the Mandarin-Thai bilingual, there are two Mandarin terms /ge1/ and

/jie1/ which relate to the Thai term /phi:2/ and s/he has to spend a period of time to check which term should be accessed. Alternatively, in the Thai-Mandarin bilingual there is only one Thai term /phi:3/, which relates to the Mandarin terms /ge1/ or /jie1/, so s/he can access the appropriate term without engaging a checking process.

5.2.4.2 Lexical Weight of Kinship System

In this study, "Lexical Weight" is defined as the total number of semantic features used in describing the meaning of a word. The number of semantic features will be calculated using the criteria set out below.

1) The feature of generation differences will be weighted as one feature.
2) *Plus Value (+)* or *Minus Value (-)* will be weighted as one feature.
3) *Plus and Minus Values (±)* will be weighted as two features.
4) *Redundant Value* and *Blank Value* will not be given lexical weight values.

For example, the English term /brʌðər/ consists of (generation 0), (-Lineal), (+Male), and (± Old), so the lexical weight of /brʌðər/ is five; whereas, the Thai term /pa:2/ consists of (generation +1), (±Lineal), (-Male), (±Paternal), and (+Old), so the lexical weight of /pa:2/ is seven. The lexical weight of /pa:2/ is thus greater than that of /brʌðər/ (the summary of Lexical Weight of kinship terms in Thai, mandarin, and English is given in Figure 12).

Lexical weight is considered here because in the theories of lexical access (in this case, the logogen theory), the reaction time to access a lexical item, which has a large number of features, should be longer than to access a lexical item, which has a smaller number of features. Thus when the word /pa:2/ is presented, the semantic features for /pa:2/, (generation +1), (±Lineal), (-Male), (±Paternal), and (+Old) will be activated with a lexical weight of 7. These features will be activated to access the lexical item /pa:2/ from the lexicon. On the other hand, when the word /brʌðər/ is presented, the semantic features (generation 0), (-Lineal), (+Male), and (± Old) will be activated with a lexical weight of 5. Thus, the reaction time to access /pa:2/ should be longer than the reaction time in accessing /brʌðər/.

5.2.4.3 Shared and Different Semantic Features Among Words within the Same Language and across Different Languages.

A basic assumption of lexical access is that if two words have a large number of shared features, accessing one word will facilitate accessing the other word. The degree of facilitation will depend on the number of shared features. For example, there are three shared features and one different feature between the Mandarin terms /ge1/ "Ego's older male sibling" and /di4/ "Ego's younger male sibling", whereas, there are two shared features and two different features between the Mandarin terms /ge1/ "Ego's older male sibling" and /mei4/ "Ego's younger male sibling". Thus, the degree of facilitation between accessing /ge1/ and /di4/ should be stronger than between accessing /ge1/ and /mei4/.

5.2.4.4 Semantic Features Presented through Compound Kinship Terms

In the present study we will describe the semantic features as (±) for *root* kinship terms. However, this feature is specified (+) or (-) for *compound* kinship terms. For example, in the English system, the feature of relative age is (±) for /brʌðər/. However, this feature is (+) for / oldər brʌðər / and (-) for / jʌŋər brʌðər/. The assumption is that this feature will affect accessing the meanings of / oldər brʌðər / and / jʌŋər brʌðər/ less than the meaning of /brʌðər/. This is called the *"Semantic Transparency Effect"*. The meanings of compound terms are thus more transparent than the meanings of root terms.

5.2.4.5 Mismatched Valence, (+)/(-) versus (±) between Languages

If a semantic feature is (+) or (-) in one language but (±) in another language, this feature will influence accessing the meanings of kinship terms in these languages differently. For example, in English, the feature of relative age is (±) for /brʌðər/, whereas, in Mandarin, this feature should be specified (+) for /ge1/ and (-) for /di4/.

An assumption is that if the feature is (±) in L1 but (+) or (-) in L2, then the bilingual will spend a longer time to access L2 words via this feature than if the feature is (+) or (-) in L1 but (±) in L2.

For the studies on lexical access to be conducted here, these issues will be studied both within each language and across two languages.

5.2.5 The Thai, Mandarin, and English Systems of Kinship Terms

The kinship terms in the present study are the terms applied for people, who are related by blood. We shall exclude the terms applied for people who are related by marriage, e.g., husbands or wives of relatives.

5.2.5.1 The Systems of Kinship Terms in Generation -3

Table 5: The Systems of Kinship Terms in Generation -3

Language / Lexical Items	Features												
	Generation Differences (from +3 to –3)	Lineality		Sex		Paternal Sides		Relation to Paternal Sides		Relative Age		Root or Compound Words	
		+ Lineal	- Lineal	+ Male	- Male	+ Paternal	- Paternal	+ Male Line	- Male Line	+ Old	- Old	+ Root	- Root
Thai													
1. le:n4	-3	+	-	+	-	+	-					+	
2.le:n4 pu:1	-3	+	-	+	-	+							-
3. le:n4 ja: 2	-3	+	-	+	-	+							-
4. le:n4 ta:0	-3	+	-	+	-		-						-
5. le:n4 ja:j0	-3	+	-	+	-		-						-
Mandarin													
1.hui3 sun0 zi3	-3	⊕		+				+					-
2.hui3 sun0 nu2	-3	⊕			-			+					-
3.wai2 .hui3 sun 0	-3		θ	+					-				-
4.wai2 .hui3 sun 0 nu2	-3		θ		-				-				-
English													
1.greɪt grænd sʌn	-3	+		+		+	-						-
2.greɪt grænd dɔ:tər	-3	+			-	+	-						-
3.greɪt grænd nefju:	-3		-	+		+	-						-
4.greɪt grænd ni:s.	-3		-		-	+	-						-
5.greɪt grænd tʃaild.	-3	+	-	+	-	+	-						-

a) The Relative Complexity of Kinship Systems

As can be seen in Table 5, given the number of kinship terms in each language, the Thai kinship system and the English kinship terms are more complex (five terms) than the Mandarin system (four terms).

With respect to the number of related words between languages, according to Table 2, it can be seen that the number of Thai terms is always larger than the number of Mandarin terms. For example, the Mandarin terms /.hui3 sun0 zi3 / relate to the Thai terms /le:n4/, /le:n4 pu:1/, and /le:n4 ja: 2/. In comparing English and Mandarin related words, the number of English terms is always larger than of Mandarin terms. For example, the Mandarin terms /hui3 sun0 zi3 / relate to the English terms /greɪt grænd sʌn/, /greɪt grænd nefju:/, and /greɪt grænd tʃaild/. Comparing Thai and English related words shows that the Thai term /le:n4/ relates to the English term /greɪt grænd tʃaild/.

b) Lexical Weight of Kinship Systems

For this generation (-3), there are root terms in Thai but compound terms in Mandarin and English. For the Thai system, the lexical weight of all terms is six (except /le:n4/ which is seven). For the Mandarin system, the lexical weight of all terms is three. For the English system, the lexical weight of all terms is five (except /greɪt grænd tʃaild/ which is seven).

c) Shared and Different Semantic Features Among Kinship Terms

The influence of shared and different semantic features among kinship terms on accessing the meanings of kinship terms will be studied within each of the three languages. For example, in the Thai system, the meanings of/le:n4 pu:1/ and /le:n4 ta:0/ differ in one feature, the feature of parental side. On the other hand, the meanings of /le:n4 pu:1/ and /le:n4 ja:j0 / differ in two features, the features of paternal side and sex.

In addition, the importance of shared and different semantic features of kinship terms will be studied between languages. For example, the meanings of /le:n4 pu:1/ in Thai and /hui3 sun0 zi3/ in Mandarin differ in three features; the features of lineality, sex and relation to paternal side. On the other hand, /le:n4 pu:1/ and /greɪt grænd sʌn/ in English differ in three features; the feature of lineality, paternal side, and sex.

d) Semantic Features Presented through Compound Terms

In the Thai system, the feature of paternal side is presented through adding the terms /pu:1 /, /ja: 2/, /ta:0 /, and /ja:j0/ after /le:n4/. In the Mandarin system, the feature of generation -3 is presented through adding the term /hui3/ before the terms used in generation -2. On the other hand, in English system this feature is presented through adding the term /greɪt/ before /grænd/. In addition, in the Mandarin system, the feature of (-Lineal) is presented through the term /wai2 /.

e)Valence, (+) / (-) versus (±) between Languages

The comparison of Thai and English shows that for the meanings of all terms, the feature "lineality" is (±) in the Thai system but is specified (+) or (-) in the English system. On the other hand, this feature is predictable from the feature "relation to paternal side" in the Mandarin system.

5.2.5.2 The Systems of Kinship Terms in Generation -2

Table 6: The Systems of Kinship Terms in Generation –2

Language/ Lexical Items	Features												
	Generation Differences (from +3 to –3)	Lineality		Sex		Paternal Sides		Relation to Paternal Sides		Relative Age		Root or Compound Words	
		+ Lineal	- Lineal	+ Male	- Male	+ Paternal	- Paternal	+ Male Line	- Male Line	+ Old	- Old	+ Root	- Root
Thai													
1. la:n4	-2	+	-	+	-	+	-					+	
2.la:n4 pu: 1	-2	+	-	+	-	+							-
3. la:n4 ja: 2	-2	+	-	+	-	+							-
4. la:n4 ta: 0	-2	+	-	+	-		-						-
5. la:n4 ja:j0	-2	+	-	+	-		-						-
Mandarin													
1. sun0 zi 3	-2	⊕		+				+					-
2. sun0 nu 2	-2	⊕			-			+					-
3.wai2 sun0	-2		θ	+					-				-
4.wai2 sun0 nu2	-2		θ		-				-				-
English													
1.grænd sʌn	-2	+		+		+	-						-
2.grænd dɔ:tər	-2	+			-	+	-						-
3.grænd nefju:	-2		-	+		+	-						-
4. grænd ni:s.	-2		-		-	+	-						-
5. grænd ʧaild.	-2	+	-	+	-	+	-						-

a) The Relative Complexity of Kinship Systems

With respect to the number of kinship terms, the English and Thai kinship systems are more complex (five terms) than the Mandarin system (four terms).

With respect to the number of related words between languages, as can be seen in Table 6, the number of Thai terms is always larger than of the number of Mandarin terms. For example, the Mandarin terms /sun0 zi3/ relate to the Thai terms /la:n4/, /la:n4 pu:1/, and /la:n4 ja: 2/. For English and Mandarin, the number of English terms is always larger than the number of Mandarin terms. For example, the Mandarin terms /sun0 zi3/ relate to the English terms /grænd sʌn/, /grænd nefju:/ and /grænd tʃaild/. For the comparison of Thai and English, the Thai term /la:n4/ relates to the English term /grænd tʃaild/.

b) Lexical Weight of Kinship Systems

For this generation, there are root terms in Thai but compound terms in Mandarin and English. For the Thai system, the lexical weight of all terms is six (except /la:n4/ which is seven). For the Mandarin system, the lexical weight of all terms is three. For the English system, the lexical weight of all terms is five (except /grænd tʃaild/ which is seven).

c) Shared and Different Semantic Features Among Kinship Terms

The influence of shared and different semantic features among kinship terms on accessing the meanings of kinship terms will be studied within the languages. For example, in Thai, the meanings of /la:n4 pu:1/ and /la:n4 ta:0/ differ in one feature, the feature of parental side. On the other hand, the meanings of /la:n4 pu:1/ and /la:n4 ja:j0/ differ in two features; the features of the paternal side and sex.

With respect to between-language differences the meanings of /la:n4 pu:1/ in Thai and /sun0 zi3/ in Mandarin differ in three features, the features of lineality, sex and relation to paternal side. On the other hand, /la:n4 pu:1/ and /grænd sʌnin English differ in three features; the feature of lineality, paternal side, and sex.

d) Semantic Features Presented through Compound Terms

In the Thai system, the feature of paternal side is presented through adding the terms /pu:1 /, /ja: 2/, /ta:0 /, and /ja:j0/ after /la:n4/. In the Mandarin system, the feature of generation -2 is presented through adding the term /sun0/ before the terms used in generation -1. On the other hand, in the English system, this feature is presented through adding the term /grænd/ before the terms used in generation -1. Finally, in the Mandarin system, the feature of (-Lineal) is presented through the term /wai2/.

e) Valence, (+) / (-) versus (±) between Languages

The comparison of Thai and English shows that for the meanings of all terms, the feature "lineality" is (±) in the Thai system but it is specified (+) or (-) in the

English system. This feature is predictable from the feature "relation to paternal side" in the Mandarin system.

5.2.5.3 The Systems of Kinship Terms in Generation -1

Table 7: The Systems of Kinship Terms in Generation -1

Language /Lexical Items	Features												
	Generation Differences (from +3 to –3)	Lineality		Sex		Paternal Sides		Relation to Paternal Sides		Relative Age		Root or Compound Words	
		+ Lineal	-Li neal	+ Male	- Male	+ Paternal	- Paternal	+ Male Line	- Male Line	+ Old	- Old	+ Root	- Root
Thai													
1. lu:k0	-1	+		+	-							+	
2. la:n4	-1		-	+	-	+	-					+	
3.lu:k0 tɕha:j0	-1	+		+									-
4. lu:k0 sa:w4	-1	+			-								-
5. la:n4 tɕha:j0	-1		-	+		+	-						-
6. la:n4 sa:w4	-1		-		-	+	-						-
Mandarin													
1. er3 zi3	-1	⊕		+									-
2. nu2 er 3	-1	⊕			-								-
3. taŋ3 zhi3	-1	⊕		+				+					-
4.wai2 sheŋ0	-1		0	+					-				-
5 taŋ3 zhi3 nu2	-1	⊕			-			+					-
6.wai2 sheŋ0 nu 2	-1		0		-				-				-
English													
1. sʌn	-1	+		+								+	
2. dɔ:tər	-1	+			-							+	
3. nefju::	-1		-	+		+	-					+	
4. ni:s	-1		-		-	+	-					+	
5. tʃaild	-1	+	-	+	-	+	-					+	

a) The Relative Complexity of Kinship Systems

With respect to the number of kinship terms in each language, the systems of Mandarin and Thai kinship terms are more complex (six terms) than the English system (five terms).

For the number of related words between languages, according to Table 7, it can be seen that the number of Thai terms is always smaller than the number of Mandarin terms. For example, the Mandarin terms /taŋ3 zhi3/, and /wai2 sheŋ0/ relate to the Thai term /la:n4 tɕha:j0/. The comparison of English and Mandarin related words, reveals that the number of English terms is always smaller than the number of Mandarin terms. For example, the Mandarin terms /taŋ3 zhi3/, and /wai2 sheŋ0/ relate to the English term /nefju:/. The comparison of Thai and English related words shows that the number of Thai terms is always larger than the number of English terms. For example, the Thai term /lu:k0/ relates to /sʌn/, and /dɔ:tər/ in English.

b) Lexical Weight of Kinship Systems

For this generation, there are root terms in Thai but compound terms in Mandarin and English. For the Thai system, the lexical weight of all terms is three (except /lu:k0/ and /la:n4/ which are four). For the Mandarin system, the lexical weight of /er3 zi3/ and /nu2 er3/ is two and for other words it is three. For the English system, the lexical weight of /sʌn/, and /dɔ:tər/is three. The lexical weight of /nefju:/ and /ni:s/ is five. The lexical weight of /tʃaild/ is seven.

c) Shared and Different Semantic Features Among Kinship Terms

In the English system, the meanings of /sʌn/ and /dɔ:tər/ differ in one feature, the feature of sex, whereas, the meanings of /sʌn/, and /ni:s/ differ in two features, the features of lineality and sex.

With respect to between-language differences the meanings of /lu:k0 tɕha:j0/ in Thai and /er3 zi3/ in Mandarin share all features, whereas, /lu:k0 tɕha:j0/ in Thai and /nu2 er3/ in Mandarin differ in one feature, the feature of sex.

d) Semantic Features Presented through Compound Terms

In the Thai system, the feature of sex is presented through adding the terms /tɕha:j0/, and /sa:w4/ after the root terms. In the Mandarin system, the feature of generation -1 is presented through the term /er3/. In addition, in the Mandarin system, the feature of (-Lineal) is presented through the term /wai2 /.

e) Valence, (+) / (-) versus (±) between Languages

According to Table 7, for Generation -1, there is no feature meeting the criterion of being (±) in a language but specified (+) or (-) in another language.

5.2.5.4 The Systems of Kinship Terms in Ego's Generation

Table 8: The Systems of Kinship Terms in Ego's Generation

Language / Lexical Items	Features												
	Generation Differences (from +3 to –3)	Lineality		Sex		Paternal Sides		Relation to Paternal Sides		Relative Age		Root or Compound Words	
		+ Lineal	- Lineal	+ Male	- Male	+ Paternal	- Paternal	+ Male Line	- Male Line	+ Old	- Old	+ Root	- Root
Thai													
1. phi:2	0	+	-	+	-					+		+	
2. no:ŋ3	0	+	-	+	-						-	+	
3. phi:2 tɕha:j0	0	+	-	+						+			-
4.no:ŋ3 tɕha:j0	0	+	-	+							-		-
5.phi:2 sa:w4	0	+	-		-					+			-
6.no:ŋ3 sa:w4	0	+	-		-						-		-
Mandarin													
1. ge1	0	+		+								+	
2. di4	0	+		+								+	
3. jie3	0	+			-							+	
4. mei4	0	+			-							+	
5. taŋ2 ge1	0	⊕		+		+		+					-
6. gu1 bia3 ge1	0		θ	+		+			-				-
7. jiu4 bia3 ge1	0		θ	+			-	+					-
8. ji2 bia3 ge1	0		θ	+			-		-				-
9. taŋ2 di4	0	⊕		+		+		+					-
10. gu1 bia3 di4	0		θ	+		+			-				-
11.jiu4 bia3 di4	0		θ	+			-	+					-
12. ji2 bia3 di4	0		θ	+			-		-				-
13.taŋ2 jie1	0	⊕			-	+		+					-
14. gu1 bia3 jie1	0		θ		-	+			-				-
15.jiu4 bia3 jie1	0		θ		-		-	+					-
16.ji2 bia3 jie1	0		θ		-		-		-				-
17.taŋ2 mei4	0	⊕			-	+		+					-

Table 8 (continued)

Language s/ Lexical Items	Features												
	Generation Differences (from +3 to –3)	Lineality		Sex		Paternal Sides		Relation to Paternal Sides		Relative Age		Root or Compound Words	
		+ Lineal	- Lineal	+ Male	- Male	+ Paternal	- Paternal	+ Male Line	- Male Line	+ Old	- Old	+ Root	- Root
Mandarin (continued)													
18. gu1 bia3 mei4	0		θ		-	+			-				-
19.jiu4 bia3 mei4	0		θ		-		-	+					-
20.ji2 bia3 mei4	0		θ		-		-		-				-
English													
1. brʌðər	0	+		+						±		+	
2. sɪstər	0	+			-					±		+	
3. kʌzən	0		-	±						±		+	
4. oldər brʌðər	0	+		+						+			-
5. jʌŋgər brʌðər	0	+		+							-		-
6. oldər sɪstər	0	+			-					+			-
7. jʌŋgər sɪstər	0	+			-						-		-

a) The Relative Complexity of Kinship Systems

With respect to the number of kinship terms in each language, the system of Mandarin kinship terms is more complex (20 terms) than the systems of Thai (7 terms) and English (7 terms). Regarding the number of related words between languages, it can be seen in Table 8 that the number of Mandarin terms is always larger than of Thai terms. For example, the Thai terms /phi:2/ and /phi:2 tɕha:j0/ relate to the Mandarin terms /ge1/, /taŋ2 ge1/, /gu1 bia3 ge1/, /jiu4 bia3 ge1/, and /ji2 bia3 ge1/. The comparison of English and Mandarin related words shows that the number of Mandarin terms is always larger than the number of English terms. For example, the English terms /brʌðər/ and /oldər brʌðər/ relate to the Mandarin terms /ge1/, /taŋ2 ge1/, /gu1 bia3 ge1/, /jiu4 bia3 ge1/, and /ji2 bia3 ge1/. The comparison of Thai and English shows that the kinship systems of Thai and English are labelled in different dimensions. For example, the Thai term /phi:2/ relates to the English root terms /brʌðər/ and /sɪstər/. On the other hand, the Thai term /nɔ:ŋ3/ also relates to the English root terms /brʌðər/ and /sɪstər/.

b) Lexical Weight of Kinship Systems

For root terms, it can be seen that the lexical weight of all Thai terms (6 semantic features) is greater than the lexical weight of all English terms (5 features). Moreover, the lexical weight of all English terms is greater than that of all Mandarin terms (3 features). For compound terms, the lexical weight of all Mandarin terms is equal to that of all English terms (4 features), whereas, the lexical weight of all Thai terms (5 features) is greater than that of Mandarin and English terms.

c) Shared and Different Semantic Features Among Kinship Terms

In the Thai system, the meanings of / phi:2/ and /no:ŋ3/ differ in one feature, the feature of sex, whereas, in the Mandarin system, the meanings of /ge1/ and /mei4/ differ in two features; the features of sex and relative age.

Regarding between-language differences, the meanings of /phi:2 tɕha:j0/ in Thai and /oldər brʌðər/ in English differ in one feature, the feature of lineality. On the other hand, /phi:2 tɕha:j0/ and /taŋ2 ge1/ in Mandarin differ in three features, the features of lineality, paternal side, and relation to paternal.

d) Semantic Features Presented through Compound Terms

In Thai, the feature "sex" is (±) in the meanings of /phi:2/ and /no:ŋ3/. However, the feature of sex is specified (+) or (-) in the meanings of compound terms. In Thai compound terms, the word /tɕha:j0/ meaning (+male) and the word /sa:w4/ meaning (-male) are added after the root terms. Thus, the influence of the feature "sex" in accessing /phi:2/ and /no:ŋ3/ should be less than in accessing /phi:2 tɕha:j0/ and /no:ŋ3 tɕha:j0/. In Mandarin, the features "paternal side" and "relation to paternal side" are blank in the meanings of root terms, whereas, they are specified (+) or (-) in the meanings of compound terms. In English, the feature "relative age" is (±) in the meanings of root terms, whereas, it is specified (+) or (-) in the meanings of compound terms.

e) Valence, (+) / (-) versus (±) between Languages

The comparison of Thai and Mandarin shows that for the meanings of root terms, the features "lineality" and "sex" are (±) in the Thai system but they are specified (+) or (-) in the Mandarin system. For compound terms, the feature "lineality" is (±) in Thai but it is specified (+) or (-) in Mandarin.

The comparison of Thai and English shows that for the meanings of root terms, the feature "sex" is (±) in the Thai system but it is specified (+) or (-) in the English system. For compound terms, there is no feature for this.

The comparison of Mandarin and English shows that for the meanings of root terms, the feature "relative age" is (±) in the English system, but it is specified (+) or (-) in the Mandarin system. For compound terms, there is no feature for this issue.

5.2.5.5 The Systems of Kinship Terms in Generation +1

Table 9: The Systems of Kinship Terms in Generation +1

Language /Lexical Items	Features												
	Generation Differences (from +3 to −3)	Lineality		Sex		Paternal Sides		Relation to Paternal Sides		Relative Age		Root or Compound Words	
		+ Lineal	- Lineal	+ Male	- Male	+ Paternal	- Paternal	+ Male Line	- Male Line	+ Old	- Old	+ Root	- Root
Thai													
1. phɔ:2	+1	+		+								+	
2. mɛ:2	+1	+			-							+	
3. luŋ0	+1		-	+		+	-			+		+	
4. pa:2	+1		-		-	+	-			+		+	
5. na:3	+1		-	+	-		-				-	+	
6. a:0	+1		-	+	-	+					-	+	
Mandarin													
1. fu2	+1	+		+								+	
2. mu4	+1	+			-							+	
3. bo2	+1	+		+		+				+		+	
4. shu0	+1	+		+		+					-	+	
5. jiu2	+1		-	+			-			+	-	+	
6. gu0	+1	+			-	+				+	-	+	
7. ji2	+1	+			-		-			+	-	+	
English													
1. fɑðər	+1	+		+								+	
2. mʌðər	+1	+			-							+	
3. ʌŋklə	+1		-	+		+	-			+	-	+	
4. ɑnt	+1		-		-	+	-			+	-	+	
5. peərənt	+1	+		+	-								-

a) The Relative Complexity of Kinship Systems

With respect to the number of kinship terms in each language, the system of Mandarin kinship terms is more complex (7 terms) than the systems of Thai (6 terms) and English (5 terms).

For the number of related words between languages, it can be see in Table that the number of Mandarin terms is always larger than of Thai terms. For example, the Thai term /luŋ0/ relates to the Mandarin terms /bo2/ and /jiu2/. The comparison of English and Mandarin related words reveals that the number of Mandarin terms is always larger than of English terms. For example, the English term /ʌŋklə/ relates to the Mandarin terms /bo2/, / shu0/, and /jiu2/. Comparing Thai and English related words reveals that the number of Thai terms is always larger than of English terms. For example, the Thai terms /luŋ0/, /na:3/, and /a:0/ relate to the English term /ʌŋklə/.

b) Lexical Weight of Kinship Systems

For root terms, we have found that the lexical weight of all English terms (except /fɑðər/, and /mʌðər/) is more than of all Thai terms (except /phɔ:2/, and /mɛ:2/) and Mandarin terms (except /fu2/, and /mu4/). The lexical weight of kinship terms meaning "Ego's father" and "Ego's mother" in these three languages is equal (3 features).

For compound terms, there is only /perənt/ in English and its lexical weight is four features.

c) Shared and Different Semantic Features Among Kinship Terms

In Thai, the meanings of /phɔ:2/ and /mɛ:2/differ in one feature, the feature of sex; whereas, the meanings of /phɔ:2/ and /luŋ0/ differ in three features, the features of lineality, paternal side and relative age.

Regarding between-language differences, the meanings of /phɔ:2/ in Thai and /fɑðər/ in English share all semantic features, whereas, /phɔ:2/ and /ʌŋklə/ in English differ in three features, those of lineality, paternal side, and relative age.

d) Semantic Features Presented through Compound Terms

For the kinship terms in this generation, there is no compound term in the Thai, Mandarin and English systems.

e) Valence, (+) / (-) versus (±) between Languages

The comparison of Thai and Mandarin shows that for the meanings of root terms, the feature "lineality" is (±) in the Thai system but is specified (+) or (-) in the Mandarin and English systems. Comparison between Mandarin and English shows that for the meanings of root terms, the feature "paternal side" is (±) in English but is specified (+) or (-) in Mandarin.

5.2.5.6 The Systems of Kinship Terms in Generation +2

Table 10: The Systems of Kinship Terms in Generation +2

Language /Lexical Items	Features												
	Generation Differences (from +3 to -3)	Lineality		Sex		Paternal Sides		Relation to Paternal Sides		Relative Age		Root or Compound Words	
		+ Lineal	- Lineal	+ Male	- Male	+ Paternal	- Paternal	+ Male Line	- Male Line	+ Old	- Old	+ Root	- Root
Thai													
1. pu:1	+2	+	-	+		+						+	
2. ja:2	+2	+	-		-	+						+	
3. ta:0	+2	+	-	+			-					+	
4. ja:j0	+2	+	-		-		-					+	
Mandarin													
1. zu4 fu 2	+2	⊕		+		+							-
2. zu4 mu4	+2	⊕			-	+							-
3. wai2 zu4 fu2	+2		θ	+			-						-
4. wai2 zu4 mu4	+2		θ		-		-						-
English													
1.grænd fɑðər	+2	+		+		+	-						-
2.grænd mʌðər	+2	+			-	+	-						-
3.greɪt ʌŋklə	+2		-	+		+	-						-
4. greɪt ɑnt	+2		-		-	+	-						-
5.grænd peərənt	+2	+	-	+	-	+	-						-

a) The Relative Complexity of Kinship Systems

With respect to the number of kinship terms in each language, the system of English kinship terms is more complex (5 terms) than the systems of Thai Mandarin (4 terms). Regarding the number of related words between languages, Table 10 shows that there is a one-to-one relation. For example, the Thai term /pu:1/ relates to the Mandarin term /zu4 fu2/. The comparison of English and Mandarin related words shows that the number of English terms is always larger than the number of Mandarin terms. For example, the Mandarin terms /zu4 fu2/ and /wai2 zu4 fu2/ relate to the English terms /grænd fɑðər/, /greɪt ʌŋklə/, and /grænd peərənt/. The comparison of Thai and English related words shows that the number of English terms is always

larger than the number of Thai terms. For example, the Thai terms /pu:1/ and /ta:0/ relate to the English terms /grænd fɑðər/, /greɪt ʌŋklə/, and /grænd perənt/.

b) Lexical Weight of Kinship Systems

For this generation, there are root terms in Thai but compound terms in Mandarin and English. In Thai the lexical weight of all terms is five. In Mandarin, the lexical weight of all terms is three. In English, the lexical weight of all terms is five except /grænd perənt/ which has a weight of six.

c) Shared and Different Semantic Features Among Kinship Terms

In Thai, the meanings of /pu:1/ and /ta:0/ differ in one feature, that of parental side, whereas, the meanings of /pu:1/ and /ja:j0/ differ in two features; the features of paternal side and sex.

Regarding between-language differences, the meanings of /pu:1/ in Thai and /zu4 fu2/ in Mandarin share all semantic features. On the other hand, /pu:1/ and /grænd fɑðər/ in English differ in two features, those of lineality, and paternal side.

d) Semantic Features Presented through Compound Terms

For the kinship terms in this generation, there are compound terms in the Mandarin and English systems. In Mandarin, the feature of generation +2 is presented through the term /zu4/, whereas, in English, this feature is presented through the term /grænd/. In addition, in Mandarin, the feature of (-Paternal) and (θLineal) is presented through the term /wai2/.

e) Valence, (+) / (-) versus (±) between Languages

The comparison of Thai and English shows that for the meanings of all terms, the feature "lineality" is (±) in Thai system but is specified (+) or (-) in English. This feature is predictable from the feature "paternal side" in Mandarin.

5.2.5.7 The Systems of Kinship Terms in Generation +3

Table 11: The Systems of Kinship Terms in Generation +3

Language /Lexical Items	Features												
	Generation Differences (from +3 to –3)	Lineality		Sex		Paternal Sides		Relation to Paternal Sides		Relative Age		Root or Compound Words	
		+ Lineal	- Lineal	+ Male	- Male	+ Paternal	- Paternal	+ Brother	- Brother	+ Old	- Old	+ Root	- Root
Thai													
1. thuat2	+3	+	-	+	-	+	-					+	
2.pu:1 thuat2	+3	+	-	+		+							-
3.ja:2 thuat2	+3	+	-		-	+							-
4.ta:0 thuat2	+3	+	-	+			-						-
5.ja:j0 thuat2	+3	+	-		-		-						-
Mandarin													
1. hui3 zu4 fu2	+3	⊕		+		+							-
2. hui3 zu4 mu4	+3	⊕			-	+							-
3.wai2 hui3zu4 fu2	+3		θ	+			-						-
4.wai2 hui3 zu4 mu4	+3		θ		-		-						-
English													
1.greɪt grænd fɑðər	+3	+		+		+	-						-
2.greɪt grænd mʌðər	+3	+			-	+	-						-
3.greɪt greɪt ʌŋklə	+3		-	+		+	-						-
4.greɪt greɪt ænt	+3		-		-	+	-						-
5.greɪt grænd peərənt	+3	+	-	+	-	+	-						-

a) The Relative Complexity of Kinship Systems

With respect to the number of kinship terms in each language, the systems of English and Thai kinship terms are more complex (5 terms) than the system of Mandarin (4 terms). With respect to between-language differences Table shows that the number of Thai terms is always larger than that of Mandarin terms. For example, the Mandarin terms /hui3 zu4 fu2/ and /wai2 hui3 zu4 fu2/ relate to Thai terms /thuat2/, /pu:1 thuat2/, and /ta:0 thuat2/. The comparison of English and Mandarin related words shows that the number of English terms is always larger than that of Mandarin terms. For example, the Mandarin terms /hui3 hui3 zu4 fu2/ and /wai2 hui 3 zu4 fu2/ relate to the English terms /greɪt grænd fɑðər/, /greɪt greɪt ʌŋklə/, and /greɪt grænd peərənt/.

The comparison of Thai and English related words shows that the number of English terms is always equal to the number of Thai terms. For example, the Thai terms /thuat2/, /pu:1 thuat2/, and /ta:0 thuat2/ relate to the English terms /greɪt grænd fɑðər/, /greɪt greɪt ʌŋklə/, and /greɪt grænd perənt/.

b) Lexical Weight of Kinship Systems

For this generation, there are root terms in Thai but compound terms in Mandarin and English. For Thai, the lexical weight of all terms is five (except /thuat 2/). For Mandarin, the lexical weight of all terms is three. For English, the lexical weight of all terms (except /greɪt grænd peərənt/) is five. However, the lexical weight of /thuat2/ and /greɪt grænd peərənt/ is six.

c) Shared and Different Semantic Features Among Kinship Terms

In Thai, the meanings of /pu:1 thuat2/ and /ta:0 thuat2/ differ in one feature, that of parental side, whereas, the meanings of /pu:1 thuat2/ and /ja:j0 thuat2/ differ in two features; the features of paternal side and sex. The meanings of /pu:1 thuat2/ in Thai and /hui3 zu4 fu2/ in Mandarin share all of the semantic features, whereas /pu:1 thuat2/ and /greɪt grænd fɑðər/ in English differ in two features, the features of lineality, and paternal side.

d) Semantic Features Presented through Compound Terms

In Thai, the feature of paternal side and sex are presented through adding the terms /pu:1/, /ja:2/, /ta:0/, and /ja:j0 /. In Mandarin, the feature of generation +3 is presented through adding the term /hui3/ used in generation +2. In English, this feature is presented through adding the term /greɪt/ before /grænd/. In addition, in Mandarin system, the feature of (-Paternal) and (θLineal) is presented through the term /wai2/.

e) Valence, (+) / (-) versus (±) between Languages

The comparison of Thai and English shows that for the meanings of all terms, the feature "lineality" is (±) in Thai but is specified (+) or (-) in English system. In Mandarin, this feature is predictable from the feature "paternal side".

The relative complexity, lexical weight of kinship terms, semantic features presented through compound terms, and valence of semantic features in generation –3 to + 3 in Thai, Mandarin, and English kinship systems are summarized in Table 12 below.

Table 12: The Summary of the Relative Complexity (in number of terms), Lexical Weight (in number of semantic features), Semantic Features through Root and Compound Terms, and Feature Valence in Thai, Mandarin, and English Kinship Systems

Note. R = the features presented through root terms , C = the features presented through compound terms

Measures of Kinship Systems	Complexity	Lexical Weight	Features through Root and Compound Words						Valence Features					
			Generation	Lineality	Sex	Paternal Sides	Relation to Paternal	Relative Age	Generation	Lineality	Sex	Paternal Sides	Relation to Paternal	Relative Age
Generation -3														
Thai	5	6-7	R	R	R	C	R	R	+/-	±	+/-	+/-	+/-	+/-
Mandarin	4	3	C	C	R	R	R	R	+/-	⊕	+/-	+/-	+/-	+/-
English	5	5-7	C	R	R	R	R	R	+/-	+/-	+/-	+/-	+/-	+/-
Generation -2														
Thai	5	6-7	R	R	C	C	R	R	+/-	±	+/-	+/-	+/-	+/-
Mandarin	4	3	C	C	R	R	R	R	+/-	⊕	+/-	+/-	+/-	+/-
English	5	5-7	C	R	R	R	R	R	+/-	+/-	+/-	+/-	+/-	+/-
Generation -1														
Thai	6	3-4	R	R	C	R	R	R	+/-	±	±	+/-	+/-	+/-
Mandarin	6	3	C	C	R	R	R	R	+/-	+/-	+/-	+/-	+/-	+/-
English	5	3-7	R	R	R	R	R	R	+/-	+/-	+/-	+/-	+/-	±
Generation o														
Thai	7	5-6	R	R	C	R	R	R	+/-	+/-	+/-	+/-	+/-	+/-
Mandarin	20	3-4	R	R	R	C	C	R	+/-	+/-	+/-	+/-	+/-	+/-
English	7	4-5	R	R	R	R		C	+/-	+/-	+/-	+/-	+/-	+/-
Generation +1														
Thai	6	3-5	R	R	R	R	R	R	+/-	±	±	+/-	+/-	+/-
Mandarin	7	3-6	R	R	R	R	R	R	+/-	+/-	+/-	+/-	+/-	+/-
English	5	3-5	R	R	R	R	R	R	+/-	+/-	+/-	+/-	+/-	±
Generation +2														
Thai	4	5	R	R	R	R	R	R	+/-	±	+/-	+/-	+/-	+/-
Mandarin	4	3	C	R	R	R	R	R	+/-	⊕	+/-	+/-	+/-	+/-
English	5	5-6	C	R	R	R	R	R	+/-	+/-	+/-	+/-	+/-	+/-
Generation +3														
Thai	5	5-6	R	R	C	C	R	R	+/-	±	+/-	+/-	+/-	+/-
Mandarin	4	3	C	C	R	C	R	R	+/-	⊕	+/-	+/-	+/-	+/-
English	5	5-6	C	R	R	R	R	R	+/-	+/-	+/-	+/-	+/-	+/-

According to Table 12, the analysis of kinship terms in each "Generation" is summarized below.

(1) The Kinship Terms in Generation –3

For Generation –3, the number of terms and the number of semantic features describing the meanings of kinship terms in Thai and English are more than in Mandarin.

According to the features through root and compound terms, for Thai, every semantic feature can be presented through root terms, except the feature "Paternal Sides", which is presented through compound terms. For Mandarin, there are the features "Generation" and "Linearity", which are presented through compound terms. Finally, for English, the feature "Generation" is presented through compound terms.

For the feature valence in each language, for Thai, every feature can be specified either as a plus or a minus value through the word meanings, except the feature "Lineality", which can be both plus and minus. For Mandarin, every feature can be specified either as a plus or a minus value, except the feature "Lineality", which can be implied the value of a plus or a minus from the value of the feature "Sex". For English, every feature can be specified either as a plus or a minus value.

(2) The Kinship Terms in Generation –2

For Generation –2, the number of terms and the number of semantic features describing the meanings of kinship terms in Thai and English are more than in Mandarin.

According to the features through root and compound terms, for Thai, every semantic feature can be presented through root terms, except the features "Sex" and "Paternal Sides", which are presented through compound terms. For Mandarin, there are the features "Generation" and "Linearity", which are presented through compound terms. Finally, for English, the feature "Generation" is presented through compound terms.

For the feature valence in each language, the valence features in this Generation are similar to Generation –3. That is, for Thai, every feature can be specified either plus or minus value through the word meanings, except the feature "Lineality", which can be both a plus and a minus. For Mandarin, every feature can be specified either as a plus or a minus value, except the feature "Lineality", which can be implied the value of a plus or a minus from the value of the feature "Sex". For English, every feature can be specified either as a plus or a minus value.

(3) The Kinship Terms in Generation –1

For Generation –1, the number of terms and the number of semantic features describing the meanings of kinship terms in Thai and Mandarin are more than in English.

According to the features through root and compound terms, for Thai, every semantic feature can be presented through root terms, except the feature "Sex", which is presented through compound terms. For Mandarin, there are the features "Generation" and "Linearity", which are presented through compound terms. Finally, for English, no semantic feature is presented through compound terms.

For the feature valence in each language, for Thai, every feature can be specified either as a plus or a minus value through the word meanings, except the features "Sex" and "Lineality", which can be both a plus and a minus. For Mandarin, every feature can be specified either as a plus or a minus value. For English, every feature can be specified either as a plus or a minus value, except the feature "Relative Age" which can be both a plus and a minus value.

(4) The Kinship Terms in Generation 0

For Generation 0, the number of terms and the number of semantic features describing the meanings of kinship terms in Mandarin are more than in Thai and English.

According to the features through root and compound terms, for Thai, every semantic feature can be presented through root terms, except the feature "Sex", which is presented through compound terms. For Mandarin, there are the features "Paternal Sides" and "Relation to Paternal", which are presented through compound terms. Finally, for English, every semantic feature can be presented through root terms, except the feature "Relative Age", which is presented through compound terms.

For the feature valence in each language, for Thai, Mandarin, and English kinterms, every feature can be specified either as a plus or a minus value through the word meanings.

(5) The Kinship Terms in Generation +1

For Generation +1, the number of terms and the number of semantic features describing the meanings of kinship terms in Mandarin are more than in Thai and English.

According to the features through root and compound terms, for all Thai, Mandarin, and English, every semantic feature can be presented through root terms.

For the feature valence in each language, for Thai, every feature can be specified either as a plus or a minus value through the word meanings, except the features "Sex" and "Lineality", which can be both a plus and a minus. For Mandarin, every feature can be specified either as a plus or a minus value. For English, every feature can be specified either as a plus or a minus value, except the feature "Relative Age" which can be both a plus and a minus value.

(6) The Kinship Terms in Generation +2

For Generation +2, the number of terms and the number of semantic features describing the meanings of kinship terms in English are more than in Thai and Mandarin.

According to the features through root and compound terms, for Thai, every semantic feature can be presented through root terms. For Mandarin and English, there is the feature "Generation" which is presented through compound terms.

For the feature valence in each language, for Thai, every feature can be specified either as a plus or a minus value through the word meanings, except the feature "Lineality", which can be both a plus and a minus value. For Mandarin, every feature can be specified either as a plus or a minus value, except the feature "Lineality", which can be implied the value of a plus or a

minus from the value of the feature "Sex". For English, every feature can be specified either as a plus or a minus value.

(7) The Kinship Terms in Generation +3

For Generation +3, the number of terms and the number of semantic features describing the meanings of kinship terms in Thai and English are more than in Mandarin.

According to the features through root and compound terms, for Thai, every semantic feature can be presented through root terms, except the features "Sex" and "Paternal Sides", which are presented through compound terms. For Mandarin, there are the features "Generation", "Linearity", and "Paternal sides", which are presented through compound terms. Finally, for English, the feature "Generation" is presented through compound terms.

For the feature valence in each language, the valence features in this Generation are similar to Generation +2. That is, for Thai, every feature can be specified either as a plus or a minus value through the word meanings, except the feature "Lineality", which can be both a plus and a minus. For Mandarin, every feature can be specified either as a plus or a minus value, except the feature "Lineality", which can be implied the value of a plus or a minus from the value of the feature "Sex". For English, every feature can be specified either as a plus or a minus value.

5.3 The Specific Purposes and Hypotheses of the Experimental Series.

5.3.1 The Within Language Priming Task

5.3.1.1 Purposes

There are two specific purposes of L1 or L2 within language Priming tasks:

1. To examine the priming effects and the reaction time for the prime-target kinship terms, which have one or more than one different semantic features within the system of Thai, Mandarin, or English.
2. To examine the priming effects and the reaction time for the kinship terms within the system of Thai, Mandarin, or English in the bilingual speakers, who use these languages as their L1 or L2.

5.3.1.2 Hypotheses

The hypotheses of the within language Priming task are presented below.

1. In the Thai, Mandarin, or English systems, the priming effects for the prime-target kinship terms with one different semantic feature will be more powerful than the priming effects for the prime-target kinship terms with more than one semantic feature. As a result, the reaction time for the prime-target kinship terms with one different semantic feature will be faster than for the prime-target kinship terms with more than one different semantic feature. (As can be seen in Table 13).
2. With reference to Table 13, the priming effects for the kinship terms in the bilingual speakers who use Thai, Mandarin, or English as L1 will be more powerful than in the bilinguals, who use these languages as L2.

3. With reference to Table 13, the priming effects for the kinship terms in L2 will be more powerful in the bilingual speakers with high L2 experience than in the bilingual speakers with low L2 experience.
4. Due to the different writing systems, the priming effects for accessing Mandarin words will be more powerful than the priming effects for accessing Thai and English words in the intralingual conditions in bilinguals using these languages as L1.

Table 13: The Construction of the Within Language Priming Task

L1	L2	L2 Experience Group	Primes AND Targets								
			Thai			Mandarin			English		
			1 Different Feature	More than 1 Different Feature	Unrelated	1 Different Feature	More than 1 Different Feature	Unrelated	1 Different Feature	More than 1 Different Feature	Unrelated
Thai	English	High	✓	✓	✓				✓	✓	✓
		Low	✓	✓	✓				✓	✓	✓
English	Thai	High	✓	✓	✓				✓	✓	✓
		Low	✓	✓	✓				✓	✓	✓
Mandarin	English	High				✓	✓	✓	✓	✓	✓
		Low				✓	✓	✓	✓	✓	✓
English	Mandarin	High				✓	✓	✓	✓	✓	✓
		Low				✓	✓	✓	✓	✓	✓

5.3.2 The Between Language Priming Task

5.3.2.1 Purposes

The specific purpose of the between L1 or L2 Priming task is to examine the priming effects and the reaction time for the prime-target kinship terms with one or more different semantic features. The primes and the targets in these studies are in different languages and the bilingual subjects are speakers who use these languages as their L1 and L2.

5.3.2.2 Hypotheses

The hypotheses of this task are presented below:

1. For Thai, Mandarin, or English targets, the priming effects for the prime-target kinship terms with one different semantic feature will be more powerful than the priming effects for the prime-target kinship terms with more than one different semantic feature. As a result, the reaction time for the prime-target kinship terms with one different semantic feature, will be faster than for the prime-target kinship terms with more than one different semantic feature.
2. In the bilinguals with low L2 experience, the priming effects in accessing the kinship terms in L2 preceded by the related kinship terms in L1 will be more powerful than accessing the kinship terms in L1 preceded by the related kinship terms in L2. As a result, the reaction time in accessing the kinship terms in L2 preceded by the related kinship terms in L1 will be faster than accessing the kinship terms in L1 preceded by the related kinship terms in L2.
3. In the bilinguals with high L2 experience, the priming effects in accessing the kinship terms in L2 preceded by the related kinship terms in L1 will not be different from accessing the kinship terms in L1 preceded by the related kinship terms in L2. As a result, the reaction time in accessing the kinship terms in L2 preceded by the related kinship terms in L1 will not be significantly different from accessing the kinship terms in L1 preceded by the related kinship terms in L2.

Table 14: The Construction of the Between Language Priming Task

L1	L2	L2 Experience Group	PRIMES	TARGETS								
				Thai			Mandarin			English		
				1 Different Feature	More than 1 Different Features	Unrelated	1 Different Feature	More than 1 Different Features	Unrelated	1 Different Feature	More than 1 Different Features	Unrelated
Thai	English	High	Thai							✓	✓	✓
		Low	English	✓	✓	✓						
English	Thai	High	Thai							✓	✓	✓
		Low	English	✓	✓	✓						
Mandarin	English	High	Mandarin							✓	✓	✓
		Low	English				✓	✓	✓			
English	Mandarin	High	Mandarin							✓	✓	✓
		Low	English				✓	✓	✓			

CHAPTER 6

BILINGUALISM AND CROSS-LANGUAGE PRIMING: METHOD AND RESULTS

6.1 Introduction

In this chapter, four experiments on cross-language Semantic Priming are presented and discussed. The design of the four experiments is the same but the subjects differ. In Experiment 1 Thai-English bilinguals with Thai as L1 and English as L2 are tested. Experiment 2 concerns English-Thai bilinguals (L1 English, L2 Thai); Experiment 3 Mandarin-English bilinguals (L1 Mandarin, L2 English); and in Experiment 4 English-Mandarin bilinguals (L1 English, L2 Mandarin).

6.2 Experiment 1:Thai-English Bilinguals

6.2.1 Subjects

Forty-eight Thai-English bilingual speakers (TE, hereafter) were placed into two groups on the basis of their L2 experience. L2 experience was measured with the English Language Experience Questionnaire (see Appendix A). 300 questionnaires were distributed to TE bilingual speakers, who were first year graduate students at the Faculty of Arts, Chulalongkorn University, in the first semester of 2001. They were asked to fill in the questionnaires and return these to the researcher within two weeks. 251 subjects of the original 300 returned the questionnaires. Those 24 subjects with the highest scores were placed in the high L2 experience group (High group, hereafter) and those 24 with lower scores were placed in the low L2 experience group (Low group, hereafter).

6.2.2 Stimuli and Design

Four language conditions were used. These are experimental sets of within Thai (L1-L1, hereafter), within English (L2-L2, hereafter), between Thai-English (L1-L2, hereafter), and between English-Thai (L2-L1, hereafter) priming conditions. In each language condition, there are 60 prime-target pairs. Half of the targets are kinship terms in the target language and the other half are not kinship terms. For each target, there are three levels of semantic relatedness between prime and target (a) primes and targets differ by one semantic feature (Hi related pairs, hereafter), (b) primes and targets differ by more than one semantic feature (Lo related pairs, hereafter), and (c) primes and targets are semantically unrelated (Unrelated pairs, hereafter). Non-kinship terms, all similar in frequency and in the number of syllables to the targets served as the unrelated targets. These are preceded by the same primes as those preceding the kinship terms.

For the L1-L1 condition, there are 60 Thai prime-target pairs. The primes and the targets were selected according to the following procedure. Thirty Thai kinship terms were chosen from the CRSLP Thai Word Frequency Corpus (see Appendix F) as the targets. Thai kinship terms with one and more than one different semantic feature, served as the Hi and the Lo related primes. Thai non-kinship terms served as the unrelated primes. These words were selected from the Thai word frequency

corpus. In addition, thirty Thai non-kinship terms, all similar in frequency and in the number of syllables to the targets, served as the unrelated targets.

For the L1-L2 condition, the same 30 Thai primes were used and 30 different Thai primes were used. The 30 targets were all English kinship terms, which were translations of the Thai targets in the L1-L1 condition. The 30 unrelated English targets were translations of the Thai targets in the L1-L1 condition.

For the L2-L2 condition, there were 60 English prime-target pairs. Thirty English kinship terms were chosen from the Brown Corpus (Francis and Kucera, 1982) as targets. English kinship terms differing by one and more than one different semantic features, served as the Hi and the Lo related primes. English non-kinship terms served as the unrelated primes. These words were selected from the English word frequency table of Francis and Kucera (1982). In addition, English non-kinship terms, all similar in frequency and in the number of syllables to the targets, served as the unrelated targets.

For the L2-L1 condition, there are 60 English prime-Thai target pairs. The thirty Thai kinship term targets were translation pairs of English kinship terms in the L2-L2 condition. The semantically related and unrelated primes are the same as those in the L2-L2 condition. The Thai translation pairs of English non-kinship terms in the L2-L2 condition served as the unrelated targets.

The experimental design is rolling design. Three lists of stimulus items were constructed such that no target appears more than once in a list. For example, targets with Hi related primes in the List 1 are preceded by Lo related primes in List 2, and by unrelated primes in List 3. Lists of primes and targets are shown in Appendix G.

The experiment involves a 2 x (2 x 2 x 3) design with one between-subjects factor, Language Experience group (high and low English experience), and three within-subjects factors: the Priming Language (L1 or L2), the Target Language (L1 or L2), and the Semantic Relatedness between primes and targets (Hi Related, Lo Related and Unrelated).

6.2.3 Procedure

All subjects were tested individually. The subjects in each language experience group were assigned to the list conditions randomly: in each language experience group, eight were assigned to the first list, eight to the second list, and the other eight to the third list. They were asked to decide whether the targets were kinship terms or not by pressing one of the two shift keys on the keyboard, appropriately labelled. The subjects were asked to press the right key if the targets were kinship terms and the left key if the targets were not kinship terms. They were asked to respond as quickly and accurately as possible. Instructions and ten practice items were given before the experimental items

The stimuli were all presented in the centre of a computer screen (Toshiba Satellite 2510CDS). In each condition there were 60 test trials. Each test trial consisted of a sequence of events as follows: a prime for 150 ms, a blank interval for 50 ms, and a target for 500 ms. Presentation of the stimuli and the collection and analysis of data were conducted using the DMDX software developed by Kenneth I. Forster and Jonathan C. Forster at the University of Arizona in 1999. This is a windows compatible version of the DMASTR software first developed by K.I. Forster and others at Monash University in 1981.

6.2.4 Results and Discussion

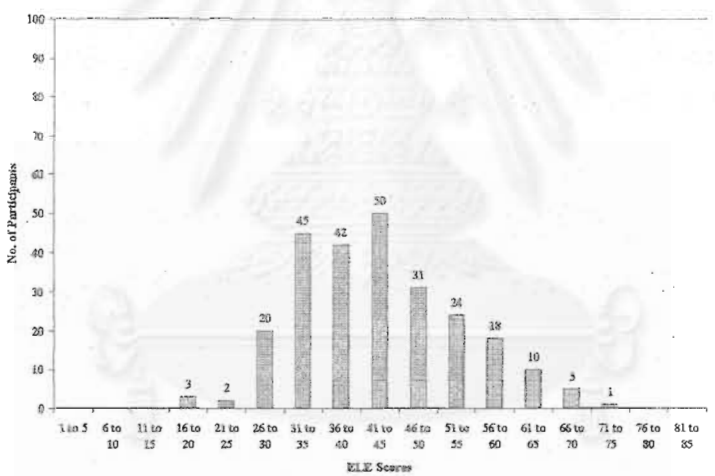
6.2.4.1 Profile of the Subjects

In this section, the distribution of TE group will be described, based on their English language experience scores (ELE Scores) obtained on the English language experience questionnaires. To describe the distributions, various descriptive statistics - the maximum and minimum value, range, median, mode, mean, and standard deviation (SD) of ELE scores are given in Table 15 and the distributions are illustrated in Figure 14 below.

Table 15: The Distribution of ELE scores in the TE Bilingual Speakers.

	Overall	High Group	Low Group
Number of Subjects	251	24	24
Mean	42.8	60	29.5
Median	42	60	30
Mode	38	60	32
Min	18	37	19
Max	72	48	37
Range	54	11	18
S.D.	10.7	6.9	4.4

(a)



(b)

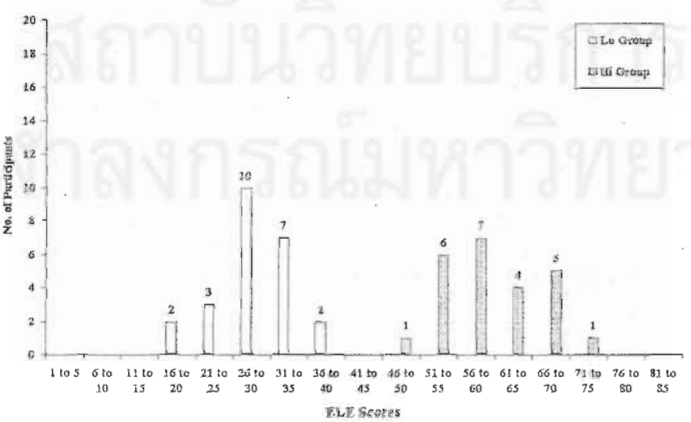


Figure 14: (a) Profile of the TE Bilinguals and
(b) Profile of the High TE and the Low TE Groups

As can be seen in Table 15, the distribution of TE bilingual speakers by their ELE scores approximates a normal distribution. There are almost equal numbers of subjects on either side of the midpoint ('41 to 45'), 112 subjects on the lower, and 89 subjects on the upper side. Moreover, the highest number of subjects (50) were concentrated on the midpoint. Mean ELE score for all subjects is 42.8, which was on the midpoint of the histogram and the standard deviation (SD) is 10.7. The range between the minimum (18) and the maximum scores (72) of ELE scores is 54.

For the High group, the distribution is similar to the overall distribution. The number of subjects on the lower site (14) is slightly larger than on the higher side (10) of the histogram. Mean, mode, and median values of ELE scores are 60, the range between the minimum (48) and the maximum (72) is 24, and the SD is 6.9.

For the Low group, the distribution almost follows a normal curve. There is a slightly larger number of subjects (9) on the upper than on the lower side of the histogram (5). The highest number of subjects (10) is on the midpoint of the scores. In the Low group, mean ELE score is 29.5, mode is 32, and median is 30. The range between the minimum (19) and the maximum (37) is 18, and the SD is 4.4.

6.2.4.2 Analysis of Priming Effects on Mean Reaction Time, and Percentage Errors

In this and all later experiments, incorrect responses were removed from the data set. Reaction time (RT) in the tasks greater than 2000 ms and less than 200 ms was also removed. This accounted for less than 2% of the data and did not change the overall pattern of results. The mean RT, percentage errors, and degrees of priming effects are presented in Table 16.

(a) The Analysis of Reaction Time and Percentage Error Rates

For the analysis of RT and percentage errors, the results of Experiment 1 are summarized in Figure 15.

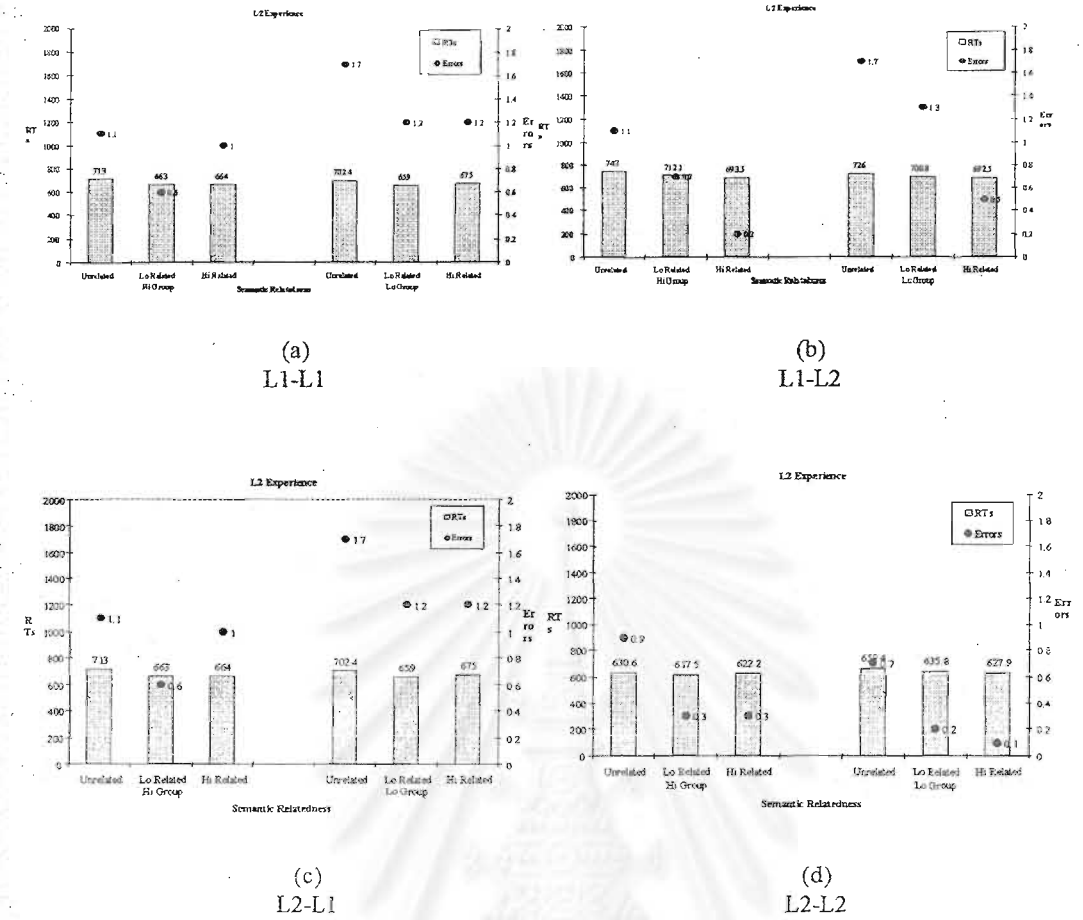


Figure 15: Mean Reaction Time (Bars) and Percentage Error Rates (Black Dots) for TE Bilinguals in Four Language Conditions: (a) L1-L1, (b) L1-L2, (c) L2-L1, and (d) L2-L2.

Inspection of Figure 15, the comparison of RT shows the ordering of the fastest to slowest RT is L1-L1, L2-L1, L2-L2, and L1-L2 in both the High and the Low groups. This implies that there was faster responding to L1 targets than to L2 targets and there was faster responding when the primes and the targets are in the same language than in different languages. The comparison of errors among these four conditions showed the ordering of the fewest to the most errors is L2-L1, L1-L1, L1-L2, and L2-L2 in both the High and the Low groups. This implies that there were fewer errors to L1 targets than to L2 targets and there were fewer errors for L2 primes than for L1 primes. The effect of Semantic Relatedness showed the same pattern in all condition. That is, the fastest RT and fewest errors occurred in the Hi related and the slowest RT and most errors in the unrelated pairs, except in L2-L2 condition for the High group. These results are similar in both the High and the Low groups.

(b) Priming Effects

In what follows, the priming effects were computed by subtracting the mean RT in a Hi or a Lo related condition from the mean RT in its corresponding unrelated condition. For example, the priming effect in the L1-L1 condition obtained in the Hi related prime-target pairs in the High L2 experience group was calculated by subtracting the mean RT of Hi related pairs in L1-L1 in the High group from the mean

RT of unrelated pairs in L1-L1 in the same subject group. The priming effects for TE bilinguals are presented in Table 16 below.

Table 16: Priming Effects (in ms) and Standard Errors (in Parentheses) for Thai-English Bilinguals with High and Low English Language Experience

Conditions			English Language Experience Groups	
PRIMES	TARGETS	Semantic Relatedness	High	Low
Thai (L1)	Thai (L1)	Hi Related	*59.7 (28.8)*	*86.2 (25.2)*
		Lo Related	*33.7 (27.8)*	*55.3 (30)*
	English (L2)	Hi Related	*30.5 (58.8)*	*79.5 (28)*
		Lo Related	*28.5 (57.1)*	*63 (27.4)*
English (L2)	Thai (L1)	Hi Related	*36.2 (37.8)*	*35.6 (25.4)*
		Lo Related	*35 (36.6)*	*16.7 (26.9)*
	English (L2)	Hi Related	*46.2 (39.9)*	*65.3 (29.4)*
		Lo Related	*39.5 (41.7)*	*18.7 (24.6)*

As can be seen in Table 16, there is little evidence for priming effects in TE bilinguals. A 2 x (2 x 2 x 2) analysis of variance (ANOVA) was conducted with L2 Experience group as the between-subject factor, and Priming Languages, Target Languages, and Semantic Relatedness as the within-subject factors. The ANOVA revealed that there were no significant main effects or significant interactions, with all $Fs < 1$. Thus for the TE subjects neither L2 Experience, Priming Language, Target Language, nor Semantic Relatedness affected the degree of Semantic Priming; Semantic Priming was statistically equivalent for all conditions.

It is a potential reason for why there were no significant main effects for the experiment. For TE subjects, the subjects are selected from a homogenous group. The subjects with high English experience may have similar formal and informal language experience with the subjects with low English experience.

6.2.5 Summary of Experiment 1

According to the hypotheses, the results found in the TE bilinguals are that the priming effects for the prime-target kinship terms with one different semantic feature were more powerful than the priming effects for the prime-target kinship terms with more than one different semantic feature in both the intralingual and the interlingual Semantic Priming tasks. As a result, the reaction time for the prime-target kinship terms with one different semantic feature was faster than the reaction time for the prime-target kinship terms with more than one different semantic feature in both the intralingual and the interlingual Semantic Priming tasks.

For the intralingual Semantic Priming tasks (Thai primes-Thai targets, and English primes-English targets), the priming effects for the kinship terms in Thai were more powerful than the priming effects for the kinship terms in English in both groups of subjects with high and low English experience. As a result, the reaction time for the kinship terms in Thai was faster than the reaction time for the kinship terms in English in both groups of subjects. However, in the subjects with high English experience, the mean priming effect for English kinship terms was more powerful than the mean priming effect obtained in the subjects with low English experience.

For the interlingual Semantic Priming tasks (Thai primes-English targets, and English primes-Thai targets), in the subjects with low English experience, the priming effects in accessing the kinship terms in English preceded by the related primes in Thai were markedly more powerful than the priming effects in accessing the kinship terms in Thai preceded by the related primes in English.

Whereas, in the subjects with high English experience, the priming effects in accessing the kinship terms in English preceded by the related primes in Thai were slightly more powerful than the priming effects in accessing the kinship terms in Thai preceded by the related primes in English.

6.3 Experiment 2: English-Thai Bilinguals

6.3.1 Subjects

The questionnaires were distributed to 200 English-Thai bilingual speakers, from two participant groups. The first group (n = 150) were teachers and students at Chulalongkorn University, Thammasart University, Chiang Mai University, Assumption University, Asian Institute of Technology, British Council Language Institute, and AUA Language Institute. The second group (n = 50) comprised people working for business and international associations such as SEAMEO Regional Language Centre (Thailand) and SIL. All questionnaires were completed in 2001. They were asked to fill in the questionnaires and return these to the researcher within 1 month. Of the initial 200, 126 subjects returned the questionnaires, and from these participants forty-eight English-Thai bilingual speakers were placed in two groups on the basis of their L2 experience as measured by the Thai Language Experience Questionnaire (see Appendix A). Of the original sample, those 24 subjects with the highest scores were placed in the High group and those 24 subjects with the lowest scores were placed in the Low group.

6.3.2 Stimuli and Design

Four language conditions were included, experimental sets of within English (L1-L1), within Thai (L2-L2,), between English-Thai (L1-L2), and between Thai-English (L2-L1) prime-target conditions. The experimental design is the same as in Experiment 1.

For the L1-L1 condition, the primes and the targets are the same set as in Experiment 1: L2-L2 condition. For the L1-L2 condition, the primes and the targets are the same set as in Experiment 1: L2-L1 condition. For the L2-L2 condition, the primes and the targets are the same set as in Experiment 1: L1-L1 condition. Finally, for the L2-L1 condition, the primes and the targets are the same set as in Experiment 1: L1-L2 condition.

As in Experiment 1, a rolling design was used and the experiment involves a 2 x (2 x 2 x 3) design with one between-subjects factor, Language Experience group (high and low English experience), and three within-subjects factors: the Priming Language (L1 or L2), the Target Language (L1 or L2), and the Semantic Relatedness between primes and targets (Hi Related, Lo Related, and Unrelated).

6.3.3 Procedure

The procedure is identical to the procedure described in Experiment 1 (6.2.3).

6.3.4 Results

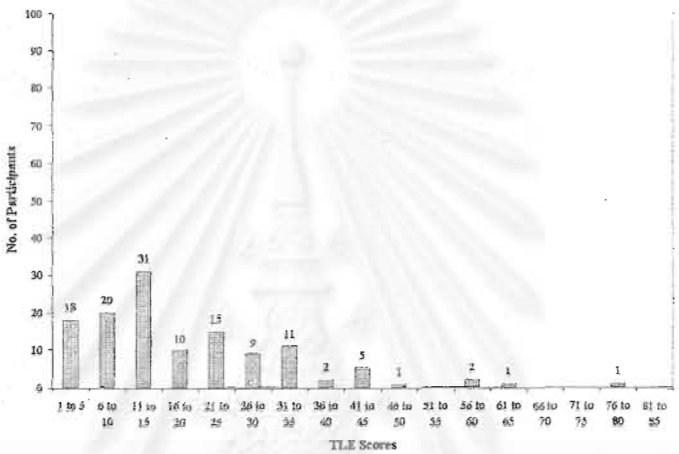
6.3.4.1 Profile of the Subjects

The distribution of the ET sample from 126 subjects is described and presented in Table 17 and is illustrated with histograms in Figure 16.

Table 17: The Distribution of TLE scores in the ET Bilingual Speakers.

	Overall	High Group	Low Group
Number of Subjects	126	24	24
Mean	17.7	35.3	10.3
Median	14.5	33.5	11
Mode	11	32	11
Min	1	23	2
Max	78	78	22
Range	77	55	20
S.D.	12.3	11.5	5.5

(a)



(b)

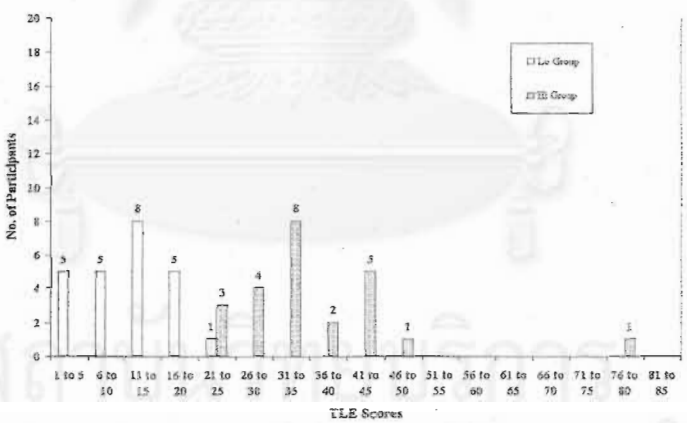


Figure 16: (a) Profile of the ET Bilinguals and
(b) Profile of the High ET and the Low ET Groups

The ET distribution of all 126 subjects was markedly skewed with most scores falling below 30 and a possible maximum score of 85. There was a larger number of subjects (96 subjects) on the lower side than on the upper side of histogram (5 subjects) with only 5 subjects on the midpoint of TLE scores. This negative skew is demonstrated by the measures of central tendency, i.e., mean score is 17.7, mode is 11, and median is 14.5. The range between the minimum score (1) and the maximum score (78) is 77, and the SD is 12.3.

The distribution of the High group is similar to the distribution of the whole group. Most of the High group obtained TLE scores on the lower side of the nominal

mid-point TLE scores (23 subjects), with only one recording a TLE score on the upper side. Mean TLE is 35.3, the mode is 32, and the median is 33.5. The range between the minimum (23) and the maximum (78) is 53, and the SD is 11.5.

For the Low group, the distribution is also negatively skewed. Most of the Lo group obtained TLE scores on the lower side of the nominal midpoint scores (10 subjects), with 6 subjects on the upper side. In the Low group, mean ELE score is 10.3, mode is 11, and median is 11. The range between the minimum (2) and the maximum (22) is 20, and the SD is 5.5.

It can be noted that the separation of the High and Low groups of ET subjects here is not as clear cut as in Experiment 1 with the TE subjects.

6.3.4.2 The Analysis of Priming Effects on Mean Reaction Time, and Percentage Errors

(a) The Analysis of Reaction Time and Percentage Error Rates

For the analysis of RT and percentage errors, the results of Experiment 2 are summarized in Figure 17.

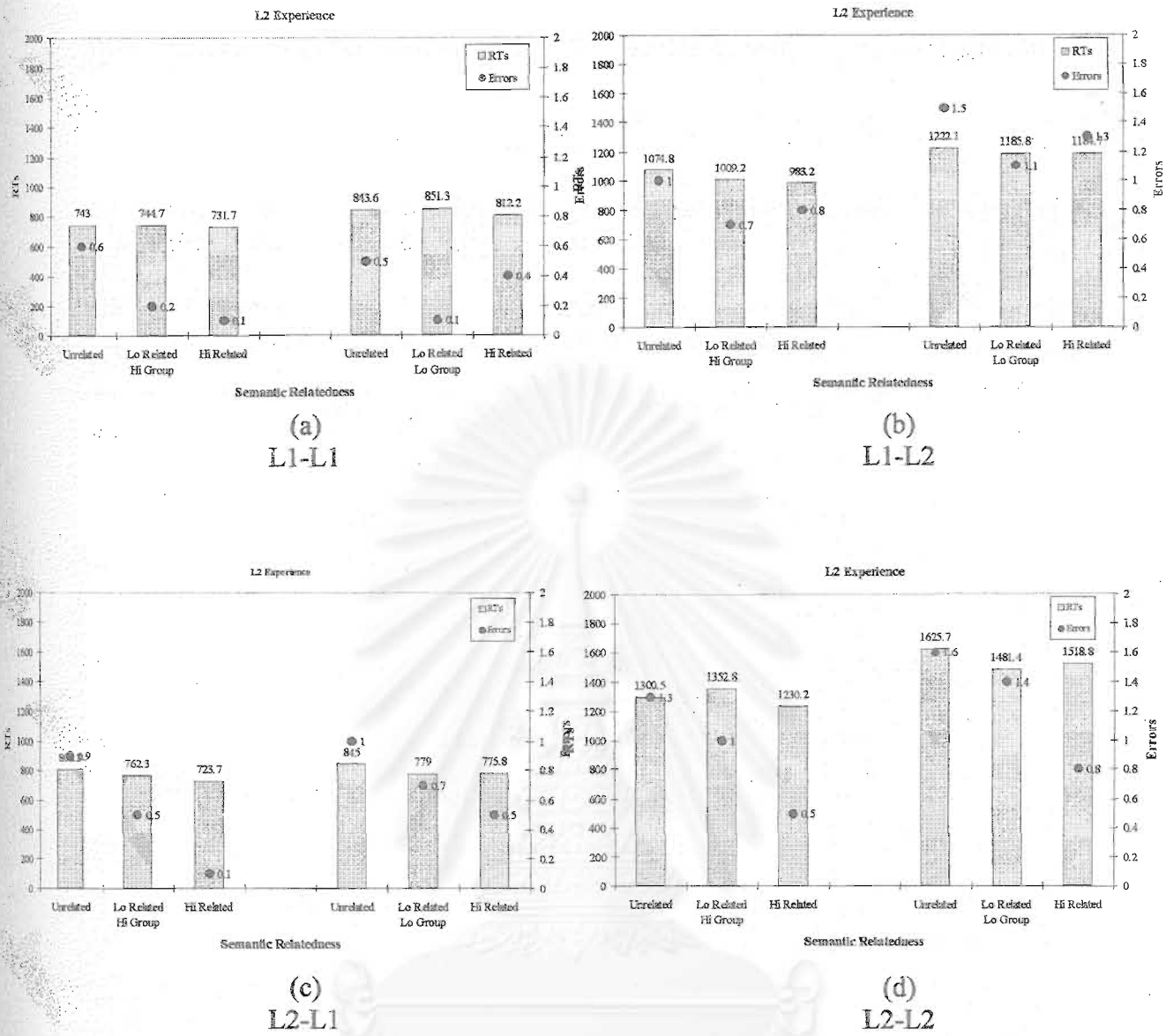


Figure 17: Mean Reaction Time (Bars) and Percentage Error Rates (Black Dots) for ET Bilinguals in Four Language Conditions: (a) L1-L1, (b) L1-L2, (c) L2-L1, and (d) L2-L2.

The comparison of RT among the four conditions in Figure 16 shows the ordering of the fastest to the slowest RT is L1-L1, L2-L1, L2-L2, and L1-L2 in the Low group. However, in the High group, the ordering is slightly different; RT in L2-L1 condition were fastest. This implies that there was faster responding to L1 targets than to L2 targets. The comparison of errors among these four conditions showed that the ordering of the fewest to the most errors is L2-L1, L1-L1, L2-L2 and L2-L1 in the High group, but L1-L1, L2-L1, L2-L2, and L1-L2 in the Low group. This implies that there were fewer errors for L1 targets than for L2 targets. Moreover, the data imply that there is a negative relationship between the RT and the errors in both the High and the Low groups: that is, when RT were fast, errors were small and when RT were slow, errors were high. The effect of Semantic Relatedness showed the same pattern in all conditions. That is, the fastest RT and the fewest errors were found in the Hi related and the slowest RT and greatest errors were found in the Unrelated pairs. This

pattern differed from that obtained in L1-L2 condition in both the High and the Low groups.

(b) Priming Effects

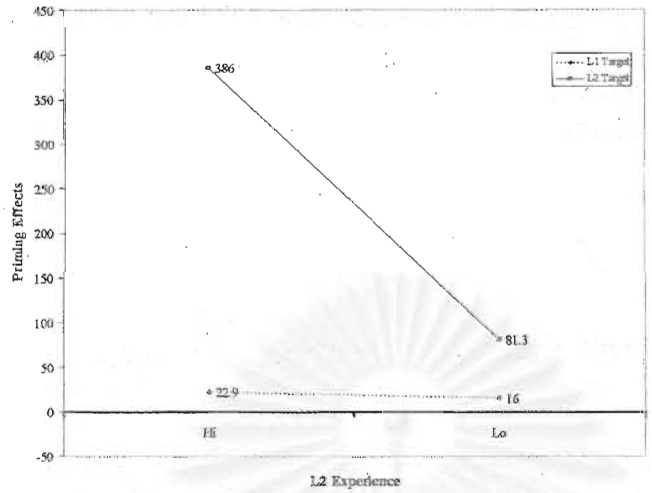
In what follows, the priming effects were computed by the same procedure as in Experiment 1 and the results are presented in Table 18.

Table18: Priming Effects (in ms) and Standard Errors (in Parentheses) for English-Thai Bilinguals with High and Low Thai Language Experience

Conditions			Thai Language Experience Groups	
PRIMES	TARGETS	Semantic Relatedness	High Group	Low Group
English (L1)	English (L1)	Hi Related	*60.8 (63)*	*69.2 (90.6)*
		Lo Related	*37.8 (76.3)*	*65.2 (88.9)*
	Thai (L2)	Hi Related	*760.3 (73.6)*	*144.3 (182)*
		Lo Related	*614.5 (100)*	*106.9 (137.1)*
Thai (L2)	English (L1)	Hi Related	*2.4 (57)*	*-31.5 (67.7)*
		Lo Related	*-9.5 (54)*	*-39.1 (65.8)*
	Thai (L2)	Hi Related	*85.1 (100.9)*	*37.5 (106)*
		Lo Related	*84.2 (100.8)*	*36.4 (113.5)*

The priming effect results of ET bilinguals are presented in Table 18. A 2 x (2 x 2 x 2) analysis of variance (ANOVA) was conducted with L2 experience group as the between-subject factor, and Priming Language, Target Language, and Semantic Relatedness as the within-subject factors. The ANOVA revealed that there was a significant main effect of the between-subject factor, L2 Experience, $F(1, 46) = 9.873$, $p < .05$ with greater priming effects in the High (mean = 204.5) than in the Low (mean = 48.6) experience group. There was also a significant difference in the effect of Priming Language, $F(1, 46) = 10.592$, $p < .05$, indicating that the priming effect for L1 primes was stronger than for L2 primes. There was also a significant effect of Target Language, $F(1, 46) = 18.191$, $p < .05$, indicating that the priming effect for L2 targets was stronger than for L1 targets. Of greater interest, however, was that these main effects were qualified by a significant interaction between L2 Experience and Priming Language, $F(1, 46) = 3.187$, $p < .05$ and between L2 Experience and Target Language, $F(1, 46) = 8.793$, $p < .05$. These interactions are schematically represented in Figure 17. As can be seen, the degree of priming occurring for the main effects of Priming Language (Figure 18a) and Target Language (Figure 18b) were accentuated with high L2 experience. There was no main effect of Semantic Relatedness or of any of its interactions.

(a)



(b)

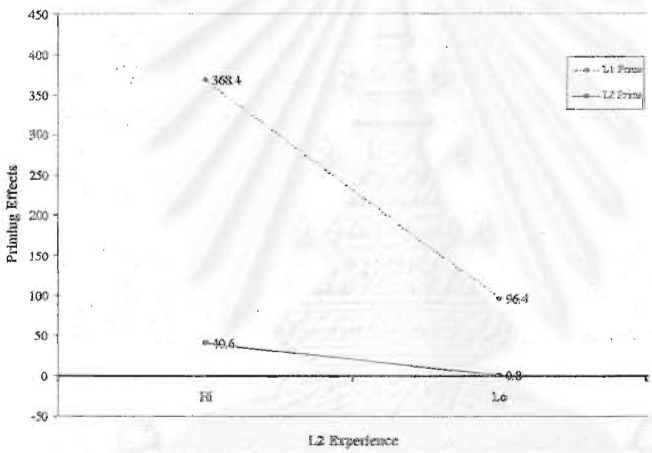


Figure 18: The Interaction between L2 Experience x Prime is presented in Figure 18a and between L2 Experience x Target in Figure 18b.

6.3.5 Summary of Experiment 2

According to the hypotheses, the results found in the ET bilinguals are that the priming effects for the prime-target kinship terms with one different semantic feature were more powerful than the priming effects for the prime-target kinship terms with more than one different semantic feature in both the intralingual and the interlingual Semantic Priming tasks. As a result, the reaction time for the prime-target kinship terms with one different semantic feature was faster than the reaction time for the prime-target kinship terms with more than one different semantic feature in both the intralingual and the interlingual Semantic Priming tasks.

For the intralingual Semantic Priming tasks (English primes-English targets, and Thai primes-Thai targets), in the subjects with low Thai experience, the priming effects for the kinship terms in English were more powerful than the priming effects for the kinship terms in Thai. As a result, the reaction time for the kinship terms in English was faster than the reaction time for the kinship terms in Thai. However, in

the subjects with high Thai experience, the priming effects for Thai kinship terms were more powerful than the priming effects for the English kinship terms.

For the interlingual Semantic Priming tasks (English primes-Thai targets, and Thai primes-English targets), in both groups of subjects with high and low Thai experience, the priming effects in accessing the kinship terms in Thai preceded by the related primes in English were markedly more powerful than the priming effects in accessing the kinship terms in English preceded by the related primes in Thai.

6.4 Experiment 3: Mandarin-English Bilinguals

6.4.1 Subjects

200 questionnaires were distributed to Mandarin-English bilingual speakers, who were graduates and post-graduate students at Assumption University, in the first semester of 2001. They were asked to fill in the questionnaires and return these to the researcher within 1 month. 114 subjects returned the questionnaires, and 24 subjects were assigned to the High group, and 24 to the Low group. Forty-eight Mandarin-English bilingual speakers were placed in two groups on the basis of their L2 experience as measured by the English Language Experience Questionnaire (see Appendix A). Those 24 subjects with the highest scores were placed in the High group and those 24 subjects with the lowest scores were placed in the Low group.

6.4.2 Stimuli and Design

Experiment 3 consists of four language conditions: within Mandarin Chinese (L1-L1), within English (L2-L2,), between Mandarin-English (L1-L2), and between English-Mandarin (L2-L1) priming conditions. The experimental design is the same as in Experiment 1.

For the L1-L1 condition, there are 60 Mandarin prime-target pairs. The primes and the targets were selected according to the following procedure. Thirty Mandarin kinship terms were chosen from the Chinese Word Frequency Corpus as the targets (National Chiao-Tung University, 1993). Mandarin kinship terms with one, and more than one semantic feature different from targets, served as the Hi and the Lo related primes respectively. Mandarin non-kinship terms served as the unrelated primes. These words were selected from the Chinese word frequency corpus. Thirty Mandarin non-kinship terms, all similar in frequency and in the number of syllables to the targets, served as the unrelated targets.

For the L1-L2 condition, there are 60 Mandarin prime-English target pairs. The primes and the targets were selected according to the following procedure. Thirty English kinship terms, which are translation pairs of Mandarin kinship terms in the L1-L1 condition, served as the kinship targets. The semantically related primes and the unrelated primes are the same as in the L1-L1 condition. The English translation pairs of Mandarin non-kinship terms in the L1-L1 condition served as the unrelated targets.

For the L2-L2 condition, the primes and the targets are the same set as in Experiment 1: L2-L2 condition. For the L2-L1 condition, there are 60 English prime-Mandarin target pairs. The primes and the targets were selected according to the following procedures. Thirty Mandarin kinship terms, which are translation pairs of English kinship terms in the L2-L2 condition served as the kinship targets. The semantically related primes and the unrelated primes are the same as those in the L2-

L2 condition. The Mandarin translation pairs of English non-kinship terms in the L2-L2 condition served as the unrelated targets.

As in Experiment 1, a rolling design was used and the experiment involves a 2 x (2 x 2 x 3) design with one between-subjects factor, Language Experience Group (high and low English experience), and three within-subjects factors: Priming Languages (L1 or L2), Target Languages (L1 or L2), and Semantic Relatedness between primes and targets (Hi Related, Lo Related, and Unrelated).

6.4.3 Procedure

The procedure is identical to the procedure described in Experiment 1 (6.2.3).

6.4.4 Results

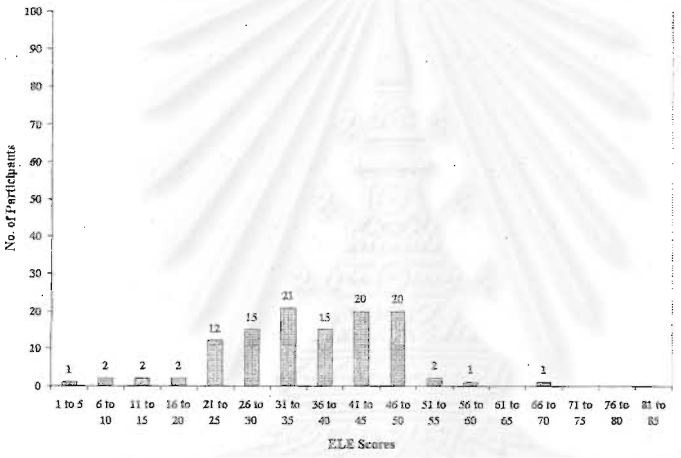
6.4.4.1 Profile of the Subjects

In this section, the distribution of the ME group will be described based on their English language experience scores (ELE Scores), which are obtained from the English language experience questionnaires (see Appendix A). The distribution is described in terms of the maximum and minimum value, range, median, mode, mean, and standard deviation. These statistic values are given in Table 19 and distributions are shown in Figure 19.

Table 19:The Distribution of ELE scores in the ME Bilingual Speakers.

	Overall	High Group	Low Group
Number of Subjects	114	24	24
Mean	36	49.6	22
Median	36	47.5	25
Mode	47	47	25
Min	5	45	5
Max	67	67	29
Range	62	22	24
S.D.	11	5.9	6.8

(a)



(b)

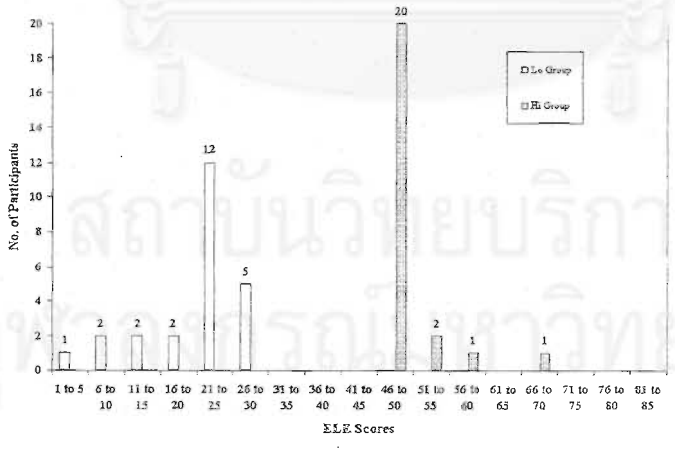


Figure 19: (a) Profile of the ME Bilinguals and
(b) Profile of the High ME and the Low ME Groups

For the 114 subjects, there was a larger number of subjects on the lower side (70 subjects) than on the upper side of the histogram (24 subjects), and 20 subjects are on the midpoint of ELE scores. This shows that the distribution of the whole ME group is negatively skewed. The mean score is 36, the mode is 47, and the median is 36. The range between the minimum (5) and the maximum (67) is 62 and the SD is 11.

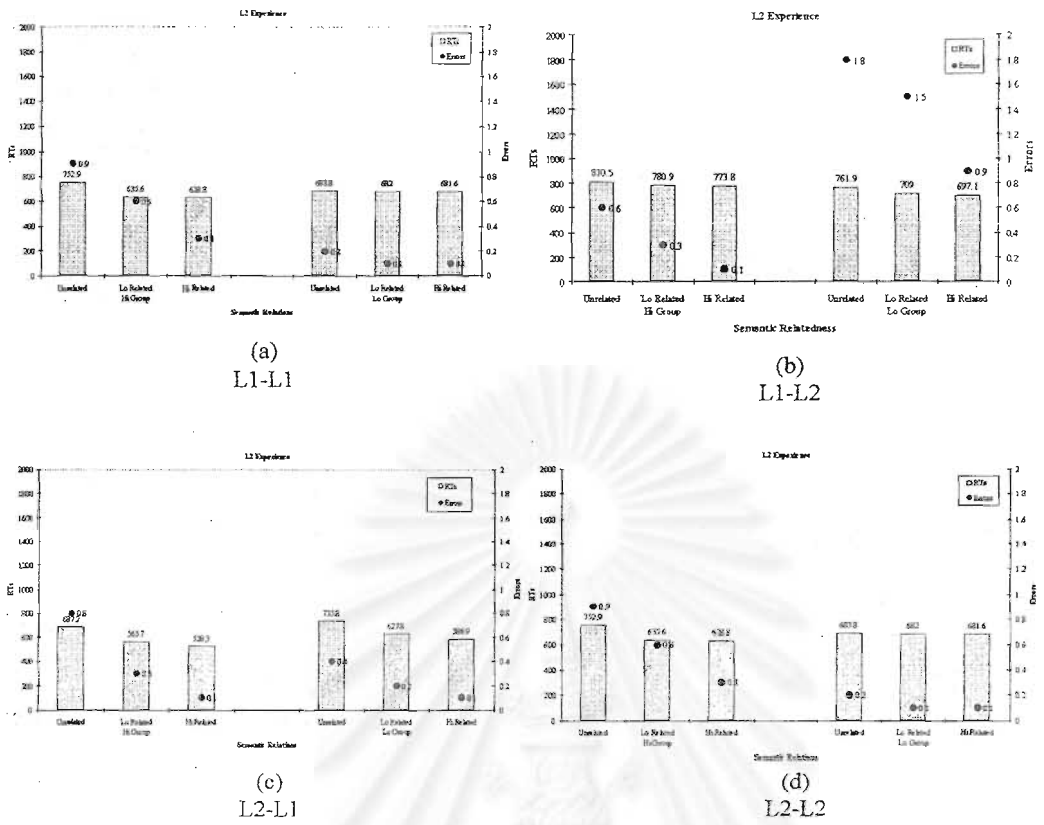
For the High group, the distribution is markedly non-normal. Most of the High group obtained ELE scores on the upper side of the scale (23 subjects) and 20 of these scored between 46 to 50. The mean ELE score is 49.6, the mode 47, and the median 47.5. The range between the minimum (45) and the maximum (67) is 22 and the SD is 5.9.

For the Low group, the distribution curve is negatively skewed. Most of the Low group obtained ELE scores on the upper side of ELE scores (19 subjects) with 5 subjects on the lower side. The mean ELE score is 22, the mode 25, and the median 25. The range between the minimum (5) and the maximum (29) is 24 and the SD is 6.8.

6.4.4.2 The Analysis of Priming Effects on Mean Reaction Time, and Percentage Errors

(a) The Analysis of Reaction Time and Percentage Error Rates

For the analysis of RT and percentage errors, the results of Experiment 3 are summarized in Figure 20.



(a) L1-L1 (b) L1-L2

(c) L2-L1 (d) L2-L2

Figure 20: Mean Reaction Time (Bars) and Percentage Error Rates (Black Dots) for ME Bilinguals in Four Language Conditions: (a) L1-L1, (b) L1-L2, (c) L2-L1, and (d) L2-L2.

The comparison of RT among the four conditions in Figure 20 shows that the RT in each language condition were slightly different and the Low group produced slightly slower RT than the High group. The comparison of errors among these four conditions showed the ordering of fewest to most errors is L1-L1, L2-L2, L2-L1, and L1-L2 in the High group, but in the Low group, the ordering is L2-L1, L1-L1, L2-L2 and L1-L2. This implies that there were fewer errors in within-language priming than in between-language priming in the High group, and there were fewer errors to L1 targets than to L2 targets in the Low group. The effect of Semantic Relatedness showed the same pattern in all conditions. That is, the fastest RT and fewest errors occur in the Hi related and the slowest RT and most errors in the unrelated pairs. An exception was the results in the L2-L2 condition in the High group, where, there were more errors in the Low related than in the unrelated pairs. Moreover, in each condition, there was a small difference between RT and errors obtained in the High and the Low groups.

(b) Priming Effects

In what follows, the priming effects were computed by the same procedure as in Experiment 1 and the results are presented in Table 20 below.

Table 20: Priming Effects (in ms) and Standard Errors (in Parentheses) for Mandarin-English Bilinguals with High and Low English Language Experience

Conditions			English Language Experience Groups	
PRIMES	TARGETS	Semantic Relatedness	High Group	Low Group
Mandarin (L1)	Mandarin (L1)	Hi Related	*159* *(18.2)*	*151.8* *(20.1)*
		Lo Related	*121.5* *(22.2)*	*110.9* *(19.7)*
	English (L2)	Hi Related	*36.7* *(21.3)*	*64.8* *(27.5)*
		Lo Related	*29.6* *(27.7)*	*53* *(34.5)*
English (L2)	Mandarin (L1)	Hi Related	*38.8* *(22)*	*2.2* *(20.3)*
		Lo Related	*32* *(19.7)*	*1.7* *(22.6)*
	English (L2)	Hi Related	*55.8* *(21.5)*	*49.5* *(41.5)*
		Lo Related	*49.4* *(24.5)*	*49.1* *(41.3)*

The results for ME bilinguals are summarized in Table 20. A 2 x (2 x 2 x 2) analysis of variance (ANOVA) was conducted with L2 experience group as the between-subjects factor, and Priming Languages, Target Languages, and Semantic Relatedness as the within-subjects factors. There was only one significant main effect; Priming Language, $F(1, 46) = 8.388$, $p < .05$, such that the priming effect for L1 priming (90.9 ms) was stronger than for L2 priming (34.8 ms). This Priming Language effect was qualified by a significant interaction between Priming Language and Target Language, $F(1, 46) = 15.863$, $p < .05$ and this is schematically represented in Figure 20. As can be seen this interaction is due to the degree of priming occurring for L1 primes being facilitated by L1 Targets, whereas, for L2 primes the priming effect is reduced by L1 Targets. Thus priming is greatest for the within-language prime-target pairs, L1-L1 and L2-L2 with the overall degree of priming being greater for L1-L2 (Mandarin-English) than for L2-L1 (English-Mandarin) pairs.

Finally, as for Experiment 1 and 2, there was no main effect of Semantic Relatedness here in Experiment 3.

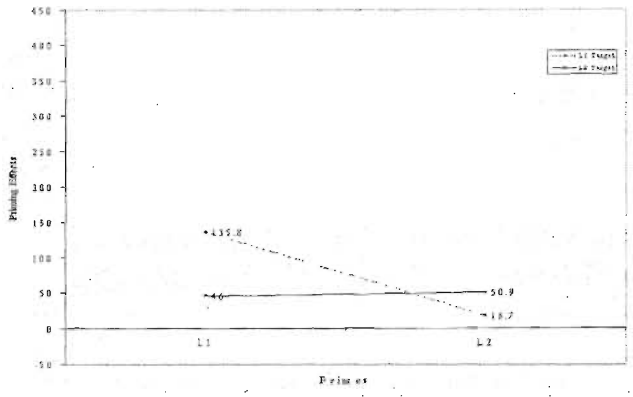


Figure 21: The Interaction between Priming Language and Target Language

6.4.5 Summary of Experiment 3

According to the hypotheses, the results found in the ME bilinguals are that the priming effects for the prime-target kinship terms with one different semantic feature were more powerful than the priming effects for the prime-target kinship terms with more than one different semantic feature in both the intralingual and the interlingual Semantic Priming tasks. As a result, the reaction time for the prime-target kinship terms with one different semantic feature was faster than the reaction time for the prime-target kinship terms with more than one different semantic feature in both the intralingual and the interlingual Semantic Priming tasks.

For the intralingual Semantic Priming tasks (Mandarin primes-Mandarin targets, and English primes-English targets), in both groups of subjects with high and low English experience, the priming effects for the kinship terms in Mandarin were more powerful than the priming effects for the kinship terms in English. As a result, the reaction time for the kinship terms in Mandarin was faster than the reaction time for the kinship terms in English. However, in the subjects with high English experience, the priming effects for English kinship terms were more powerful than the priming effects in the subjects with low English experience.

In the interlingual Semantic Priming tasks, Mandarin primes-English targets, and English primes-Mandarin targets), in the subjects with high and low English experience, the mean priming effects in accessing the kinship terms in English preceded by the related primes in Mandarin were more powerful than the priming effects in accessing the kinship terms in Mandarin preceded by the related primes in English.

6.5 Experiment 4: English-Mandarin Bilinguals

6.5.1 Subjects

The 59 questionnaires were distributed to English-Mandarin bilingual speakers, who were students in the Chinese language programme, at Beijing University. There were fewer questionnaires distributed for this group because there was a short time to distribute the questionnaires. They were asked to fill in the questionnaires and participate in the experiments in return for payment (US $25 per participant). Of the 59 subjects who returned the questionnaires, forty-eight English-Mandarin bilingual speakers were selected and placed in two groups on the basis of their L2 experience as measured by the Mandarin Language Experience Questionnaire

(see Appendix A). Those 24 subjects with the highest scores were placed in the High group and those 24 subjects with the lowest scores were placed in the Low group.

6.5.2 Stimuli and Design

Experiment 4 consists of four language conditions, experimental sets of within English (L1-L1), within Mandarin (L2-L2,), between English-Mandarin (L1-L2), and between Mandarin-English (L2-L1) prime-target conditions. The experimental design is the same as in Experiment 1.

For the L1-L1 condition, the primes and the targets are the same set as in Experiment 3: L2-L2 condition. For the L1-L2 condition, the primes and the targets are the same set as in Experiment 3: L2-L1 condition. For the L2-L2 condition, the primes and the targets are the same set as in Experiment 3: L1-L1 condition. Finally, for the L2-L1 condition, the primes and the targets are the same set as in Experiment 3: L1-L2 condition.

As in Experiment 1, a rolling design was used and the experiment involved a 2 x (2 x 2 x 3) design with one between-subjects factor, Language Experience group (high and low English experience), and three within-subjects factors: the Priming Language (L1 or L2), the Target Language (L1 or L2), and the Semantic Relatedness between primes and targets (Unrelated, Hi Related, and Lo Related).

6.5.3 Procedure

The procedure is identical to the procedure described in Experiment 1 (6.2.3).

6.5.4 Results

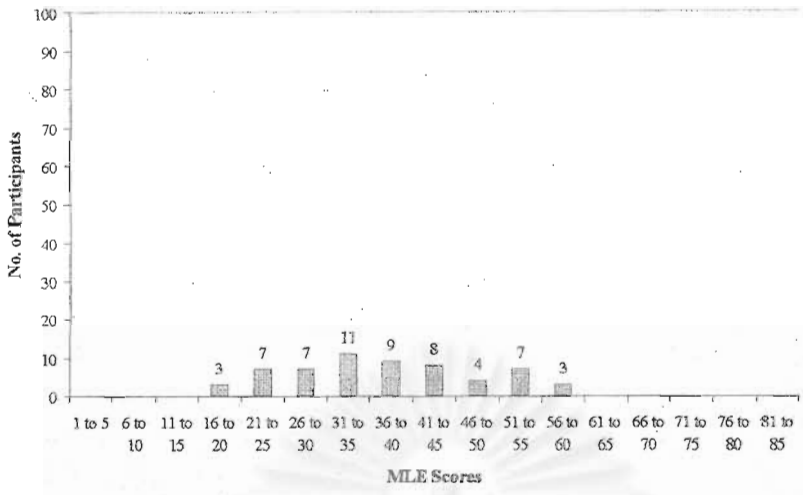
6.5.4.1 Profile of the Subjects

The distribution of the EM sample from 59 subjects is described in Table 21 and is illustrated with histograms in Figure 22 below.

Table 21: The Distribution of MLE scores in the EM Bilingual Speakers.

	Overall	High Group	Low Group
Number of Subjects	59	24	24
Mean	35.5	48	26.7
Median	35	47.5	27.5
Mode	39	39	31
Min	11	39	18
Max	59	59	33
Range	48	20	15
S.D.	12.2	6.2	4.7

(a)



(b)

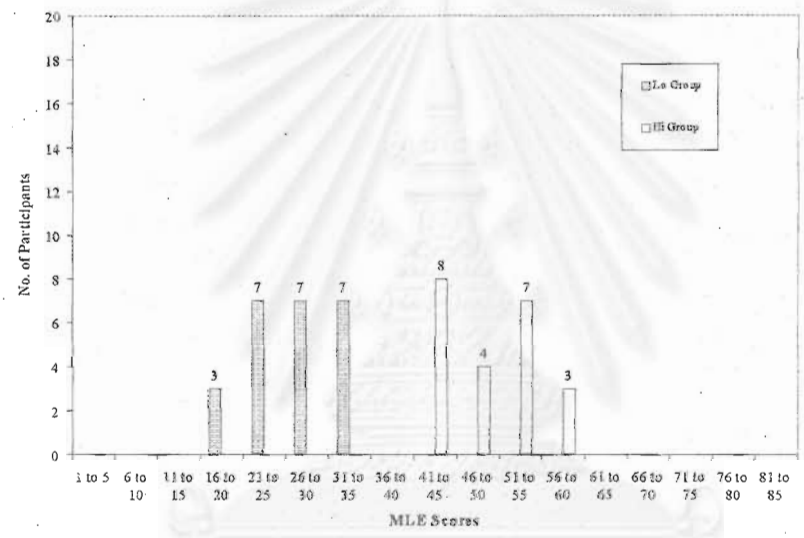


Figure 22: (a) Profile of the EM Bilinguals and (b) Profile of the High EM and the EM Low Groups

For the overall distribution (59 subjects), there were more subjects on the upper side (37 subjects) than on the lower side of the histogram (14 subjects) and 8 subjects who were on the midpoint of MLE scores. The distribution of the whole group is negatively skewed. Mean ELE score is 36, the mode is 47, and the median 36. The range between the minimum (5) and the maximum (67) is 62 and the SD is 11.

For the High group, the distribution is positively skewed. Most of ME High group obtained MLE scores on the lower side of the scale (23 subjects). The mean of ELE is 49.6, the mode 47, and the median 47.5. The range between the minimum (45) and the maximum (67) is 22 and the SD is 5.9.

For the Low group, the distribution curve is negatively skewed. Most of ME Low group obtained MLE scores on the upper side of the scale (19 subjects) and there were 5 subjects on the lower side. Mean MLE score is 22, the mode is 25, and the median is 25. The range between the minimum (5) and the maximum (29) is 24 and the SD is 6.8.

6.5.4.2 The Analysis of Priming Effects on Mean Reaction Time, and Percentage Errors

(a) The Analysis of Reaction Time and Percentage Error Rates

For the analysis of RT and percentage errors, the results of the Experiment 4 are summarized in Figure 23.

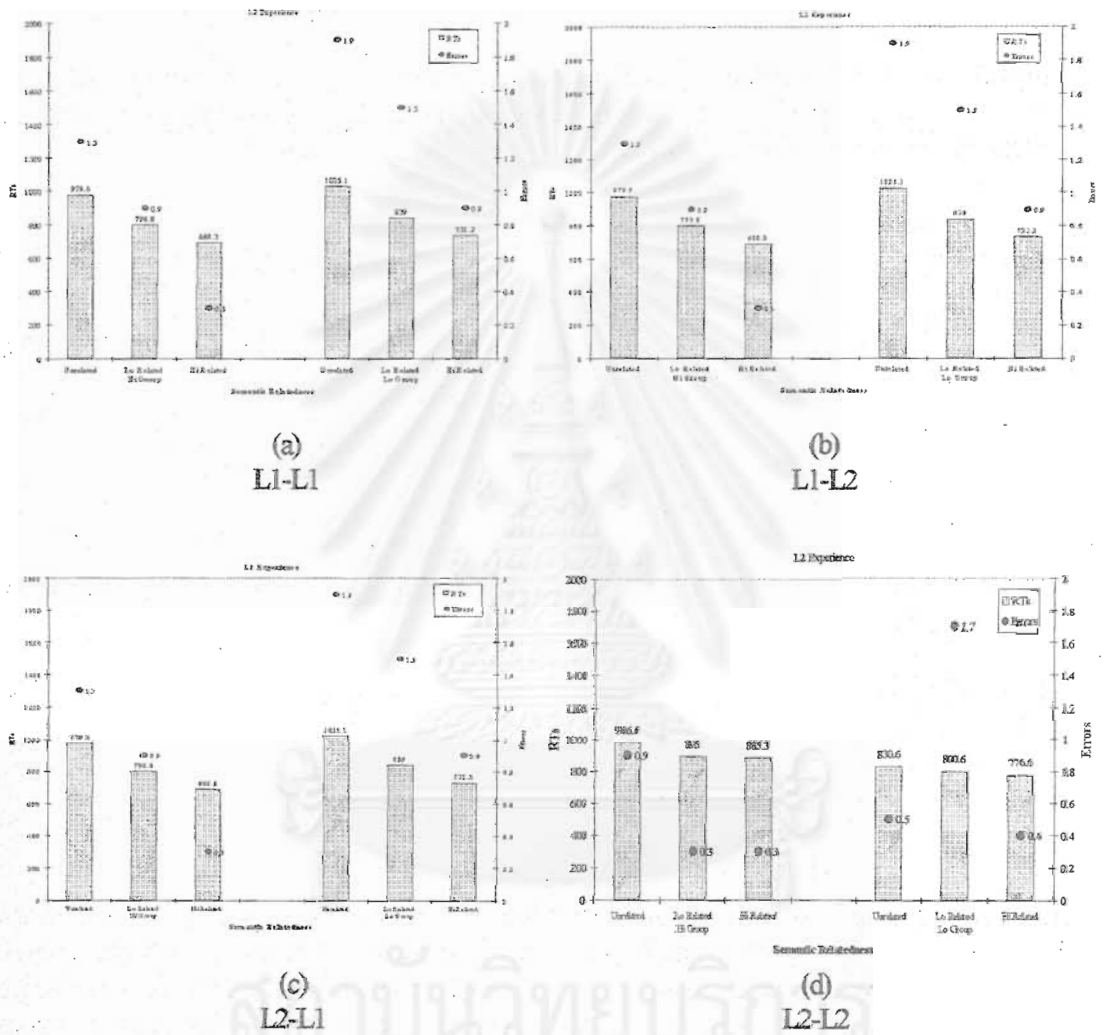


Figure 23: Mean Reaction Time (Bars) and Percentage Error Rates (Black Dots) for EM Bilinguals in Four Language Conditions: (a) L1-L1, (b) L1-L2, (c) L2-L1, and (d) L2-L2.

Inspection of Figure 23, the comparison of RT among these four conditions showed the ordering of the fastest to slowest RT in each condition is L1-L1, L2-L1, L1-L2, and L2-L2 in the High group, and it is L1-L1, L2-L1, L2-L2, and L1-L2 in the Low group. The comparison of errors among these four conditions showed that the ordering of the fewest to the most errors is L1-L1, L2-L1, L2-L2, and L1-L2 in the High group but in the Low group, the ordering is L1-L1, L2-L2, L1-L2 and L2-L1.

The effect of semantic relatedness showed the same pattern in all conditions. That is, there were the fastest RT and the smallest errors in the Hi related and the slowest RT and the greatest errors in the unrelated pairs, except those obtained in L2-L1 condition.

(b) Priming Effects

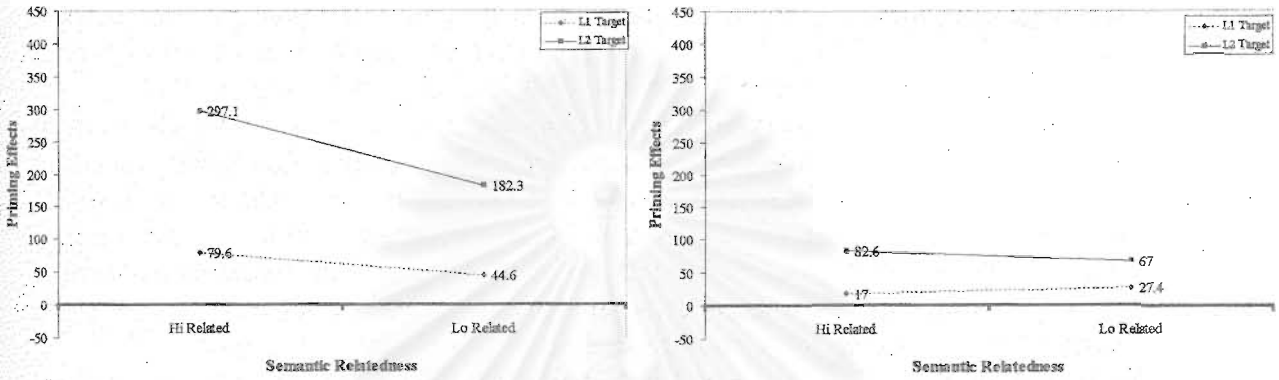
In what follows, the priming effects were computed by the same procedure as in Experiment 1. The results are presented in Table 22 below.

Table 22: Priming Effects (in ms) and Standard Errors (in Parentheses) for English-Mandarin Bilinguals with High and Low Mandarin Language Experience

Conditions			Mandarin Language Experience Groups	
PRIMES	TARGETS	Semantic Relatedness	High Group	Low Group
English (L1)	English (L1)	Hi Related	*95* *(26.3)*	*64.3* *(23.7)*
		Lo Related	*30.2* *(31)*	*59* *(25.1)*
	Mandarin (L2)	Hi Related	*291.3* *(24.3)*	*302.9* *(17.3)*
		Lo Related	*180.8* *(23)*	*183.9* *(21.7)*
Mandarin (L2)	English (L1)	Hi Related	*3.5* *(17.2)*	*-37.6* *(31.7)*
		Lo Related	*-12.1* *(36)*	*-42.8* *(34.6)*
	Mandarin (L2)	Hi Related	*101.3* *(19.9)*	*64* *(25.8)*
		Lo Related	*87.5* *(19.4)*	*46.6* *(29)*

The priming results for EM bilinguals are presented in Table 22. A 2 x (2 x 2 x 2) analysis of variance (ANOVA) was conducted with L2 experience group as the between-subject factor, and Priming Languages, Target Languages, and Semantic Relatedness as the within-subject factors. There was a main effect of Priming Language, $F(1, 46) = 45.341$, $p < .05$, such that the effect for L1 primes (150.9 ms) was stronger than for L2 primes (26.3 ms). The effect of Target Language was also significant, $F(1, 46) = 108.903$, $p < .05$, indicating that the priming effect for L2 targets (157.3) was stronger than for L1 targets (19.9). The effect of Priming Language was qualified by a significant interaction between Priming Language and Target Language, $F(1, 46) = 6.319$, $p < .05$, due to greatest priming for L2 Targets. In addition, there was a significant main effect of Semantic Relatedness, $F(2, 45) = 26.054$, $p < .05$, with greater priming effects for Hi related pairs (110.6) than for Lo related pairs (66.6). Further, there were significant interactions between Priming Language and Semantic Relatedness, $F(2, 45) = 10.987$, $p < .05$, between Target Language and Semantic Relatedness, $F(2, 45) = 5.96$, $p < .05$, and between Priming Language, Target Language and Semantic Relatedness, $F(2, 45) = 4.126$, $p < .05$. This 3-way interaction is shown in Figure 24. These results indicate that the degree of priming effects obtained from the main effects of Priming Language, Target

Language, and the interaction between Priming and Target Language are qualified by the effect of Semantic Relatedness: priming effects were greater for the Hi related relation. As can be seen in Figure 24, there is generally greater priming for L2 primes, and for L2 targets, irrespective of Semantic Relatedness. However, the degree of facilitation for L2 targets over L1 targets is much higher for Hi Semantic Relatedness than for Lo Semantic Relatedness, which has a much more modest facilitation for Lo Semantic Relatedness.



(a) (b)

Figure 24: The Interaction between Priming Language, Target Language, and Semantic Relatedness. The Result of L1 Priming is presented in Figure 24a and L2 Priming in Figure 24b

6.5.5 Summary of Experiment 4

According to the hypotheses, the results found in the EM bilinguals that the priming effects for the prime-target kinship terms with one different semantic feature were more powerful than the priming effects for the prime-target kinship terms with more than one different semantic feature in both the intralingual and the interlingual Semantic Priming tasks. As a result, the reaction time for the prime-target kinship terms with one different semantic feature was faster than the reaction time for the prime-target kinship terms with more than one different semantic feature in both the intralingual and the interlingual Semantic Priming tasks.

For the intralingual Semantic Priming tasks (English primes-English targets, and Mandarin primes-Mandarin targets), in the subjects with low Mandarin experience, the priming effects for the kinship terms in English were more powerful than the priming effects for the kinship terms in Mandarin. As a result, the reaction time for the kinship terms in English was faster than the reaction time for the kinship terms in Mandarin. However, in the subjects with high Mandarin experience, the priming effects for Mandarin kinship terms were more powerful than the priming effects for the English kinship terms.

For the interlingual Semantic Priming tasks (English primes-Mandarin targets, and Mandarin primes-English targets), in both the subjects with high and low Mandarin experience, the priming effects in accessing the kinship terms in Mandarin preceded by the related primes in English were markedly more powerful than the

priming effects in accessing the kinship terms in English preceded by the related primes in Mandarin.

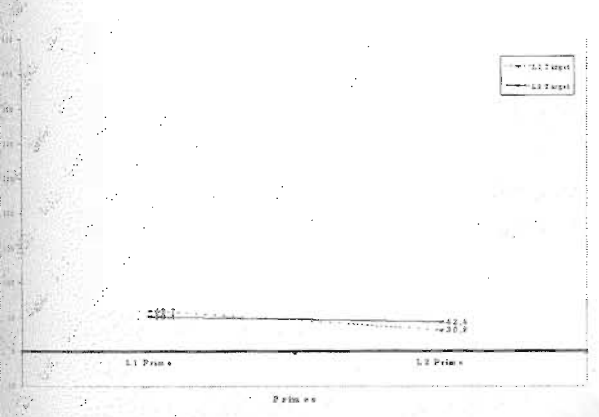
6.6 Summary of Experiments 1-4

Firstly with respect to the hypothesis regarding the writing systems, the results showed that the priming effects obtained in the Mandarin intralingual condition were more powerful than those effects found in the Thai and the English intralingual conditions. In the bilinguals using these three languages as L1, these experiments suggest that logographic writing system produces greater semantic priming effects than alphabetic writing system (see also 7.2.3).

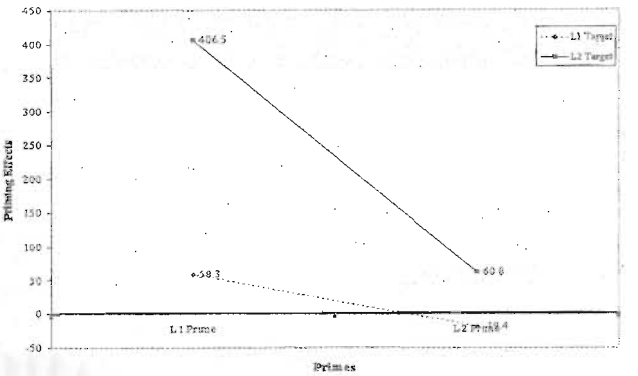
To determine whether L1 and L2 semantic information is stored and retrieved from a shared semantic system or two language specific semantic systems in bilinguals with high and low L2 experience, previous studies (eg., Chen and Ng, 1989) proposed that experiments on cross-language Semantic Priming would provide support for the notion that words in bilinguals' two languages share a common conceptual representation. The results of the four experiments here bear on this issue and are summarized in Figure 24. The results can be summarized as follows:

For the present study, the results of Experiments 1-4 demonstrated the cross-language priming effects supporting the notion that the semantic representations of words in a bilingual's two languages are integrated within a shared conceptual representation system. Thus, the hypothesis that words in different languages are stored apart from one another in language-specific conceptual representation systems cannot account for the results of the present study.

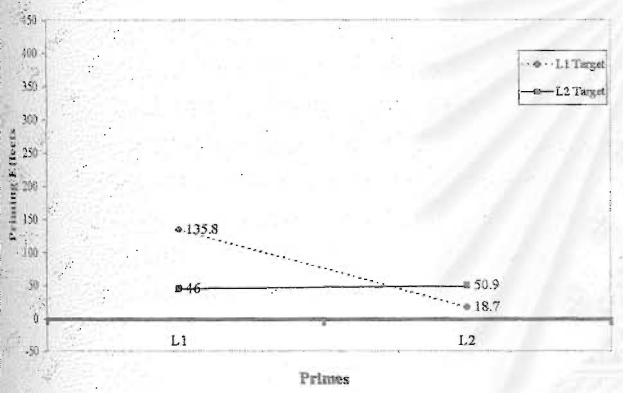
In the following conclusion, the nature of the interaction between Priming Language and Target Language obtained in the four experiments is presented in Figure 25.



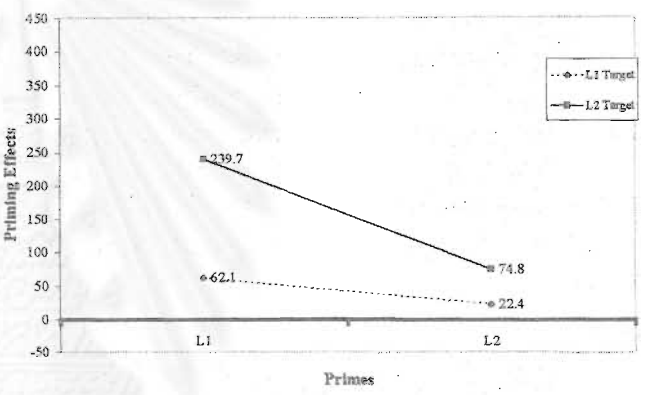
(a)
TE



(b)
ET



(c)
ME



(d)
EM

Figure 25: The Interaction between Priming Language and Target Language for TE (Figure 25a), ET (Figure 25b), ME (Figure 25c), and EM (Figure 25d)

As can be seen in Figure 25a and c, the interaction of Priming Language and Target Language in TE and ME bilinguals illustrated the same pattern. That is, L1 Primes produced slightly stronger effects than L2 Primes and the L1 Targets produced slightly stronger effects than L2 Targets. In addition, the L1 Prime effect was increased by L1 Target but reduced by L2 Target, and the effect of L2 Primes was increased by L2 Targets but reduced by L1 Targets. That is priming was generally better within languages than between languages in the TE and ME bilinguals.

The interaction of Priming Language and Target Language in ET and EM bilinguals also illustrate a similar pattern, but one which is quite different from the pattern obtained in TE and ME bilinguals. For ET and EM bilinguals L1 primes produced stronger effects than L2 primes and L2 targets produced stronger effects than L1 targets. Thus, the L1 priming effect was increased by L2 targets but reduced by L1 targets and the L2 priming effect was increased by L2 targets but reduced by L1 targets in the ET and EM bilinguals.

The results of Experiments 1 and 3 support the findings of previous studies in that primes or targets in L1 will produce stronger effects than primes or targets in L2 (although note that the priming effects in Experiment 1 were not significant). Moreover, they also support findings that the effect of L1 Primes is increased by L1

Targets, but reduced by L2 Targets, whereas the effect of L2 Primes is increased by L2 Targets but reduced by L1 Targets. Thus, there was a stronger priming effect in the L1-L2 condition than in the L2-L1 condition. These data are consistent with the revised hierarchical models proposed by Kroll and Stewart (1994), as already described in Chapter 2.

The results of Experiments 2 and 4 are different and do not support the results of previous studies. For these results, a critical question that must be addressed is why there were stronger priming effects for targets in L2 (Thai in Experiment 2, and Mandarin in Experiment 4). There are no reports of stronger priming effects for L2 targets than for L1 targets in previous studies. It can be noted that the ET and EM bilinguals acquire L2 experience in the environment of L2. Whereas, the TE and ME bilinguals acquire L2 experience in the environment of L1. These different types of learning may influence the different patterns of priming effects in L1 and L2 in bilingual speakers.

An effect of L2 experience was only obtained in Experiment 2. Thus, despite the above anomalous results this study is relevant to the hypothesis that bilinguals with different L2 experience will have a different mode of L2 lexical access. In addition, the effect of Semantic Relatedness reaches significance only in Experiment 4, and this supports a previous finding from a semantic priming study in which there were stronger effects when the primes and the targets were semantically related as compared to unrelated (Seidenberg and McClellan, 1989). However, it is very difficult to sustain any general arguments regarding the effects of L2 Experience and Semantic Relatedness in the present study because these two main effects are not consistently found across the four experiments.

CHAPTER 7

SUMMARY, DISCUSSION AND RECOMMENDATIONS

7.1 Introduction

This chapter will briefly summarize and discuss the results of this thesis, and suggestions for further research will also be presented.

7.2 Summary and Discussion

7.2.1 Bilingual Lexical Access using Stroop Interference Task

In this thesis, experiments using the Cross-Language Stroop Interference Task addressed the issue of whether the lexical and the semantic systems of L1 and L2 languages are different in bilinguals with varying levels of L2 experience. This was investigated by examining the Stroop interference effects in Thai-English bilinguals (Thai as L1, English as L2) with high and low English language experience in four conditions: (1) Thai intralingual condition (L1-L1), (2) English intralingual condition (L2-L2), (3) Thai-English interlingual condition (L1-L2), and (4) English-Thai interlingual condition (L2-L1) (see Chapter 4 for details). The experiments demonstrated that the L1-L1 Stroop effect for the High Experience group is slightly higher than for the Low Experience group. However, the L2-L2 Stroop effect in the High group is markedly higher than in the Low group, and closer to the L1-L1 Stroop effect than in the Low group. The results suggest that the closer L2 proficiency is to L1 proficiency, the closer the interference of within-L2 processing is to that of within-L1 processing. In the L1-L2 interlingual condition, the Stroop effect in the Low group is markedly higher than in the High group. However, the L2-L1 Stroop effect in the Low group is much lower than in the High group.

In sum, the results of the intralingual Stroop experiment provide some evidence of two language-specific lexical systems. This can be concluded from the difference between interference in the L1 and L2 intralingual conditions as the High groups are closer to each other than in the Low group. On the other hand, the findings in the interlingual conditions present clear evidence that bilinguals must share a common conceptual system for words in different languages, since a simultaneously presented word in one language interferes with the colour-naming response in the other language. In addition, the present results also suggest that the interference in the interlingual condition is qualified by both linguistic perception and production. That is, the degree of interference from linguistic perception was increased by the interference from linguistic production (see Chapter 4).

7.2.2 Linguistic Analysis of Kinship Systems

In this thesis the kinship systems of Thai, Mandarin and English kinship terms were described and compared in order to construct Thai, Mandarin, and English kinship terms as stimulus items for using cross-language priming with Thai-English, English-Thai, Mandarin-English, and English-Mandarin subjects.

The present study thus provides a systematic linguistic analysis of cross-language kinship terms, which may be adapted for further study on lexical access

using these terms as stimulus items. The present analysis method included the distinctive features that have been designated to describe both the semantic and morphological features of kinship terms, and via these distinctive features, the study also provides a system of five values for describing kinship terms (see details in Chapter 5).

The results of this analysis show that the system of Mandarin kinship terms is more complex than Thai or English (Table 12, Chapter 5). On the basis of the analysis of these systems of Thai, Mandarin, and English kinship terms, lists of stimulus items used in the present priming studies were prepared.

7.2.3 Bilingual Lexical Access using the Semantic Priming Task

The strong hypotheses addressed in this research was whether L1 and L2 semantic information is stored and retrieved from a shared semantic system or two language specific semantic systems in bilinguals with high and low second language experience. To answer this question, the Semantic Priming task was employed. The major hypotheses were as follows: (1) If high L2 experience bilinguals store and access L1 and L2 words from two language-specific conceptual representations, then cross-language priming effects should not be obtained. (2) If only low L2 experience bilinguals store and access L1 and L2 words from a common conceptual representation, while high L2 experience bilinguals have separate lexicons, then cross-language priming effects will be obtained for Low but not High L2 Experience group. A weaker version of the hypothesis would be that cross-language priming would be less than within-language priming.

The main results of the priming studies can be summarized as follows: (1) There were cross-language priming effects in both the High and the Low L2 experience groups in all four experiments: for TE (No statistical significance in Experiment 1), ET, ME, and EM. (2) There were stronger priming effects for L1 primes than for L2 primes. (3) There were interactions between Prime Language and Target Language, indicating an asymmetry in cross-language priming effects between L1-L2 and L2-L1 conditions. (4) The results of these studies fail to obtain consistent significant main effects of L2 Experience and Semantic Relatedness. The main effect of L2 Experience was significant only for the results of Experiment 2 with ET bilinguals. Similarly, the main effect of Semantic Relatedness was significant only for the results of Experiment 4 with EM bilinguals, showing that priming was greater when kinship terms differed between prime and target by more than one semantic feature than when they differed by one feature alone.

The results of this study provide support for the hypothesis that there is a common conceptual representation in bilinguals. On the basis of the Revised Hierarchical Model proposed by Kroll and Stewart (1994) (see details in Chapter 2), words in L1 and L2 are stored and retrieved from one common conceptual system. However, there is a different retrieval process for L1 and L2 words. According to this model, there are two types of links between words and the conceptual system: lexical links and conceptual links. These two types of links are established between words and the conceptual system, irrespective of whether they are L1 or L2 words. Nevertheless, accessing L1 words will rely more on conceptual links and accessing L2 words will rely more on lexical links, especially in beginning L2 learners. Moreover, this model further proposes that links may differ in strength. That is, the lexical links from L2 to L1 words with the same meanings are stronger than the

reverse links, and the conceptual links between L1 words and concepts are stronger than between L2 words and concepts (see Chapter 2).

The clear prediction from this model is that accessing words via conceptual links will produce stronger semantic priming effects than via lexical links. The presentation of L1 words is more likely to activate their corresponding conceptual representations in both L1 and L2 than is the presentation of L2 words. In contrast, presentation of L2 words is more likely to activate the corresponding L1 words than a concept. The pattern of results in the present study supports this model, that is L1 primes produced stronger semantic priming effects than did L2 primes. However, it should be noted that if accessing words via conceptual links produces stronger effects than via lexical links, accessing L1 targets should produce stronger effects than accessing L2 targets on every occasion. However, it is clearly the case that in Experiments 1 and 3 there were stronger priming effects for L1 targets than for L2 targets, whereas in Experiments 2 and 4 there were stronger priming effects for L2 targets than for L1 targets.

So, a problem raised in the present studies is that, for Experiments 2 and 4, L2 targets produced clearly stronger effects than L1 targets did. There is one possible explanation applying to Experiment 4, in which English is L1 and Mandarin is L2, using the notion of the time course of semantic activation in a logographic writing system. A logography is a system in which the basic unit in writing is associated with a unit of meaning, a morpheme. There is no unit of the logographic writing system that encodes single phonemes, nor are there grapheme-phoneme conversion rules. Chinese is a logographic or meaning-based writing system, which is quite different from alphabetic writing systems such as Thai or English (eg. Chen, 1987; Perfetti and Tan, 1998; Chen and Liu, 1992; Chen, 1999; Inhoff, Liu, and Tang, 1999) Thus, reading Mandarin Chinese is very different from reading alphabetic languages. A Chinese reader can read words by going directly from writing units (characters) to meaning, whereas, for Thai or English readers of alphabetic writing, lexical access must also involve phonological information. Thus alphabetic writing systems need simultanous availability of graphemic, phonological, and semantic information. So, whereas an alphabetic writing system encourages an explicit sublexical relationship between graphic and phonological forms, in an logographic writing systems this process may be different.

An alternative explanation could be applied. That is a Mandarin Chinese character includes phonology as a constant (eg. Daneman, Reingold and Davidson, 1995). The character will thus access its associated phonological and semantic information either as a whole or with the useful parts and the sublexical graphics, and phonological connections may not play a role in accessing a Mandarin character. Thus, Mandarin Chinese could present the opportunity for orthographic and phonological information to arise synchronously at the sublexical level. Mandarin words could then access word meanings faster than the Thai or English alphabetic words. Then, there would be stronger target effects for Mandarin words and this was, in fact, found. However, this notion serves to explain only the data of Experiment 4 but not Experiment 2, in which English is L1 and Thai is L2.

Some studies have claimed that the greater the degree of differences in language structures between L1 and L2, the more difficult the learning task (Fries, 1945, cited in Bausch und Kasper, 1979; Lado, 1957). However, this hypothesis in its stronger form has been since the seventies opposed (Bausch und Kasper, 1979). Also, the results of this study do not support this claim. According to Fries' and Lado's claims, the assumption is that bilinguals, whose L1 is more complex than L2, will

develop their L2 proficiency easier than those whose L1 is simpler than L2. Thus, it is hypothesized in the present study that native English speakers will find it more difficult to learn Thai or Mandarin than will native Thai or Mandarin speakers to learn English. If so, then the ET and the EM bilinguals should find it more difficult to respond to Thai or Mandarin words than would TE and ME bilinguals. However, the results of the present study do not support this hypothesis.

The results of this study showed similar cross-language priming asymmetries to previous studies in bilingual lexical access (e.g. Altarriba, 1992; Chen and Ng, 1989; Frenck and Pynte, 1987; Jin, 1990; Gollan, Forster, and Frost, 1997; Jiang, 1999). That is, cross-language priming was larger when the primes were in L1 and the targets were in L2, than when the primes were in L2 and the targets were in L1.

According to the Revised Hierarchical Model, asymmetrical cross-language priming can be attributed to different kinds of connections to a shared conceptual representational system. When the language order is L1-L2, the connections are assumed to be conceptual, whereas when the language order is L2-L1, the connections are assumed to be lexical. Thus, the conceptual connections should produce stronger semantic priming effects than the lexical connections.

Although the present study very clearly showed that prime and target languages affect the degree of semantic priming, they are less clear in demonstrating the effects of L2 Experience and Semantic Relatedness responsible for semantic priming. In the remainder of this discussion, we will consider the claim that L2 Experience and Semantic Relatedness influence lexical access and semantic priming effects.

As previously presented in Chapter 2, the Revised Hierarchical Model contends that there is the development of links between lexical and conceptual systems as the bilingual becomes more proficient in L2. Further studies on bilingualism (e.g., Kroll and de Groot, 1997; McElree, Jia, and Litvak, 2000) assumed that L2 experience is an index for L2 proficiency. The implication of these studies is that L2 experience must strengthen and enrich the conceptual links between L2 word forms and meanings. For example, if conceptual representations are viewed as a set of semantic features, then in high L2 experience bilinguals, L2 words will be associated with a greater number of semantic features via conceptual links than in the low L2 experience bilinguals. In other words, the development of conceptual links between L2 words and the conceptual system as a function of L2 experience will increase the probability that conceptual information can be retrieved. This could lead to improvements in priming effects in Semantic Priming tasks.

However, only in Experiment 2 was there a significant main effect of L2 experience on priming. A possible explanation is that there are the other factors, which play a role in the development of L2 proficiency. According to previous studies in L2 proficiency (eg. Ellis, 1986), the following factors may play some part: (1) the age when bilinguals begin to learn L2 (2) their attitude and motivation toward L2 ; and (3) the personality of bilinguals, (eg. Prince, 1996; Nagy, 1997).

With respect to Semantic Relatedness, only the results of Experiment 4 showed a significant effect of Semantic Relatedness on priming. However, previous studies (eg, Seidenberg and McClellan, 1989) suggest that different degrees of semantic relatedness between primes and targets should result in different degrees of priming effects. That is the semantically related prime-target pairs should produce stronger effects than the unrelated pairs. A possible explanation for the inconsistent effect of

Semantic Relatedness found in the present studies is that the degree of difference between the levels of semanticity in the Hi, the Lo, and the unrelated pairs may be too small to have a significant effect on behaviour.

Finally, the results of both the Stroop Interference and the Cross-Language Semantic Priming tasks provide support for the Revised Hierarchical Model (Kroll and Stewart, 1994). That is word meanings in L1 and l2 are stored and retrieved from a common semantic system in both the high and the low L2 experience bilinguals. However, the retrieval process of L1 and L2 words in the high L2 experience bilinguals is different from that in the low L2 experience bilinguals. As can be seen in Figure 26, in the high L2 experience bilinguals, L1 and L2 word forms can directly access word meanings from the common semantic system.

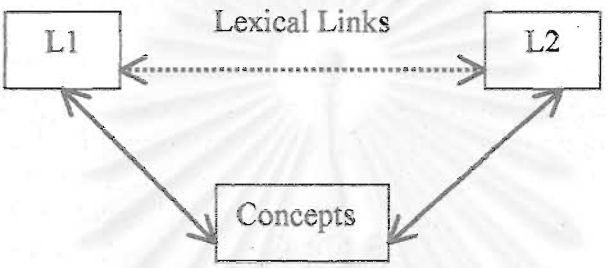


Figure 26: The Storage and the Retrieval Process of L1 and L2 Words in the High L2 Experience Bilinguals. Adapted from the Revised Hierarchical Hypothesis (Kroll and Stewart, 1994).
Normal Lines = Links usually used
Dotted Lines = Links not usually used

However, in the low L2 experience bilinguals, L1 word forms can directly access word meanings from the common semantic system but L2 words form indirectly access meanings from the common semantic system via semantically related L1 words (see Figure 27).

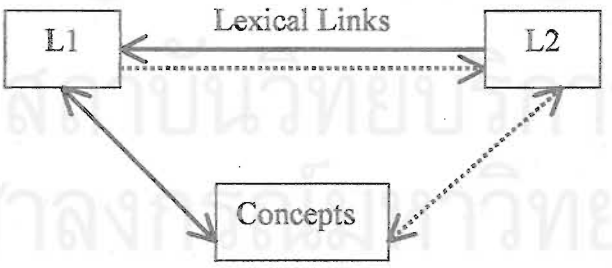


Figure 27: The Storage and the Retrieval Process of L1 and L2 Words in the Low L2 Experience Bilinguals. Adapted from the Revised Hierarchical Hypothesis (Kroll and Stewart, 1994).
Normal Lines = Links usually used
Dotted Lines = Links not usually used

In the following part, recommendations for further study will be presented.

7.3 Recommendations

1. As discussed in the previous section, the results of Experiments 1 and 3 with English as L2 revealed stronger priming effects for L1 targets (Thai in Experiment 1, Mandarin in Experiment 2) than for L2 targets. In contrast, the results of Experiments 2 and 4 with English as L1 revealed stronger priming effects for L2 targets (Thai in Experiment 2, Mandarin in Experiment 4) than for L1 targets. Two possible reasons concerning the lexical access in logographic writing system and the difference between L1 and L2 in L2 learning were applied above to explain these results. However, it is unclear what might be the cause(s) of these contrasting results. This is an important point of the present study that needs further explanation and study. For example, studies could include different kinds of bilinguals with different types of L2 acquisition, i.e, the bilinguals, who acquire L2 in the environment of L1 or L2.

2. As mentioned earlier, there are other factors, over and above the effect of L2 experience, which may play a role in the development of L2 proficiency and L2 lexical access. Thus, in further studies, the L2 questionnaire should be developed to ask subjects about other factors such as (1) when they began to learn L2 (2) their attitude and motivation toward L2 and (3) their personality and characteristics (eg. Finocchiaro and Sako, 1983)

3. Further studies should be designed to use other word categories. Different word categories may reveal different effects such as accessing content ('open class') words may be faster and less errors than accessing function ('closed class') words (eg. Deutsch, Frost and Forster, 1998.).

4. The writing system may effect the development of L2 proficiency. Further studies should be conducted with subjects who use a language with two different writing systems: logographic and alphabetic writing systems. For example, Japanese language has Kanji, which is logographic and Kana, which is alphabetic and one meaning can be represented using both Kanji and Kana. Previous studies (eg. Fang, Tzeng, and Alva, 1981) suggested that these two writing systems are developed and accessed differently in native Japanese speakers. Thus, this raises the possibility that there is an effect of writing system on the development of L2 proficiency.

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APPENDICES

APPENDIX A

The Questionnaires

In what follow, the second language experience questionnaires, which were distributed to the participants in Experiments 1-5 are shown.

1 English Language Experience Questionnaire (Experiments 1 and 2)

In this section, the English language experience questionnaire used for Thai-English bilingual participants in Experiments 1 and 2 is shown below.

หมายเลข.....

แบบสำรวจประสบการณ์ทางภาษาอังกฤษ

ตอนที่ 1

คำชี้แจง ให้ทำเครื่องหมายกากบาท (X) ลงในช่องของข้อมูลต่อไปนี้ ตามลำดับความมากน้อย

ข้อมูล	คะแนน			
	ไม่เคย	น้อยครั้ง	บ่อย	บ่อยมาก
1. ท่านเคยเรียนวิชาภาษาอังกฤษจากอาจารย์ชาวต่างประเทศที่โรงเรียนหรือมหาวิทยาลัยหรือไม่				
2. ท่านเคยเรียนร่วมกับนักเรียนชาวต่างประเทศที่โรงเรียนหรือมหาวิทยาลัยหรือไม่				
3. ท่านเคยใช้ห้องปฏิบัติการทางภาษาที่โรงเรียนหรือมหาวิทยาลัยหรือไม่				
4. ครูที่สอนภาษาอังกฤษพูดอังกฤษกับท่านขณะสอนหรือไม่				
5. ท่านเคยรายงานหน้าชั้นเป็นภาษาอังกฤษหรือไม่				
6. ท่านเคยอ่านนิตยสารซึ่งใช้ภาษาอังกฤษหรือไม่				
7. ท่านเคยอ่านหนังสือพิมพ์ภาษาอังกฤษหรือไม่				
8.ท่านเคยอ่านนวนิยายหรือหนังสืออ่านเล่นอื่นๆ ที่เป็นภาษาอังกฤษหรือไม่				
9.ท่านเคยอ่านตำราในวิชาเรียนซึ่งเขียนด้วยภาษาอังกฤษหรือไม่				
10. ท่านเคยอ่านข่าวสารจาก Internet หรือ Homepage ใช้ภาษาอังกฤษหรือไม่				
11. ท่านเคยอ่านการ์ตูนภาษาอังกฤษหรือไม่				
12.ท่านเคยติดต่อกับเพื่อนทางจดหมายโดยใช้ภาษาอังกฤษหรือไม่				
13. ท่านเคยติดต่อกับผู้อื่นโดยใช้ e-mail ภาษาอังกฤษหรือไม่				
14.ท่านเคยเดินทางไปเที่ยวต่างประเทศและใช้ภาษาอังกฤษในการสื่อสารหรือไม่				
15. ท่านเคยเดินทางไปเรียนภาษาอังกฤษในต่างประเทศหรือไม่				
16. ท่านเคยร่วมกิจกรรมนอกเวลาที่ใช้ภาษาอังกฤษหรือไม่ เช่น การโต้วาที หรือตอบปัญหาชิงรางวัลหรือไม่				

17. ท่านเคยฟังเพลงภาษาอังกฤษหรือไม่				
18. ท่านเคยดูวีดีโอหรือภาพยนตร์ซึ่งพากษ์ด้วยเสียงภาษาอังกฤษ บ่อยแค่ไหน				
19. ท่านเคยดูรายการข่าวภาคภาษาอังกฤษหรือไม่				
20. ท่านเคยดูภาพยนตร์ วีดิทัศน์หรือสารคดีภาษาอังกฤษหรือไม่				
21. ท่านเคยดูคอนเสิร์ตของศิลปินต่างประเทศหรือไม่				
22. ท่านเคยเล่นเกมส์ต่างๆ เกี่ยวกับภาษาอังกฤษ เช่น Scrabble และ Cross words หรือไม่				
23. ท่านเคยอ่านประกาศ หรือโฆษณาที่ใช้ภาษาอังกฤษหรือไม่				
24. ท่านเคยฟังเทปซึ่งสอนการฟัง-พูดภาษาอังกฤษหรือไม่				
25. ท่านเคยสนทนากับชาวต่างประเทศด้วยภาษาอังกฤษหรือไม่				

ตอนที่ 2

คำชี้แจง ให้ท่านตอบคำถามต่อไปนี้ตามความเป็นจริง

1. ขณะเรียนชั้น ม. 6 ท่านเรียนภาษาอังกฤษสัปดาห์ละกี่ชั่วโมง

.....

2. ปัจจุบันท่านเรียนภาษาอังกฤษในชั้นเรียนสัปดาห์ละกี่ชั่วโมง

.....

3. ปัจจุบันท่านเรียนพิเศษภาษาอังกฤษสัปดาห์ละกี่ชั่วโมง

.....

4. ท่านเคยอ่านนิตยสารภาษาอังกฤษอะไรบ้าง

.....

5. ท่านเคยอ่านหนังสือพิมพ์ภาษาอังกฤษอะไรบ้าง

.....

6. ท่านเคยอ่านหนังสือเรียนภาษาอังกฤษอะไรบ้าง

.....

7. ท่านเคยอ่านนวนิยายภาษาอังกฤษอะไรบ้าง

.....

8. ท่านมีเพื่อนทางจดหมายซึ่งติดต่อโดยใช้ภาษาอังกฤษกี่คน

.....

9. ท่านเคยเดินทางไปเที่ยวต่างประเทศ ซึ่งต้องใช้ภาษาอังกฤษในการสื่อสารประเทศใดบ้าง

.....

10. ท่านเคยเดินทางไปเรียนภาษาอังกฤษในประเทศใดบ้าง เป็นเวลานานเท่าใด

.....

11. นิสิตชอบดูรายการโทรทัศน์ ซึ่งใช้ภาษาอังกฤษรายการใด

.....

ขอบคุณสำหรับความร่วมมือ

2 Thai Language Experience Questionnaire (Experiment 3)

In this section, the Thai language experience questionnaire used for English-Thai bilingual participants in Experiment 3 is shown below.

Part 1

Directions. Mark the best answer with a cross (X)

Situations	Marks			
	Never	Seldom	Sometimes	Often
1. Have you ever studied Thai with any foreign teacher at school or university?				
2. Have you ever studied with any foreign student at school or university?				
3. Have you ever studied in the Thai lab?				
4. Nowadays, do your Thai teachers speaker Thai to you on the Thai course?				
5. Have you ever presented any report in Thai language?				
6. Have you ever read any magazine in Thai language?				
7. Have you ever read any newspaper in Thai language?				
8. Have you ever read any fiction in Thai language?				
9. Have you ever read any textbook in Thai language?				
10. Have you ever read any information in Thai language from the internet?				
11. Have you ever read any cartoon book in Thai language?				
12. Have you ever had any correspondence with any penfriend, using Thai language?				
13. Have you ever had any correspondence with the others, sending e-mails in Thai language?				
14. Have you ever been to any foreign country and had to communicate with Thai language?				
15. Have you ever studied any Thai course in the foreign country?				
16. Have you ever joined any extra curriculum activity using Thai language, i.e., debating?				
17. Have you ever listened any Thai song?				
18. Have you ever watched any movie and VDO in Thai language?				
19. Have you ever watched any news in Thai language?				
20. Have you ever watched any documentary in Thai language?				
21. Have you ever watched any concerts of the foreign singers?				
22. Have you ever played any game using Thai language such as scrabble and crosswords?				
23. Have you ever read any call or investigation in Thai language?				
24. Have you ever listened to any Thai teaching tape?				
25. Have you ever had any Thai conversation with the foreigners?				

Part2

Directions. Answer the following questions.

1. How many hours per a week did you study Thai courses in Grade 12?

.....

2. Nowadays, how many hours per a week do you study Thai at university?

.....

3. Nowadays, how many hours per a week do you study Thai (on the extra courses)?

.....

4. Which Thai magazines do you read?

.....

5. Which Thai newspaper do you read?

.....

6. Which subjects do you use the Thai textbooks?

.....

7. Which Thai fictions do you read?

.....

8. How many penfriends do you have? (You have to correspond to them with Thai language).

.....

9. Have you ever been to any foreign country, where you have to communicate with Thai?

.....

10. Have you ever taken the Thai courses in the foreign country? Which country and how long is it?

.....

11. Which TV programmes in Thai do you watch?

.....

3 English Language Experience Questionnaire (Experiment 4)

In this section, the English language experience questionnaire used for Mandarin-English bilingual participants in Experiment 4 is shown below.

Part 1

Directions. Mark the best answer with a cross (X)

Situations	Marks			
	Never	Seldom	Sometimes	Often
1. Have you ever studied English with any foreign teacher at school or university?				
2 Have you ever studied with any foreign student at school or university?				
3. Have you ever studied in the English lab?				
4. Nowadays, do your English teachers speaker English to you on the English course?				
5. Have you ever presented any report in English language?				
6. Have you ever read any magazine in English language?				
7. Have you ever read any newspaper in English language?				
8. Have you ever read any fiction in English language?				
9. Have you ever read any textbook in English language?				
10. Have you ever read any information in English language from the internet?				
11. Have you ever read any cartoon book in English language?				
12. Have you ever had any correspondence with any penfriend, using English language?				
13. Have you ever had any correspondence with the others, sending e-mails in English language?				
14. Have you ever been to any foreign country and had to communicate with English language?				
15. Have you ever studied any English course in the foreign country?				
16. Have you ever joined any extra curriculum activity using English language, i.e., debating?				
17. Have you ever listened any English song?				
18. Have you ever watched any movie and VDO in English language?				
19. Have you ever watched any news in English language?				
20. Have you ever watched any documentary in English language?				
21. Have you ever watched any concerts of the foreign singers?				
22. Have you ever played any game using English language such as scrabble and crosswords?				
23. Have you ever read any call or investigation in English language?				
24. Have you ever listened to any English teaching tape?				
25. Have you ever had any English conversation with the foreigners?				

Part2

Directions. Answer the following questions.

1. How many hours per a week did you study English courses in Grade 12?

.....

2. Nowadays, how many hours per a week do you study English at university?

.....

3. Nowadays, how many hours per a week do you study English (on the extra courses)?

.....

4. Which English magazines do you read?

.....

5. Which English newspaper do you read?

.....

6. Which subjects do you use the English textbooks?

.....

7. Which English fictions do you read?

.....

8. How many penfriends do you have? (You have to correspond to them with English language).

.....

9. Have you ever been to any foreign country, where you have to communicate with English?

.....

10. Have you ever taken the English courses in the foreign country? Which country and how long is it?

.....

11. Which TV programmes in English do you watch?

.....

4 Mandarin Chinese language Experience Questionnaire (Experiment 5)

In this section, the Mandarin Chinese language experience questionnaire used for English-Mandarin bilingual participants in Experiment 5 is shown below.

Part 1

Directions. Mark the best answer with a cross (X)

Situations	Marks			
	Never	Seldom	Sometimes	Often
1. Have you ever studied Chinese with any foreign teacher at school or university?				
2 Have you ever studied with any foreign student at school or university?				
3. Have you ever studied in the Chinese lab?				
4. Nowadays, do your Chinese teachers speaker Chinese to you on the Chinese course?				
5. Have you ever presented any report in Chinese language?				
6. Have you ever read any magazine in Chinese language?				
7. Have you ever read any newspaper in Chinese language?				
8. Have you ever read any fiction in Chinese language?				
9. Have you ever read any textbook in Chinese language?				
10. Have you ever read any information in Chinese language from the internet?				
11. Have you ever read any cartoon book in Chinese language?				
12. Have you ever had any correspondence with any penfriend, using Chinese language?				
13. Have you ever had any correspondence with the others, sending e-mails in Chinese language?				
14. Have you ever been to any foreign country and had to communicate with Chinese language?				
15. Have you ever studied any Chinese course in the foreign country?				
16. Have you ever joined any extra curriculum activity using Chinese language, i.e., debating?				
17. Have you ever listened any Chinese song?				
18. Have you ever watched any movie and VDO in Chinese language?				
19. Have you ever watched any news in Chinese language?				
20. Have you ever watched any documentary in Chinese language?				
21. Have you ever watched any concerts of the foreign singers?				
22. Have you ever played any game using Chinese language such as scrabble and crosswords?				
23. Have you ever read any call or investigation in Chinese language?				
24. Have you ever listened to any Chinese teaching tape?				
25. Have you ever had any Chinese conversation with the foreigners?				

Part2

Directions. Answer the following questions.

1. How many hours per a week did you study Chinese courses in Grade 12?

.....

2. Nowadays, how many hours per a week do you study Chinese at university?

.....

3. Nowadays, how many hours per a week do you study Chinese (on the extra courses)?

.....

4. Which Chinese magazines do you read?

.....

5. Which Chinese newspaper do you read?

.....

6. Which subjects do you use the Chinese textbooks?

.....

7. Which Chinese fictions do you read?

.....

8. How many penfriends do you have? (You have to correspond to them with Chinese language).

.....

9. Have you ever been to any foreign country, where you have to communicate with Chinese?

.....

10. Have you ever taken the Chinese courses in the foreign country? Which country and how long is it?

.....

11. Which TV programmes in Chinese do you watch?

.....

APPENDIX B

Participants in the Stroop Study (Experiment 1)

The overall number of participants and the scores that they obtained from the English language experience questionnaires in Experiment 1 is presented in Table.

No.	Ages	Part 1																									Part 2										
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	1	2	3	4	5	6	7	8	9	10	11
1	17	1	0	1	2	2	2	0	2	2	1	2	2	1	0	0	0	0	1	2	2	2	0	0	2	2	7	0	0	1	4	2	0	1	0	0	0
2	17	0	0	2	1	1	0	0	2	1	0	0	1	2	0	0	1	0	0	2	2	1	0	2	2	2	8	0	0	0	1	2	2	0	0	0	0
3	18	0	1	1	2	1	0	1	0	2	0	1	2	1	0	0	0	2	0	1	1	0	1	1	1	1	6	0	0	0	2	2	0	2	0	0	0
4	19	1	0	2	1	0	0	1	1	0	1	1	0	1	0	0	0	2	1	1	1	1	2	2	2	1	4	4	0	0	1	0	2	0	0	0	0
5	17	1	1	2	1	2	0	1	2	1	1	2	2	1	0	0	0	0	0	1	1	2	1	2	2	1	5	5	0	4	2	2	1	1	0	0	0
6	17	1	1	2	1	1	0	1	1	2	2	2	2	2	0	0	0	0	0	0	0	0	1	2	1	1	5	0	0	0	1	1	1	2	0	0	0
7	18	2	1	1	1	1	2	1	2	2	2	1	0	0	0	0	0	0	0	2	2	2	1	0	2	2	7	0	0	4	2	1	1	0	0	0	0
8	18	1	0	1	0	1	1	1	1	1	2	1	1	2	2	1	0	2	0	2	2	1	2	2	2	0	6	0	0	2	4	2	0	0	2	2	2
9	18	1	1	2	0	0	0	2	0	0	0	2	2	0	2	0	0	0	0	0	0	0	2	0	1	2	9	0	0	0	1	0	4	1	1	1	0
10	17	1	0	1	1	1	1	2	1	2	1	1	1	1	0	0	0	2	2	1	1	0	2	2	1	1	8	0	6	1	2	0	1	0	0	0	0
11	17	1	0	1	2	1	1	1	1	1	2	0	0	1	1	0	0	2	2	2	1	1	1	1	1	1	0	0	0	1	1	1	0	0	2	2	0
12	18	1	1	1	1	1	1	1	0	1	1	1	1	1	0	0	1	1	3	1	1	0	1	1	1	1	4	0	0	3	3	1	0	1	0	0	0
13	18	0	0	1	1	1	1	1	1	1	1	0	3	1	1	0	0	1	1	1	1	1	1	1	1	1	4	0	0	1	3	1	4	1	1	1	0
14	18	1	0	1	1	1	1	1	1	1	1	1	0	0	0	0	0	1	1	1	1	0	1	1	1	1	5	0	0	1	1	1	0	0	0	0	0
15	18	1	0	1	3	1	1	1	1	0	0	1	1	0	1	0	0	3	3	1	1	1	1	1	1	1	7	0	0	0	1	1	0	1	1	1	0
16	17	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	1	1	1	1	1	0	1	1	1	1	6	6	4	1	4	6	3	1	0	0	0
17	18	0	0	3	1	1	3	3	3	3	1	1	1	0	0	0	0	3	3	3	3	3	1	3	3	1	7	7	0	1	1	1	1	1	0	0	0
18	18	1	0	1	1	1	1	1	1	1	1	1	1	0	1	0	1	3	3	1	1	3	1	1	0	1	7	0	0	7	1	1	1	1	0	0	0
19	18	1	1	1	1	1	1	1	1	1	1	1	1	3	0	0	3	3	3	1	1	1	3	1	1	3	7	0	0	3	1	1	0	1	0	0	0
20	17	1	1	3	1	1	1	1	1	1	0	1	1	0	1	1	0	1	1	1	1	0	1	1	1	1	6	0	1	0	1	3	3	4	1	1	1
21	17	1	1	1	1	1	1	1	1	1	1	1	0	1	0	0	0	1	1	1	1	0	1	1	1	1	10	0	0	1	1	0	1	0	0	0	0
22	18	1	0	1	1	1	0	1	1	1	1	1	0	0	0	0	0	3	1	0	1	0	1	1	1	1	8	8	3	0	1	3	0	0	0	0	0
23	19	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	3	3	1	1	1	1	3	1	1	10	0	0	1	1	1	1	1	1	1	0
24	17	1	1	1	1	1	1	1	1	1	3	1	1	3	1	1	1	3	3	1	3	3	1	1	1	1	6	0	0	4	3	1	3	3	1	1	1
25	17	1	1	1	1	3	1	1	1	1	1	1	1	1	0	0	1	1	1	1	1	1	1	1	1	1	10	10	3	1	1	1	0	1	0	0	0
26	18	1	0	1	1	1	1	1	1	1	2	1	1	1	1	0	0	2	1	1	2	1	1	1	0	1	6	0	0	2	2	2	1	2	1	1	0
27	18	1	0	0	1	0	1	2	1	1	2	2	1	2	0	0	0	2	2	1	1	1	1	2	0	1	6	0	0	2	1	3	1	1	0	0	0
28	18	0	0	1	1	1	2	1	2	0	1	1	0	0	1	0	0	1	1	1	1	1	1	0	1	2	9	0	0	1	2	0	1	0	1	1	0
29	17	1	1	1	2	1	2	1	1	1	2	1	2	1	0	0	0	1	1	2	1	1	2	2	1	1	4	0	0	2	2	1	2	2	0	0	0
30	17	0	0	2	2	1	1	1	2	1	1	1	1	1	1	1	2	1	1	0	1	1	1	2	0	1	6	0	0	1	3	1	3	1	1	1	1
31	18	0	1	1	1	1	1	1	1	2	1	2	1	1	1	1	0	1	1	2	1	1	1	2	2	1	4	0	0	1	1	0	1	5	2	2	1
32	18	0	1	1	1	1	1	1	1	1	1	1	1	1	0	0	2	1	1	2	2	1	1	1	1	1	10	6	0	4	1	7	3	1	0	0	0
33	18	1	1	2	1	1	1	1	1	2	1	1	1	1	0	0	0	1	1	1	1	1	2	1	1	2	6	0	0	0	1	0	0	1	0	0	0

No.	Ages	Part 1																								Part 2									
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	1	2	3	4	5	6	7	8	9	10	11
34	17	1	1	1	3	1	3	1	3	3	1	3	1	1	1	0	1	3	3	1	3	1	1	2	2	3	6	6	1	3	2	3	10	1	2	2	0
35	17	1	0	1	1	1	1	1	1	1	0	1	0	0	1	0	0	1	2	0	2	1	1	1	1	1	10	2	0	3	1	1	1	0	2	2	0
36	18	1	1	1	1	1	1	1	0	1	1	1	1	1	0	0	1	3	2	1	1	1	2	1	2	2	6	0	0	1	2	6	0	2	0	0	0
37	19	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	3	3	1	1	1	2	1	1	1	8	0	2	0	2	2	1	1	0	0	0
38	17	2	0	1	1	1	1	3	1	1	1	1	1	1	1	0	0	3	3	2	3	1	1	3	0	2	6	0	0	4	2	2	0	0	2	2	0
39	17	1	1	1	1	1	1	1	1	1	1	1	3	3	1	0	1	1	1	1	1	0	1	1	2	1	4	0	0	1	2	0	1	10	7	7	0
40	18	1	0	1	1	1	1	1	1	0	1	1	1	1	0	0	0	1	2	1	2	0	1	1	1	1	8	0	0	2	1	1	0	0	0	0	0
41	18	1	0	1	1	1	1	1	1	1	3	1	0	1	1	0	0	1	3	2	3	2	1	0	0	1	0	0	0	2	2	1	1	0	0	0	0
42	18	2	0	1	3	1	1	1	1	3	1	1	1	1	1	1	0	3	3	1	2	3	1	1	1	1	8	0	0	3	2	3	4	3	2	2	1
43	17	1	0	1	1	1	1	1	1	3	3	1	1	3	1	1	0	3	2	1	3	3	2	2	1	1	8	0	0	4	1	2	0	1	2	2	1
44	17	2	0	1	1	1	1	1	1	1	1	1	1	1	0	0	1	3	3	1	3	3	2	1	2	2	8	0	0	1	3	2	3	2	0	0	0
45	18	0	0	1	1	1	1	1	1	1	1	1	1	1	1	0	0	1	2	2	1	0	2	2	2	1	6	0	0	1	1	0	0	1	1	1	0
46	18	1	1	3	1	3	1	1	1	3	1	1	1	1	0	0	3	3	3	2	2	1	2	2	3	2	10	0	0	2	2	2	2	0	0	0	0
47	18	3	0	1	1	1	1	0	1	1	1	0	1	1	1	1	1	1	2	1	1	1	0	1	1	1	8	0	0	1	1	2	3	0	0	0	1
48	17	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	1	1	1	1	1	0	1	1	2	1	8	0	0	2	2	1	1	0	0	0	0
49	17	2	1	1	1	1	1	1	1	1	1	1	1	1	0	0	1	1	1	1	1	1	2	2	1	1	10	0	0	2	2	2	0	0	0	0	0
50	18	0	0	1	2	1	1	2	1	1	2	0	1	0	1	0	1	3	3	1	3	1	1	1	1	1	6	6	0	1	2	1	3	0	1	1	0
51	19	0	1	2	1	1	3	2	2	1	3	1	3	3	3	2	1	3	3	3	3	2	2	3	2	3	10	0	0	1	3	10	3	0	1	1	1
52	17	2	0	2	2	2	1	3	1	1	3	1	0	3	2	1	0	3	3	1	2	1	2	2	1	1	8	0	0	5	1	3	3	0	8	8	1
53	17	1	0	2	2	1	1	3	1	2	2	0	1	2	0	0	0	3	3	1	3	1	1	2	1	1	6	6	4	0	2	1	0	1	0	0	0
54	18	2	0	2	3	1	1	1	1	2	1	3	0	0	1	1	0	2	3	1	2	0	1	2	1	2	8	0	10	1	1	1	1	0	2	2	1
55	18	0	1	1	2	1	1	1	1	1	2	1	1	1	1	0	0	2	2	1	2	0	1	2	2	1	10	0	0	0	2	0	1	2	0	0	0
56	18	1	0	1	1	1	0	1	1	1	2	1	1	1	0	0	1	2	2	1	2	1	1	2	1	1	8	8	0	0	1	2	1	0	0	0	0
57	17	2	1	1	2	2	2	2	3	2	3	1	3	3	1	1	3	3	3	2	2	1	3	2	1	3	6	0	0	3	1	2	3	10	3	3	1
58	17	1	1	1	1	1	2	3	2	1	3	1	1	3	1	0	0	3	3	1	3	2	1	1	1	1	6	4	4	3	3	5	3	3	1	1	0
59	18	3	3	3	0	1	1	1	1	1	3	1	2	3	2	2	0	3	3	2	3	3	1	0	1	3	4	0	0	0	1	1	3	0	1	1	2
60	18	2	0	0	2	1	1	2	1	2	0	1	0	0	0	0	1	2	1	0	1	1	1	2	2	1	8	0	0	0	2	1	0	0	0	0	0
61	18	1	1	1	0	1	2	1	2	2	2	2	1	2	2	1	1	3	3	3	3	1	1	3	1	2	6	0	0	1	1	1	0	2	1	1	1
62	18	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	0	2	2	1	1	0	3	2	2	1	5	0	0	2	1	1	0	0	1	1	0
63	17	1	0	1	2	1	1	1	1	3	3	1	1	2	1	0	1	3	3	2	2	3	1	2	1	1	6	0	0	1	2	1	2	3	0	0	0
64	18	2	0	1	3	1	1	1	3	3	1	1	1	0	0	0	1	3	3	1	1	0	1	1	1	1	7	0	0	0	1	3	7	0	0	0	0
65	18	1	2	2	1	1	2	1	2	1	3	1	1	3	1	1	1	3	3	1	3	3	1	2	1	1	6	0	0	4	2	1	0	0	3	3	1

No	Ages	Part 1																								Part 2									
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	1	2	3	4	5	6	7	8	9	10	11
66	17	0	2	2	0	0	2	2	0	3	0	0	0	0	0	0	0	2	2	2	3	0	2	2	2	0	00	0	0	1	1	0	0	1	0	0	0
67	17	2	0	0	0	0	2	2	2	0	3	2	3	3	2	0	0	3	3	0	2	2	2	2	2	3	8	0	2	2	1	2	2	2	2	2	1
68	18	3	0	3	2	2	3	3	3	3	3	3	3	2	3	0	2	3	3	3	3	2	3	3	2	3	6	0	0	3	1	1	5	2	1	1	0
69	19	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	8	0	0	1	2	1	1	0	0	0	0
70	17	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	3	3	0	3	0	0	0	0	0	8	0	0	0	1	1	0	1	0	0	0
71	17	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	5	0	0	3	3	3	7	0	0	0	0
72	18	2	0	2	3	0	2	2	2	0	3	0	0	0	0	0	0	3	3	0	2	0	0	2	0	2	5	0	0	0	1	2	2	0	1	1	0
73	18	0	0	2	2	2	0	2	0	0	2	0	2	2	0	0	0	3	3	0	0	2	2	0	0	0	00	0	0	1	2	1	1	1	1	1	0
74	18	0	0	0	2	0	3	0	3	0	3	2	3	3	2	0	0	3	3	0	0	0	0	2	2	3	5	0	0	3	1	1	7	1	1	1	1
75	17	0	2	2	3	2	0	0	0	2	2	2	0	0	0	0	0	3	3	0	2	0	2	3	2	0	6	0	2	0	1	2	0	0	0	0	0
76	17	0	0	2	2	0	2	2	0	2	3	0	0	0	0	0	0	3	3	2	2	3	2	3	2	0	6	0	0	3	1	1	0	0	0	0	0
77	18	0	0	0	2	0	2	0	0	0	3	0	0	3	0	0	0	3	3	2	3	3	0	3	0	0	8	0	0	1	1	1	3	1	0	0	0
78	18	3	1	1	3	2	1	1	1	3	2	1	1	2	1	1	1	1	2	1	1	1	1	1	2	2	5	0	0	0	2	3	1	3	4	4	0
79	18	2	1	1	2	1	1	3	3	2	3	1	1	2	1	1	1	3	3	1	3	1	1	2	1	1	8	0	2	2	3	2	2	3	0	0	0
80	18	1	1	2	3	1	2	1	2	1	1	2	1	2	1	1	1	3	3	2	2	3	2	2	1	1	8	0	0	2	1	1	2	1	0	0	0
81	17	1	1	2	1	1	3	2	2	2	3	2	1	2	1	1	2	3	1	1	1	2	1	3	2	1	6	6	0	4	3	1	2	0	0	0	0
82	18	2	2	1	1	1	1	1	1	3	2	2	3	3	1	1	1	3	3	1	2	1	1	1	2	1	7	0	3	0	3	2	0	8	0	0	0
83	18	3	2	2	3	3	2	1	2	1	1	2	2	2	2	1	2	3	3	2	2	2	1	2	3	2	10	10	3	1	2	2	2	2	2	2	0
84	18	2	1	2	2	1	2	2	1	3	2	2	2	3	1	1	1	2	2	1	2	1	2	2	1	1	8	0	0	3	3	2	1	1	0	0	0
85	19	1	1	2	1	1	1	2	1	1	1	1	1	1	1	1	1	2	2	1	1	1	1	2	2	1	6	6	0	1	2	3	3	3	2	2	2
86	18	1	1	1	3	2	3	2	2	1	1	1	1	1	1	1	1	2	2	1	1	1	2	2	2	1	10	10	0	2	1	3	1	1	0	0	0
87	18	1	1	2	2	1	2	2	1	1	1	2	1	1	1	1	1	2	3	1	1	2	2	2	2	1	5	0	0	1	2	0	1	0	0	0	0
88	17	1	1	2	2	1	2	1	1	1	2	1	3	3	2	1	1	3	3	1	1	2	1	1	1	2	7	0	0	2	2	0	1	4	3	3	1
89	18	2	1	1	2	1	3	3	2	2	2	1	2	2	1	0	1	3	3	1	2	2	1	2	2	3	10	0	0	3	1	3	3	2	1	1	0
90	17	3	0	2	2	2	2	1	2	2	3	2	2	3	2	2	1	3	3	1	2	1	2	2	0	2	10	0	0	1	0	4	1	0	5	5	1
91	18	2	1	1	2	1	1	0	0	2	1	0	1	2	1	1	0	3	3	0	3	1	1	2	2	1	6	0	0	2	0	2	0	0	2	2	1
92	17	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	1	1	2	1	0	1	3	2	1	1	4	0	0	3	3	3	1	0	0	0	0
93	17	2	0	3	1	2	1	3	2	1	1	1	0	1	0	0	0	3	2	1	2	1	2	3	2	1	10	0	0	2	3	0	0	0	0	0	0
94	18	1	1	2	2	1	1	2	1	1	2	2	1	2	1	1	1	3	2	1	2	2	2	1	1	1	6	0	0	1	2	2	1	0	3	3	2
95	18	1	1	2	2	1	1	1	1	1	2	1	1	2	1	3	1	2	3	1	2	2	1	2	1	1	6	0	0	1	3	2	4	2	0	0	0

No	Ages	Part 1																								Part 2										
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	1	2	3	4	5	6	7	8	9	10	11
96	17	0	1	2	2	1	1	1	1	2	2	1	1	2	0	0	0	3	3	3	3	2	2	2	1	1	6	0	0	1	1	0	1	1	0	0	0
97	17	0	0	1	1	1	1	1	1	2	2	1	1	1	0	0	0	3	3	1	3	2	1	2	1	1	6	0	0	1	3	2	3	0	0	0	0
98	17	2	1	3	2	1	3	2	1	2	2	1	0	0	0	0	0	3	3	2	3	0	2	1	1	1	8	0	0	0	2	1	0	0	0	0	0
99	17	2	2	2	3	3	2	2	2	2	1	1	1	2	1	0	3	3	3	2	2	1	1	2	1	3	10	0	0	5	5	9	4	2	1	1	0
100	17	0	2	2	2	1	1	1	1	2	1	1	2	2	0	0	0	3	3	1	3	3	2	2	2	1	6	0	0	3	1	1	0	2	0	0	0

APPENDIX C

Stimulus Items for the Stroop Study

In this section, the stimulus items used in the presented study will be presented.

1. Stimulus Items Used in Non-Linguistic Stroop Task

XXX XXX XXX
XXX XXX XXX
XXX XXX XXX
XXX XXX XXX

2. Stimulus Items Used in Thai Linguistic Stroop Task

แดง แดง แดง
เขียว เขียว เขียว
ดำ ดำ ดำ
ดำ ดำ ดำ

3. Stimulus Items Used in English Linguistic Stroop Task

RED RED RED
GREEN GREEN GREEN
BLUE BLUE BLUE
BLACK BLACK BLACK

APPENDIX D

Statistical Analysis of Experiment 1

The reaction times (in ms.) in High English experience group is presented below.

No	Non-linguistics Perception-Thai Production	Non-linguistics Perception-English Production	Thai Perception-Thai Production	Thai Perception-English Production	English Perception-English Production	English Perception-Thai Production
1	107.8	104.5	131.7	128.3	120.8	110.9
2	109.2	108.8	138.2	134.8	136.5	121.8
3	163.3	178.9	199.7	180.8	205.5	181.4
4	104.8	105.8	135.7	121.8	127.7	110.4
5	113	121.7	150.3	142.1	148.3	125.7
6	126.8	139.8	157.6	154.1	135.7	138.2
7	113.3	104.8	133.2	125	119.8	117.2
8	103.8	121	135.5	130.7	139.8	127.9
9	111.2	128.2	140.7	145.8	114.2	126.5
10	114.2	100	117.8	118.3	120.9	95.8
11	83.3	95.3	123.9	114.5	121.8	99.8
12	94.3	99	121.9	116.8	115.7	105.8
13	99.8	109.3	129.7	121.2	113.8	113.9
14	106.5	103.2	132	114.3	112.8	108.2
15	105	122	128.3	113.3	130.2	108.8
16	103.6	103.7	130.5	128.3	116.7	104.8
17	101	121.5	135.5	138.5	130	108.5
18	104.1	114	140.2	143.5	121	111.8
19	112.5	120	200.5	185.5	138.5	190.5
20	114	118	140.5	131.5	200	108.4
21	119.1	125	155	132.5	130.5	109.5
22	121	126	160	155.5	145.5	125
23	114.1	130.1	135	154	135	137.5
24	110.3	115.1	140	130	120.5	117.2
25	121	130	145	131.5	140.5	127
26	103.4	105	120.5	150.5	115.5	130.6
27	111.2	115	135	120.5	121	108.8
28	104.6	120	125	115	125	111.5
29	105.7	115	130	117	120.5	115
30	112.8	123.5	152	125	115.5	110.2
31	114.3	115	130.5	115	140	111.5
32	109	118	140	115	115.5	105.5
33	115.6	120	141	130	118.6	112.1
34	105	150	158	135	170.5	125
35	113.6	123	210	140.5	210	191.5
36	101	141	155	118	130.5	115.4
37	111	151	160	1114.5	150.5	125
38	179.3	120	167	160.5	140.2	135.5
39	142.5	120	143	111.5	119.8	118.5
40	182	145	145	122.5	139	130.5
41	126.3	116	160.5	1125	112.2	125
42	154	124	127	134.5	121	141
43	171	160	153	115	122.8	115.5
44	142.6	120	151	130	116.5	102.5
45	109.5	100	149	135.6	113.8	110.5
46	110	154	123	118	135	112.5
47	127.5	160	138	1112.5	117.8	100
48	130	112	140.5	115.5	210.5	108
49	141.5	130	141.5	120.5	161	121.5
50	126	145	148.2	110.3	128	120

The reaction times (in ms.) in Low English experience group is presented below.

No	Non-linguistics Perception-Thai Production	Non-linguistics Perception-English Production	Thai Perception-Thai Production	Thai Perception-English Production	English Perception-English Production	English Perception-Thai Production
1	103.7	105.8	125.8	130.8	111.5	102.5
2	99.8	107.8	122.8	135.5	117.5	102.3
3	96.6	105.3	131.7	132.8	114.2	1101.6
4	103.9	110.7	130.5	135.8	111.8	107.2
5	104.8	105.2	123.3	135.5	118.5	102.9
6	102.8	104.8	116	139.9	118.3	103
7	100.9	97.5	112	140	113	102
8	90.6	100	116.7	136.9	112	92.8
9	99	103.2	116.7	123.7	105.3	98.3
10	81.8	89.8	106.7	134.3	106.7	85.2
11	74.3	85.8	113.8	118.4	108.8	76.9
12	76.6	121.6	108.9	132.3	97.8	81.2
13	115.3	100.7	135.5	131.9	95.3	117.6
14	84.9	102.1	121.8	119.6	147.5	89.4
15	106.8	101.6	141.7	153.3	107.6	108.3
16	92.6	125.2	125.3	140.7	110	92.5
17	107.6	104.2	133.3	141.8	105.8	106.9
18	100.5	110.2	122.8	144.9	125	110.5
19	111.8	135	120.5	163	127	112
20	102	121	122.5	136.3	124.5	111.2
21	101.5	111.8	130.5	1311	121.5	107
22	100	131.5	130	123.8	118	112
23	90.5	95.8	125	153.8	123	113
24	100	99.8	115	140	122	112
25	85.5	113.5	110	163.9	100.5	102.5
26	74.5	111	115.6	132.5	116.8	108.5
27	76.5	98.5	106.5	143	118.5	90.5
28	115.5	115.8	120.5	128.5	107.8	77.5
29	85.9	115.5	140	135.5	105.3	82.5
30	106.5	115.5	125	141	137.5	118.5
31	92.5	125.5	122	129	117.5	100
32	108.5	115.5	131.5	160	114	118.5
33	104	114	120	141.5	128.3	102.5
34	98.5	100.6	125	145.5	123	116.5
35	104.2	100.5	115	145	122	112.5
36	105.6	114	112	153	115.3	110
37	101.5	107.5	116.5	149.5	116.5	108
38	95	115.5	105.5	147	118.5	102
39	110	117.5	114	164	104.5	105
40	85.5	115.5	118	120	105.6	102.8
41	74.5	131.5	135.5	140	135.5	108.3
42	77	110.5	140	181	117.6	105.2
43	116	112.5	125.6	160.2	110	111.2
44	85	11.6	133	163.8	115.3	116.5
45	110.5	135	142	124	135	109.4
46	95.5	105.8	110.5	128.5	111	120.5
47	108.5	109	135.5	102	120.5	116.5
48	110	100	120	111.5	124.5	117
49	100.5	100	135.5	120.5	121.8	118
50	112.2	105	124	143.5	120.5	140

APPENDIX E

Participants in the Priming Task Studies (Experiments 2 to 5)

1 Experiment 2: Thai-English Bilinguals

a) The overall number of participants and the scores that they obtained from the English language experience questionnaires in Experiment 2 is presented in Table.

No.	Names	Ages	Part 1																									Part 2										
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	1	2	3	4	5	6	7	8	9	10	11
1	น.ส. พิชชา พงษ์วัฒนสุข	18	0	1	1	2	1	0	2	1	1	2	1	1	2	0	0	1	3	2	1	1	2	1	1	2	2	8	0	0	0	3	0	1	0	0	0	0
2	น.ส. มณฑิรา มหาทรัพย์	19	1	0	2	1	1	1	1	1	1	1	1	0	0	1	0	0	3	3	1	2	2	1	1	2	1	9	0	0	3	1	3	1	0	1	1	0
3	นาย ศรุต โกมลิทธิพงศ์	18	0	0	1	1	1	1	1	1	1	2	2	0	1	1	0	0	3	3	1	2	2	1	2	1	1	4	0	0	1	3	1	0	0	1	1	0
4	น.ส. ณัฐดรุณ ปัญญาไว	18	2	1	1	2	1	2	2	3	2	3	2	1	3	0	0	1	3	3	2	3	0	2	2	2	2	10	0	2	3	3	3	4	1	0	0	0
5	น.ส. นิภาพร จันบ่ารุง	19	0	0	2	2	1	2	2	2	2	2	1	2	2	0	0	0	2	2	1	1	0	1	1	1	1	6	6	0	1	2	1	2	1	0	0	0
6	น.ส. เปรมฆดี เสรีวัฒน์	18	1	0	1	1	1	1	1	1	1	1	1	0	1	0	0	0	2	1	1	1	1	1	1	1	1	7	0	0	1	1	1	0	0	0	0	0
7	น.ส. พิณ ศิริสุทธินันท์	18	1	1	2	2	0	1	1	1	2	1	1	1	0	1	1	0	3	2	1	2	0	1	2	1	1	10	10	0	2	1	1	0	0	3	3	1
8	น.ส. พรทินา เมฆเกรียงไกร	18	1	0	1	0	1	1	1	1	1	2	1	1	2	2	1	0	2	3	2	2	1	2	2	2	3	6	0	0	2	4	2	0	0	2	2	2
9	น.ส. มาริสา เดชศิลา	18	1	1	2	3	3	3	2	3	3	3	2	2	3	2	0	0	3	3	3	3	3	2	3	1	2	9	0	0	0	1	0	4	1	1	1	0
10	น.ส. พงษ์พลอย สุขะพงษ์	17	1	0	1	1	1	1	2	1	2	1	1	1	1	0	0	0	2	2	1	1	0	2	2	1	1	8	0	5	1	2	0	1	0	0	0	0
11	น.ส. วโลกร หังสวนัส	19	1	0	1	2	1	1	1	1	1	2	0	0	1	1	0	0	2	2	2	1	1	1	1	1	1	3	0	0	1	1	1	0	0	2	2	0
12	น.ส. กรรณิการ์ เอียรธีรภาพ	18	2	1	1	1	1	1	2	0	2	1	1	1	1	0	0	1	2	3	1	1	0	1	1	1	1	4	0	0	3	3	2	0	2	0	0	0
13	น.ส. ศศิพินทุ์ ศิษฐานนท์	18	0	0	2	2	1	2	1	1	1	1	0	3	2	1	0	0	2	1	2	1	1	2	1	1	1	4	0	0	2	3	1	4	2	1	1	0
14	น.ส. พรทิพย์ ชินสูงเนิน	18	1	0	1	2	1	1	1	1	1	1	1	0	0	0	0	0	1	1	1	1	0	1	2	1	1	6	0	0	1	1	2	0	0	0	0	0
15	น.ส. เธวิดา โพมสว่าง	18	1	0	2	3	2	1	1	1	0	0	1	1	0	1	0	0	3	3	2	1	2	1	2	2	1	7	0	0	0	1	2	0	1	2	2	0
16	นาย ปิยะชาติ แร่เล้า	17	1	2	2	1	1	1	2	2	2	1	1	1	0	0	0	1	1	2	1	2	0	2	2	2	1	6	6	4	1	4	6	3	1	0	0	0
17	น.ส. ภัสสริน พรหมรอด	18	0	0	3	1	1	3	3	3	3	1	1	2	0	0	0	0	3	3	3	3	3	1	3	3	1	7	7	0	1	1	1	1	1	0	0	0
18	นาย พรชัย เสริมงหลอย	18	1	0	2	2	1	2	2	1	2	2	2	2	0	1	0	1	3	3	1	1	3	2	2	0	1	7	0	0	7	2	2	2	1	0	0	0
19	นาย ฤทธิชัย นิลสุ	18	2	1	2	2	2	2	2	1	1	2	2	1	3	0	0	3	3	3	2	2	1	3	2	1	3	7	0	0	3	2	2	0	2	0	0	0
20	น.ส. อัยยิกา สุวรรณวสัยกร	18	2	1	3	2	2	1	1	2	1	0	2	2	0	2	1	0	1	2	2	1	0	1	2	2	2	6	0	2	0	2	3	3	4	2	2	1
21	น.ส. ยุพวรรณ โสภิตวุฒิวงศ์	17	1	0	1	2	2	1	2	1	2	1	1	1	1	1	0	0	2	3	2	2	1	1	2	0	1	8	8	0	0	2	3	0	0	3	3	0
22	น.ส. ณัฐศิริ ศรีวานิชภูมิ	17	1	0	1	2	1	2	1	1	0	1	1	0	0	0	0	0	3	3	2	0	2	2	2	1	2	6	0	0	6	1	3	1	0	0	0	0
23	น.ส. ดวงรัตน์ ต้นธนาศิริกุล	17	1	0	2	1	1	1	1	0	3	0	1	0	0	0	0	1	3	3	1	1	1	2	2	1	1	8	0	0	0	2	2	0	0	0	0	0
24	น.ส. จัดรสุดา ประเสริฐศิริสุข	17	3	0	1	3	1	1	1	1	2	2	1	1	1	0	0	1	2	2	2	2	2	3	1	1	1	8	0	0	2	2	1	1	0	0	0	0
25	นาย พีรวโรจ ชำนาญกิจ	18	0	0	2	2	1	1	1	1	3	3	1	0	3	0	0	1	3	3	1	3	3	2	2	2	1	5	0	0	2	3	1	1	3	0	0	0
26	น.ส. อรุณี สุริยันรัตกร	18	2	0	1	2	1	3	3	2	2	2	2	0	1	1	0	2	3	1	1	2	0	2	2	2	2	4	4	0	2	3	6	5	0	1	1	0
27	นาย วันรนะ ทองคำเบา	18	1	0	0	1	0	1	2	1	1	2	2	1	2	0	0	0	2	2	1	1	1	1	2	0	1	6	0	0	2	1	3	1	1	0	0	0
28	น.ส. ศุภกร โอภาสินา	17	1	0	2	3	3	2	1	2	0	1	1	0	0	1	0	0	3	3	1	3	3	1	0	3	2	9	0	0	1	2	0	1	0	1	1	0
29	น.ส. ปวิตรา มาตย์คำ	18	1	1	3	2	1	2	1	1	1	2	1	2	1	0	0	0	3	3	2	3	3	2	2	1	1	4	0	0	2	2	1	2	2	0	0	0
30	น.ส. จิณห์จุฑา บุญธรรมจันดา	17	1	0	2	2	1	1	1	2	1	1	1	1	1	1	1	2	3	3	0	1	3	1	2	0	1	6	0	0	1	3	1	3	1	1	1	1
31	น.ส. ชลากร รัตนพันธ์	18	0	1	1	1	1	1	1	1	2	3	2	3	3	1	2	0	3	3	2	1	3	1	2	2	3	4	0	0	1	1	0	1	5	2	2	1
32	น.ส. อาจารี ระยะสะ	18	2	1	1	1	1	3	3	3	3	3	3	3	3	0	0	2	3	3	2	2	3	3	3	1	1	10	6	0	4	1	7	3	1	0	0	0
33	น.ส. อุบลวรรณ วงศ์พิทักษ์	18	1	1	2	1	1	1	1	1	2	1	1	1	1	0	0	0	1	1	1	1	1	2	1	1	2	6	0	0	0	1	0	0	1	0	0	0
34	น.ส. เพียงเพ็ญ ทองวัฒนา	18	0	1	2	1	1	0	1	0	1	2	2	0	3	0	0	0	3	3	2	2	2	2	2	1	1	7	0	0	1	2	1	0	0	0	0	0

No.	Names	Ages	Part 1																									Part 2										
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	1	2	3	4	5	6	7	8	9	10	11
35	น.ส. อภิญญา แสงสานนท์	18	1	1	2	3	2	3	2	3	3	2	3	2	2	1	0	1	3	3	1	3	1	1	2	2	3	6	6	1	3	2	3	10	1	2	2	0
36	น.ส. ณัฐกาญจน์ ชัครวิเศษสิริวะกุล	19	1	0	2	2	1	1	1	1	1	0	1	0	0	1	0	0	2	2	0	2	1	1	1	1	1	10	2	0	3	1	1	1	0	2	2	0
37	น.ส. นิลยวรรณ พิทยะปรีชากุล	18	1	2	2	1	2	2	2	0	2	2	1	2	1	0	0	2	3	2	1	1	1	2	1	2	2	6	0	0	1	2	6	0	2	0	0	0
38	น.ส. วิมพิภา สถิตเสถียร	16	1	1	1	1	1	1	1	1	2	2	1	1	2	1	0	1	3	3	1	1	1	2	1	1	1	8	0	2	0	2	2	1	1	0	0	0
39	น.ส. กอยกมล ศิริภักดี	18	2	0	2	2	1	2	3	1	1	1	1	1	2	2	0	0	3	3	2	3	1	1	3	0	2	6	0	0	4	2	2	0	0	2	2	0
40	น.ส. สุภาพร จีนใหม่	19	1	1	1	1	2	1	1	1	1	2	1	3	3	1	0	1	2	1	1	1	0	1	1	2	1	4	0	0	1	2	0	1	10	7	7	0
41	น.ส. ชนิดา ดวงวัสเนานนท์	18	1	0	2	2	2	1	2	1	0	1	1	1	1	0	0	0	2	2	1	2	0	1	1	1	1	8	0	0	2	1	1	0	0	0	0	0
42	นาย ศรสะรณ โกวิทวณิรชา	18	1	0	1	1	1	2	2	2	2	3	2	0	2	1	0	0	2	3	2	3	2	1	0	0	1	0	0	0	2	2	1	1	0	0	0	0
43	น.ส. พรพรรษา โชยะเตระ	18	2	0	1	3	2	2	2	2	3	2	1	1	1	1	1	0	3	3	1	2	3	1	1	1	1	8	0	0	3	2	3	4	3	2	2	1
44	น.ส. เมสารี สวนสน	17	1	0	1	1	1	1	1	1	3	3	1	1	3	2	1	0	3	2	1	3	3	2	2	1	1	8	0	0	4	1	2	0	1	2	2	1
45	น.ส. วัลภา ศิรเจา	17	2	0	2	2	1	1	2	2	2	2	1	2	1	0	0	1	3	3	1	3	3	2	1	2	2	8	0	0	1	3	2	3	2	0	0	0
46	น.ส. พรรณวดี ตั้งสกุล	18	0	0	1	2	1	1	1	1	1	1	1	1	1	1	0	0	2	2	2	1	0	2	2	2	1	6	0	0	1	1	0	0	1	1	1	0
47	น.ส. นิพร้อตา ชัยสาต้นดี	18	1	1	3	2	3	2	2	1	3	1	1	1	1	0	0	3	3	3	2	2	1	2	2	3	2	10	0	0	2	2	2	2	0	0	0	0
48	น.ส. วิภานดา วิมลระภูล	18	3	0	1	2	1	1	0	1	2	1	0	1	1	1	1	1	2	2	1	1	1	0	1	1	1	8	0	0	1	1	2	3	0	0	0	1
49	น.ส. อาพาพร จำปา	18	1	1	2	1	2	1	1	1	1	2	1	1	1	0	0	1	2	1	1	1	0	1	1	2	1	8	0	0	2	2	1	1	0	0	0	0
50	น.ส. ภาริน ดารารุจา	17	2	1	2	2	1	2	1	1	1	1	1	1	1	0	0	1	2	1	1	1	1	2	2	1	1	10	0	0	2	2	2	0	0	0	0	0
51	นาย ภูริพูร อัศวัครพงศ์	18	0	0	1	2	1	1	2	1	1	2	0	1	0	1	0	1	3	3	1	3	1	1	1	1	1	6	6	0	1	2	1	3	0	1	1	0
52	น.ส. สินีนาถ ศรีโพธิ์ทองนาค	18	0	1	2	1	1	3	2	2	1	3	1	3	3	3	2	1	3	3	3	3	2	2	3	2	3	10	0	0	1	3	10	3	0	1	1	1
53	น.ส. อรนุช โชยะโท	17	2	0	2	2	2	1	3	1	1	3	1	0	3	2	1	0	3	3	1	2	1	2	2	1	1	8	0	0	5	1	3	3	0	8	8	1
54	น.ส. สิรินุช อาจหยัมสวรค	18	1	0	2	2	1	1	2	1	2	2	0	1	2	0	0	0	3	3	1	3	1	1	2	1	1	6	6	4	0	2	1	0	1	0	0	0
55	น.ส. ธิติพร จันเสนาะ	17	2	0	2	3	1	1	1	1	2	1	3	0	0	1	1	0	2	3	1	2	0	1	2	1	2	8	0	10	1	1	1	1	0	2	2	1
56	น.ส. หทัยภัทร พูนผลกุล	18	0	1	1	2	1	1	1	1	1	2	1	1	1	1	0	0	2	2	1	2	0	1	2	2	1	10	0	0	0	2	0	1	2	0	0	0
57	นาย แสงสว่าง กิตติสยาม	18	1	0	1	1	1	0	1	1	1	2	1	1	1	0	0	1	2	2	1	2	1	1	2	1	1	8	8	0	0	1	2	1	0	0	0	0
58	น.ส. วริสตา ศรีรัตนา	18	2	1	1	2	2	2	2	3	2	3	1	3	3	1	1	3	3	3	2	2	1	3	2	1	3	8	0	0	3	1	2	3	10	3	3	1
59	น.ส. เมธินี รุ่งแจ้ง	18	1	1	1	1	1	2	3	2	1	3	1	1	3	1	0	0	3	3	1	3	2	1	1	1	1	6	4	4	3	3	5	3	3	1	1	0
60	นาย เวชพูภัทร วิสัทร	19	3	3	3	0	1	1	1	1	1	3	1	2	3	2	2	0	3	3	2	3	3	1	0	1	3	4	0	0	0	1	1	3	0	1	1	2
61	น.ส. กัลยา ชาวบ้านแพ้ว	17	2	0	0	2	1	1	2	1	2	0	1	0	0	0	0	1	2	1	0	1	1	1	2	2	1	8	0	0	0	2	1	0	0	0	0	0
62	น.ส. ยชิจิตรา วงษ์สวรรค์	17	1	1	1	0	1	2	1	2	2	2	2	1	2	2	1	1	3	3	3	3	1	1	3	1	2	6	0	0	1	1	1	0	2	1	1	1
63	น.ส. ดารารวรรณ มาลีสี	18	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	0	2	2	1	1	0	3	2	2	1	5	0	0	2	1	1	0	0	1	1	0
64	น.ส. ฐิตินันท์ เทพหัสดิน	19	1	0	1	2	1	1	1	1	3	3	1	1	2	1	0	1	3	3	2	2	3	1	2	1	1	6	0	0	1	2	1	2	3	0	0	0
65	น.ส. อภิรดี อภิชิตชัย	18	2	0	1	3	1	1	1	3	3	1	1	1	0	0	0	1	3	3	1	1	0	1	1	1	1	7	0	0	0	1	3	7	0	0	0	0
66	น.ส. สุภาดวง เล้าสกุล	18	1	2	2	1	1	2	1	2	1	3	1	1	3	1	1	1	3	3	1	3	3	1	2	1	1	6	0	0	4	2	1	0	0	3	3	1
67	น.ส. วิภร นิลยนิมิต	18	1	0	1	2	1	1	1	2	2	1	1	0	0	1	0	0	3	1	1	1	0	1	1	1	1	6	0	2	0	1	0	0	0	2	2	0
68	น.ส. ธรรมสารี สมรูป	19	0	0	1	1	0	2	1	0	1	1	1	0	0	1	0	1	2	1	1	1	0	2	1	1	0	4	0	0	1	2	0	0	0	0	0	0

No.	Names	Ages	Part 1																									Part 2										
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	1	2	3	4	5	6	7	8	9	10	11
69	น.ส. พงมาน สุภัทรจัน	17	1	2	2	1	0	2	2	1	3	1	0	1	1	0	0	1	2	2	2	2	1	2	2	2	1	10	0	0	1	1	0	0	1	0	0	0
70	น.ส. หงสา รักษ์ บริสุทธิ์ศรี	17	2	1	1	1	1	2	2	2	1	3	2	3	3	2	1	1	3	3	1	2	2	2	2	2	3	8	0	2	2	1	2	2	2	2	2	1
71	น.ส. น้ำนวล พิพัฒน์ยง	18	3	1	3	2	2	3	3	3	3	3	3	3	2	3	0	2	3	3	3	3	2	3	3	2	3	6	0	0	3	1	1	5	2	1	1	0
72	น.ส. ธณัญญา พิเชษฐ์ธนโภคิน	19	1	1	1	1	1	0	1	1	2	1	1	0	0	0	0	0	1	1	0	1	1	1	2	1	1	8	0	0	1	2	1	1	0	0	0	0
73	น.ส. จุฑามาศ ศิริประชา	17	0	1	1	1	2	0	1	1	1	1	1	1	1	0	0	1	3	3	0	3	1	1	1	1	0	8	0	0	0	1	1	0	1	0	0	0
74	นาย กำพล ปิยะศิริกุล	17	1	0	1	2	1	1	1	1	1	1	1	0	0	0	0	1	1	2	1	1	1	1	1	0	1	5	0	0	3	3	3	7	0	0	0	0
75	นาย จิตรพันธุ์ หัวระเวณิง	18	2	0	2	3	1	2	2	2	0	3	0	0	1	1	0	0	3	3	1	2	1	1	2	1	2	5	0	0	0	1	2	2	0	1	1	0
76	น.ส. นฤพร โรจนประเสริฐ	18	1	1	2	2	2	1	2	1	1	2	1	2	2	1	0	0	3	3	1	1	2	2	1	1	1	10	0	0	1	2	1	1	1	1	1	0
77	น.ส. สุพฤกษา พงษ์สุวรรณ์	18	1	1	1	2	1	3	1	3	1	3	2	3	3	2	1	1	3	3	1	1	1	1	2	2	3	5	0	0	3	1	1	7	1	1	1	1
78	น.ส. ดวงกมล สาธีรัตน์	17	0	2	2	3	2	1	1	1	2	2	2	0	1	1	1	1	3	3	1	2	1	2	3	2	1	6	0	2	0	1	2	0	0	0	0	0
79	น.ส. ปิยนุช ลิ่มเจริญกิจ	17	0	1	2	2	1	2	2	1	2	3	1	0	1	0	0	1	3	3	2	2	3	2	3	2	1	6	0	0	3	1	1	0	0	0	0	0
80	น.ส. สุรัญชนา บัทมโกวิท	18	1	1	1	2	1	2	1	1	1	3	1	1	3	0	0	1	3	3	2	3	3	1	3	1	1	8	0	0	1	1	1	3	1	0	0	0
81	น.ส. ชลิตา สันตติทรัพย์	18	3	1	1	3	2	0	1	1	3	2	1	0	2	1	0	1	1	2	1	1	0	1	1	2	2	5	0	0	0	2	3	1	3	4	4	0
82	น.ส. พิมพ์นรา วงศ์วิริยะ	18	2	0	0	2	1	1	3	3	2	3	1	1	2	0	0	0	3	3	1	3	0	1	2	1	0	8	0	2	2	3	2	2	3	0	0	0
83	น.ส. อิศรา วงศ์สุภาพ	18	0	1	2	3	1	2	1	2	1	1	2	1	2	0	0	0	3	3	2	2	3	2	2	1	1	8	0	0	2	1	1	2	1	0	0	0
84	น.ส. ศุภวรรณ คุ้มรุ่งโรจน์	17	1	0	2	1	0	3	2	2	2	3	2	0	2	1	0	2	3	1	1	1	2	1	3	2	1	6	6	0	4	3	1	2	0	0	0	0
85	น.ส. ปริยากรณ์ สงวนฤทธิชัย	18	2	2	1	1	1	0	1	0	3	2	2	3	3	0	0	1	3	3	1	2	1	1	1	2	1	7	0	3	0	3	2	0	8	0	0	0
86	น.ส. ณัฐกานต์ ศุขโต	18	3	2	2	3	3	2	1	2	1	1	2	2	2	2	0	2	3	3	2	2	2	1	2	3	2	10	10	3	1	2	2	2	2	2	2	0
87	น.ส. วรรณเจลิม กันตีทรงศ์พิพัฒน์	18	2	1	2	2	1	2	2	1	3	2	2	2	3	0	0	0	2	2	1	2	1	2	2	1	1	8	0	0	3	3	2	1	1	0	0	0
88	น.ส. อรวีร์ ภูมิวงศ์พิพักษ์	19	1	1	2	1	1	1	2	1	1	1	1	1	1	1	1	1	2	2	1	1	0	1	2	2	1	6	6	0	1	2	3	3	3	2	2	2
89	น.ส. ศศิณี ชูอรุณ	18	0	0	1	3	2	3	2	2	1	1	1	1	1	0	0	1	2	2	1	1	1	2	2	2	1	10	10	0	2	1	3	1	1	0	0	0
90	น.ส. รัชยา วีรการณ์	18	1	0	2	2	1	2	2	1	1	1	2	1	1	0	0	1	2	3	1	1	2	2	2	2	1	5	0	0	1	2	0	1	0	0	0	0
91	น.ส. อนุตรา มหาเดชน์	17	1	1	2	2	1	2	1	1	0	2	1	3	3	2	1	0	3	3	1	1	2	1	1	0	2	7	0	0	2	2	0	1	4	3	3	1
92	น.ส. นิศรา จิมขันท์	18	2	1	1	2	1	3	3	2	2	2	1	2	2	1	0	1	3	3	1	2	2	1	2	2	3	10	0	0	3	1	3	3	2	1	1	0
93	น.ส. ศิรินพร ศรีเมธสุนทร	17	3	0	2	2	2	2	1	2	2	3	2	2	3	2	2	1	3	3	1	2	1	2	2	0	2	10	0	0	1	0	4	1	0	5	5	1
94	น.ส. อิษณา บาปุยะวาทย์	18	2	1	1	2	1	1	0	0	2	1	0	1	2	1	1	0	3	3	0	3	1	1	2	2	1	6	0	0	2	0	2	0	0	2	2	1
95	น.ส. ศิริพร ศรีรัตน์สกุลรัย	17	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	1	1	2	1	0	1	3	2	1	1	4	0	0	3	3	3	1	0	0	0	0
96	น.ส. สุธีรา สัสยพันธ์	17	2	0	3	1	2	1	3	2	1	1	1	0	1	0	0	0	3	2	1	2	1	2	3	2	1	10	0	0	2	3	0	0	0	0	0	0
97	น.ส. ณัฐยา นิรัญญสมบัติ	18	1	1	2	2	1	1	2	1	1	2	2	1	2	1	1	1	3	2	1	2	2	2	1	1	1	6	0	0	1	2	2	1	0	3	3	2
98	น.ส. อทิติยา ดำรงกิตกุล	18	1	1	2	2	1	1	1	1	1	2	1	1	2	1	0	1	2	3	1	2	2	1	2	1	1	6	0	0	1	3	2	4	2	0	0	0

No.	Names	Ages	Part 1																									Part 2										
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	1	2	3	4	5	6	7	8	9	10	11
99	น.ส. ปาริชาต ชินทรสมบัติ	17	0	1	2	2	1	1	1	1	2	2	1	1	2	0	0	0	3	3	3	3	2	2	2	1	1	6	0	0	1	1	0	1	1	0	0	0
100	น.ส. อลิษา สาส์งช์	17	0	0	1	1	1	1	1	1	2	2	1	1	1	0	0	0	3	3	1	3	2	1	2	1	1	6	0	0	1	3	2	3	0	0	0	0
101	น.ส. อรุณรุ่ง มหานนทกุล	17	2	1	3	2	1	3	2	1	2	2	1	0	0	0	0	0	3	3	2	3	0	2	1	1	1	8	0	0	0	2	1	0	0	0	0	0
102	น.ส. สุวิมล เมฆยานันท์	18	2	2	2	3	3	2	2	2	2	1	1	1	2	1	0	3	3	3	2	2	1	1	2	1	3	10	0	0	5	5	9	4	2	1	1	0
103	น.ส. ปิยะรัตน์ สินธนานนท์	18	0	2	2	2	1	1	1	1	2	1	1	2	2	0	0	0	3	3	1	3	3	2	2	2	1	6	0	0	3	1	1	0	2	0	0	0
104	น.ส. พิชญทัฬห์ จันทร์พุฒ	18	1	0	2	2	0	1	1	1	0	0	1	1	0	0	0	0	2	2	1	1	1	2	1	2	2	4	0	0	0	4	1	1	0	0	0	0
105	น.ส. นิธิวดี อนันตโท	17	0	1	1	2	2	1	2	2	2	3	2	1	2	1	0	1	3	3	2	3	3	1	3	2	2	10	0	0	1	2	3	1	1	0	0	0
106	น.ส. พุทธามณี ศรสานนท์	19	1	1	2	2	1	2	1	1	1	3	2	1	3	1	1	1	2	1	2	1	3	1	2	1	2	6	0	0	3	3	2	3	10	1	1	1
107	น.ส. ภควันต์ เรืองกฤษ	18	1	0	1	2	2	2	3	2	2	1	2	2	1	0	0	3	3	1	2	2	2	3	3	2	2	7	0	0	1	4	2	3	1	0	0	0
108	น.ส. บุศรินทร์ แก้วประเสริฐ	18	0	0	2	1	1	3	3	2	1	3	3	1	2	0	0	1	3	3	2	2	1	3	2	2	2	8	0	0	3	1	2	2	0	0	0	0
109	น.ส. อรรัมภา เสนานาคบุ	18	0	1	1	2	1	0	1	0	2	3	1	2	1	0	0	0	2	3	1	1	0	1	1	1	1	6	0	0	0	2	2	0	7	0	0	0
110	น.ส. มรกต กรรมสาธก	19	1	0	2	1	0	0	1	1	0	1	1	0	1	0	0	0	2	1	1	1	1	2	2	2	1	4	4	0	0	1	0	2	0	0	0	0
111	น.ส. พันธิตรา ธนะเจนเจิด	18	2	1	2	1	2	3	1	2	1	1	2	2	1	0	0	0	3	3	1	1	2	1	2	2	1	5	5	0	4	2	2	1	1	0	0	0
112	น.ส. ปริศนา จันทรารมย์	18	1	1	2	1	1	0	1	1	2	2	2	2	2	0	0	0	3	3	3	3	0	1	2	1	1	5	0	0	0	1	1	1	2	0	0	0
113	น.ส. ลลิตา ฉิงคานนท์	17	2	1	1	1	1	2	1	2	2	2	1	0	3	0	0	0	3	3	2	2	2	1	0	2	2	7	0	3	4	2	1	1	3	0	0	0
114	น.ส. จุดี สุวรรณวงศ์	18	1	1	2	2	1	2	2	2	1	1	1	0	1	0	0	0	2	2	1	2	0	1	2	1	2	10	0	0	1	2	0	1	0	0	0	0
115	น.ส. พิชัมพร จุนเณร	17	1	0	2	1	1	0	1	1	1	1	1	0	0	0	0	0	3	2	0	1	0	1	2	2	1	8	8	3	0	2	3	0	0	0	0	0
116	น.ส. สราพร เอี่ยวเจริญ	18	2	1	2	2	2	2	1	1	2	2	1	2	2	2	0	1	3	3	1	1	2	2	3	1	2	10	0	0	1	1	1	1	2	1	1	0
117	น.ส. นิสา จิวเจริญ	17	1	1	1	2	1	2	2	2	2	3	1	1	3	1	1	1	3	3	2	3	3	2	2	1	1	8	0	0	4	3	1	3	3	2	2	2
118	น.ส. อรนุช ประยูรทอง	17	2	1	2	2	3	2	2	2	2	2	1	1	2	0	0	2	2	2	1	2	1	2	1	2	2	10	10	3	1	2	2	0	2	0	0	0
119	น.ส. ศรินยา ตันฑวรรธนะ	19	1	0	1	1	1	1	1	1	1	2	1	1	1	1	0	0	2	3	1	2	1	1	1	0	1	6	0	0	2	2	2	1	2	1	1	0
120	น.ส. พนารัตน์ หัตถกิจวิไล	18	3	2	1	3	3	3	3	1	3	3	2	3	3	1	0	2	3	3	2	3	2	1	3	1	2	7	0	4	2	3	2	1	2	1	1	0
121	น.ส. นินี อรัณยะนาค	18	1	0	1	0	0	2	2	1	3	3	2	3	3	3	3	0	3	3	1	2	1	1	0	1	3	10	10	0	2	1	0	0	5	1	1	1
122	น.ส. จิรารัตน์ วิเศษวาณิชย์	18	1	0	2	1	1	2	2	1	2	3	0	1	3	1	1	1	2	3	1	1	1	1	0	0	1	8	0	0	4	1	0	2	2	3	3	1
123	น.ส. บุณยนุช เกตุอักษณ์	18	0	0	1	1	1	1	2	2	1	1	2	1	1	0	0	1	2	2	1	2	1	1	2	1	1	8	0	4	1	2	1	0	2	0	0	0
124	น.ส.สุภมาน มิตรสมหวัง	17	2	1	1	2	0	2	1	3	1	3	0	2	3	1	1	0	3	3	2	3	0	3	3	2	1	4	0	0	4	1	1	2	1	2	2	1
125	น.ส. แสงระวี ลักษณะโสภิณ	18	1	1	2	1	2	1	1	2	2	2	1	1	1	0	0	1	3	3	1	2	1	1	1	1	1	5	0	0	1	2	1	1	0	0	0	0
126	น.ส. เสาวภา หลิมวิจิตร	17	2	0	1	1	0	1	1	1	1	2	2	0	2	0	0	0	3	3	2	2	0	1	3	1	2	8	0	3	0	1	1	1	0	0	0	0
127	น.ส. มนทกานติ พงษ์ธนะ	17	2	1	2	1	1	2	1	1	1	2	1	2	3	1	1	0	3	3	2	1	2	1	0	1	1	5	5	0	1	1	1	2	2	1	1	1
128	น.ส. ศยามล พันสิทา	18	0	0	2	2	1	2	1	1	1	3	2	1	2	0	0	1	3	1	1	1	2	2	3	2	2	4	3	0	2	2	0	2	1	0	0	0
129	น.ส. ภัทริยา ประดิษฐธีระ	17	1	1	2	2	1	2	1	1	2	2	1	1	1	1	0	0	3	2	1	1	2	2	2	1	1	8	0	0	0	1	0	0	0	1	1	0

No.	Names	Ages	Part 1																									Part 2									
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	1	2	3	4	5	6	7	8	9	10	11
130	น.ส. กุลยา เสารส	18	2	1	1	1	1	1	1	1	1	1	0	2	1	1	1	1	3	3	1	3	1	1	1	0	1	8	0	0	1	1	2	0	3	1	1	1
131	น.ส. พรรณวิภา จันทร์เพ็ญ	18	2	3	2	1	2	2	2	2	3	3	3	3	3	2	3	2	3	3	2	2	2	2	3	1	3	6	0	0	1	2	1	0	5	3	3	1
132	น.ส. ปาริชาติ์ กองศิลป์	16	0	0	1	3	1	0	2	1	3	1	1	0	0	0	0	0	3	2	1	1	1	3	2	1	1	5	0	0	0	2	2	2	0	0	0	0
133	น.ส. พงจินต์ นิลคำแหง	17	1	0	1	2	1	1	1	1	1	1	1	0	1	0	0	0	3	2	0	1	1	2	1	0	0	6	0	0	2	1	4	1	0	0	0	0
134	น.ส. พิมพนิช จุนเกรง	18	2	1	2	2	2	3	2	2	2	3	2	3	3	0	0	2	3	3	3	2	2	1	3	2	3	6	0	0	4	2	3	2	10	0	0	0
135	น.ส. ชุทัยวรรณ ทรัพย์ทวีโชค	18	1	1	1	1	0	0	1	1	0	1	1	1	2	1	0	1	1	2	1	0	1	1	1	1	1	6	0	0	0	2	1	2	1	3	3	0
136	น.ส. กุลธิดี เชิงชลาด	18	1	1	2	2	2	1	1	2	2	1	1	1	1	0	0	2	1	2	2	1	0	2	1	1	2	10	0	0	1	2	1	2	3	0	0	0
137	น.ส. พิมพิกา ธวิรัฐ	17	3	3	3	2	1	2	2	3	2	3	1	1	2	1	0	1	2	3	3	3	0	1	2	2	3	6	0	10	2	3	4	6	0	2	2	0
138	นาย พรชิษฐ์ สว่างศิลป์	18	2	2	3	2	1	3	2	3	1	3	2	2	3	1	0	0	3	3	2	3	3	1	3	1	2	10	6	0	2	1	3	3	6	1	1	0
139	น.ส. กมลลิวิ สังข์เสวี	17	2	3	3	3	3	2	2	2	1	3	1	3	3	0	0	1	3	3	2	1	1	1	3	3	3	10	0	0	2	2	2	2	7	0	0	0
140	น.ส. วมพุนุท คติงานิมมานนท์	18	1	0	2	1	2	1	1	1	2	1	1	2	1	0	0	0	2	1	1	1	0	1	1	1	2	6	0	0	2	2	2	0	5	0	0	0
141	น.ส. ฐาปนัท ธุจิตานนท์	18	1	1	2	2	1	1	1	1	1	2	1	1	2	0	0	1	3	3	1	2	1	1	2	0	1	10	0	0	1	3	1	1	1	0	0	0
142	น.ส. ภัทราภา ไตรรตนันต์วุฒิกุล	17	2	3	2	2	2	3	3	3	3	3	2	3	3	3	2	2	3	2	2	2	2	2	2	2	2	10	0	0	3	2	3	3	3	4	4	1
143	น.ส. สุพิน สุกสรรค์	18	2	0	1	2	1	1	1	1	2	0	1	0	0	1	0	1	3	3	0	1	2	1	2	1	1	8	8	2	2	1	1	3	0	0	0	0
144	น.ส. บุษราคัม หอมวิ่น	19	1	0	2	1	0	1	1	1	1	1	1	2	2	1	0	0	3	3	1	3	1	1	1	1	1	6	0	0	1	1	2	2	3	0	0	0
145	น.ส. ลลิลทิพย์ วัชรเศรษฐพรรณ	18	2	0	1	1	2	1	2	1	1	2	1	1	2	0	0	2	2	2	1	2	1	1	2	1	1	5	5	0	3	2	1	2	0	0	0	0
146	น.ส. เพ็ญสุดา ช่องไพบิภา	19	1	0	1	2	1	1	1	1	1	1	1	0	1	0	0	1	2	2	1	1	1	1	2	1	1	10	10	0	1	2	0	2	0	0	0	0
147	น.ส. เบญจวรรณ ธีระวาณิช	17	0	0	1	1	2	1	1	1	1	2	1	2	1	0	0	3	3	2	1	1	3	1	2	2	2	7	0	0	0	0	0	0	2	0	0	0
148	น.ส. วิภานดี หวังวิชญ	18	2	1	0	3	1	2	1	1	2	3	1	3	3	1	0	1	3	3	1	2	1	0	1	1	2	5	0	0	1	2	4	2	8	1	1	0
149	น.ส. ภาณี ศรอธรรมรัตน์	18	2	0	2	2	2	2	2	1	2	3	1	1	3	0	0	0	3	3	1	3	3	2	2	0	1	5	0	0	2	1	1	0	0	0	0	0
150	น.ส. โยธิน มงคลิก	17	1	0	1	1	1	1	2	1	2	2	2	1	1	0	0	0	3	2	2	3	1	2	2	2	1	6	0	0	2	3	2	1	5	0	0	0
151	น.ส. ศนาวรรณ ทรงสกุลเกียรติ	17,4	2	0	1	2	1	2	2	2	2	2	2	0	1	0	0	0	3	3	1	2	2	1	3	3	1	10	0	0	1	1	2	1	0	0	0	0
152	น.ส. วรนุช สุวัฒนพิมพ์	17,11	2	1	2	3	3	3	1	1	3	3	2	3	3	2	0	1	3	3	2	2	1	2	3	1	1	10	0	2	1	4	4	1	7	6	6	0
153	น.ส. นลวรรณ สุขวัฒนสถาพร	18,8	1	1	3	3	1	2	2	2	0	3	2	3	3	0	0	1	3	3	2	2	1	3	3	3	2	6	0	0	2	3	0	2	5	0	0	0
154	น.ส. สุวัธรา หวังจิตต์เจริญ	18,7	1	1	2	1	1	2	1	1	1	2	1	2	3	1	0	1	3	2	1	1	2	1	3	3	3	6	6	0	3	3	2	0	7	1	1	0
155	น.ส. ฐิติพร วงศ์วัฒนสิน	18,3	2	0	1	2	1	1	1	1	3	3	1	1	2	0	0	0	2	3	1	3	2	1	2	1	1	6	0	0	2	2	1	3	1	0	0	0
156	น.ส. ณณิตตา จุนเจริญ	18,8	0	0	1	2	0	2	2	2	3	1	1	1	0	0	0	2	2	1	2	1	1	3	3	2	2	8	0	0	1	4	1	2	0	0	0	0
157	น.ส. จอมสุดา จิราธิวัฒน์	18	3	1	1	3	3	3	2	1	3	3	1	2	3	3	1	1	3	3	1	3	3	2	3	3	3	8	8	0	6	3	4	5	6	6	6	1
158	น.ส. สุวิตา นวมเจริญ	17,10	2	1	2	2	1	1	1	1	1	1	1	1	0	0	0	1	2	2	1	1	1	1	2	0	2	8	0	0	1	2	1	0	1	0	0	0
159	น.ส. วรกาญจน์ เลิศยศธนวัฒน์	18,2	2	1	1	2	1	2	1	2	1	3	1	2	2	3	0	1	3	3	1	2	2	1	3	1	2	10	0	0	2	1	0	1	2	2	2	0
160	น.ส. ธรณิวา เจริญเดช	18,3	3	0	2	3	3	2	3	3	3	3	3	2	2	3	0	2	3	3	2	3	3	3	2	1	2	8	8	2	5	2	1	2	2	10	10	0
161	น.ส. ดาเด็ด ศิระวุฒิ	18,2	1	0	1	2	1	1	1	1	3	2	1	1	1	1	1	0	2	3	1	1	0	1	2	0	1	8	0	0	1	2	1	1	1	1	1	1
162	น.ส. พัลณี สังพงษ์เพ็ชร์	18,10	2	0	1	2	1	0	1	0	3	1	1	3	1	0	0	0	3	3	1	3	0	1	1	2	1	10	0	0	0	2	2	0	3	0	0	0
163	น.ส. นลินี นิราศลม	18,7	2	0	1	1	0	1	2	1	1	0	1	0	0	0	0	0	2	3	1	1	1	2	3	1	1	5	0	10	1	2	0	0	0	0	0	0

No.	Names	Ages	Part 1																									Part 2										
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	1	2	3	4	5	6	7	8	9	10	11
164	น.ส. วรรณภัสสร์ ไชยแพง	18.2	2	1	2	3	2	3	2	3	3	2	3	2	2	1	1	1	3	3	2	3	1	2	2	2	2	10	0	0	1	3	1	3	2	1	1	0
165	น.ส. จารุวรรณ วุฒิสิงห์	18.8	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	1	1	1	1	0	0	1	0	0	6	0	0	0	1	2	1	0	0	0	0
166	น.ส. อัจฉรา สุ่นหรั่งสระศรี	17.9	1	1	1	1	1	0	1	1	2	1	0	1	2	0	0	1	1	1	1	1	0	3	1	0	1	6	0	0	0	1	2	0	1	1	1	0
167	น.ส. สมกมล มีสุวรรณ	18.1	1	0	1	1	2	0	2	2	1	1	1	0	0	0	0	1	3	3	0	2	2	0	2	1	2	6	0	0	0	2	2	0	0	0	0	0
168	น.ส. พักจิตร คุณมี	19.1	1	1	2	2	2	2	1	2	1	1	1	1	0	0	0	1	3	3	1	3	1	1	2	2	2	7	0	2	7	2	2	1	1	0	0	0
169	น.ส. อรยา แม้นเหมือน	18.3	3	1	1	2	1	1	1	2	2	3	1	2	2	1	0	1	3	3	1	1	2	1	2	1	2	7	3	0	0	1	2	0	1	2	2	0
170	น.ส. วนาพา เกตะปัญญา	17.7	1	0	1	1	1	1	1	1	2	1	0	1	1	1	0	2	3	3	2	3	3	1	2	2	1	8	0	0	1	2	2	3	1	2	2	0
171	น.ส. จิณา แม่สุวรรณ	18.7	2	1	2	1	1	2	2	2	1	2	2	3	3	0	0	2	3	3	1	2	2	1	3	1	3	7	0	0	5	3	1	2	10	0	0	0
172	น.ส. พิสุทธินี บำหรับ	17.8	1	0	2	2	1	3	3	2	1	3	2	1	2	1	0	1	3	3	1	3	2	2	1	2	1	5	6	0	7	1	1	3	0	1	1	0
173	น.ส. สุภาพร แสงส่องสิน	18.9	1	0	2	2	0	1	1	1	0	0	1	0	0	0	0	0	3	2	0	1	0	1	1	2	1	6	0	0	2	3	1	4	0	0	0	0
174	น.ส. กุลวัลย์ พัฒนสุวรรณ	18.3	2	3	2	2	1	3	2	3	1	3	2	3	2	1	1	0	3	3	2	1	3	1	3	2	1	8	0	2	3	1	0	1	2	0	0	0
175	น.ส. ปาณฑิต นวรนาถสกุล	19.4	1	1	1	3	2	1	1	1	2	1	1	1	1	0	0	1	2	2	1	2	2	2	1	2	2	9	9	0	2	1	4	3	3	0	0	0
176	น.ส. ปิยบุตร เมณฑ์กุล	18	1	0	1	1	1	2	2	1	1	2	1	1	2	0	0	0	2	1	1	1	1	1	1	1	1	6	0	0	0	1	0	0	1	0	0	0
177	น.ส. วญาดา ยินทรสูต	18.3	1	1	2	3	0	1	2	3	3	2	1	1	3	0	0	1	3	3	1	2	1	1	2	2	1	5	5	0	1	1	2	1	1	0	0	0
178	น.ส. สุพรนา กล้าหาญ	18	1	1	1	1	2	2	2	1	0	1	1	2	2	0	0	0	3	3	2	2	1	2	2	1	1	6	0	2	1	1	1	1	0	1	1	0
179	น.ส. เบญจพร เย็นเศรณี	18.1	1	0	1	2	1	0	1	1	2	1	1	0	0	1	0	0	2	2	1	1	0	1	2	2	1	4	4	0	0	2	2	0	0	2	2	0
180	น.ส. พิชญดา นันทนาท	17.5	1	0	2	1	2	2	2	1	2	1	1	0	1	0	0	1	1	2	0	2	1	1	2	1	1	6	6	0	0	2	1	0	0	0	0	0
181	น.ส. ชลิตวรรณ คนหริพย์ไพศาล	18.7	0	0	1	3	1	2	1	1	2	2	0	0	1	1	0	0	3	2	1	1	1	1	1	1	1	8	0	0	2	1	2	0	0	2	2	0
182	น.ส. พิมพ์รัก สุขสวัสดิ์	17.8	1	1	0	2	1	2	2	1	2	3	1	0	1	0	0	1	2	2	1	1	1	1	2	2	1	8	0	0	0	2	2	1	0	0	0	0
183	น.ส. วิรญา กุลบุตร์	17.9	1	1	2	1	2	1	1	2	2	2	1	2	2	2	0	1	2	2	1	1	1	1	2	0	1	7	0	0	1	2	3	1	2	4	4	0
184	น.ส. มนุรดา พรชนะรักษ์	17.6	1	2	3	2	2	2	1	2	2	3	1	2	2	1	0	1	3	3	2	3	0	1	3	2	2	10	0	2	5	2	4	1	1	1	1	0
185	น.ส. มณฑิรา โกมาสพิพัฒน์	18.1	1	0	1	1	1	2	1	3	2	1	2	1	0	0	0	1	2	1	1	1	1	1	2	2	1	9	0	0	2	1	3	2	1	0	0	0
186	น.ส. ณัฐฐิยา ศรีธารทิพย์วงศ์	18.3	2	1	3	2	1	3	3	3	3	3	2	1	2	2	2	1	3	3	2	2	3	1	3	1	3	6	6	3	3	1	1	5	2	4	4	4
187	น.ส. ศุภญา ประทุมทอง	18.7	1	2	3	3	2	2	2	2	2	1	2	1	1	0	0	2	2	1	1	1	0	2	1	1	1	6	0	0	1	2	0	0	0	0	0	0
188	น.ส. ปาริชาติ จิ๋นนม	17.10	1	0	1	0	1	3	1	1	3	2	1	3	1	0	0	2	3	2	1	2	2	2	1	1	1	4	0	0	3	1	5	4	2	0	0	0
189	น.ส. ปริยา จิ๋นจูเวส	18.3	2	1	1	1	2	3	1	2	2	2	1	1	3	1	1	1	2	2	1	1	1	1	3	1	1	6	6	3	5	2	3	2	1	5	5	1
190	น.ส. นภาลัย มีจรรยากุล	18.2	2	0	2	3	2	2	2	2	2	2	2	1	1	0	0	1	3	2	1	2	2	1	2	1	1	9	0	0	2	1	4	2	0	0	0	0
191	นาย ทูนเพิ่ม โพทยวัลย์	16.11	1	0	1	2	1	3	2	3	3	2	2	0	2	1	0	2	3	3	2	3	1	2	3	3	3	6	6	5	6	1	3	4	0	1	1	0
192	น.ส. อิสราณี จายสุวรรณศรี	18.2	2	0	1	3	1	1	2	2	2	2	1	0	0	0	0	0	2	2	1	1	0	1	0	0	1	8	0	0	1	1	2	3	0	0	0	0
193	น.ส. ลลิตา คุณาภิญญา	17.10	1	0	2	1	2	1	1	1	1	2	1	3	3	1	0	0	3	3	2	2	1	1	1	1	1	5	0	0	1	1	1	2	2	2	2	0
194	น.ส. พัชญาณ์ อีระวัฒน์สกุล	18.5	1	1	1	1	1	1	1	1	2	2	1	1	3	1	0	1	3	3	2	3	1	1	2	1	3	8	0	5	3	4	4	2	1	1	1	0
195	น.ส. วาสนา หิรัญถาวร	17.11	2	0	1	2	1	1	1	1	2	2	1	1	2	1	0	0	2	1	1	1	1	1	2	1	1	8	8	0	0	3	1	1	0	1	1	0

No.	Names	Ages	Part 1																									Part 2										
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	1	2	3	4	5	6	7	8	9	10	11
196	น.ส.สุธนิ ปิยานุวัฒน์เจริญ	18.8	2	0	2	2	1	1	1	1	1	2	1	1	2	1	0	1	3	3	1	1	0	1	2	1	1	6	0	0	1	3	2	0	0	1	1	0
197	น.ส. ภวรรษา ชัยกิตเลิศ	18.7	1	1	2	1	1	1	1	2	1	2	2	0	0	1	0	0	3	3	1	3	3	3	2	1	1	6	0	0	1	2	2	1	0	1	1	0
198	น.ส. ธีรพร ชมเดช	18.7	2	1	1	2	1	2	1	2	2	3	1	1	3	2	2	1	3	3	1	2	1	1	2	1	2	10	10	0	4	4	6	2	1	4	4	2
199	น.ส. มนัสวี สุขวัฒน์	18.4	3	1	2	2	1	3	2	2	1	3	2	1	3	0	0	1	2	3	1	3	0	3	3	2	2	10	10	0	2	3	0	2	1	0	0	0
200	น.ส. ภรณีย์ หินันโสตถิกุล	18.1	1	1	2	1	1	1	1	1	2	2	1	1	2	1	0	1	2	2	1	1	0	2	1	1	1	5	0	2	1	4	1	4	3	0	0	0
201	น.ส. ธีรนุช วนิชยางกูรพงศ์	17.5	0	0	2	1	1	2	2	1	1	3	1	0	2	1	0	0	3	3	2	3	1	1	2	1	1	6	0	0	1	1	1	0	0	0	0	0
202	น.ส. สุฑี นาสวัสดิ์	18.5	1	1	1	0	1	0	1	2	0	3	0	0	3	0	0	0	3	2	1	1	1	0	1	0	0	6	0	0	0	2	2	2	1	0	0	0
203	น.ส. ธัญญารัตน์ ภูเจริญ	18.2	1	1	2	1	2	2	2	1	1	2	2	1	2	0	0	1	2	2	2	2	2	2	2	2	2	5	0	0	1	3	3	3	2	0	0	0
204	น.ส. อังค์วรา กรินหมะพันธ์	17.6	0	0	0	2	1	2	1	1	1	2	1	0	2	0	0	0	3	1	2	2	1	1	2	1	1	8	0	0	2	1	1	2	0	0	0	0
205	น.ส. ปิยะนุช จิรวัฒน์กิตุใญ	18.8	2	1	1	3	1	2	3	2	2	2	1	1	2	0	0	1	3	2	1	1	2	1	2	0	1	8	0	0	1	3	4	4	1	0	0	0
206	น.ส. จารุนาฏ เลิศสกุลเจริญ	18	1	2	2	1	2	2	2	3	2	2	2	3	3	2	1	1	3	3	2	2	1	2	3	2	2	10	0	2	2	2	2	2	3	1	1	0
207	น.ส. พราตี ธรรมจินดา	18.3	0	1	0	1	2	1	1	1	1	2	1	1	2	1	0	2	3	3	1	2	1	2	1	1	2	8	0	0	1	1	1	0	0	2	2	0
208	น.ส. บุศนียา คะนุคย์	17	1	1	1	·2	0	1	1	1	2	3	1	3	3	0	0	1	3	3	3	3	2	1	2	1	2	4	0	0	4	2	0	1	10	0	0	0
209	น.ส. ทิชาพร อนันตพฤกษา	17.7	1	0	1	1	1	0	1	1	1	1	0	0	0	0	0	0	2	1	0	0	0	0	1	1	1	7	0	0	0	2	1	2	0	0	0	0
210	น.ส. สิริพนา เกียรติศักดิ์นิกร	18.11	1	0	0	1	0	1	2	2	2	0	1	1	0	1	1	1	3	3	1	3	1	1	1	2	1	10	0	0	1	1	3	1	0	1	1	1
211	น.ส. วิไลลักษณ์ ทิศธิวงศ์	17.11	2	1	1	3	2	2	2	2	2	3	2	1	3	3	0	0	3	3	3	3	3	1	1	2	3	10	0	0	2	2	1	0	2	2	2	0
212	น.ส. นภามน รุ่งวิทู	17.11	1	1	2	·2	2	3	3	3	3	3	3	3	3	0	0	1	3	3	3	3	3	2	3	2	3	6	0	0	6	1	3	3	2	0	0	0
213	น.ส. พิรดา ทีปพงศ์	18	1	0	0	3	1	1	1	2	1	3	2	2	2	0	0	1	3	3	1	3	2	1	3	1	2	4	0	0	1	2	1	4	3	0	0	0
214	น.ส. รุ่งทิพย์ พรหมมณีวงศ์	18.2	2	0	1	1	1	1	1	2	2	2	2	1	2	0	0	1	3	3	1	2	2	1	2	2	1	7	0	0	2	2	2	1	0	0	0	0
215	น.ส. พิมพ์นภา อมฤตาระวัย	18.1	2	1	3	2	3	2	2	2	2	3	1	0	3	0	0	1	3	3	1	3	3	2	1	1	2	6	0	0	1	3	3	3	5	0	0	0
216	น.ส. สุธิรา เพชรสายทิพย์	17.10	1	1	2	1	1	1	1	1	1	0	1	1	0	0	0	1	2	2	1	1	1	1	1	1	1	6	0	0	0	2	1	0	0	0	0	0
217	น.ส. นุสรา ชัยสิทธิโรจน์	18.6	1	0	3	1	1	1	2	2	1	2	2	2	0	1	0	0	3	3	1	2	2	2	3	1	1	6	0	0	0	3	3	1	2	3	3	0
218	น.ส. วิภาวี วิบูลย์ศิริวัน	18.5	1	1	1	1	1	1	1	1	1	1	1	2	2	0	0	1	1	1	1	2	2	1	2	1	1	6	0	0	2	1	4	4	1	0	0	0
219	น.ส. สุวรัตน์ เหียมสุวรรณ	19.9	2	0	3	2	1	1	1	2	2	1	0	1	0	0	0	0	2	1	1	1	1	1	1	1	1	5	6	0	1	1	0	1	0	0	0	0
220	น.ส. ศุจจินดา ธนะพรพันธุ์	18.1	1	1	2	1	1	2	3	1	1	3	2	1	2	1	1	0.	2	3	2·	1	2	2	1	1	1	4	0	0	2	2	2	1	0	1	1	1
221	น.ส. กุศลิน รุจทะพุทธิ	18	1	0	1	1	0	1	1	1	2	1	1	0	0	0	0	1	3	2	1	2	0	1	1	2	1	7	0	0	3	3	2	0	0	0	0	0
222	น.ส. กุลยา ถลิตพาณิชย์	18.10	3	0	1	2	1	1	1	3	1	2	1	1	2	3	1	1	3	1	1	3	3	3	2	2	2	8	0	0	1	1	3	1	0	3	3	1
223	น.ส. วาสนา ผสมญาติ	18.10	1	1	1	2	1	1	2	1	2	1	1	0	0	0	0	0	2	2	1	1	2	2	1	1	1	10	0	0	0	2	2	0	0	0	0	0
224	น.ส. ธัญวลี พิเชษฐ์วิวาาห	18.1	2	0	2	2	2	1	1	1	2	2	2	1	3	2	1	0	3	3	3	3	3	2	3	2	2	8	4	0	1	2	2	2	0	4	4	1

No.	Names	Ages	Part 1																									Part 2										
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	1	2	3	4	5	6	7	8	9	10	11
225	น.ส. ศุภนันท์ เลิศมโนรัตน์	18,5	1	1	2	2	1	2	1	2	1	2	1	3	3	0	0	1	3	3	3	2	1	1	2	1	1	6	0	0	1	2	5	3	6	0	0	0
226	น.ส. พัทธ์ชนันท์ ศิละพัฒนะ	18,1	1	0	1	1	1	1	2	2	1	2	1	0	0	1	0	0	3	1	1	1	0	1	2	2	1	7	0	0	3	2	5	1	0	2	2	0
227	น.ส. จรรย์ [illegible]	19,1	2	1	1	2	1	2	1	2	1	2	1	2	3	1	0	1	1	1	1	1	0	1	1	2	3	10	0	0	2	1	1	1	4	1	1	0
228	น.ส. โสภณา จันทร [illegible]	18,7	1	1	1	2	2	3	2	1	1	1	1	1	1	2	0	0	3	3	2	2	2	1	1	2	2	7	0	0	4	1	1	0	2	3	3	0
229	น.ส. ณัฐชิตา ชิมประเสริฐ	17,9	1	1	2	1	1	1	1	1	0	2	1	0	1	1	0	0	2	3	2	1	0	1	2	2	1	8	0	0	1	1	0	2	0	2	2	0
230	น.ส. มหิรา สุทธิวัฒน [illegible]	18,1	0	2	2	1	2	3	3	2	2	3	3	3	3	2	2	1	3	3	2	3	3	2	3	1	2	8	0	0	6	1	0	2	7	4	4	2
231	น.ส. พนิดา สุรชัยกุลวัฒนา	18,1	2	1	2	2	2	2	2	2	1	3	1	2	3	1	0	0	3	3	2	3	1	2	2	2	2	6	0	5	0	1	2	2	1	1	1	0
232	นาย เศหาสน์ ธอพงษ์ไพบูลย์	18,8	1	0	3	2	3	3	3	3	2	2	2	1	1	1	0	2	3	3	3	3	3	2	3	3	3	4	4	0	2	2	1	1	1	1	1	0
233	นาย วันวนะ ทุ่นสุวะ	18,7	2	0	1	2	1	1	2	1	1	1	2	1	1	0	0	0	3	3	3	3	1	2	3	2	1	8	0	3	2	1	1	1	1	0	0	0
234	น.ส. ประภาณัช ประภาสะวัส	17,11	3	3	1	2	3	2	1	1	0	3	1	3	3	3	0	2	3	3	1	3	2	1	3	1	3	7	0	2	1	3	2	1	4	5	5	0
235	นาย นำพล จำสุนทร	19,7	0	0	2	1	1	1	1	0	1	1	1	1	1	0	0	0	2	2	1	1	0	1	0	1	1	5	3	0	2	3	1	0	0	0	0	0
236	น.ส. นฤทิพย์ เครือคณ [illegible]	18,9	1	2	1	2	1	1	1	1	2	2	2	1	2	1	0	2	3	3	2	2	2	2	1	1	2	4	0	0	2	2	1	1	0	1	1	0
237	น.ส. กมลรัตน์ กมลนาวิน	18,10	1	1	2	2	2	2	2	1	2	2	1	1	2	1	0	1	2	2	2	2	1	1	2	1	1	8	0	0	2	1	2	1	3	0	0	0
238	น.ส. นุวพนิต นาคพิทักษ์	18,4	3	1	2	3	2	3	1	1	3	3	1	1	3	3	2	1	3	3	1	3	1	1	3	1	3	6	0	0	1	1	0	2	0	7	7	2
239	น.ส. ภัฏฏาธินี ชิงคุลานนท์	17,11	3	1	2	3	2	2	1	1	3	3	1	3	3	2	2	1	3	3	1	1	1	2	2	2	2	10	10	0	3	2	4	2	3	1	1	1
240	น.ส. นัฐวรรณ วงษ์ประดู่	18,2	2	1	2	3	3	2	1	2	2	2	1	2	2	1	1	0	3	3	3	3	2	2	3	3	2	10	0	0	2	2	4	2	10	1	1	1
241	น.ส. บุลวัฒน์ พฤกษานุกูล	18,1	1	0	1	1	0	1	1	0	0	1	1	0	1	0	0	0	2	1	1	0	0	0	1	1	1	10	0	2	0	3	0	0	0	1	1	0

b) Names of Participants in the High and the Low groups in order from the highest to the lowest scores are shown below:

No.	High Group	No.	Low Group
1	น.ส.ปุณณาณ มิตรสมหวัง	1	น ส. ธรรมสารี สมรูป
2	น.ส. นินี อรัญยะนาค	2	น ส จารุวรรณ ชูศิลธุ
3	น.ส. จุฑามณี กชสามมณี	3	น.ส. ทิชาพร อนันตพฤกษา
4	น.ส. ธีรพร ชมเดช	4	น ส เปรมวดี เสรีรักษ์
5	นาย เชษฐภัทร วิสัทร	5	น.ส. พรทิพย์ ธีนสูงเนิน
6	น ส. รอมลุดา จิราธีวัฒน์	6	น ส. วไลกร พังลวนัล
7	น.ส. ศุวิมล แพทยานันท์	7	น ส. มรกต กรรมลาธก
8	น.ส. ชลากร รัตนพันธ์	8	นาย นำพล ธำศุนทร
9	น.ส. ภัทราภา ไตรอนันต์วุฒิกุล	9	น.ส. บุลวัชร์ พฤกษานุบาล
10	น.ส. ณัฐฐิยา ศรีธารทิพย์วงศ์	10	น.ส. อะนัญญา พิเชษฐ์ธนโภคิน
11	น.ส. นัฐพรรณ วงษ์ประดู่	11	น.ส ธัชอรา สุนทรัจเรรงค์
12	น.ส. อรนิชา เจริญเลิศ	12	น.ส. เพ็ญสุดา ว่องไววิภา
13	น.ส. พรรณนิภา จันทร์เพ็ญ	13	น.ส พรรณวดี ตั้งสกุล
14	น.ส. วรนุช ศุวัฒนพิมพ์	14	นาย วันชนะ ทองคำเภา
15	น.ส. มทิรา สุทธิวัฒนานิธิ	15	น.ส อุบลวรรณ วงศ์พิทักษ์
16	น.ส. น้ำนวล พิทักษ์มงคล	16	น.ส. กัลยา ชาวบ้านแพ้ว
17	น.ส. วริตตา ศรีรัตนา	17	น ส สุวดี นาสวัสดิ์
18	น.ส. สินีนาถ ศรีโพธิ์ทองนาค	18	น ส ลุธิรา เพชรสายทิพย์
19	น.ส. พิมพนิจ จุนทรง	19	น.ส วิยร นิลยนิมิต
20	น.ส. พิมพิกา ทวิรัฐ	20	น.ส. จุฑามาศ ศิรประชา
21	น.ส. นุชนนิต นาคพิทักษ์	21	น ส พิชญทัพน์ จันทร์ขุลม
22	น.ส. อภิญญา แสงสานนท์	22	น.ส ทิรัมพร ขุนเณร
23	น.ส. ฐาปนัท รุจิตานนท์	23	น.ส จงจินต์ นิลคำแหง
24	น ส. พนารัตน์ หัตถกิจวิโร	24	น ส. ปุวรัตน์ เทียมสุวรรณ์

2 Experiment 3: English-Thai Bilinguals

a) The number of overall participants and the scores that they obtained from the Thai language experience questionnaires in Experiment 3 is presented in Table.

No.	Names	Ages	Part 1																									Part 2										
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	1	3	4	5	6	7	8	9	10	11	12
1	Alexia Dimitmou	30	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	1	1	1	0	1	0	0	0	0	0	0	0	1	0	0	0	0	1	0	3
2	Tonia	25	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0
3	Linda Cruikshank	47	0	0	0	3	0	0	1	0	0	0	0	0	0	0	0	2	1	0	0	0	0	0	0	1	0	10	0	6	0	0	0	0	0	1	0	0
4	Joanne Mason	35	1	0	1	3	0	1	0	0	0	1	0	0	0	0	0	0	3	2	2	2	2	0	0	0	0	2	0	2	1	0	0	0	0	0	0	3
5	Lausa Mckin	30	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
6	Stephen Raw	32	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1	1	0	0	0	1	3	0	1	0	0	0	0	0	0	0	1
7	Miranda Kuil	28	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8	David Puckey	36	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	0	2	0	0	1	0	10	0	0	0	0	0	0	0	0	0	1
9	Frans	35	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	10	0	5	0	2	0	0	0	0	0	0
10	Adrian Mason	31	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11	Jill Kinsey	36	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	0	0	5	0	2	0	0	0	0	0	0
12	David Wandless	31	0	1	0	1	0	0	1	0	0	0	0	0	0	0	0	0	1	1	1	1	0	0	0	0	1	6	0	0	0	1	0	0	0	0	0	2
13	Kristy Nuttall	22	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	2	1	1	1	1	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0
14	Marc Edmonds	35	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
15	Lee Stevens	24	0	1	0	0	0	1	1	0	0	0	1	0	0	3	0	2	2	1	1	1	1	0	0	0	2	0	0	0	1	2	0	1	0	0	0	2
16	Jan Schauseil	34	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1	1	1	2	0	0	0	0	10	0	0	0	0	0	0	0	1	0	2
17	Udra Phillips	44	1	2	2	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	1	1	10	0	0	0	0	0	0	0	0	1	0
18	Michell Tan	30	0	1	0	2	0	0	0	0	0	0	0	0	0	3	2	0	1	0	1	0	0	0	0	1	3	3	0	3	0	0	0	0	0	1	0	0
19	James Whitlam	32	0	1	0	1	0	1	1	1	1	1	1	0	0	0	1	1	2	2	1	2	1	0	0	3	1	3	0	0	2	1	1	0	0	1	1	2
20	W Stark	N/A	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	2	2	1	1	0	0	0	0	4	0	0	0	0	0	0	0	0	0	1
21	John Gunthen	N/A	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1	0	0	0	0	0	1	0	5	0	0	0	0	0	0	0	1	0	6
22	Peter Burgess	50	0	0	0	0	0	1	1	3	1	1	0	2	2	0	0	1	2	1	1	1	1	0	0	1	1	0	0	0	1	1	0	10	3	1	0	3
23	Martin Haywood	45	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	1	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	2	0	0
24	Brian Anthony Curtin	32	0	1	0	0	0	1	1	0	1	0	0	0	0	0	0	0	3	2	2	1	0	0	2	2	2	4	0	5	2	3	2	0	0	0	48	2
25	William Carlon	59	1	1	1	0	0	0	1	0	0	0	0	0	0	1	1	0	1	1	1	0	1	0	1	0	3	10	0	1	0	0	0	0	0	0	16	1

No.	Names	Ages	Part 1																									Part 2										
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	1	3	4	5	6	7	8	9	10	11	12
26	John Orr	56	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	3	0	1	0	0	0	0	0	0	0	0
27	James E. Powell	54	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	2	2	2	2	2	1	0	3	1	10	0	0	0	0	0	0	0	0	0	10
28	William Page	63	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1	1	0	1	0	0	0	0	10	0	0	0	0	0	0	0	1	0	3
29	David Russell	58	0	1	1	0	0	1	2	3	0	0	0	0	0	3	3	3	0	3	2	0	0	0	2	0	3	10	0	0	4	3	0	10	0	1	1	5
30	Barry Lush	40	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0
31	Charles Price	56	3	0	0	0	0	1	1	1	1	1	0	0	0	0	0	0	2	1	1	1	1	0	1	1	1	10	0	0	0	3	0	0	0	0	0	0
32	Richard Meek	43	1	1	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	2	0	0	0	0	0	0	0	0	0	0
33	Anthony Sheridan	41	0	0	0	0	0	0	1	0	0	0	1	0	0	1	0	0	1	1	1	0	1	0	0	1	0	0	0	1	0	1	0	0	0	1	0	0
34	Andrew	38	1	0	0	0	0	0	1	0	1	1	0	1	0	3	0	1	2	1	1	0	1	1	0	1	3	4	0	0	0	0	0	0	0	1	8	0
35	Sheila Taylor	36	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	2	1	1	0	1	0	0	1	2	10	0	0	0	0	0	0	0	1	0	3
36	Matthew Billig	35	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	2	1	1	1	2	0	0	0	1	0	0	0	0	0	0	0	0	1	0	5
37	Graham Rogers	49	0	0	0	2	0	0	1	0	0	1	0	0	3	1	0	0	3	3	3	1	3	0	1	1	3	2	0	0	1	0	1	0	0	1	0	3
38	mj	25	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	1	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0
39	Anupatt P. Yuttachai	71	1	2	0	0	1	1	1	0	1	0	0	0	0	0	0	0	2	0	3	0	0	0	0	0	0	10	0	0	1	3	0	0	0	0	0	1
40	Matthew Christie	30	0	0	0	3	0	0	0	0	0	0	0	0	0	3	0	1	2	1	1	0	2	0	0	0	1	5	0	2	0	0	0	0	0	1	0	0
41	clinton henderson	26	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	1	1	1	1	0	0	1	0	0	0	1	0	0	0	0	0	0	0	2
42	Arthur G. Wright	39	1	0	0	0	0	0	0	0	0	0	0	0	0	3	1	2	0	0	1	0	0	0	0	1	3	10	0	0	0	0	0	0	0	1	48	0
43	N/A	60	1	0	0	0	0	0	0	0	0	0	0	0	0	2	1	0	2	1	1	0	1	0	1	0	1	6	3	0	0	0	0	0	0	1	36	0
44	Esther White	53	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	1	1	1	1	0	0	1	1	10	0	0	0	0	0	0	0	1	0	0
45	Lucy Taylor	28	1	0	0	3	0	0	0	0	0	0	0	0	0	2	1	0	2	0	1	0	0	0	0	0	3	10	0	0	0	0	0	0	0	1	0	0
46	James Francom	24	1	2	0	1	0	0	0	0	0	0	0	0	0	1	1	0	0	1	0	0	0	0	0	0	0	10	0	6	0	0	0	0	0	1	6	0
47	D.P.	45	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	1	1	1	1	1	0	0	2	0	0	0	2	0	0	1	0	0	0	0	2
48	John Wrenshall	54	3	1	0	3	3	0	0	1	1	0	0	0	0	3	1	0	1	1	1	1	0	0	0	1	3	6	1	2	0	0	0	1	2	0	0	0
49	Judy Anakavanit	48	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1	1	0	0	0	3	0	0	0	0	0	0	0	0	2	0	0
50	Peter F.	41	0	0	0	0	1	1	1	0	0	1	0	1	1	1	0	0	1	1	1	1	0	0	1	0	0	10	0	0	0	0	0	0	10	3 w	0	0

No.	Names	Ages	Part 1																									Part 2										
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	1	3	4	5	6	7	8	9	10	11	12
51	Terence O'Donnell	34	0	3	0	0	0	2	2	0	2	1	2	1	1	0	0	0	0	0	1	0	0	0	1	0	1	6	0	0	1	1	0	0	1	0	0	1
52	Mike Raship	40	0	0	0	0	0	1	1	1	0	1	1	3	2	3	0	0	2	2	1	1	1	0	0	0	3	0	0	0	1	1	0	4	2	11 x	0	2
53	Harry	57	0	0	1	0	1	1	1	0	1	0	0	1	0	1	0	1	1	0	0	1	0	0	2	1	0	5	0	0	3	1	0	0	3	7 w	0	2
54	Gray Sattler	50	0	0	0	3	0	0	0	0	0	1	0	0	0	0	0	0	3	2	2	2	2	0	0	1	1	10	0	0	5	0	1	0	0	0	0	4
55	Felix Erni	57	0	0	0	0	1	1	1	1	1	1	1	1	0	1	2	1	1	1	2	2	1	0	1	1	1	1	0	2	0	1	2	2	1	1	2 y	10
56	Rounvald Scott	73	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	1	1	0	0	0	0	2	0	0	0	0	0	0	0	0	0	1
57	Ian William Slates	32	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
58	Grainne Mckeown	24	0	0	0	3	0	0	0	0	0	0	1	0	1	3	3	0	3	1	1	0	0	0	3	3	3	10	0	8	0	0	0	0	0	0	0	0
59	Janice Pono	30	1	0	0	2	2	0	0	0	0	0	0	0	0	3	0	0	1	0	1	0	0	0	0	0	2	10	0	3	0	0	0	0	0	0	0	0
60	Kirk R. Person	33	0	0	0	0	1	1	1	1	1	1	0	0	0	3	0	1	3	2	3	2	2	0	1	0	1	0	0	0	0	1	1	1	0	2	0	2
61	John Lee	24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	1	0	0	0	1	5	0	0	5	0	0	0	0	0	0	0
62	Sofi	23	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	2	1	3	6	2	0	0	0	0	0	0	0	0
63	Mears Pilipin	24	0	1	0	0	0	0	0	0	0	0	0	0	0	1	1	0	1	1	1	0	1	0	1	0	1	4	1	0	0	0	0	0	0	0	0	0
64	Sajjad Anwar	24	0	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	3	1	1	1	2	0	0	0	1	0	0	0	0	0	0	0	0	0	0	4
65	Russell Parnett	52	0	0	0	2	0	0	1	1	1	1	1	0	0	0	0	1	2	2	2	2	1	0	1	2	1	0	0	0	0	2	0	0	0	0	0	3
66	Megon Goos	29	0	3	0	3	0	1	1	0	0	0	1	0	0	3	3	1	2	3	3	3	2	0	2	1	3	10	10	10	0	0	0	0	0	1	8	10
67	Swanli Junemann	N/A	0	0	0	3	0	0	0	0	0	0	0	0	0	2	0	0	0	0	1	1	0	0	0	2	1	10	0	10	0	0	1	0	0	0	0	2
68	Paul Melling	N/A	2	0	0	3	0	1	1	0	1	0	1	0	1	0	0	0	1	1	0	0	1	0	1	1	1	10	10	10	2	2	1	0	0	1	0	4
69	Crabtree	N/A	1	0	0	0	1	1	1	1	0	1	0	0	1	1	0	0	1	1	1	1	0	0	1	0	2	10	0	0	1	2	0	10	0	1	0	1
70	Brier	28	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1	0	0	0	1	0	10	0	0	3	0	0	0	0	0	0	0
71	Sandage	52	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	0	0	0	2	0	10	0	0	0	0	0	0	0	0	0	3
72	Whorton	59	0	0	0	3	2	2	0	0	3	0	0	1	0	1	0	1	2	2	2	2	0	0	0	0	3	4	2	4	1	0	10	0	0	1	1	10
73	Chik Clotilda	N/A	2	0	0	3	1	0	1	0	1	0	0	0	0	3	0	0	0	1	1	0	0	0	3	1	2	10	10	10	0	1	1	0	10	1	1	1
74	Liz Newlands	45	0	3	0	0	0	2	2	2	1	0	0	2	0	1	0	3	3	2	3	1	1	0	0	3	3	3	0	5	2	2	0	3	1	1	0	4
75	G.U.	42	0	0	0	1	0	1	1	0	1	0	0	0	0	1	1	0	1	1	1	0	0	0	0	1	1	4	0	0	0	0	0	0	0	0	0	1

No.	Names	Ages	Part 1																									Part 2										
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	1	3	4	5	6	7	8	9	10	11	12
76	Greg Converse	42	1	0	1	0	1	1	1	1	1	0	0	0	0	2	1	1	1	1	1	1	0	0	0	1	1	6	0	0	2	2	2	2	0	4	0	0
77	Scott Townsend	26	0	1	0	3	1	0	0	0	3	0	0	0	0	0	1	0	1	1	1	1	1	0	0	2	1	10	10	10	0	0	1	0	0	0	1	10
78	Geoff Englebrecht	52	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	0	1	0	0	1	1	6	0	0	0	0	0	0	0	0	1	3
79	Susan	48	2	0	0	0	0	0	0	0	0	0	0	0	0	3	2	0	2	0	1	1	1	0	0	0	1	6	0	1	0	0	0	0	0	1	0	1
80	Sandy	24	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0		0	0	0	0	0	0
81	Mark Naismith	20	1	0	0	3	1	2	1	1	1	2	1	1	2	3	1	0	3	3	2	1	2	0	1	0	2	afs	10	10	0	0	1	7	10	2	4	4
82	N/A	N/A	3	3	0	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	1	3	0	10	10	0	2	3	10	10	5	24	0
83	David	N/A	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1	0	0	1	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0
84	Stephen	49	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
85	Karl Peters	49	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
86	James Haew	51	0	0	0	0	1	1	2	1	0	1	1	1	1	1	0	0	1	1	1	1	0	0	1	0	1	0	0	0	3	3	0	5	0	0	2	4
87	Ken Manson	37	0	3	0	3	1	1	1	0	1	0	1	0	0	0	0	0	2	1	1	1	0	0	2	2	1	10	0	4	0	0	1	0	0	0	0	0
88	Husnah	40	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
89	Pat Lew	39	0	0	0	3	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	2	0	10	10	10	0	0	0	0	0	1	0	0
90	Martin Hosken	35	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	10	0	0	0	0	0	0	0	0	0	0
91	Alexander	41	0	0	0	0	0	1	0	0	1	1	0	0	0	0	1	0	1	1	1	1	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1
92	Saimon Buard	35	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	2	2	2	2	2	0	0	2	0	1	0	0	0	0	0	0	0	0	0	0	0
93	Jacky Kotta	34	0	0	0	0	0	2	0	0	0	0	0	1	0	0	1	0	1	0	0	0	1	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0
94	John Smith	22	0	0	1	1	1	2	2	1	1	2	2	1	1	1	2	1	1	2	2	1	2	1	1	0	1	2	0	0	0	1	0	0	0	0	0	1
95	N/A	53	0	0	0	0	1	1	1	1	1	0	0	1	0	0	0	0	2	1	1	1	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
96	Peter Ross	37	2	2	0	3	1	1	2	2	2	1	0	1	1	3	0	1	2	1	1	0	1	2	1	0	0	3	0	0	1	3	1	1	2	1	56	1
97	Dale Kvalheim	53	0	0	0	0	0	1	1	1	1	3	3	3	3	3	3	3	2	2	3	1	2	0	1	0	1	2	0	0	0	1	5	6	0	0	0	7
98	Wilma Mcnamara	34	0	1	1	1	1	0	1	0	1	1	0	0	1	0	0	0	1	2	3	1	1	0	2	2	3	10	0	0	0	1	1	0	5	0	0	4
99	Luther Wilbert	35	0	2	2	1	1	2	0	0	2	0	1	1	1	0	1	1	1	1	1	1	1	0	2	2	3	6	0	0	7	10	2	0	3	1	0	4
100	Stephen Allen	35	0	2	2	1	1	1	0	0	0	0	0	0	1	0	1	1	1	1	1	1	0	1	2	3	3	10	0	0	0	0	1	0	0	1	0	0
101	Werasale Le Salle	30	0	3	0	0	0	2	2	1	1	1	1	1	1	0	0	0	3	3	3	3	3	3	1	0	0	0	0	0	10	4	0	0	0	0	0	4

No.	Names	Ages	Part 1																									Part 2										
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	1	3	4	5	6	7	8	9	10	11	12
102	Robb Stewart	30	0	2	0	2	1	1	2	1	3	2	0	0	3	1	0	2	3	3	3	3	1	0	3	0	1	10	0	0	4	2	5	10	10	2	0	3
103	Kurt Russe	56	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0
104	Russell Clark	34	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	1	0	1	0	1	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	1
105	Keith Challenger	N/A	2	1	0	3	0	1	1	0	1	0	1	0	0	0	2	0	1	1	1	1	1	0	0	0	1	10	0	0	0	0	0	0	0	0	0	0
106	Gary King	50	2	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	2	1	2	0	0	0	0	0	0	0	0	0
107	R. Wiemers	36	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	1	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0
108	Simon Foles	29	0	0	0	3	3	1	1	1	1	2	1	0	0	3	3	0	2	1	1	1	1	0	2	0	3	2	0	0	1	0	2	0	0	0	0	3
109	N/A	50	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
110	Alf Hodges	44	0	1	0	0	1	0	1	0	1	0	1	0	1	1	0	0	2	1	1	1	2	0	1	0	3	0	10	2	2	1	0	0	0	0	0	3
111	Robert Brown	40	0	0	0	0	0	1	1	2	0	0	1	0	1	3	0	0	1	1	1	1	1	1	1	1	3	0	10	1	1	0	1	0	0	0	0	3
112	Robert Thornhill	50	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	1	1	1	1	0	0	0	0	3	0	4	1	0	0	0	0	0	0	0	0
113	Anna Bunya-Anata	37	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	1	1	1	1	1	1	0	0	0	3	0	2	0	0	0	0	0	0	0	0	1

b) Names of Participants in the High and the Low groups in order from the highest to the lowest scores are shown below:

No.	High Group	No.	Low Group
1	John Wrenshall	1	Adrian Mason
2	Megon Goos	2	Miranda Kuil
3	Whorton	3	David Puckey
4	Chik Clotilda	4	Alexia Dimitmou
5	Liz Newlands	5	Tonia
6	Greg Converse	6	Linda Cruikshank
7	Scott Townsend	7	David Wandless
8	Mark Naismith	8	Michell Tan
9	N/A	9	Martin Haywood
10	Ken Manson	10	William Carlon
11	John Smith	11	Richard Meck
12	Peter Ross	12	Anthony Sheridan
13	Dale Kvalheim	13	Andrew
14	Wilma Mcnamara	14	Mears Pilipin
15	Luther Wilbert	15	Brier
16	Stephen Allen	16	Sandage
17	Werasale Le Salle	17	Geoff Englebrecht
18	Robb Stewart	18	Susan
19	Simon Foles	19	Sandy
20	Ken	20	Pat Lew
21	Anthony	21	Martin Hosken
22	Michael Sozanski	22	Alexander
23	David Russell	23	John Wyss
24	N/A	24	John Beyani

3 Experiment 4: Mandarin Chinese-English Bilinguals

The overall number of participants and the scores that they obtained from the English language experience questionnaires in Experiment 4 is presented in Table.

No.	Names	Ages	Part 1																									Part 2										
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	1	3	4	5	6	7	8	9	10	11	12
1	Wei Xu	20	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	1	1	1	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	3
2	Liu Ping	20	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0
3	Linda	20	0	0	0	3	0	0	1	0	0	0	0	0	0	0	0	0	2	1	0	0	0	0	0	0	1	0	10	0	6	0	0	0	0	0	1	0	0
4	Xu Dong	21	1	0	1	3	0	1	0	0	0	1	0	0	0	0	0	0	0	1	1	2	2	0	0	0	0	2	0	2	1	0	0	0	0	0	0	3
5	Xiao Mei	28	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6	Hon Wu	18	2	0	2	2	1	2	3	1	1	1	1	1	2	2	0	0	3	3	2	3	1	1	3	0	2	6	0	0	4	2	2	0	0	2	2	0
7	Xiao Chen	28	1	1	1	1	2	1	1	1	1	2	1	3	3	1	0	1	2	1	1	1	0	1	1	2	1	4	0	0	1	2	0	1	10	7	7	0
8	David	19	1	0	2	2	2	1	2	1	0	1	1	1	1	0	0	0	2	2	1	2	0	1	1	1	1	8	0	0	2	1	1	0	0	0	0	0
9	Lin Zhen	18	1	0	1	1	1	2	2	2	2	3	2	0	2	1	0	0	2	3	2	3	2	1	0	0	1	0	0	0	2	2	1	1	0	0	0	0
10	Ye Lin	20	2	0	1	3	2	2	2	2	3	2	1	1	1	1	1	0	3	3	1	2	3	1	1	1	1	8	0	0	3	2	3	4	3	2	2	1
11	Zhao Chen	19	1	0	1	1	1	1	1	1	3	3	1	1	3	2	1	0	3	2	1	3	3	2	2	1	1	8	0	0	4	1	2	0	1	2	2	1
12	David	21	2	0	2	2	1	1	2	2	2	2	1	2	1	0	0	1	3	3	1	3	3	2	1	2	2	8	0	0	1	3	2	3	2	0	0	0
13	Wang Huai	18	0	0	1	2	1	1	1	1	1	1	1	1	1	1	0	0	2	2	2	1	0	2	2	2	1	6	0	0	1	1	0	0	1	1	1	0
14	Pan Li	20	1	1	2	2	1	2	2	2	1	1	1	0	1	0	0	0	2	2	1	2	0	1	2	1	2	10	0	0	1	2	0	1	0	0	0	0
15	Li Xin	24	1	0	2	1	1	0	1	1	1	1	1	0	0	0	0	0	3	2	0	1	0	1	2	2	1	8	8	3	0	2	3	0	0	0	0	0
16	Bin Huang	19	2	1	2	2	2	2	1	1	2	2	1	2	2	2	0	1	3	3	1	1	2	2	3	1	2	10	0	0	1	1	1	1	2	1	1	0
17	Zhao Xu	24	1	1	1	2	1	2	2	2	2	3	1	1	3	1	1	1	3	3	2	3	3	2	2	1	1	8	0	0	4	3	1	3	3	2	2	2
18	Michell	18	2	1	2	2	3	2	2	2	2	2	1	1	2	0	0	2	2	2	1	2	1	2	1	2	2	10	10	3	1	2	2	0	2	0	0	0
19	Lin Xu	18	1	0	1	1	1	1	1	1	1	2	1	1	1	1	0	0	2	3	1	2	1	1	1	0	1	6	0	0	2	2	2	1	2	1	1	0
20	Liu Lin	18	3	2	1	3	3	3	3	1	3	3	2	3	3	1	0	2	3	3	2	3	2	1	3	1	2	7	0	4	2	3	2	1	2	1	1	0
21	Wang Zhao	18	1	0	1	0	0	2	2	1	3	3	2	3	3	3	3	0	3	3	1	2	1	1	0	1	3	10	10	0	2	1	0	0	5	1	1	1
22	Gang Liu	24	1	0	2	1	1	2	2	1	2	3	0	1	3	1	1	1	2	3	1	1	1	1	0	0	1	8	0	0	4	1	0	2	2	3	3	1
23	Xie Lei	18	0	0	1	1	1	1	2	2	1	1	2	1	1	0	0	1	2	2	1	2	1	1	2	1	1	8	0	4	1	2	1	0	2	0	0	0
24	Zhang Mao	18	0	1	0	0	0	1	1	0	1	0	0	0	0	0	0	0	3	2	2	1	0	0	2	2	2	4	0	5	2	3	2	0	0	0	48	2
25	Jackie	18	1	1	1	0	0	0	1	0	0	0	0	0	0	1	1	0	1	1	1	0	1	0	1	0	3	10	0	1	0	0	0	0	0	0	16	1

No.	Names	Ages	Part 1																									Part 2										
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	1	3	4	5	6	7	8	9	10	11	12
26	Mao Tei	18	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	3	0	1	0	0	0	0	0	0	0	0
27	Yue Wu	19	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	2	2	2	2	2	1	0	3	1	10	0	0	0	0	0	0	0	0	0	10
28	Yuan Zhang	18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1	1	0	1	0	0	0	0	10	0	0	0	0	0	0	0	1	0	3
29	Jie Yuan	19	0	1	1	0	0	1	2	3	0	0	0	0	0	3	3	3	0	3	2	0	0	0	2	0	3	10	0	0	4	3	0	10	0	1	1	5
30	Ning Li	18	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0
31	Zho Zhi	18	3	0	0	0	0	1	1	1	1	1	0	0	0	0	0	0	0	2	1	1	1	1	0	1	1	1	10	0	0	0	3	0	0	0	0	0	0
32	Hai Zhi	19	1	1	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	2	0	0	0	0	0	0	0	0	0	0
33	Zhu Zhen	18	0	0	1	3	2	3	2	2	1	1	1	1	1	0	0	1	2	2	1	1	1	2	2	2	1	10	10	0	2	1	3	1	1	0	0	0
34	Zhen Zhen	19	1	0	2	2	1	2	2	1	1	1	2	1	1	0	0	1	2	3	1	1	2	2	2	2	1	5	0	0	1	2	0	1	0	0	0	0
35	Zhang	18	1	1	2	2	1	2	1	1	0	2	1	3	3	2	1	0	3	3	1	1	2	1	1	0	2	7	0	0	2	2	0	1	4	3	3	1
36	Yan Yan	18	2	1	1	2	1	3	3	2	2	2	1	2	2	1	0	1	3	3	1	2	2	1	2	2	3	10	0	0	3	1	3	3	2	1	1	0
37	Gao yan	19	3	0	2	2	2	2	1	2	2	3	2	2	3	2	2	1	3	3	1	2	1	2	2	0	2	10	0	0	1	0	4	1	0	5	5	1
38	Cao Wei	18	2	1	1	2	1	1	0	0	2	1	0	1	2	1	1	0	3	3	0	3	1	1	2	2	1	6	0	0	2	0	2	0	0	2	2	1
39	Qi Ueng	19	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	1	1	2	1	0	1	3	2	1	1	4	0	0	3	3	3	1	0	0	0	0
40	Zhao Zhao	18	2	0	3	1	2	1	3	2	1	1	1	0	1	0	0	0	3	2	1	2	1	2	3	2	1	10	0	0	4	3	0	0	0	0	0	0
41	Yanan	18	1	1	2	2	1	1	2	1	1	2	2	1	2	1	1	1	3	2	1	2	2	2	1	1	1	6	0	0	1	2	2	1	0	3	3	2
42	Yan Dong	18	1	1	2	2	1	1	1	1	1	2	1	1	2	1	0	1	2	3	1	2	2	1	2	1	1	6	0	0	1	3	2	4	2	0	0	0
43	N/A	20	1	0	0	0	0	0	0	0	0	0	0	0	0	2	1	0	2	1	1	0	1	0	1	0	1	6	3	0	0	0	0	0	0	1	36	0
44	N/A	19	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	1	1	1	1	0	0	1	1	10	0	0	0	0	0	0	0	1	0	0
45	Kun Feng	N/A	1	0	0	3	0	0	0	0	0	0	0	0	0	2	1	0	2	0	1	0	0	0	0	0	3	10	0	0	0	0	0	0	0	1	0	0
46	James Xu	24	1	2	0	1	0	0	0	0	0	0	0	0	0	1	1	0	0	1	0	0	0	0	0	0	0	10	0	6	0	0	0	0	0	1	6	0
47	Hui Peter	18	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	1	1	1	1	1	0	0	2	0	0	0	2	0	0	1	0	0	0	0	2
48	John	20	3	1	0	3	3	0	0	1	1	0	0	0	0	3	1	0	1	1	1	1	0	0	0	1	3	6	1	2	0	0	0	1	2	0	0	0
49	Bian Hi	18	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1	1	0	0	0	3	0	0	0	0	0	0	0	0	2	0	0
50	Bian Ping	21	0	0	0	0	1	1	1	0	0	1	0	1	1	1	0	0	1	1	1	1	0	0	1	0	0	10	0	0	0	0	0	0	10	3 w	0	0

No.	Names	Ages	Part 1																									Part 2											
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	1	3	4	5	6	7	8	9	10	11	12
51	Fang Wu	25	0	3	0	0	0	2	2	0	2	1	2	1	1	0	0	0	0	0	1	0	0	0	1	0	1	6	0	0	1	1	0	0	1	0	0	1
52	Michelle Wan	20	0	0	0	0	0	1	1	1	0	1	1	3	2	3	0	0	2	2	1	1	1	0	0	0	3	0	0	0	1	1	0	4	2	11 x	0	2
53	Fang Zhang	18	0	0	1	0	1	1	1	0	1	0	0	1	0	1	0	1	1	0	0	1	0	0	2	1	0	5	0	0	3	1	0	0	3	7 w	0	2
54	Wei Jing	20	0	0	0	3	0	0	0	0	0	1	0	0	0	0	0	0	3	2	2	2	2	0	0	1	1	10	0	0	5	0	1	0	0	0	0	4
55	Liu Li	18	0	0	0	0	1	1	1	1	1	1	1	1	0	1	2	1	1	1	2	2	1	0	1	1	1	1	0	2	0	1	2	2	1	1	2 y	10
56	Sandy Wan	20	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	1	1	0	0	0	0	2	0	0	0	0	0	0	0	0	0	1
57	Tei Tiang	18	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
58	Yue Zhang Wi	18	0	0	0	3	0	0	0	0	0	0	1	0	1	3	3	0	3	1	1	0	0	0	3	3	3	10	0	8	0	0	0	0	0	0	0	0
59	Yuan Li Lian	19	1	0	0	2	2	0	0	0	0	0	0	0	0	3	0	0	1	0	1	0	0	0	0	0	2	10	0	3	0	0	0	0	0	0	0	0
60	Yuan Qui	18	0	0	0	0	1	1	1	1	1	1	0	0	0	3	0	1	3	2	3	2	2	0	1	0	1	0	0	0	0	1	1	1	0	2	0	2
61	Li Ming	19	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	1	0	0	0	1	5	0	0	5	0	0	0	0	0	0	0
62	Zhi Mark	18	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	2	1	3	6	2	0	0	0	0	0	0	0	0
63	Wu Zhi	18	0	1	0	0	0	0	0	0	0	0	0	0	0	1	1	0	1	1	1	0	1	0	1	0	1	4	1	0	0	0	0	0	0	0	0	0
64	Zhu Zo	19	0	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	3	1	1	1	2	0	0	0	1	0	0	0	0	0	0	0	0	0	0	4
65	Li Li	18	0	0	0	2	0	0	1	1	1	1	1	0	0	0	0	1	2	2	2	2	1	0	1	2	1	0	0	0	0	2	0	0	0	0	0	3
66	Wei Sin Ho	19	0	3	0	3	0	1	1	0	0	0	1	0	0	3	3	1	2	3	3	3	2	0	2	1	3	10	10	10	0	0	0	0	0	1	8	10
67	Wang Hei Wee	18	0	0	0	3	0	0	0	0	0	0	0	0	0	2	0	0	0	0	1	1	0	0	0	2	1	10	0	10	0	0	1	0	0	0	0	2
68	Paul	18	2	0	0	3	0	1	1	0	1	0	1	0	1	0	0	0	1	1	0	0	1	0	1	1	1	10	10	10	2	2	1	0	0	1	0	4
69	Li Wu	19	1	0	0	0	1	1	1	1	0	1	0	0	1	1	0	0	1	1	1	1	0	0	1	0	2	10	0	0	1	2	0	10	0	1	0	1
70	Brian Wu	18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1	0	0	0	1	0	10	0	0	3	0	0	0	0	0	0	0
71	Dan Zhang	19	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	0	0	0	2	0	10	0	0	0	0	0	0	0	0	0	3
72	Michelle Wang	18	0	0	0	3	2	2	0	0	3	0	0	1	0	1	0	1	2	2	2	2	0	0	0	0	3	4	2	4	1	0	10	0	0	1	1	10
73	Li Ming	18	2	0	0	3	1	0	1	0	1	0	0	0	0	3	0	0	0	1	1	0	0	0	3	1	2	10	10	10	0	1	1	0	10	1	1	1
74	Claudia Lin	18	0	3	0	0	0	2	2	2	1	0	0	2	0	1	0	3	3	2	3	1	1	0	0	3	3	3	0	5	2	2	0	3	1	1	0	4
75	N/A	N/A	0	0	0	1	0	1	1	0	1	0	0	0	0	1	1	0	1	1	1	0	0	0	0	1	1	4	0	0	0	0	0	0	0	0	0	1

No.	Names	Ages	Part 1																									Part 2										
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	1	3	4	5	6	7	8	9	10	11	12
76	Sam	19	1	0	1	0	1	1	1	1	1	0	0	0	0	2	1	1	1	1	1	1	0	0	0	1	1	6	0	0	2	2	2	2	0	4	0	0
77	Hui Lee	18	0	1	0	3	1	0	0	0	3	0	0	0	0	0	1	0	1	1	1	1	1	0	0	2	1	10	10	10	0	0	1	0	0	0	1	10
78	Lee Gin	19	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	0	1	0	0	1	1	6	0	0	0	0	0	0	0	0	1	3
79	Susan	18	2	0	0	0	0	0	0	0	0	0	0	0	0	3	2	0	2	0	1	1	1	0	0	0	1	6	0	1	0	0	0	0	0	1	0	1
80	Sandy	18	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0		0	0	0	0	0	0
81	Peter lee	19	1	0	0	3	1	2	1	1	1	2	1	1	2	3	1	0	3	3	2	1	2	0	1	0	2	afs	10	10	0	0	1	7	10	2	4	4
82	N/A	18	3	3	0	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	1	3	0	10	10	0	2	3	10	10	5	24	0
83	N/A	19	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1	0	0	1	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0
84	N/A	18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
85	Peter Xu	18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
86	James Huan Xi	19	0	0	0	0	1	1	2	1	0	1	1	1	1	1	0	0	1	1	1	1	0	0	1	0	1	0	0	0	3	3	0	5	0	0	2	4
87	Wang Fei	18	0	3	0	3	1	1	1	0	1	0	1	0	0	0	0	0	2	1	1	1	0	0	2	2	1	10	0	4	0	0	1	0	0	0	0	0
88	Huang Xu	19	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
89	Wei Zing	18	0	0	0	3	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	2	0	10	10	10	0	0	0	0	0	1	0	0
90	Li We	18	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	10	0	0	0	0	0	0	0	0	0	0
91	Alex Tan	18	0	0	0	0	0	1	0	0	1	1	0	0	0	0	1	0	1	1	1	1	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1
92	Suzanna	18	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	2	2	2	2	2	0	0	2	0	1	0	0	0	0	0	0	0	0	0	0	0
93	Jacky Chen	19	0	0	0	0	0	2	0	0	0	0	0	1	0	0	1	0	1	0	0	0	1	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0
94	N/A	18	0	0	1	1	1	2	2	1	1	2	2	1	1	1	2	1	1	2	2	1	2	1	1	0	1	2	0	0	0	1	0	0	0	0	0	1
95	Wei Rui	20	0	0	0	0	1	1	1	1	1	0	0	1	0	0	0	0	2	1	1	1	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
96	Randy	20	2	2	0	3	1	1	2	2	2	1	0	1	1	3	0	1	2	1	1	0	1	2	1	0	0	3	0	0	1	3	1	1	2	1	56	1
97	David Cheng	18	0	0	0	0	0	1	1	1	1	3	3	3	3	3	3	3	3	2	2	3	1	2	0	1	0	1	2	0	0	0	1	5	6	0	0	0	7
98	Cheng Wei Fu	19	0	1	1	1	1	0	1	0	1	1	0	0	1	0	0	0	1	2	3	1	1	0	2	2	3	10	0	0	0	1	1	0	5	0	0	4
99	Sue	18	0	2	2	1	1	2	0	0	2	0	1	1	1	0	1	1	1	1	1	1	1	0	2	2	3	6	0	0	7	10	2	0	3	1	0	4
100	Kelly Cheng	21	0	2	2	1	1	1	0	0	0	0	0	0	1	0	1	1	1	1	1	1	0	1	2	3	3	10	0	0	0	0	1	0	0	1	0	0
101	Cheng Hui	20	0	3	0	0	0	2	2	1	1	1	1	1	1	0	0	0	3	3	3	3	3	3	1	0	0	0	0	0	10	4	0	0	0	0	0	4

No.	Names	Ages	Part 1																									Part 2										
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	1	3	4	5	6	7	8	9	10	11	12
102	Li Li	18	0	1	1	2	1	0	2	1	1	2	1	1	2	0	0	1	3	2	1	1	2	1	1	2	2	8	0	0	0	3	0	1	0	0	0	0
103	Hui Wong	19	1	0	2	1	1	1	1	1	1	1	1	0	0	1	0	0	3	3	1	2	2	1	1	2	1	9	0	0	3	1	3	1	0	1	1	0
104	P. Wei Sheng	18	0	0	1	1	1	1	1	1	1	2	2	0	1	1	0	0	3	3	1	2	2	1	2	1	1	4	0	0	1	3	1	0	0	1	1	0
105	N/A	N/A	2	1	1	2	1	2	2	3	2	3	2	1	3	0	0	1	3	3	2	3	0	2	2	2	2	10	0	2	3	3	3	4	1	0	0	0
106	Seng Guo Wei	18	0	0	2	2	1	2	2	2	2	2	1	2	2	0	0	0	2	2	1	1	0	1	1	1	1	6	6	0	1	2	1	2	1	0	0	0
107	Chang Sue	19	1	0	1	1	1	1	1	1	1	1	1	0	1	0	0	0	2	1	1	1	1	1	1	1	1	7	0	0	1	1	1	0	0	0	0	0
108	Qui Qian	18	1	1	2	2	0	1	1	1	2	1	1	1	0	1	1	0	3	2	1	2	0	1	2	1	1	10	10	0	2	1	1	0	0	3	3	1
109	Lin Lee	18	1	0	1	0	1	1	1	1	1	2	1	1	2	2	1	0	2	3	2	2	1	2	2	2	3	6	0	0	2	4	2	0	0	2	2	2
110	Le Zhang	18	0	1	0	0	1	0	1	0	1	0	1	0	1	1	0	0	2	1	1	1	2	0	1	0	3	0	10	2	2	1	0	0	0	0	0	3
111	Cheng	18	0	0	0	0	0	1	1	2	0	0	1	0	1	3	0	0	1	1	1	1	1	1	1	1	3	0	10	1	1	0	1	0	0	0	0	3
112	Jechy Lin	19	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	1	1	1	1	0	0	0	0	3	0	4	1	0	0	0	0	0	0	0	0
113	Anita Wang	18	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	1	1	1	1	1	1	0	0	0	3	0	2	0	0	0	0	0	0	0	0	1
114	N/A	18	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	1	1	1	1	1	1	0	0	0	3	0	2	0	0	0	0	0	0	0	0	1

b) Names of Participants in the High and the Low groups in order from the highest to the lowest scores are shown below:

No.	High Group	No.	Low Group
1	Linda	1	Lin Ping
2	Hui Ice	2	Xiao Mei
3	Qui Qian	3	N/A
4	Zhan Chen	4	Pter Xu
5	Michell	5	James Xi
6	Liu Lin	6	Wei Xu
7	Wang Zhao	7	Alex Tan
8	Peter Lee	8	Mao Tei
9	N/A	9	Wei Rui
10	Randy	10	Ning Li
11	David Cheng	11	Cheng Hui
12	Wang Zhao	12	Hai Zhi
13	Kelly Cheng	13	Lili
14	Gang Liu	14	Qi Ueng
15	Wei Sheng	15	Hui Wang
16	Zhu Zhen	16	Hui Peter
17	Seng Guo Wei	17	Lin Lee
18	Gao Yau	18	Michelle Wan
19	Gao Wei	19	Le Zheng
20	Wei Sun Ho	20	Fang Zheng
21	Li Ming	21	Anita Wang
22	Seng Guo Wei	22	Sandy Wan
23	Qui Qian	23	Lin Zhen
24	Ye Lin	24	Claudia Liu

4 Experiment 5: English-Mandarin Chinese Bilinguals

The overall number of participants and the scores that they obtained from the Mandarin Chinese language experience questionnaires in Experiment 5 is presented in Table.

No.	Names	Ages	Part 1																									Part 2										
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	1	2	3	4	5	6	7	8	9	10	11
1	Denton Mason	29	3	2	2	3	1	0	1	0	3	0	0	0	0	2	2	0	0	2	0	1	0	0	0	3	3	1	1	1	0	1	1	0	0	1	1	0
2	William Gallagher	26	2	0	1	2	1	1	0	0	1	1	0	3	1	1	2	1	3	3	2	2	1	1	2	1	1	1	1	1	1	1	1	0	1	1	1	1
3	Ben Thomson	52	3	2	1	3	0	0	1	0	3	1	0	2	2	2	2	1	0	2	1	1	0	0	1	1	2	1	1	1	0	1	1	0	1	1	1	1
4	William McDowall	22	1	1	0	3	1	0	0	0	1	0	1	0	0	2	3	1	0	1	1	0	0	0	1	3	2	1	1	1	1	1	1	1	0	1	1	1
5	N/A	20	1	1	0	2	1	1	1	1	1	1	1	1	1	1	1	1	0	1	0	0	0	0	1	1	3	1	1	0	1	1	1	0	0	1	1	1
6	John Wrenshall	22	2	0	0	2	2	1	1	0	3	1	0	1	3	3	1	0	0	1	1	0	0	1	1	2	1	1	0	1	1	1	0	1	1	1	1	0
7	Jeff	22	2	1	0	1	1	2	2	1	3	1	0	1	3	3	1	0	0	1	1	0	0	1	1	2	1	1	0	1	1	0	1	1	1	1	1	1
8	PattricK	24	3	2	1	3	2	1	1	0	3	0	0	1	0	3	3	2	1	0	2	2	1	0	3	2	3	1	1	0	1	1	1	0	1	1	1	1
9	John Erberge	25	3	3	1	2	2	1	1	1	2	1	1	1	1	2	2	2	1	1	2	1	1	1	3	2	3	1	1	0	1	1	1	1	1	1	1	1
10	William Kean	21	3	0	0	2	0	0	0	0	3	0	0	0	0	3	3	0	1	0	1	0	0	0	0	0	2	1	1	0	0	0	0	0	0	1	1	1
11	Ryan Neville	21	3	1	0	3	1	0	0	0	3	0	0	0	0	3	3	0	0	0	1	1	0	0	1	2	2	1	1	0	0	0	1	0	1	1	1	1
12	Gail Calton	24	3	0	0	2	0	0	0	0	2	0	0	0	0	3	3	0	0	0	1	1	0	0	0	0	0	1	1	0	1	1	1	0	0	1	1	0
13	Katherine	17	3	2	0	2	1	1	1	1	1	1	1	1	1	3	3	1	1	1	2	2	0	0	1	1	3	1	1	0	1	1	1	0	1	1	1	1
14	Steven Brown	19	2	2	2	2	1	1	1	1	1	1	0	1	0	3	3	0	0	0	1	1	0	0	1	0	3	1	1	0	1	1	1	0	0	1	1	1
15	Charles Richardson	19	3	1	0	2	1	1	1	1	1	1	1	1	1	3	3	1	1	1	2	2	0	0	1	1	3	1	1	0	1	1	1	0	0	1	1	1
16	Stuart Charlton	18	3	1	0	0	0	0	0	0	0	0	0	0	0	3	3	1	0	0	1	1	0	0	1	0	3	0	1	0	0	1	1	0	0	1	1	0
17	Ben Williams	22	2	2	1	2	2	2	2	2	2	2	1	1	1	3	3	2	1	1	1	1	0	0	1	1	3	1	1	0	1	1	1	0	0	1	1	0
18	Ken STRAUST	17	2	2	1	1	1	0	0	0	0	0	0	1	1	1	2	1	1	1	1	1	2	0	1	1	3	1	1	0	0	1	0	0	1	0	1	1
19	Janette Brown	18	3	0	0	0	0	0	0	0	0	0	0	0	0	3	3	0	0	0	2	0	0	0	0	0	3	1	1	0	0	0	1	0	0	1	1	0
20	Jane Gordon	19	2	0	0	2	1	1	1	0	1	0	0	0	0	3	3	0	0	0	1	1	0	0	1	1	3	1	1	0	1	1	1	0	0	1	1	1
21	Ken William	17	3	0	0	2	0	0	1	0	3	0	0	0	0	3	3	0	0	0	0	0	0	0	0	1	2	1	1	0	1	1	1	0	0	1	1	1
22	Catherine Right	22	3	1	0	0	0	1	1	1	1	0	0	0	0	2	2	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	1	0	1	1	1	0
23	Sam Barton	24	3	3	3	3	3	3	3	0	3	1	0	1	0	3	3	1	1	1	2	2	1	0	2	2	3	1	1	1	1	1	1	0	1	1	1	1
24	Sarah Anderson	21	3	2	1	3	1	2	2	1	3	1	0	1	1	3	3	1	1	0	1	1	0	0	1	1	3	1	1	0	1	1	1	0	1	1	1	1
25	Thomas	23	3	3	2	3	3	2	2	0	3	2	1	0	0	3	3	1	1	1	1	2	1	0	3	2	3	1	1	0	1	1	1	1	1	1	1	1

No.	Names	Ages	Part 1																									Part 2										
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	1	2	3	4	5	6	7	8	9	10	11
26	Phillip Brier	18	3	2	0	2	0	0	1	0	3	0	0	0	0	3	3	0	0	0	1	1	0	0	1	0	2	1	1	0	0	0	0	0	0	1	1	0
27	Paul Russell	20	3	1	1	3	2	2	2	1	3	2	1	1	1	1	3	3	1	1	0	1	1	0	0	3	3	1	1	0	1	1	1	1	1	1	1	1
28	Daniel Hartnett	27	3	2	2	3	3	1	1	0	3	1	1	1	0	2	2	3	1	2	2	1	0	1	1	2	3	1	1	1	0	1	1	0	1	1	1	1
29	Paul Rempel	38	2	2	1	2	2	2	2	2	2	0	0	0	0	2	3	1	1	1	1	0	0	0	1	0	3	1	0	0	1	1	1	1	0	1	1	1
30	N/A	20	3	1	1	3	2	1	1	1	3	2	2	2	2	3	3	2	1	2	3	2	1	1	0	2	3	1	1	1	1	1	1	1	1	1	1	1
31	Harrington	18	3	2	1	3	2	2	1	0	3	2	2	0	1	3	2	0	3	2	1	1	3	1	1	1	3	1	1	1	1	1	1	1	1	1	1	1
32	Thomas Anderson	25	3	3	1	3	1	1	1	1	1	1	0	0	1	3	3	1	1	1	3	3	0	0	3	3	3	1	1	1	0	0	1	0	1	1	1	1
33	Rureshi	26	2	0	1	2	1	1	0	0	1	1	0	3	1	1	2	1	3	3	2	2	1	1	2	1	1	1	1	1	1	1	1	0	1	1	1	1
34	John Armstrong	24	1	1	1	1	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	0	1	0	0	1	1	1	1	1	0	0	1	0	0	1	1	1
35	Jeff	19	3	3	3	3	1	0	0	0	1	0	2	2	0	3	3	0	1	2	1	1	3	1	0	0	3	1	1	1	0	0	1	0	1	1	1	1
36	Andrew Carson	21	2	1	0	3	1	0	0	0	0	0	0	0	0	2	3	0	0	0	1	0	0	0	0	1	2	1	1	1	0	0	1	0	0	1	1	1
37	Dolis	26	3	2	0	3	0	0	0	0	2	0	0	1	1	1	1	0	1	1	1	1	0	0	3	0	2	1	1	1	0	0	1	0	1	1	1	0
38	Amanda Wilworth	20	2	1	2	3	1	0	1	0	2	1	1	0	1	2	2	0	3	1	1	1	1	0	0	1	2	1	1	1	0	1	1	0	1	1	1	1
39	Laith Geghman	23	3	0	0	3	1	1	2	0	3	3	2	1	3	3	3	1	2	1	2	1	1	1	1	1	3	1	1	0	1	1	1	1	1	1	1	1
40	Ben Houbinton	25	3	1	3	1	0	0	1	0	0	1	0	0	1	0	0	0	1	1	1	0	1	1	0	3	1	1	1	1	1	0	0	1	0	0	0	1	0
41	Lee Sa John	20	1	2	1	3	1	0	1	0	0	0	1	1	0	3	3	1	2	2	1	0	0	1	2	2	2	1	1	1	0	0	1	0	1	1	1	1
42	Nicholas Law	22	2	2	1	3	0	0	1	0	1	0	0	1	1	3	3	0	1	1	1	0	0	0	0	1	3	1	1	1	1	1	1	1	1	1	1	1
43	Kate Duclos	20	3	2	3	3	3	3	3	3	3	3	0	0	0	3	3	1	0	2	2	0	1	0	0	2	3	1	1	1	0	0	1	1	0	1	1	0
44	Edlington	21	3	1	1	3	1	0	0	0	0	0	0	0	0	3	3	0	0	0	2	2	2	2	2	2	2	1	1	1	1	1	1	1	1	1	1	1
45	Alexander	24	3	2	2	3	0	1	1	0	1	0	1	1	0	3	2	1	1	1	1	0	0	0	2	1	3	1	1	1	0	1	1	0	0	1	1	1
46	Rebella Lavelle	23	3	0	2	3	1	0	1	0	3	0	0	0	0	3	3	0	0	0	0	0	0	0	0	2	2	1	1	1	0	0	1	0	0	1	1	0
47	Alex jennings	24	2	2	1	2	1	1	1	1	1	1	1	0	1	2	1	0	1	1	1	0	0	0	0	0	1	1	1	0	0	1	1	0	1	1	1	1
48	G Markhopez	22	2	2	0	2	2	0	0	0	3	1	1	0	0	2	2	1	1	1	1	1	1	1	1	0	1	2	1	1	1	0	0	1	0	0	1	1	1
49	Sarah Anne Hicks	18	2	1	0	3	0	0	0	0	2	0	0	0	0	1	1	1	1	0	1	1	1	1	1	0	2	2	1	1	1	0	0	1	0	0	1	1	1
50	Randolph Culmer	22	2	1	0	0	0	0	0	0	0	0	0	1	0	0	3	0	1	2	2	0	1	1	0	1	3	1	1	0	0	0	1	0	0	0	0	1
51	Ross Asher0rt	21	3	1	1	3	0	1	1	0	3	2	1	0	1	3	3	0	2	1	1	1	2	1	0	2	3	1	1	1	0	1	1	0	0	1	1	1

No.	Names	Ages	Part 1																									Part 2										
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	1	2	3	4	5	6	7	8	9	10	11
52	Blac Kirby.	23	3	1	1	3	1	0	0	0	0	0	0	0	0	3	3	1	1	1	1	1	1	1	0	2	2	0	1	1	0	0	1	0	0	1	1	1
53	James Pukington	20	2	1	1	3	1	1	1	0	3	0	1	0	1	3	3	0	2	0	1	1	1	0	1	0	2	1	1	1	0	0	1	0	0	1	1	1
54	Jennifer Ju	19	2	3	0	3	2	0	0	0	0	0	3	0	0	3	3	0	3	3	1	3	3	3	3	3	3	1	1	1	0	0	1	0	0	1	1	1
55	Lynn	27	1	1	0	1	0	0	0	0	0	0	0	0	0	1	1	0	1	0	1	1	0	0	1	3	2	1	1	1	0	0	0	0	0	1	1	1
56	Esworthy	18	3	1	1	2	1	0	0	0	3	0	0	0	0	3	3	1	1	1	0	0	1	0	0	1	3	1	1	1	0	0	1	0	0	1	1	0
57	Anissa Brenner	18	2	0	0	2	0	0	0	0	0	0	1	0	0	3	3	0	0	1	1	0	0	0	0	1	1	1	1	1	0	0	1	0	0	1	1	1
58	Pete Younger	24	2	1	0	3	0	0	1	0	1	0	0	0	0	3	3	0	1	1	1	0	1	0	0	2	2	1	1	1	0	1	1	0	0	1	1	1
59	Chans	33	1	1	1	3	0	0	0	0	1	0	0	0	1	1	1	1	1	1	1	1	0	0	1	2	2	1	1	1	0	0	1	0	0	1	1	1

b) Names of Participants in the High and the Low groups in order of the highest to the lowest scores are shown below:

No.	High Group	No.	Low Group
1	Sam Barton	1	Catherine Right
2	Thomas	2	Janette Brown
3	Harrington	3	John Armstrong
4	Kate Duclos	4	Lynn
5	Laith Geghman	5	Randolph Culmer
6	John Erberge	6	Anissa Brenner
7	Jennifer Ju	7	Gail Calton
8	Paul Russell	8	William Kean
9	Daniel Hartnett	9	Andrew Carson
10	Thomas Anderson	10	Ben Houbmton
11	PattricK	11	Ken William
12	Sarah Anderson	12	Phillip Brier
13	Ben Williams	13	Sarah Anne Hicks
14	Jeff	14	Chans
15	Ross Ashcr0rt	15	Jane Gordon
16	William Gallagher	16	Rebella Lavelle
17	Katherine	17	Ken Straust
18	Charles Richardson	18	Ryan Neville
19	Ben Thomson	19	Dolis
20	Edlington	20	Alex Jennings
21	Jeff	21	Pete Younger
22	Paul Rempel	22	Esworthy
23	Amanda Wilworth	23	William McDowall
24	N/A	24	Blac Kirby

APPENDIX F

The CRSLP Thai Word Frequency Corpus

1 Introduction

In this thesis, the frequency of stimulus words in English, Thai, and Mandarin must be controlled. For English words, a well-established word frequency corpus, the 'Brown Corpus'" (Kucera and Francis 1967) is used. For Mandarin words, the frequency and stroke count corpus, which was developed at the Department of Computer Science and Information Engineering, National Chiao-Tung University, Taiwan in 1993, is used. In the Thai language, there was no existing word frequency corpus at the beginning of these studies, so it was important that one be developed. The initial stages of the first Thai word frequency corpus has have been completed by Dr Sudaporn Luksaneeyanawin at the Center for Research in Speech and Language Processing (CRSLP), Chulalongkorn University, Bangkok, and further development is currently underway.

A brief description of the Brown Corpus and the Chinese Corpus is presented below, along with some discussion of the Thai corpus.

2 Brown Corpus

The Brown Corpus is the word frequency corpus of present-day American English. It consists of 1,014,312 English words, which are from English prose printed in the United States during 1961. The corpus consists of a wide range of genres in two main categories, informative and imaginative prose. For informative prose, there are 374 samples from nine genre categories, e.g., press: editorial, reportage and review, religion, skills and hobbies, popular lore, bells, letters, bibliography, and memoirs, miscellaneous, and learned. For the imaginative prose, there are 126 samples from six categories of fiction, e.g., general, mystery and detective, science, adventure and Western, romance and love, and humor fiction. Two genres are not included in the Brown Corpus, verse and drama. This is because verse represents a specific writing style, which is different from prose, and drama presents spoken language, which is different from written language. Moreover, fictional works with more than 50% dialogue were also excluded.

The selection procedure of the actual samples was made by various random methods. The actual number of samples within each category was selected using a table of random numbers. The page on which to begin the sample was also selected by a random number table. Each sample begins with the first sentence on the selected page. Each sample terminated at the next sentence break after a total of 2000 words was collected.

3 Chinese Word Frequency Corpus

The Chinese word frequency corpus used in the present study is the word frequency corpus of present-day Chinese characters, which is in the development at the Department of Computer Science and Information Engineering, National Chiao-Tung University, Taiwan. The corpus consists of 171,882,493 Chinese characters, which are from Chinese news accessed on the internet during 1993-1994.

4 The CRSLP Thai Word Frequency Corpus

The Thai Word Frequency Corpus, developed at CRSLP at Chulalongkorn University, is the first Thai word frequency corpus of present-day written Thai. This corpus consists of 1,000,000 Thai words, and was collected from Thai prose published between1999 and 2000. The genres used in the CRSLP Thai Corpus were based on those in the Brown Corpus, but also took into account previous studies of Thai reading and writing prose. In addition, the sampling procedures closely modeled the procedures used in the Brown corpus.
Dr. Sudaporn Luksaneeyanawin, Director of the CRSLP, will publish the genres with their subcategories and the number of samples used in the Thai Corpus at a later date. At the moment, the Thai Word Frequency Corpus is still being developed at the CRSLP at Chulalongkorn University under the direction of Dr. Sudaporn Luksaneeyanawin.

a) The Lists of Genres

The corpus consists of 1,000,000 Thai words, which were collected from Thai prose published between 1999 and 2000. The genres used in the corpus are divided into 2 main categories: the informative and the imaginative proses. For, the informative prose, they are 9 subcategories and 750,000 words or 75% of the whole corpus. For the imaginative prose, they are 6 subcategories and 250,000 words or 25% of the whole corpus. The list of categories is presented below.

The List of Genres and the Number of Word Samples Collected from Each Genre

A. Informative Prose

Genres	The Number of Words
1. Press: Reports	100,000
2. Press: Editorial, Letter to Editor	50,000
3. Press: Reviews	26,000
4. Religion	24,000
5. Skills and Hobbies	100,000
6. Popular Lore	100,000
7. Belles Lettres, Biography, Memoirs	100,000
8. Government Documents, Foundation Reports, Industry Reports, College Catalog.	100,000
9. Learned	150,000

B. Imaginative Prose

Genres	The Number of Words
10. General Fiction	76,000
11. Mystery and Detective Fiction	20,000
12. Science Fiction	10,000
13. Adventure Fiction	20,000
14.Love Story	74,000
15.Humor	50,000

b) Coding Procedure

For the coding procedure, Thai language does not have a word boundary between words. Thus, the text was segmented by the students using the markers, which are presented following.

1. Using / to mark Word Boundary.
2. Using @ to mark a beginning of a paragraph and using @@ to mark an ending of a paragraph.
3. Using # for small space and ## for big space.
4. If the word is a Monomorphemic Word, it does not have to mark anything.
5. Using **m** to mark Mathematic Formula and Numbers.
6. Put **ee** for Spelling Error.
7. Put **b** in front of Borrowed or Loanwords.
8. Put **!** in front of Expressive Words.
9. Put **c** in front of Compound Words and ^ is inserted between the free forms in the compound.
10. Put **x** in front of Complex Words and * is inserted between the bound and the free forms in the complex.
11. Put **r** in front of Reduplicatives. ^ is inserted between the free forms in the compound. * is also inserted between the bound and the free forms in the complex.
12. Using **s** to mark Semantic Couplet.
13. Using **l** to mark Slang.
14. Using **p** to mark Proper Name.
15. Using **f** to mark Foreign Word.
16. Using **a** to mark Adage and Proverb.
17. Using **y** to mark Acronym and Abbreviation

Word Frequency Result

No	Word	Freq
1	ที่	30118
2	และ	18766
3	เป็น	18001
4	มี	16966
5	ของ	16036
6	จะ	15531
7	ว่า	12487
8	ก็	10869
9	มา	10680
10	นี้	7799
11	กับ	7549
12	จาก	7431
13	แล้ว	7122
14	อยู่	6840
15	กัน	6450
16	แต่	6191
17	นั้น	5480
18	คน	5403
19	ทำ	5390
20	อย่าง	5143
21	หรือ	5093
22	ถึง	5000
23	ด้วย	4888
24	ขึ้น	4798
25	ต้อง	4465
26	ซึ่ง	4081
27	ทาง	3858
28	ทั้ง	3817
29	ยัง	3802
30	ตาม	3734
31	เขา	3578
32	เมื่อ	3529
33	จึง	3346
34	มาก	3308
35	เพื่อ	3297
36	เข้า	3275
37	คือ	3243
38	เรื่อง	3194
39	ต่อ	3087
40	ปี	2904
41	ออก	2838
42	ยัง	2831
43	คัว	2754
44	เรา	2664
45	เพราะ	2643
46	เกิด	2630
47	ส่วน	2442
48	รับ	2414
49	ผม	2401
50	ดี	2366
51	เวลา	2287
52	เห็น	2217
53	วัน	2197
54	ลง	2155
55	ต่างๆ	2104
56	แก	2100
57	การ	2047
58	งาน	2034
59	สำหรับ	2015
60	กว่า	2008
61	จน	1998
62	เช่น	1940
63	นำ	1878
64	ทุก	1848
65	ครั้ง	1712
66	บัน	1711
67	ก่อน	1695
68	หน้า	1681
69	ด้าน	1648
70	ดู	1625
71	ประเทศ	1619
72	กล่าว	1606
73	ถ้า	1606
74	ยาย	1606
75	ดัง	1590
76	ลูก	1567
77	เดียว	1538
78	ทง	1507
79	เลย	1485
80	ผู้	1479
81	สามารถ	1453
82	ท่าน	1430
83	คุณ	1418
84	เอง	1407
85	สุด	1403
86	2	1386
87	ละ	1385
88	1	1378
89	หลาย	1372
90	เอา	1359
91	กลับ	1347
92	อัน	1320
93	อะไร	1311
94	บ้าน	1305
95	3	1294
96	แห่ง	1294
97	รู้	1257
98	จำนวน	1249
99	ทรง	1236
100	เหมือน	1235
101	บอก	1231
102	ผล	1227
103	ตั้ง	1226
104	เธอ	1225
105	เพียง	1203
106	หา	1199
107	แบบ	1191
108	จัด	1189
109	น้ำ	1178
110	หลัง	1174
111	ขอ	1166
112	เคย	1163
113	ปัญหา	1162
114	สอง	1157
115	พอ	1156
116	ขณะ	1143
117	ชีวิต	1126
118	รวม	1125
119	สิ่ง	1095
120	กำลัง	1093
121	ต่าง	1092
122	บาง	1091
123	การศึกษา	1090
124	พบ	1083
125	พวก	1079
126	เงิน	1074
127	คิด	1059
128	ระหว่าง	1056
129	บาท	1055
130	ควร	1053
131	ลูก	1052
132	ชื่อ	1031
133	ชุด	1020
134	นอก	1015
135	ยิ่ง	987
136	เสีย	979
137	เท่า	974
138	ผ่าน	973
139	ตอน	960
140	ส่ง	954
141	ความ	950
142	พร้อม	942
143	แม่	937
144	ระดับ	930
145	ฉัน	927
146	กลุ่ม	926
147	อาหาร	920
148	สูง	916
149	เสียง	903
150	ข้อมูล	897
151	ร่วม	896
152	เมื่อ	891
153	หาก	890
154	เดิน	889
155	น้อย	871
156	สำคัญ	866
157	เด็ก	860
158	คน	858
159	ตรง	856
160	ช่วย	851
161	วิชา	843
162	สี	842
163	พ่อ	836
164	ตลอด	831
165	สร้าง	831
166	เรียก	824
167	ประสาท	823
168	เริ่ม	819
169	นะ	810
170	ระบบ	809
171	ชั้น	801
172	เฉพาะ	795
173	พ.ศ.	793
174	กิน	771
175	แรก	770
176	ลักษณะ	770
177	ขนาด	763
178	มอง	749
179	คู่	748
180	ศึกษา	745
181	...ฝ่า	740
182	นี่	739
183	อื่น	737
184	นั่น	733
185	ช่วง	731
186	ต้น	730
187	สังคม	730
188	เรียน	726
189	ชาย	724
190	หมด	724
191	ที	721
192	รถ	717
193	รัฐบาล	711
194	ทราบ	706
195	บริษัท	704
196	ทั่ว	701
197	ฝ่าย	697
198	บ้าง	695
199	วันที่	695
200	ถาม	690
201	แสดง	689
202	คำ	677
203	ล้าน	677
204	รูป	668
205	เปิด	667
206	ขาย	660
207	จริง	659
208	ตา	654
209	เกี่ยว	648
210	ถือ	645
211	กิน	643
212	ทิริบ	643
213	4	639
214	เดือน	636
215	อยาก	635
216	อาย	634
217	ช้าง	630
218	ชนิด	626
219	รัก	617
220	เหตุ	616
221	ประกอบ	614
222	นั่ง	612
223	พระ	611
224	ราคา	610
225	บุคคล	608
226	เพิ่ม	607
227	ประชาชน	602
228	พญิง	593
229	ปัจจุบัน	592
230	มือ	592

APPENDIX G

Stimulus Items for the Priming Studies

In this section, the stimulus items used in the presented study will be presented.

1. Stimulus Items Used in Thai-Thai Priming Condition

Targets		Primes		
Non-Kinship	**Kinship**	**Hi Related**	**Lo Related**	**Unrelated**
ชิ้น 'pieces'	เหลน 'great grand children'	หลาน 'grand children'	ลุง 'father or mother' older brother'	นก 'bird'
ทุน 'fund'	พี่ 'older brother or sister'	น้อง 'younger brother or sister'	ลูก 'children'	ปู 'crab'
ร้าน 'shop'	น้อง 'younger brother or sister'	พี่ 'older brother or sister'	แม่ 'mother'	มด 'ant'
หอย 'shell'	ลุง 'father or mother' older brother'	ป้า 'father or mother' older sister'	น้า 'mother' younger brother or sister'	กุ้ง 'shrimp'
พัด 'fan'	ป้า 'father or mother' older sister	ลุง 'father or mother' older brother'	น้า 'mother' younger brother or sister'	ฟัน 'tooth'
บ่อ 'pool'	น้า 'mother's younger brother or sister'	อา 'father's younger brother or sister'	พ่อ 'father'	ดิน 'soil'
กุ้ง 'shrimp'	อา 'father's younger brother or sister'	น้า 'mother's younger brother or sister'	แม่ 'mother'	หอย 'shell'
หม้อ 'pot'	เหลนปู่ 'father's father's father's grandchildren'	เหลนตา 'mother's father's father's grandchildren'	หลานย่า father's mother's grandchildren'	ยางลบ 'eraser'
กระติก 'canteen'	เหลนตา 'mother's father's father's grandchildren'	เหลนปู่ 'father's father's father's grandchildren'	เหลนย่า 'father's father's mother's grandchildren'	รถยนต์ 'car'
ก้นขวด 'bottom of bottle'	เหลนย่า 'father's father's mother's grand children	เหลนยาย 'mother's mother's mother's grand children	หลานตา 'mother's father's grandchildren'	ต้นไม้ 'tree'
กระบอง 'stick'	เหลนชาย 'great-grandniece'	เหลนสาว 'great-grandnephew'	ลูกชาย 'son'	ดวงดาว 'star'

Targets		Primes		
Non-Kinship	**Kinship**	**Hi Related**	**Lo Related**	**Unrelated**
เงินเดือน 'salary'	ปู่ทวด 'father's father's father'	ย่าทวด 'father's father's mother'	ยายทวด 'mother's mother's mother'	ธงชาติ 'flag'
พระจันทร์ 'moon'	ตาทวด 'mother's mother's father'	ยายทวด 'mother's mother's mother'	ย่าทวด 'father's father's mother'	ปากกา 'pen'
เงินสด 'cash'	ย่าทวด 'father's father's mother'	ปู่ทวด 'father's father's father'	ตาทวด 'mother's father's father'	น้ำตก 'waterfall'
พระพุทธ 'buddha'	ยายทวด 'mother's mother's mother'	ตาทวด 'mother's mother's father'	ปู่ทวด 'father's father's father'	ชายหาด 'beach'
สี 'colour'	พ่อ 'father'	แม่ 'mother'	ตา 'mother's father'	วัด 'temple'
กลุ่ม 'group'	แม 'mother'	พ่อ 'father'	ย่า 'father's mother'	ปลา 'fish'
ตึก 'building'	ปู่ 'father's father'	ย่า 'father's mother'	ยาย 'mother's mother'	รัง 'nest'
แพ 'raft'	ย่า 'father's mother'	ปู่ 'father's father'	ตา 'mother's father'	ฝน 'rain'
รูปภาพ 'picture'	ตา 'mother's father'	ยาย 'mother's mother'	ย่า 'father's mother'	ถ้ำ 'cave'
ถัง 'tin'	ยาย 'mother's mother'	ย่า 'father's mother'	ปู่ 'father's father'	เกาะ 'island'
เงิน 'silver'	ลูก 'child'	แม่ 'parents'	ป้า 'father or mother' older sister'	กา 'blackbird'
ระเบิด 'bomb'	ลูกชาย 'son'	ลูกสาว 'daughter'	ตาทวด 'mother's mother's father'	พัดลม 'electric-fan'
ต้นไม้ 'tree'	ลูกสาว 'daughter'	หลานสาว 'grand-daughter'	ย่าทวด 'father's father's mother'	น้ำตาล 'brown'
ห้องขัง 'jail'	หลานชาย 'grandson'	หลาน สาว'granddaughter'	ยายทวด 'mother's mother's mother'	ทองคำ 'gold'
หลังบ้าน 'backyard'	หลานสาว 'grand-daughter'	หลานชาย 'grandson'	น้า 'aunt'	เสื้อผ้า 'clothes'
ช้อนชา 'teaspoon'	พี่ชาย 'older brother'	น้องชาย 'younger brother'	น้องสาว 'younger sister'	เครื่องกล 'machine'
สีฟ้า 'blue'	พี่สาว 'older sister'	พี่ชาย 'older brother'	น้องชาย 'younger-brother'	ตู้เย็น 'refrigerator'

Targets		Primes		
Non-Kinship	**Kinship**	**Hi Related**	**Lo Related**	**Unrelated**
เจ้าหญิง 'princess'	น้องชาย 'younger brother'	น้องสาว 'younger sister'	พี่สาว 'older sister'	เส้นทาง 'route'
ดวงตา 'eyes'	น้องสาว 'younger sister'	น้องชาย 'younger brother'	พี่ชาย 'older brother'	ป่าไม้ 'forest'

2. Stimulus Items Used in Thai-English Priming Condition

Targets		Primes		
Non-Kinship	**Kinship**	**Hi Related**	**Lo Related**	**Unrelated**
Pieces 'pieces'	Great-grand children 'great grand children'	หลาน 'grand children'	ลุง 'father or mother' older brother'	นก 'bird'
Fund 'fund'	Older brother 'older brother or sister'	น้อง 'younger brother or sister'	ลูก 'children'	ปู 'crab'
Shop 'shop'	Younger brother 'younger brother or sister'	พี่ 'older brother or sister'	แม่ 'mother'	มด 'ant'
Shell 'shell'	Uncle 'father or mother's older brother'	ป้า 'father or mother' older sister'	น้า 'mother's younger brother or sister'	กุ้ง 'shrimp'
Fan 'fan'	Aunt 'father or mother's older sister	ลุง 'father or mother's older brother'	น้า 'mother's younger brother or sister'	ฟัน 'tooth'
Pool 'pool'	Aunt 'mother's younger brother or sister'	อา 'father's younger brother or sister'	พ่อ 'father'	ดิน 'soil'
Shrimp 'shrimp'	Aunt 'father's younger brother or sister'	น้า 'mother's younger brother or sister'	แม่ 'mother'	หอย 'shell'
Pot 'pot'	Great-grandniece 'father's father's father's grandchildren'	เหลนตา 'mother's father's father's grandchildren'	หลานย่า father's mother's grandchildren'	ยางลบ 'eraser'
Canteen ' canteen'	Great-grandson 'mother's father's father's grandchildren'	เหลนปู่ 'father's father's father's grandchildren'	เหลนย่า 'father's father's mother's grandchildren'	รถยนต์ 'car'
Bottom 'bottom of bottle'	Great-grandniece 'father's father's mother's grand children	เหลนยาย 'mother's mother's mother's grand children	หลานตา 'mother's father's grandchildren'	ต้นไม้ 'tree'
Stick 'stick'	Great-grandnephew 'great-grandniece'	เหลนลาว 'great-grandnephew'	ลูกชาย 'son'	ดวงดาว 'star'
Salary 'salary'	Great-grandfather 'father's father's father'	ย่าทวด 'father's father's mother'	ยายทวด 'mother's mother's mother'	ธงชาติ 'flag'
Moon 'moon'	Great-grandfather 'mother's mother's father'	ยายทวด 'mother's mother's mother'	ย่าทวด 'father's father's mother'	ปากกา 'pen'

Targets		Primes		
Non-Kinship	**Kinship**	**Hi Related**	**Lo Related**	**Unrelated**
Cash 'cash'	Great-grandmother 'father's father's mother'	ปู่ทวด 'father's father's father'	ตาทวด 'mother's father's father'	น้ำตก 'waterfall'
Buddha 'buddha'	Great-grandmother 'mother's mother's mother'	ตาทวด 'mother's mother's father'	ปู่ทวด 'father's father's father'	ชายหาด 'beach'
Colour 'colour'	Father 'father'	แม่ 'mother'	ตา 'mother's father'	วัด 'temple'
Group 'group'	Mother 'mother'	พ่อ 'father'	ย่า 'father's mother'	ปลา 'fish'
Building 'building'	Grandfather 'father's father'	ย่า 'father's mother'	ยาย 'mother's mother'	รัง 'nest'
Raft 'raft'	Grandmother 'father's mother'	ปู่ 'father's father'	ตา 'mother's father'	ฝน 'rain'
Picture 'picture'	Grandfather 'mother's father'	ยาย 'mother's mother'	ย่า 'father's mother'	ถ้ำ 'cave'
Tin 'tin'	Grandmother 'mother's mother'	ย่า 'father's mother'	ปู่ 'father's father'	เกาะ 'island'
Silver 'silver'	Child 'child'	แม่ 'parents'	ป้า 'father or mother's older sister'	กา 'blackbird'
Bomb 'bomb'	Son 'son'	ลูกสาว 'daughter'	ตาทวด 'mother's mother's father'	พัดลม 'electric-fan'
Tree 'tree'	Daughter 'daughter'	หลานสาว 'grand-daughter'	ย่าทวด 'father's father's mother'	น้ำตาล 'brown'
Jail 'jail'	Grandson 'Children's son'	หลาน สาว'granddaughter'	ยายทวด 'mother's mother's mother'	ทองคำ 'gold'
Backyard 'backyard'	Niece 'grand-daughter'	หลานชาย 'grandson'	น้า'aunt'	เสื้อผ้า 'clothes'
Teaspoon 'teaspoon'	Older brother 'older brother'	น้องชาย 'younger brother'	น้องสาว 'younger sister'	เครื่องกล 'machine'
Blue 'blue'	Older sister 'older sister'	พี่ชาย 'older brother'	น้องชาย 'younger-brother'	ตู้เย็น 'refrigerator'
Princess 'princess'	Younger brother 'younger brother'	น้องสาว 'younger sister'	พี่สาว 'older sister'	เส้นทาง 'route'
Eyes 'eyes'	Younger sister 'younger sister'	น้องชาย 'younger brother'	พี่ชาย 'older brother'	ป่าไม้ 'forest'

3. Stimulus Items Used in English-English Priming Condition

Targets		Primes		
Non-Kinship	**Kinship**	**Hi Related**	**Lo Related**	**Unrelated**
Town	Children	Parents	Aunt	Salesman
Flowers	Uncle	Aunt	Brother	Truckdriver
Hen	Aunt	Uncle	Sister	Living-room
Estate	Consins	Brother	Parents	Showroom
Oppression	Grand children	Children	Aunt	Folk-dance
Armchairs	Grand parents	Parents	Cousins	Lipstick
Checkbook	Grand son	Son	Daughter	Coat
Firecrackers	Grand daughter	Daughter	Son	Newspaper
Instructors	Grand nephew	Nephew	Niece	Mint
Prayer-books	Great-grandchildren	Grandchildren	Parents	Rabbit
Solar-Radiation	Older brother	Brother	Grand father	Lady-bugs
Sales-building	Great-grandson	Great-granddaughter	Daughter	Salesman
Librarian-board	Great-granddaughter	Great-grandson	Great-grandmother	Truckdriver
Turtle-neck	Great-grandnephew	Great-grandniece	Great-grandmother	Living-room
Wall-flower	Great-grandniece	Great-grandnephew	Great-grandfather	Showroom
River	Son	Daughter	Niece	Dish
Plateform	Daughter	Son	Aunt	Finger
Ground	Father	Mother	Uncle	Carpet
Party	Mother	Father	Aunt	Food
Weight	Parents	Children	Niece	House
Super-secret	Older-brother	Older-sister	Uncle	Secondary-school
Heavy-weight	Younger-brother	Older-brother	Father	Primary-school
Table-tennis	Older-sister	Younger-sister	Aunt	Ring
Adolscent	Great father	Grand mother	Nephew	Ring
Basketball	Grand mother	Grand father	Father	Paint
Line-Fragments	Great-grandchildren	Grandchildren	Children	Folk-dance
Large-package	Great-grandfather	Great-grandmother	Grandniece	Dining-room
Light-transmitting	Great-grandmother	Great-grandfather	Grandnephew	Knee-length
Motal-keepers	Great-granduncle	Great-grandaunt	Great-grandmother	Middle-school
Horse-chestnut	Great-grandaunt	Great-granduncle	Great-grandniece	Private-school

4. Stimulus Items Used in English-Thai Priming Condition

Targets		Primes		
Non-Kinship	**Kinship**	**Hi Related**	**Lo Related**	**Unrelated**
เมือง 'Town'	ลูก 'Children'	Parents	Aunt	Salesman
ดอกไม้ 'Flowers'	ลุง 'Uncle'	Aunt	Brother	Truckdriver
ไก่ 'Hen'	น้า 'Aunt'	Uncle	Sister	Living-room
ที่ 'Estate'	ญาติ 'Cousins'	Brother	Parents	Showroom
ความกด 'Oppression'	หลาน 'Grand children'	Children	Aunt	Folk-dance
เก้าอี้ 'Armchairs'	ย่า 'Grand parents'	Parents	Cousins	Lipstick
สมุดเช็ค 'Checkbook'	หลานชาย 'Grand son'	Son	Daughter	Coat
ตัวตัดไฟ 'Firecrackers'	หลานสาว 'Grand daughter'	Daughter	Son	Newspaper
คำสั่ง 'Instructors'	หลานชาย 'Grand nephew'	Nephew	Niece	Mint
บทสวด 'Prayer-books'	เหลน 'Great-grandchildren'	Grandchildren	Parents	Rabbit
รังสี 'Solar-Radiation'	พี่ชาย 'Older brother'	Brother	Grand father	Lady-bugs
ตึกขาย 'Sales-building'	เหลนชาย 'Great-grandson'	Great-granddaughter	Daughter	Salesman
ป้ายประกาศ 'Librarian-board'	เหลนสาว 'Great-granddaughter'	Great-grandson	Great-grandmother	Truckdriver
คอเต่า 'Turtle-neck'	เหลนชาย 'Great-grandnephew'	Great-grandniece	Great-grandmother	Living-room
ดอกไม้ 'Wall-flower'	เหลนสาว 'Great-grandniece'	Great-grandnephew	Great-grandfather	Showroom
แม่น้ำ 'River'	ลูกชาย 'Son'	Daughter	Niece	Dish
กระดาน 'Plateform'	ลูกสาว 'Daughter'	Son	Aunt	Finger
พื้น 'Ground'	พ่อ 'Father'	Mother	Uncle	Carpet
งาน 'Party'	แม่ 'Mother'	Father	Aunt	Food

Targets		Primes		
Non-Kinship	**Kinship**	**Hi Related**	**Lo Related**	**Unrelated**
น้ำหนัก 'Weight'	แม่ 'Parents'	Children	Niece	House
ความลับ 'Super-secret'	พี่ชาย 'Older-brother'	Older-sister	Uncle	Secondary-school
รุ่นใหญ่ 'Heavy-weight'	น้องชาย 'Younger-brother'	Older-brother	Father	Primary-school
ปิงปอง 'Table-tennis'	พี่สาว 'Older-sister'	Younger-sister	Aunt	Ring
วัยรุ่น 'Adolscent'	ตา 'Great father'	Grand mother	Nephew	Ring
บาสเกตบอล 'Basketball'	ย่า 'Grand mother'	Grand father	Father	Paint
เส้นแบ่ง 'Line-Fragments'	เหลน 'Great-grandchildren'	Grandchildren	Children	Folk-dance
หีบห่อ 'Large-package'	ตาทวด 'Great-grandfather'	Great-grandmother	Grandniece	Dining-room
การจ่ายไฟ 'Light-transmitting'	ย่าทวด 'Great-grandmother'	Great-grandfather	Grandnephew	Knee-length
คนงาน 'Motal-keepers'	ตาทวด 'Great-granduncle'	Great-grandaunt	Great-grandmother	Middle-school
ต้นไม้ 'Horse-chestnut'	ย่าทวด 'Great-grandaunt'	Great-granduncle	Great-grandniece	Private-school

5。Stimulus Items Used in Mandarin-Mandarin Priming Condition

Target		Primes		
Non-Kinship	Kinship	Hi Related	Lo Related	Unrelated
徒 'student'	伯 'father' s older brother'	叔 'father' s younger brother'	姑 'father' s sister'	木 'tree'
袋 'bag'	姑 'father' s sister'	姨 'mother' s sister'	舅 'mother' s brother'	糖 'sugar'
副 'officer'	姨 'mother' s younger brother'	姑 'father' s younger brother'	姑 'father' s sister'	雨 'rain'
天竺鯛 'fish'	姑表哥 'father' s sister' s older son'	姑表弟 'father' s sister' s younger son'	姑表妹 'mother' s sister' s younger daughter'	地道 'classroom'
結怨 'hatred'	姑表姐 'father' s younger brother' s older son'	舅表第 'father' s younger brother' s younger son'	孫子 'father' s grandson'	教室 'classroom'
大民主 'democracy'	姨表哥 'mother' s younger brother' s older son'	姨表姐 mother' s younger brother' s older brother'	堂子 'father' s brother or sister' s son'	反映 'mirror'
水龍卷 'waterspout'	姑表弟 'father' s sister' s younger son'	姑表妹 'father' s sister' s younger daughter'	儿子 'son'	本子 'book'
小五金 'hardware'	姑表弟 'father' s younger brother' s younger son'	姑表哥 'father' s younger brother' s younger daughter'	會孫女 'mother' s sister' s daughter'	學堂 'school'
電烙鐵 'electric iron'	姨表弟 'father' s sister' s older daughter'	姨表哥 'father' s sister' s younger daughter'	會孫女 'mother' s sister' s daughter'	气窗 'window'
起落架 'gear'	姑表姐 'father' s younger brother' s older daughter'	姑表妹 'father' s younger brother' s younger daughter'	會孫子 'mother' s brother or sister' s son'	明星 'star'

水墨畫 'painting'	舅表姐 'mother' s younger brother' s older daughter'	舅表妹 'mother' s younger brother' s younger daughter'	堂直 'father' s brother or sister' s son'	教練 'train'
大雜燴 'hotchpotch'	姨表姐 'father' s sister' s younger daughter'	姨表妹 'father' s sister' younger son'	孫子 'son'	無線電 'radio'
小提琴 'violin'	姑表妹 'father' s younger brother' s younger daughter'	姑表弟 'father' s younger brother' s younger son'	儿子 'mother' s sister or brother' s grandson'	電視 'television'
說大話 'boash'	舅表妹 'mother' s younger brother' s younger daughter'	舅表弟 'mother' s younger brother' s younger son'	祖父 'father' s father'	大門 'gate'
意 'idea'	哥 'older brother'	弟 'younger brother'	妹 'younger sister'	手 'hand'
奶 'milk'	弟 'younger brother'	哥 'older brother'	伯 'father' s older brother'	通 'sugar'
鐵 'iron'	姐 'older sister'	哥 'older brother'	弟 'younger brother'	水 'river'
兵 'soldier'	妹 'younger sister'	弟 'younger brother'	哥 'older brother'	路 'road'
地志學 'topology'	會孫子 'father' s great grand son'	孫子 'father' s grandson'	外孫子 'mother' s grandson'	老林 'forest'
大袋鼠 'kangaroo'	會孫女 'mother' s great granddaughter'	孫女 'father' s great granddaughter'	外孫女 'mother' s granddaughter'	時鐘 'clock'
水龍卷' waterspout'	waterspout 'waterspout'	外會孫 'mother' s great grandson'	會孫子 'father' s great grandson'	孫女 'father' s granddaughter' 論文 'paper'
通都大邑' metropolis'	metropolis 'metropolis'	外會孫女 'mother' s great granddaughter'	會孫女 'father' s great granddaughter'	孫子 'father' s grandson' 相册 'photo album'

大蒜 'garlic'	祖母 'father' s father' s mother'	祖父 'father' s father' s father'	伯 'father' s older brother'	時鐘 'clock'
老師傅 'worker'	外祖父 'mother' s mother' s father'	外祖母 'mother' s mother' s mother'	叔 'father' s younger brother'	前額 'forehead'
第二性 'secondary'	母 'father' s mother'	父 'father' s father'	外祖父 'mother' s mother' s father'	大衣 'overcoat'
深海 'sea'	外甥 'mother' s sister' s son'	堂直 'father' s brother' s son'	堂直女 'father' s brother' s daughter'	地方 'room'
人影儿 'human figure'	堂直女 'father' s brother' s daughter'	外甥女 'mother' s sister' s daughter'	外甥 'mother' s sister' s son'	地板 'floor '
小賣部 'small shop'	外甥女 'mother' s sister' s daughter'	外甥 'mother' s sister' s son'	儿子 'son'	電冰箱 'refrigerator'

6。 Stimulus Items Used in Mandarin-English Priming Condition

Target		Primes		
Non-Kinship	Kinship	Hi Related	Lo Related	Unrelated
student 'student'	uncle 'father' s older brother'	叔 'father' s younger brother'	姑 'father' s sister'	木 'tree'
bag 'bag'	aunt 'father' s sister'	姨 'mother' s sister'	舅 'mother' s brother'	糖 'sugar'
officer 'officer'	uncle 'mother' s younger brother'	姑 'father' s younger brother'	姑 'father' s sister'	雨 'rain'
fish 'fish'	nephew 'father' s sister' s older son'	姑表弟 'father' s sister' s younger son'	姑表妹 'mother' s sister' s younger daughter'	地道 'classroom'
hatred 'hatred'	nephew 'father' s younger brother' s older son'	舅表第 'father' s younger brother' s younger son'	孫子 'father' s grandson'	教室 'classroom'
democracy 'democracy'	nephew 'mother' s younger brother' s older son'	姨表姐 mother' s younger brother' s older brother'	堂子 'father' s brother or sister' s son'	反映 'mirror'
waterspout 'waterspout'	nephew 'father' s sister' s younger son'	姑表妹 'father' s sister' s younger daughter'	儿子 'son'	本子 'book'
hardware 'hardware'	nephew 'father' s younger brother' s younger son'	姑表哥 'father' s younger brother' s younger daughter'	會孫女 'mother' s sister' s daughter'	學堂 'school'
iron 'electric iron'	aunt 'father' s sister' s older daughter'	姨表哥 'father' s sister' s younger daughter'	會孫女 'mother' s sister' s daughter'	气窗 'window'
gear 'gear'	nicce 'father' s younger brother' s older daughter'	姑表妹 'father' s younger brother' s younger daughter'	會孫子 'mother' s brother or sister' s son'	明星 'star'
painting 'painting'	niece 'mother' s younger brother' s older daughter'	舅表妹 'mother' s younger brother' s younger daughter'	堂直 'father' s brother or sister' s son'	教練 'train'

hotchpotch 'hotchpotch'	niece 'father' s sister' s younger daughter'	姨表妹 'father' s sister' s younger son'	孫子 'son'	無線電 'radio'
violin 'violin'	niece 'father' s younger brother' s younger daughter'	姑表弟 'father' s younger brother' s younger son'	儿子 'mother' s sister or brother' s grandson'	電視 'television'
boash 'boash'	niece 'mother' s younger brother' s younger daughter'	舅表弟 'mother' s younger brother' s younger son'	祖父 'father' s father'	大門 'gate'
idea 'idea'	Older brother 'older brother'	弟 'younger brother'	妹 'younger sister'	手 'hand'
milk 'milk'	又能個人 brother' s 'younger brother'	哥 'older brother'	伯 'father' s older brother'	通 'sugar'
iron ' iron'	older sister 'older sister'	哥 'older brother'	弟 'younger brother'	水 'river'
Soldier 'soldier'	younger sister 'younger sister'	弟 'younger brother'	哥 'older brother'	路 'road'
topology 'topology'	great grand son 'father' s great grand son'	孫子 'father' s grandson'	外孫子 'mother' s grandson'	老林 'forest'
kangaroo 'kangaroo'	great grand daughter 'mother' s great granddaughter'	孫女 'father' s great granddaughter'	外孫女 'mother' s granddaughter'	時鐘 'clock'
waterspout 'waterspout'	waterspout 'waterspout'	great grand son 'mother' s great grandson'	會孫子 'father' s great grandson'	孫女 'father' s granddaughter' 論文 'paper'
metropolis 'metropolis'	metropolis 'metropolis'	great grand daughter 'mother' s great granddaughter'	會孫女 'father' s great granddaughter'	孫子 'father' s grandson' 相册 'photo album'
secret 'secret'	great grand father 'father' s father' s father'	祖母 'father' s father' s mother'	母 'father' s mother'	大街 'street'
garlic 'garlic'	great grand mother 'father' s father' s mother'	祖父 'father' s father' s father'	伯 'father' s older brother'	時鐘 'clock'

worker 'worker'	great grand father 'mother' s mother' s mother' s father'	外祖母 'mother' s mother' s mother'	叔 'father' s younger brother'	前額 'forehead'
secondary 'secondary'	grand mother 'father' s mother'	父 'father' s father'	外祖父 'mother' s mother' s father'	大衣 'overcoat'
sea 'sea'	nephew 'mother' s sister' s son'	堂直 'father' s brother' s son'	堂直女 'father' s brother' s daughter'	地方 'room'
figure 'human figure'	niece 'father' s brother' s daughter'	外甥女 'mother' s sister' s daughter'	外甥 'mother' s sister' s son'	地板 'floor'
grocery 'small shop'	niece 'mother' s sister' s daughter'	外甥 mother' s sister' s son'	儿子 'son'	電冰箱 'refrigerator'

7。Stimulus Items Used in English-Mandarin Priming Condition

Targets		Primes		
Non-Kinship	Kinship	Hi Related	Lo Related	Unrelated
都 'Town'	儿子 Children'	Parents	Aunt	Salesman
開花 'Flowers'	伯 Uncle'	Aunt	Brother	Truckdriver
產蛋雞 'Hen'	媽 Aunt'	Uncle	Sister	Living-room
產業 'Estate'	表親 'Cousins'	Brother	Parents	Showroom
反面 'Oppression'	外孫 Grand children'	Children	Aunt	Folk-dance
椅 'Armchairs'	外祖父 Grand parents'	Parents	Cousins	Lipstick
法典 'Checkbook'	孫子 Grand son'	Son	Daughter	Coat
自誇 'Crackers'	孫外 Grand daughter'	Daughter	Son	Newspaper
教員 Instructors'	外孫 Grand nephew'	Nephew	Niece	Mint
論著 'Prayer-books'	外會孫 Great-grand children'	Grandchildren	Parents	Rabbit
天日 'Solar-Radiation '	哥 Older brother'	Brother	Grand father	Lady-bugs
大厦 'Sales-building '	會孫 Great-grandson'	Great-grand daughter	Daughter	Salesman
地板 'Librarian-board '	外會孫女 Great-grand daughter'	Great-grandson	Great-grandmother	Truckdriver
頭頸 Turtle-neck'	外會孫 Great-grand nephew'	Great-grandniece	Great-grandmother	Living-room
花 Wall-flower'	外會孫女 Great-grandniece '	Great-grand nephew	Great-grandfather	Showroom
水 'River'	儿子 Son'	Daughter	Niece	Dish
中板 'Plateform'	外儿 'Daughter'	Son	Aunt	Finger
地 'Ground'	父 Father'	Mother	Uncle	Carpet
黨務 'Party'	母 Mother'	Father	Aunt	Food

重量 'Weight'	父 Parents'	Children	Niece	House
機密 'Super-secret'	哥 Older-brother'	Older-sister	Uncle	Secondary-school
重 'Heavy-weight'	第 Younger-brother'	Older-brother	Father	Primary-school
表 Table-tennis'	姐 Older-sister'	Younger-sister	Aunt	Ring
年青 'Adolscent'	外祖父 Grand father'	Grand mother	Nephew	Ring
高球 Basketball'	祖母 Grand mother'	Grand father	Father	Paint
線段 Line-Fragments'	外會孫女 Great-grandchildren'	Grandchildren	Children	Folk-dance
一攬子 Large-package'	會祖父 Great-grandfather'	Great-grandmother	Grandniece	Dining-room
發射 'Light-transmitting'	會祖母 Great-grandmother'	Great-grandfather	Grandnephew	Knee-length
同事 'Motal-keepers'	外會祖父 Great-granduncle'	Great-grandaunt	Great-grand mother	Middle-school
家譜 'tree''	外會祖母 Great-grandaunt'	Great-granduncle	Great-grand niece	Private-school

APPENDIX H

Statistical Analysis of Experiments 2 - 5

The raw data, means, standard errors (se) and Analysis of Variance (ANOVA) using SPSS for priming effects in Experiments 2 to 5 are presented below.

The abbreviations used in Appendix follow.

EX = Second Language Experience; High = High Group, Low = Low Group

Scores = The scores that participants obtained on the L2 Experience Questionnaires

PE = Priming Effects; RT = Mean Reaction Times, ER = Percentage Error Rates

H = Hi Related prime-Target Pairs; L = Lo Related prime-Target Pairs; U = Unrelated prime-Target Pairs

1= First Language

2 = Second Language

1. Experiment 1: Thai-English Bilinguals

1.1. Raw Data

1.1.1 High Thai-English Bilinguals

No.	Scores	PEH 11	PEH 22	PEH 12	PEH 21	PEL 11	PEL 22	PEL 12	PEL 21	RTH 11	RTH 22	RTH 12	RTH 21	RTL 11	RTL 22	RTL 12	RTL 21	RTU 11	RTU 22	RTU 12	RTU 21	ERH 11	ERH 22	ERH 12	ERH 21	ERL 11	ERL 22	ERL 12	ERL 21	ERU 11	ERU 22	ERU 12	ERU 21
1	60	111	72	89	301	197	11	-184	220	535	578	689	649	570	601	635	561	538	669	619	556	0.2	0.6	0.8	0.6	0.6	0.8	0.2	0.2	1	1	1.2	0.8
2	60	75	-140	-129	-46	-103	-17	25	-25	533	777	599	508	694	627	616	662	545	588	750	595	0.4	0	0	0	0.8	0	0	0.2	1.2	0.6	0.8	0.6
3	60	241	249	-11	142	208	187	-189	390	527	732	528	563	504	597	665	637	600	713	673	569	0.2	0.6	0	0	1	1	0.2	0	2	1.4	0.6	1
4	60	-27	-326	-486	-85	-93	17	67	-22	748	783	615	613	553	727	687	744	752	723	657	592	0	0	0	0	0.2	0	0	0	0.8	0.6	0.2	0.2
5	60	160	218	117	-62	101	145	41	-90	664	668	649	556	537	661	638	647	583	656	759	604	0	0	0.2	0	0	0	0.4	0	0.8	0.2	0.6	0.4
6	60	126	350	11	-309	174	290	-370	155	458	524	555	637	617	663	714	793	708	703	830	664	0	2.4	0	0.2	0.6	1.6	0.4	0.6	2	2	0.8	0.8
7	60	-53	-165	-122	38	-175	29	45	10	701	766	678	542	528	620	622	764	658	672	895	540	0.4	0.6	0.4	0.4	1	0.8	0.6	0.8	3	1	1	1.2
8	60	209	51	-65	26	95	80	-132	57	463	579	585	629	594	622	833	549	671	875	521	606	0	1.2	0	0.2	0	2	0	0.2	1	2.6	1.2	0.6
9	60	-46	-73	-39	-133	-118	19	-3	-22	494	668	609	626	556	611	733	724	592	639	638	622	0.2	0	0.4	0	0.6	0	0.2	0	1.6	0.8	0.4	0.6
10	61	231	227	20	195	226	262	-132	76	532	591	695	501	632	816	555	535	680	833	659	640	0.2	0.6	0.2	0.6	0.2	0.8	0.2	0	0.8	1	0.6	0.4
11	61	-117	39	362	-350	19	-173	400	-240	480	618	641	611	572	639	681	562	578	664	710	618	0.6	0	0.6	0	1.8	0.2	2	0.2	2	0.8	2.2	0.6
12	61	254	447	-5	64	151	523	-658	-77	604	690	672	553	724	845	792	678	648	819	878	694	0.2	0.6	1	0	1	0.8	1.8	0.4	1.6	1	2	0.8
13	61	-100	33	200	188	-93	-81	281	141	506	652	740	639	694	680	693	543	581	653	729	658	0	3	0	0	0.4	1	0.2	0.8	1.2	1.6	0.4	1
14	62	-210	24	667	-141	-31	-430	633	-505	665	703	871	658	501	529	787	642	727	777	768	895	0.4	0	0	0	0.6	0	0.4	0	1.2	0.8	0.8	1.2
15	64	225	170	20	13	90	234	-149	18	539	590	1084	575	865	773	684	538	537	660	702	776	0	1.2	0	1.2	0	0.4	0.2	0	0.4	0.8	1	0.6
16	64	131	85	199	5	171	13	159	35	722	900	550	615	493	591	676	667	573	713	992	620	0	0	0	1	0	0	0	0	0.4	0.4	1	0.8
17	65	192	-79	-60	21	29	39	-140	-8	544	580	714	578	494	629	643	552	574	670	843	625	0.4	0	0.4	0	1.2	0	2.6	0	1.6	0.6	3	0.4
18	65	-82	112	172	33	97	-131	87	133	616	627	589	677	532	592	909	528	657	839	631	578	0.6	3	0.3	0.6	1.8	1.2	2	0.4	2	1.8	2.6	0.8
19	66	117	-53	-186	357	-186	141	20	-7	524	643	722	633	480	573	658	486	625	687	704	605	0	2.4	0	0.4	0.2	0.8	0.2	0.6	0.6	1	0.6	1
20	67	-98	92	660	143	150	-405	623	207	570	561	722	687	604	823	681	536	745	787	890	644	0	1.2	0	1.2	0.4	0.6	0.4	0.4	0.8	1.4	0.8	1.2
21	68	208	-79	-165	-52	48	-5	-28	26	491	666	714	684	506	628	758	636	744	770	751	521	0	1.2	0.2	0.2	0.2	0.6	2.6	0.2	1	1.2	3	1.4
22	69	36	-407	-658	449	-192	97	55	349	600	850	746	825	665	675	875	633	520	532	675	654	0	0.6	0	0.4	1.8	0.4	0.6	0.4	2	1.2	1	1.8
23	69	-80	188	136	-11	142	-33	143	-17	515	571	726	776	539	618	993	559	785	766	789	574	0.6	1.2	0	0.2	0.6	0.4	0.4	0.4	0.8	1.4	0.6	2
24	72	-71	74	5	82	-99	136	91	36	602	620	950	598	722	773	563	644	477	707	768	685	0	3	0	0.6	0	0.6	0	0.2	1.4	1	0.4	0.8

1.1.2 Low Thai-English Bilinguals

NL.	ScLres	PEH11	PEH22	PEH12	PEH21	PEL11	PEL22	PEL12	PEL21	RTH11	RTH22	RTH12	RTH21	RTL11	RTL22	RTL12	RTL21	RTU11	RTU22	RTU12	RTU21	ERH11	ERH22	ERH12	ERH21	ERL11	ERL22	ERL12	ERL21	ERU11	ERU22	ERU12	ERU21
1	18	4	63	-62	-10	-32	10	-3	17	643	671	590	564	546	623	873	631	743	682	679	578	0	1	1.2	0.4	1.6	0.8	0.6	0	2.2	2	0.8	0.6
2	18	36	9	148	278	-125	194	129	146	516	657	751	595	716	782	597	572	604	640	622	846	0.8	0.4	0.8	0	1	1	0.8	0	1.8	1	1	0.8
3	20	89	-12	145	156	111	146	7	101	465	564	526	761	498	505	704	501	702	791	515	537	0.2	0.8	0.2	0	0.4	1.2	1.6	0	0.8	1.4	1.8	0.2
4	22	267	37	42	226	177	-35	-34	128	644	676	1156	675	710	1019	612	612	599	681	670	891	0	0.2	0	0	0	1	1.4	0	0.6	1.2	1.6	0.4
5	25	-81	-15	110	97	65	25	145	-5	574	591	562	571	632	549	634	597	727	755	637	577	0.8	0	0.4	0	1	1	1.4	0	2	1.6	2	0.6
6	26	246	253	92	140	87	102	-89	286	560	589	568	990	528	526	949	534	702	872	558	525	0	1.8	0.4	0	0.6	1.8	0.8	0	2.2	2	2.2	0.8
7	26	-50	-94	83	118	117	42	139	-210	609	595	769	555	727	774	602	583	540	610	647	681	0.2	1.2	0.8	0.2	0.4	1	1	0.2	0.8	1.6	2	1
8	26	-14	-59	308	84	93	-60	62	-74	485	722	607	580	578	611	663	702	672	659	571	595	0.4	1.2	0.2	0	1	2.2	1.2	0.4	2	2.8	1.8	1.2
9	26	107	67	29	98	36	57	-16	163	642	637	754	526	696	729	721	611	596	656	836	589	0	0.6	0.8	0	0	1.2	0.6	0	1.8	1.8	0.8	0.6
10	27	244	-11	-17	34	150	-225	126	-127	533	556	604	702	538	591	736	573	763	818	602	636	0	0.8	0.6	0.2	0.2	1.2	1.4	0	0.6	1.4	1.8	0.8
11	27	144	27	83	-43	44	-37	13	-75	639	744	533	454	503	532	504	869	513	525	876	525	0.4	0.2	1.2	0	0.8	0.6	2	0.2	1	0.8	2.2	1
12	27	3	29	172	138	-76	-153	66	-64	552	636	691	872	656	712	1344	709	807	1159	686	632	0	0.8	1	0	0.8	1.2	2	0.2	1.2	1.6	2.2	1.2
13	28	27	11	10	-98	-113	-22	73	-104	656	768	649	568	647	648	573	558	539	687	852	620	0	2.6	1.4	0	0.8	1.2	1.8	0.4	1.4	1.4	2	0.8
14	28	17	44	236	-17	241	165	94	192	744	1005	552	510	565	557	586	1071	534	575	1219	560	0	2.4	0.8	0	0	1	1.2	0	1	1.2	1.6	0.2
15	28	24	-17	-162	-50	-164	-189	18	-227	516	550	654	707	669	614	822	560	741	784	661	573	0	1.8	0.6	0.6	0.2	1.8	0.6	0	0.8	2	0.8	0.2
16	28	-92	278	428	51	-311	5	302	-100	533	699	592	588	535	612	735	585	644	678	720	687	0	0.2	0	0.2	0	1	1.2	0	0.2	3	1.8	0.4
17	28	30	107	219	52	80	18	200	73	536	605	717	658	697	723	797	574	702	644	657	679	0	0.2	0.2	0	0.2	1	2.6	0	0.6	3	3	0.6
18	28	59	222	96	-88	147	238	-223	61	724	821	579	610	545	578	664	687	619	681	751	629	0	2.8	0.6	0.2	0.4	1.6	2	0.2	1	1.8	2.2	1
19	29	101	44	-8	-4	145	-26	56	160	418	492	744	497	744	686	538	509	534	633	558	858	0	3.2	0.4	0.2	0	2	1.4	0.4	0.8	2.2	1.8	1.2
20	29	169	226	83	-43	142	34	135	108	800	1162	651	630	552	592	688	861	702	684	1311	773	2	1.4	0.2	0.8	0.2	1.8	1.8	0	0.4	2	2	1.4
21	29	253	93	51	-159	238	112	-7	-123	523	636	812	622	681	710	694	566	727	617	638	574	0	1.2	0.2	0.2	0.4	1	1.6	0	0.6	1	2.2	0.6
22	29	-80	-319	-41	206	-145	-171	156	14	531	527	1237	561	759	1004	525	544	556	624	570	1011	0	0.8	0	0.2	0	0.6	0.8	0	1.2	1.6	1	0.6
23	29	324	201	61	-221	300	100	-37	20	709	727	672	581	474	506	667	662	669	693	842	570	0.4	1.4	0	0	1.8	0.8	1	0	2	2.2	1.2	0.2
24	30	241	383	-197	-91	121	118	201	41	577	571	649	692	576	633	591	587	509	710	746	680	0	2.8	0	0.2	0.4	0.8	1.2	0.2	0.6	1	1.6	0.4

1.2 Analysis of Means, Minimum, Maximun, Standard Error and Standard Deviation

1.2.1 High Thai-English Bilinguals

	N	Range	Minimum	Maximum	Mean		Std. Deviation	Variance
	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Statistic
PEHI11	24	464.00	-210.00	254.00	59.6667	28.7962	141.0719	19901.275
PEHI22	24	854.00	-407.00	447.00	46.2083	39.9368	195.6496	38278.781
PEHI12	24	1325.00	-658.00	667.00	30.5000	58.8452	288.2814	83106.174
PEHI21	24	799.00	-350.00	449.00	36.1667	37.7939	185.1516	34281.101
PELO11	24	418.00	-192.00	226.00	33.6667	27.7752	136.0702	18515.101
PELO22	24	953.00	-430.00	523.00	39.5000	41.7256	204.4126	41784.522
PELO12	24	1291.00	-658.00	633.00	28.5417	57.0871	279.6687	78214.607
PELO21	24	895.00	-505.00	390.00	35.0000	36.5803	179.2060	32114.783
Valid N (listwise)	24							

1.2.2 Low Thai-English Bilinguals

	N	Range	Minimum	Maximum	Mean		Std. Deviation	Variance
	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Statistic
PEHI11	24	416.00	-92.00	324.00	86.1667	25.1985	123.4468	15239.101
PEHI22	24	702.00	-319.00	383.00	65.2917	29.3917	143.9893	20732.911
PEHI12	24	625.00	-197.00	428.00	79.5417	28.0003	137.1730	18816.433
PEHI21	24	499.00	-221.00	278.00	35.5833	25.4024	124.4459	15486.775
PELO11	24	611.00	-311.00	300.00	55.3333	30.0492	147.2105	21670.928
PELO22	24	463.00	-225.00	238.00	18.6667	24.6322	120.6726	14561.884
PELO12	24	525.00	-223.00	302.00	63.0417	22.4488	109.9761	12094.737
PELO21	24	513.00	-227.00	286.00	16.7083	26.8596	131.5848	17314.563
Valid N (listwise)	24							

1.3 Tests of Within-Subjects Contrasts

Source	PRIME	TARGET	SF	Type III Sum of Squares	df	Mean Square	F	Sig.
PRIME	Linear			30816.667	1	30816.667	.714	.403
PRIME * EX	Linear			34808.167	1	34808.167	.806	.374
Error(PRIME)	Linear			1986607.167	46	43187.112		
TARGET		Linear		253.500	1	253.500	.006	.937
TARGET * EX		Linear		4134.375	1	4134.375	.104	.749
Error (TARGET)		Linear		1831446.625	46	39814.057		
SF			Linear	33152.667	1	33152.667	2.553	.117
SF * EX			Linear	8893.500	1	8893.500	.685	.412
Error(SF)			Linear	597337.333	46	12985.594		
PRIME * TARGET	Linear	Linear		9460.510	1	9460.510	.153	.697
PRIME * TARGET * EX	Linear	Linear		499.594	1	499.594	.008	.929
Error (PRIME* TARGET)	Linear	Linear		2842586.396	46	61795.356		
PRIME * SF	Linear		Linear	5.510	1	5.510	.000	.984
PRIME * SF * EX	Linear		Linear	2194.594	1	2194.594	.171	.681
Error (PRIME* SF)	Linear		Linear	589725.396	46	12820.117		
TARGET * SF		Linear	Linear	38.760	1	38.760	.001	.970
TARGET * SF * EX		Linear	Linear	1528.010	1	1528.010	.058	.811
Error (TARGET*SF)		Linear	Linear	1221489.229	46	26554.114		
PRIME * TARGET * SF	Linear	Linear	Linear	7704.167	1	7704.167	.718	.401
PRIME * TARGET * SF * EX	Linear	Linear	Linear	234.375	1	234.375	.022	.883
Error (PRIME* TARGET*SF)	Linear	Linear	Linear	493614.458	46	10730.749		

1.4 Tests of Between-Subjects Effects

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Intercept	798437.760	1	798437.760	24.071	.000
EX	18509.260	1	18509.260	.558	.459
Error	1525807.979	46	33169.739		

2 Experiment 2: English-Thai Bilinguals

2.1 Raw Data

2.1.2 High English-Thai Bilinguals

No	Scores	PEH11	PEH22	PEH12	PEH21	PEL11	PEL22	PEL12	PEL21	RTH11	RTH22	RTH12	RTH21	RTL11	RTL22	RTL12	RTL21	RTU11	RTU22	RTU12	RTU21	ERH11	ERH22	ERH12	ERH21	ERL11	ERL22	ERL12	ERL21	ERU11	ERU22	ERU12	ERU21
1	23	-262	-98	296	137	-45	46	81	-148	746	848	827	528	522	714	919	816	525	750	1007	662	0	0.4	1	0	0.8	1	0.4	0.2	1	1.2	0.8	1.2
2	23	-248	-5	791	540	-394	-422	474	435	813	750	1310	559	982	1127	1059	624	597	705	1384	1059	0	0.2	0.2	0	0	0.2	0.4	0.2	0.2	0.4	0.6	0.4
3	24	-384	1096	543	177	-167	1179	180	31	1000	1055	1169	626	772	844	1735	765	594	2023	1290	857	0	0.4	0.2	0	0.8	1	0.4	0.2	1.2	1.2	0.6	0.6
4	25	70	264	757	-116	255	-355	867	148	685	722	1664	794	517	1341	1341	530	754	986	934	664	0	0	0.4	0	0.4	2	0.2	0.4	1.6	2.2	0.4	0.6
5	26	169	121	1097	-110	197	138	1194	-404	563	660	1743	629	504	652	929	938	706	810	609	519	0	0.2	0.2	0	0.2	0.2	0.6	0	0.8	0.6	0.8	0.2
6	28	-400	-268	248	261	-121	-529	-190	-68	910	762	723	476	637	1064	547	803	513	486	1099	736	0	0.4	0.2	0	0.2	0.4	0.8	0.2	0.6	0.8	1	0.6
7	28	251	-126	684	290	-746	-232	771	393	726	991	1497	809	1719	1073	897	710	1007	845	1256	1103	0.2	0.2	0.8	0.2	0.8	0.8	1	0.6	1	1	1.2	0.8
8	29	11	930	491	-112	305	1320	277	-187	822	1192	1100	780	860	1253	1053	787	834	2024	1091	790	0.2	0.4	1	0	0	2	0.2	0.2	1.4	2.2	0.4	0.4
9	32	32	61	477	227	-219	-38	291	279	510	835	999	594	761	963	1052	575	520	933	973	839	0.4	0.2	1.2	0	0.4	0	0.4	0	0.6	0.4	0.8	0.2
10	32	509	403	1003	-486	284	285	792	104	508	801	1544	1112	733	825	1525	522	1017	1146	1388	626	0	0.6	0.8	0.4	0.2	0.6	0.4	0	0.4	0.8	0.6	0.2
11	32	285	-1307	437	2	-176	-360	160	111	495	2181	1353	781	956	1289	1116	679	794	838	1578	790	0.2	0	0.4	0	0.8	0.2	3	0.2	1	0.6	3	0.6
12	33	-274	503	1130	-116	-78	646	1276	-278	864	1066	1019	653	692	913	2000	815	595	1566	1247	537	0.2	0.4	1.2	0	0.8	0.6	2	0.4	1.2	0.8	2.2	0.8
13	34	-132	-138	1281	316	-58	75	1375	161	674	881	600	509	570	668	1888	664	512	744	1305	825	0	2.8	0.2	0	0.2	0.8	0.4	0.8	0.4	1	0.6	1.6
14	34	191	604	299	-137	-156	243	-47	153	462	469	1114	753	809	837	762	471	661	1082	553	616	0	0.2	0.4	0	0.4	0.2	0.8	0	0.6	1.2	1	0.6

No	Scores	PEH11	PEH22	PEH12	PEH21	PEL11	PEL22	PEL12	PEL21	RTH11	RTH22	RTH12	RTH21	RTL11	RTL22	RTL12	RTL21	RTU11	RTU22	RTU12	RTU21	ERH11	ERH22	ERH12	ERH21	ERL11	ERL22	ERL12	ERL21	ERU11	ERU22	ERU12	ERU21
15	34	920	540	750	-729	1142	298	814	-56	947	879	1632	1462	725	1119	1895	789	1757	1417	1150	733	0	1	0.2	0.2	0.2	0.6	1	0	0.6	1.8	1.2	0.4
16	35	-261	-130	729	215	-230	-61	557	285	803	1055	1264	536	772	1197	1329	557	1378	1186	1071	833	0	0.2	0.2	0	0.2	1	1.2	0	0.8	0.4	1.6	0.2
17	39	296	85	1005	-266	350	103	652	-224	542	960	970	788	525	942	1292	729	869	1045	1401	524	0.2	0.2	0.6	0	0.8	1.2	3	0	1.2	1.2	3.2	0.2
18	40	-114	-314	1018	-112	364	53	667	-589	994	1196	1310	641	516	841	2008	1118	880	818	1547	529	0	2	0.8	0.4	0.8	0.8	2.2	0.4	1	1.4	2.6	0.6
19	41	279	318	465	-90	564	-925	109	-137	788	847	1535	801	503	2092	1648	768	1121	1186	1247	710	0	2.4	0.2	0.2	0.4	0.6	1	0.6	1.6	1	1.6	0.8
20	42	107	-680	975	256	-158	20	1146	-22	565	1700	1421	588	852	993	1529	860	673	1013	2286	844	0	1.2	0.4	0.6	0.6	0.6	1.2	0.4	0.8	1.2	1.8	0.6
21	43	159	139	1410	-232	-81	-247	1476	203	461	640	1278	918	721	1026	663	483	620	778	2253	691	0	1	0.4	0.4	0.4	0.4	3	0.2	0.4	0.8	3.2	0.4
22	45	224	-134	472	-191	369	454	141	-211	606	1128	545	690	461	484	1703	710	804	970	1000	488	0	0.8	0.2	0	1.2	0.4	0.6	0.4	1.6	0.6	0.8	0.6
23	48	-238	61	1079	112	-78	214	1096	-456	1081	1130	1282	760	921	1001	1984	1316	822	1191	2101	860	0.2	1	0.2	0	0.8	0.6	0	0.2	1	0.6	0.2	0.4
24	78	270	118	811	222	-215	115	590	250	803	848	1625	774	1264	963	1592	844	847	1253	1441	996	0	2	0.2	0	0.2	0.2	0.2	0	1	0.8	0.6	0.2

2.2.2 Low English-Thai Bilinguals

No	Scores	PEH11	PEH22	PEH12	PEH21	PEL11	PEL22	PEL12	PEL21	RTH11	RTH22	RTH12	RTH21	RTL11	RTL22	RTL12	RTL21	RTU11	RTU22	RTU12	RTU21	ERH11	ERH22	ERH12	ERH21	ERL11	ERL22	ERL12	ERL21	ERU11	ERU22	ERU12	ERU21
1	2	-212	286	-592	21	-304	-98	-554	136	782	670	1344	891	874	1054	1382	776	570	956	790	912	0	1	1	0.6	1	1	0.6	0.2	1.6	1.2	0.8	1.2
2	2	-822	-726	1233	-53	108	222	1089	-708	1445	1602	1120	553	515	654	976	1208	623	876	2209	500	0.6	1	1	1	1	1.2	0.8	0	1.4	1.4	1	0.6
3	3	43	374	-547	511	-679	-566	-766	641	574	757	1817	675	1296	1697	1598	545	617	1131	1051	1186	1	0.8	1	1	1.2	1	1.6	0	1.8	1.2	1.8	0.8
4	3	-73	-56	933	265	-60	-274	130	124	661	1051	1589	524	648	1269	786	665	588	995	1719	789	0	0.4	2	1.2	1	0.8	2	0	1.2	1	2.2	0.2
5	5	-430	-121	226	-27	-20	0	186	-1	1131	1322	1152	768	721	1201	1112	742	701	1201	1338	741	1	0.2	2.2	0.8	1	0.8	1.4	0	1.6	1.6	1.6	0.2
6	6	-237	185	30	248	-57	178	61	54	1022	1084	1416	870	842	1091	1447	1064	785	1269	1477	1118	0.2	2	1.8	0.2	0.6	1.2	1	0	0.8	1.6	1.2	0.2
7	6	-285	-270	1237	10	82	-778	969	3	977	1228	1321	780	610	1736	1053	787	692	958	2290	790	0.2	1.4	1	0.4	0.6	0.8	1	0.2	0.8	1	1.2	0.4
8	7	25	662	665	192	-13	413	634	105	532	670	1575	689	570	919	1544	776	557	1332	2209	881	0.4	1.4	0.4	0.2	1.2	2	1.2	0.2	1.4	2.6	1.4	0.6
9	9	410	-312	-265	-339	184	512	280	-170	566	1326	838	1082	792	502	1383	913	976	1014	1118	743	0	1	0.8	0.2	1	1	1	0	1.2	1.6	1.2	0.2
10	10	-76	-409	35	720	-966	-1070	-691	699	596	1149	2008	536	1486	1810	1282	557	520	740	1317	1256	0	1.2	0.6	0.4	0.2	1.4	1.4	0.2	0.6	1.8	1.8	0.4
11	11	676	568	-185	-705	689	1042	486	-188	576	1224	1321	1269	563	750	1992	752	1252	1792	1807	564	0.4	0.4	1	0.2	1	0.8	2	0.2	1.2	1	2.2	0.6
12	11	202	315	-1129	-252	64	506	-572	89	498	1110	1804	879	636	919	2361	538	700	1425	1232	627	0	0.8	1	0	0.6	1	2.2	0	0.8	1.2	2.4	0.2
13	11	119	-51	165	-78	-427	-256	-233	-52	650	1198	1497	779	1196	1403	1099	753	769	1147	1264	701	0	1.6	1.2	0	0.8	1	1.8	0.2	0.8	1.2	2	0.6
14	11	136	-276	484	-38	-82	-92	285	83	743	1323	1560	1051	961	1139	1361	930	879	1047	1845	1013	0	2	0.8	0	0	1.2	1.2	0	0.2	1.6	1.6	1
15	11	-17	1052	-1843	-107	-291	741	233	-158	694	963	838	860	968	1274	2914	911	677	2015	1071	753	0.2	1.8	0.6	0.6	0.2	1.8	1	0	0.4	2.2	1.2	0.4
16	11	472	-140	242	-538	111	751	-312	102	595	1393	2008	1281	956	502	1454	641	1067	1253	1696	743	0	0.2	0.2	0.2	0	0.8	1.2	0	1.2	1.4	1.4	0.2
17	11	-127	-595	853	71	308	-785	202	-116	988	1082	1442	817	553	1272	791	1004	861	487	1644	888	0	0.2	0.2	0.2	0.2	0.8	2.6	0	0.6	1	2.8	0.2
18	11	1292	1149	-704	-729	1204	637	-411	97	543	623	1652	1328	631	1135	1945	502	1835	1772	1241	599	0	2.8	1	0	0.4	0.6	2	0	0.8	1.6	2.2	0.2
19	16	-722	-980	1135	168	18	-885	704	-756	1401	1860	1468	573	661	1765	1037	1497	679	880	2172	741	0.2	3	0.4	0	0.2	2	1.4	0.2	0.4	1.8	1.6	0.6

No	Scores	PEH11	PEH22	PEH12	PEH21	PEL11	PEL22	PEL12	PEL21	RTH11	RTH22	RTH12	RTH21	RTL11	RTL22	RTL12	RTL21	RTU11	RTU22	RTU12	RTU21	ERH11	ERH22	ERH12	ERH21	ERL11	ERL22	ERL12	ERL21	ERU11	ERU22	ERU12	ERU21
20	17	67	46	174	-78	266	137	866	-444	731	1308	1131	632	532	1217	1823	998	798	1354	1997	554	3	1.2	0.2	0.6	0.2	1.4	1.8	0	0.4	2	2	0.2
21	17	222	151	-102	23	342	141	110	-57	758	1382	1291	764	638	1392	1503	844	980	1533	1401	787	3	1.2	0.2	0.4	0.6	0.8	1.6	0	0.8	1.4	2	0.2
22	18	381	113	-307	-62	383	1	-1191	-126	781	1152	2858	988	779	1264	1974	1052	1162	1265	1667	926	0.2	0.8	0	0.4	0.2	1	0.8	0	0.6	1.2	1	0.4
23	18	494	-459	2359	155	470	293	1606	-113	649	1861	1544	841	673	1109	791	1109	1143	1402	3150	996	0.4	1.4	0	0	2	0.8	1	0.2	2.2	1	1.2	0.8
24	22	123	393	-634	-133	235	103	-546	-182	726	1094	1857	817	594	1384	1945	866	849	1487	1311	684	1	2.8	0	0	0.6	1	1.2	0.2	0.8	1.4	1.4	0.6

2.3 The Analysis of Means, Minimum, Maximun, Standard Error, and Standard Deviation

EX	PRIME	TARGET	SF	Mean	Std. Error	95% Confidence Interval	
						Lower Bound	Upper Bound
High	1	1	1	60.833	78.210	-96.596	218.263
			2	37.833	83.116	-129.471	205.138
		2	1	760.333	137.022	484.523	1036.144
			2	614.542	118.986	375.036	854.047
	2	1	1	2.417	62.898	-124.191	129.024
			2	-9.458	60.636	-131.513	112.597
		2	1	85.125	103.495	-123.199	293.449
			2	84.167	107.298	-131.812	300.145
Low	1	1	1	69.208	78.210	-88.221	226.638
			2	65.208	83.116	-102.096	232.513
		2	1	144.292	137.022	-131.519	420.102
			2	106.875	118.986	-132.631	346.381
	2	1	1	-31.458	62.898	-158.066	95.149
			2	-39.083	60.636	-161.138	82.972
		2	1	37.458	103.495	-170.866	245.782
			2	36.375	107.298	-179.604	252.354

2.2 Analysis of Means, Minimum, Maximun, Standard Error, and Standard Deviation

2.2.1 High English-Thai Bilinguals

	N	Range	Minimum	Maximum	Mean		Std. Deviation	Variance
	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Statistic
PEHI11	24	1320.00	-400.00	920.00	46.6250	63.0431	308.8471	95386.505
PEHI22	24	2403.00	-1307.00	1096.00	83.2917	100.8734	494.1769	244210.824
PEHI12	24	1405.00	5.00	1410.00	726.7500	73.6365	360.7438	130136.109
PEHI21	24	1269.00	-729.00	540.00	-3.4167	57.0362	279.4189	78074.949
PELO11	24	1888.00	-746.00	1142.00	42.6667	76.3357	373.9669	139851.275
PELO22	24	2245.00	-925.00	1320.00	85.0417	100.7710	493.6752	243715.172
PELO12	24	1666.00	-190.00	1476.00	593.7500	100.0167	489.9795	240079.935
PELO21	24	1024.00	-589.00	435.00	-18.3750	53.9460	264.2803	69844.071
Valid N (listwise)	24							

2.2.2 Low English-Thai Bilinguals

	N	Range	Minimum	Maximum	Mean		Std. Deviation	Variance
	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Statistic
PEHI11	24	2114.00	-822.00	1292.00	69.2083	90.5692	443.6965	196866.607
PEHI22	24	2129.00	-980.00	1149.00	37.4583	106.0422	519.4988	269878.955
PEHI12	24	4202.00	-1843.00	2359.00	144.2917	181.9548	891.3928	794581.085
PEHI21	24	1449.00	-729.00	720.00	-31.4583	67.6895	331.6094	109964.781
PELO11	24	2170.00	-966.00	1204.00	65.2083	88.9190	435.6122	189757.998
PELO22	24	2112.00	-1070.00	1042.00	36.3750	113.4629	555.8525	308971.984
PELO12	24	2797.00	-1191.00	1606.00	106.8750	137.0710	671.5081	450923.071
PELO21	24	1455.00	-756.00	699.00	-39.0833	65.7398	322.0579	103721.297
Valid N (listwise)	24							

2.3 Tests of Within-Subjects Contrasts

Source	PRIME	TARGET	SF	Type III Sum of Squares	df	Mean Square	F	Sig.
PRIME	Linear			4302336.760	1	4302336.760	10.592	.002
PRIME * EX	Linear			1294561.500	1	1294561.500	3.187	.081
Error(PRIME)	Linear			18685380.490	46	406203.924		
TARGET		Linear		4404980.167	1	4404980.167	18.191	.000
TARGET * EX		Linear		2129210.510	1	2129210.510	8.793	.005
Error(TARGET)		Linear		11139020.573	46	242152.621		
SF			Linear	80562.094	1	80562.094	1.012	.320
SF * EX			Linear	25938.375	1	25938.375	.326	.571
Error(SF)			Linear	3662471.281	46	79618.941		
PRIME * TARGET	Linear	Linear		1724580.094	1	1724580.094	2.983	.091
PRIME * TARGET * EX	Linear	Linear		1906884.375	1	1906884.375	3.298	.076
Error (PRIME* TARGET)	Linear	Linear		26595909.281	46	578171.941		
PRIME * SF	Linear		Linear	53392.667	1	53392.667	.679	.414
PRIME * SF	Linear		Linear	53392.667	1	53392.667	.679	.414
PRIME * SF * EX	Linear		Linear	22785.844	1	22785.844	.290	.593
Error (PRIME*SF)	Linear		Linear	3618585.740	46	78664.907		
TARGET * SF		Linear	Linear	28877.344	1	28877.344	.405	.528
TARGET * SF * EX		Linear	Linear	10837.500	1	10837.500	.152	.699
Error(TARGET*SF)		Linear	Linear	3282913.906	46	71367.694		
PRIME * TARGET * SF	Linear	Linear	Linear	45240.167	1	45240.167	.356	.554
PRIME * TARGET * SF * EX	Linear	Linear	Linear	13183.594	1	13183.594	.104	.749
Error (PRIME*TARGET*SF)	Linear	Linear	Linear	5849426.490	46	127161.445		

2.4 Tests of Between-Subjects Effects

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Intercept	6148912.667	1	6148912.667	26.032	.000
EX	2332201.760	1	2332201.760	9.873	.003
Error	10865624.823	46	236209.235		

3. The Experiment 3: Mandarin-English Bilinguals

3.1 Raw Data

3.1.1 High Mandarin-English Bilinguals

No.	Scores	PE H 11	PE H 22	PE H 12	PE H 21	PE L 11	PE L 22	PE L 12	PE L 21	RT H 11	RT H 22	RT H 12	RT H 21	RT L 11	RT L 22	RT L 12	RT L 21	RT U 11	RT U 22	RT U 12	RT U 21	ER H 11	ER H 22	ER H 12	ER H 21	ER L 11	ER L 22	ER L 12	ER L 21	ER U 11	ER U 22	ER U 12	ER U 21
1	67	106	92	153	-37	68	147	116	45	532	683	734	675	570	628	771	593	638	638	887	775	0	0.2	0.2	0	0.6	0	0	0.2	1.2	0.4	0.4	1.2
2	58	212	-49	-119	-86	151	-21	0	-76	433	731	864	625	494	703	745	615	645	539	745	682	0	0	0	0	0.4	0	0	0.4	1.6	1	0.6	0.6
3	55	73	66	-68	-42	96	98	-25	-59	527	654	795	616	504	622	752	633	600	574	727	720	0	0	0	0	0.2	0.2	0.2	0.2	1.2	1.2	0.6	0.8
4	55	204	-52	107	-81	199	89	19	-113	548	792	758	715	553	651	846	747	752	634	865	740	0	0	0	0	0	0	0	0.2	0.6	0.2	0.2	0.4
5	50	154	-25	57	-13	181	22	129	-90	564	736	810	599	537	689	738	676	718	586	867	711	0	0.2	0.2	0	0	0.4	0.4	0.4	0.4	0.2	0.6	0.4
6	50	257	157	34	-44	298	59	107	120	458	568	883	784	417	666	810	620	715	740	917	725	0	0	0	0.2	0.4	0.4	0.4	0.8	0.8	1.8	0.6	0.8
7	48	234	-106	80	-73	207	-11	269	-114	501	811	982	734	528	716	793	775	735	661	1062	705	0.2	0	0	0.4	0.8	0.4	0.4	1	1	1	0.6	1.2
8	43	208	322	58	-131	177	195	-201	-8	463	585	725	784	494	712	984	661	671	653	783	907	0	0	0	0.6	0	0	0	1.2	1.2	1.2	0.2	1.2
9	48	100	-104	140	86	64	-61	-6	58	520	766	633	507	556	723	779	535	620	593	773	662	0	0.4	0.4	0.2	0.4	0.2	0.2	1	0.8	0.2	0.2	1.4
10	48	69	-51	-16	152	36	22	54	77	599	632	711	511	632	559	641	586	668	663	695	581	0.2	0	0	0.2	0.2	0.2	0.2	2	0.4	0.8	0.2	1.2
11	48	2	-11	-12	38	-18	-59	2	-16	552	623	786	556	572	671	772	610	554	594	774	612	0.4	0.4	0.4	0.2	0.8	0.8	0.8	0.8	1.2	0.4	0.8	2.2
12	47	94	152	-143	190	-62	422	-177	102	568	803	855	548	724	533	889	636	662	738	712	955	0	0.8	0.8	0.2	0.8	0.6	0.6	0.6	1.6	1.2	0.6	1.2
13	47	37	106	-106	168	-36	-30	17	146	521	671	862	509	594	807	739	531	558	677	756	777	0	0	0	0	0.4	0.2	0.2	1	0.8	1.4	1.2	0.8
14	47	92	228	35	265	71	181	179	263	580	609	893	527	601	656	749	529	672	792	928	837	0	0	0	0.4	0.4	0.4	0.4	1.2	0.6	0.6	0.6	1.2
15	47	215	113	68	98	171	103	-5	189	421	613	712	693	465	623	785	602	636	791	780	726	0	0	0	0.6	0.2	0.2	0.2	0	1.2	0.8	0.2	1.4
16	47	12	115	95	-19	-38	20	164	-92	543	561	811	636	593	656	742	709	555	617	906	676	0	0	0	0.8	0	0	0	0	0.2	0.2	0.2	0.2
17	47	182	19	23	150	172	-107	28	-32	484	683	726	615	494	809	721	797	666	765	749	702	0.4	0.4	0.4	0.2	0.2	0	0	0	0.4	0.2	0.2	0.2
18	47	187	1	16	72	188	96	-317	53	533	801	574	515	532	706	907	534	720	587	590	802	0.2	0	0	0.6	0.8	0.8	0.8	0.4	1.2	1	1	0.2
19	47	95	183	88	66	104	2	-102	80	589	561	570	531	580	742	760	517	684	597	658	744	0	0	0	0.4	0	0.2	0.2	0.6	0.2	0.2	1.2	0.6
20	46	252	-5	109	137	191	116	73	71	543	980	910	609	604	859	946	675	795	746	1019	975	0	0	0	0.4	0.2	0.4	0.4	0.2	0.8	0.6	0.6	1.2
21	46	248	76	-27	-8	232	58	-1	7	590	752	837	633	606	770	811	618	838	625	810	828	0	0.2	0.2	0.4	0.2	0.6	0.6	0	0.6	0.8	0.8	0.8
22	46	192	80	-34	-132	-35	43	36	42	538	537	859	888	765	574	789	714	730	756	825	617	0	0	0	0.6	0.4	0.6	0.6	0.6	1.2	0.8	0.8	0.2
23	45	351	30	356	91	341	-2	264	29	529	782	508	552	539	814	600	614	880	643	864	812	0.6	0	0	1	0	0.4	0.4	0.8	0.2	1	0.6	1
24	45	239	3	-13	84	159	-197	87	86	542	795	772	729	622	995	672	727	781	813	759	798	0	0	0	0.8	0	0.2	0.2	0.2	0.2	0.6	0.4	1.2

3.1.2 Low Mandarin-English Bilinguals

No.	Scores	PEHL11	PEHL22	PEHL12	PEHL21	PELL11	PELL22	PELL12	PELL21	RTHL11	RTHL22	RTHL12	RTHL21	RTLL11	RTLL22	RTLL12	RTLL21	RTLU11	RTLU22	RTLU12	RTLU21	ERHL11	ERHL22	ERHL12	ERHL21	ERLL11	ERLL22	ERLL12	ERLL21	ERLU11	ERLU22	ERLU12	ERLU21
1	5	186	119	105	73	86	149	-43	40	532	707	624	545	632	677	772	578	718	826	729	618	0	0.2	0	0.2	0.6	0.8	2	0	0.8	1	3	0.2
2	6	241	-155	61	13	141	-292	104	84	533	742	713	779	633	879	670	708	774	587	774	792	0	0.4	0.2	0	0.8	0.4	0.8	0	1	0.6	1.2	0.4
3	7	302	289	26	11	202	292	-233	31	521	536	519	539	621	533	778	519	823	825	545	550	0	0.8	0.2	0	0.2	0.6	1.6	0	0.4	0.8	1.8	0.2
4	11	152	-174	34	5	52	-231	55	-53	543	853	756	807	643	910	735	865	695	679	790	812	0	0.2	0	0.2	0	1	1.4	0	0.2	1.2	2	0
5	13	171	426	3	6	171	440	-276	-2	684	635	527	600	684	621	806	608	855	1061	530	606	0.8	0	0.6	0	0.8	1	1.6	0.2	1	1.6	3	0.2
6	20	163	427	38	-130	63	424	66	-159	758	619	551	653	858	622	523	682	921	1046	589	523	0	0	1.4	0	0.6	1	1	0	0.8	1.8	1	0
7	20	292	-51	6	97	192	-190	29	82	501	702	766	619	601	841	743	634	793	651	772	716	0.2	1.2	2	0.2	0.4	1	1.2	0.2	0.6	2	1.6	0.2
8	21	40	-101	83	-29	27	-57	42	14	563	762	625	651	576	718	666	608	603	661	708	622	0.4	1.4	1	0	0.4	2	1.2	0.4	0.6	3	1.8	0.4
9	21	203	-53	124	3	86	-36	74	-41	560	761	718	645	677	744	768	689	763	708	842	648	0	0.8	1	0	0	1	0.8	0	0.2	1.2	1	0.2
10	23	262	362	329	65	88	191	382	69	513	606	559	579	687	777	506	575	775	968	888	644	0	0.2	1.2	0.2	0.2	0.8	1.2	0	0.4	1	1.4	0
11	24	-17	-373	150	-53	335	-107	166	-44	869	853	558	539	517	587	542	530	852	480	708	486	0.4	0	1.2	0	0	0.8	3	0.2	0.2	1	3	0.2
12	25	156	352	136	33	-49	131	100	11	511	748	629	607	716	969	665	629	667	1100	765	640	0	0.6	2	0.2	0	1	2	0.2	0.2	1.2	2.2	0.2
13	25	51	113	1	30	43	53	51	0	505	564	795	500	513	624	745	530	556	677	796	530	0	2	1.4	0	0	0.8	1.8	0.2	0.2	1	2	0.2
14	25	339	86	206	-15	318	-46	264	-19	569	534	780	553	590	666	722	557	908	620	986	538	0	2	1.2	0	0	0.8	1.2	0	0	1	2	0.2
15	25	159	114	235	-126	57	120	283	-196	562	694	627	919	664	688	579	989	721	808	862	793	0	1	0.6	0.6	0.2	1	0.6	0	0.2	1.2	0.8	0.2
16	25	33	4	-159	144	7	-1	-162	94	601	757	860	504	627	762	863	554	634	761	701	648	0	0	1	0.2	0	0.8	1.4	0	0.2	1.6	1.6	0.4
17	25	86	19	69	-100	110	44	218	-89	624	745	732	834	600	720	583	823	710	764	801	734	0	0	1.2	0	0.2	0.6	2.8	0	0.2	1.8	3	0.6
18	25	81	-32	155	-92	160	256	30	-184	704	922	643	807	625	634	768	899	785	890	798	715	0	1	0.6	0	0.2	0.8	2	0.2	0.2	2	2.2	0.8
19	25	32	140	-257	61	13	-239	-280	-16	518	504	866	812	537	883	889	889	550	644	609	873	0	2	0.4	0.2	0	1	1.4	0	0	1.2	1.6	0
20	26	241	-98	159	117	214	295	80	83	550	1054	801	807	577	661	880	841	791	956	960	924	0	1	0.6	0	0	1.8	1.8	0	0	2	2	0.2
21	27	14	-74	-106	-82	3	-160	147	-91	611	701	875	801	622	787	622	810	625	627	769	719	0	1	0.2	0.2	0.2	0.8	1.6	0	0.2	1.6	1.8	0.2
22	27	198	-49	-124	268	39	-22	-87	328	529	677	858	619	688	650	821	559	727	628	734	887	0	0.4	1	0	0	1.4	1	0	0	1.4	1.2	0
23	27	170	-102	242	-169	170	37	185	-24	580	848	702	888	580	709	759	743	750	746	944	719	0.4	0.4	1	0	0.8	1	1	0	1	1.2	1.2	0
24	29	89	-1	39	-78	134	127	76	123	645	762	647	751	600	634	610	550	734	761	686	673	0	0.8	2	0.2	0	1	1.2	0.2	1	1.6	1.4	0.2

3.2 Analysis of Means, Minimum, Maximun, Standard Error, and Standard Deviation

3.2.1 High Mandarin-English Bilinguals

	N	Range	Minimum	Maximum	Mean		Std. Deviation	Variance
	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Statistic
PEHI11	24	349.00	2.00	351.00	158.9583	18.2375	89.3452	7982.563
PEHI22	24	428.00	-106.00	322.00	55.8333	21.5403	105.5255	11135.623
PEHI12	24	499.00	-143.00	356.00	36.7083	21.3337	104.5136	10923.085
PEHI21	24	397.00	-132.00	265.00	38.7917	21.9379	107.4733	11550.520
PELO11	24	403.00	-62.00	341.00	121.5417	22.2334	108.9208	11863.737
PELO22	24	619.00	-197.00	422.00	49.3750	24.5159	120.1028	14424.679
PELO12	24	586.00	-317.00	269.00	29.5833	27.6951	135.6777	18408.428
PELO21	24	377.00	-114.00	263.00	32.0000	19.7347	96.6801	9347.043
Valid N (listwise)	24							

3.2.2 Low Mandarin-English Bilinguals

	N	Range	Minimum	Maximum	Mean		Std. Deviation	Variance
	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Statistic
PEHI11	24	356.00	-17.00	339.00	151.8333	20.1458	98.6939	9740.493
PEHI22	24	800.00	-373.00	427.00	49.5000	41.4571	203.0975	41248.609
PEHI12	24	586.00	-257.00	329.00	64.7917	27.5370	134.9032	18198.868
PEHI21	24	437.00	-169.00	268.00	2.1667	20.3080	99.4885	9897.971
PELO11	24	384.00	-49.00	335.00	110.9167	19.7087	96.5527	9322.428
PELO22	24	732.00	-292.00	440.00	49.0833	41.3080	202.3673	40952.514
PELO12	24	662.00	-280.00	382.00	52.9583	34.4679	168.8574	28512.824
PELO21	24	524.00	-196.00	328.00	1.7083	22.5689	110.5647	12224.563
Valid N (listwise)	24							

3.3 Tests of Within-Subjects Contrasts

Source	PRIMES	TARGETS	SF	Type III Sum of Squares	df	Mean Square	F	Sig.
PRIMES	Linear			302177.042	1	302177.042	8.388	.006
PRIMES * EX	Linear			17253.844	1	17253.844	.479	.492
Error(PRIMES)	Linear			1657180.615	46	36025.666		
TARGETS		Linear		79407.510	1	79407.510	3.267	.077
TARGETS * EX		Linear		25155.375	1	25155.375	1.035	.314
Error (TARGETS)		Linear		1118057.615	46	24305.600		
SF			Linear	18620.510	1	18620.510	3.018	.089
SF * EX			Linear	26.042	1	26.042	.004	.948
Error(SF)			Linear	283832.948	46	6170.281		
PRIMES * TARGETS	Linear	Linear		357704.167	1	357704.167	15.863	.000
PRIMES * TARGETS * EX	Linear	Linear		119.260	1	119.260	.005	.942
Error (PRIMES*TARGETS)	Linear	Linear		1037300.573	46	22550.012		
PRIMES * SF	Linear		Linear	10375.042	1	10375.042	1.855	.180
PRIMES * SF * EX	Linear		Linear	635.510	1	635.510	.114	.738
Error (PRIMES*SF)	Linear		Linear	257217.448	46	5591.684		
TARGETS * SF		Linear	Linear	5355.094	1	5355.094	1.206	.278
TARGETS * SF * EX		Linear	Linear	3.375	1	3.375	.001	.978
Error (TARGETS* SF)		Linear	Linear	204313.531	46	4441.599		
PRIMES * TARGETS * SF	Linear	Linear	Linear	5221.500	1	5221.500	.653	.423
PRIMES * TARGETS * SF * EX	Linear	Linear	Linear	1.260	1	1.260	.000	.990
Error(PRIMES* TARGETS* SF)	Linear	Linear	Linear	367986.740	46	7999.712		

3.4 Tests of Between-Subjects Effects

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Intercept	1517299.594	1	1517299.594	58.850	.000
EX	2380.042	1	2380.042	.092	.763
Error	1185991.365	46	25782.421		

4. The Experiment 4: English-Mandarin Bilinguals

4.1 Raw Data

4.1.1 High English-Mandarin Bilinguals

Number	Scores	PE HI L1L 1	PE HI L2L 2	PE HI 12	PE HI L2L 1	PE LO L1L 1	PE LO L2L 2	PE LO 12	PE LO L2L 1	RT HI L1L 1	RT HI L2L 2	RT HI 12	RT HI L2L 1	RT LO L1L 1	RT LO L2L 2	RT LO 12	RT LO L2L 1	RT UN L1L 1	RT UN L2L 2	RT UN 12	RT UN L2L 1	ER HI L1L 1	ER HI L2L 2	ER HI 12	ER HI L2L 1	ER LO L1L 1	ER LO L2L 2	ER LO 12	ER LO L2L 1	ER UN L1L 1	ER UN L2L 2	ER UN 12	ER UN L2L 1
1	59	216	295	277	76	226	245	244	187	569	626	780	865	559	676	813	754	785	921	1057	941	0	0.6	1.2	0	0.4	0.8	0	0.4	0.2	0.4	0.4	0.6
2	58	43	294	241	18	-99	194	113	265	793	622	839	926	935	722	967	679	836	916	1080	944	0	0.2	0	0	0	0.8	0.2	0.2	0.4	1.2	0.2	0.8
3	56	-204	272	107	89	-329	134	27	73	711	759	851	774	836	897	931	790	507	1031	958	863	0	0.6	0.2	0	0.2	1	0.2	0	0.6	1.4	0.6	0.6
4	55	250	208	120	-121	203	111	-3	30	606	778	839	810	653	875	962	659	856	986	959	689	0	0.2	0.8	0	0.2	0.2	0.2	0.4	1.2	2	0.8	0.2
5	54	228	70	44	-156	66	31	115	-282	523	862	585	701	685	901	514	827	751	932	629	545	0	0.2	0.2	0	0	0	0.8	0.2	0.4	0.8	0.6	0.8
6	53	-49	-1	553	-100	-94	108	440	-96	556	1084	541	828	601	975	654	824	507	1083	1094	728	0	0.4	0.2	0	0.2	0.2	0.2	0.2	0	0.2	0.6	0.4
7	52	77	70	435	66	66	51	381	171	879	917	585	894	890	936	639	789	956	987	1020	960	0	0.2	0.2	0	0.2	0.6	0.8	0.4	0.2	0.4	0.2	0.4
8	52	-208	22	411	52	-117	79	154	120	849	976	542	927	758	919	799	859	641	998	953	979	0.2	0.4	0.8	0	0	0.2	0.8	0.2	0.2	0.8	0.8	0.6
9	51	-62	32	236	-50	-223	-31	199	123	704	901	685	817	865	964	722	644	642	933	921	767	0.2	0.2	0.2	0	0.2	0	0.6	0.2	0.2	0.4	1	0.4
10	51	175	64	188	35	123	112	166	-5	652	1019	621	644	704	971	643	684	827	1083	809	679	0.2	0.6	0.4	0.4	0.2	0.4	0.4	0	0.4	0.2	1.2	0.6
11	50	45	212	305	72	-100	101	318	125	662	782	683	781	807	893	670	728	707	994	988	853	0.2	0.2	0.2	0	0.6	0.2	3	0.2	0.6	0.8	1.8	0.2
12	49	150	114	319	15	73	121	263	-161	725	926	678	673	802	919	734	849	875	1040	997	688	0	0.2	0.2	0	0.8	0.4	2	0.2	0.6	0.6	3	0.6
13	46	170	91	245	49	138	12	164	136	629	885	697	814	661	864	778	727	799	976	942	863	0	0.8	0.6	0	0.4	1	1	1	0.8	1.2	1.8	0.4
14	46	15	208	280	-13	-3	207	233	196	637	872	576	751	655	873	623	542	652	1080	856	738	0	0.2	0.2	0	0.4	0	0.6	0	1.2	1.4	1.2	2
15	45	96	159	310	27	-88	128	256	-6	704	901	618	775	888	932	672	808	800	1060	928	802	0	0	0	0	0.2	0.8	1.2	1.2	1.4	0.2	1	0.2
16	45	107	-27	486	-16	100	87	318	-59	783	1108	556	876	790	994	724	919	890	1081	1042	860	0	0	0	0	0.4	0.2	1.2	0	0.2	1	1.2	3
17	44	212	2	198	-199	205	-13	49	-220	591	835	848	819	598	850	997	840	803	837	1046	620	0.2	0	0.2	0	0.8	0.8	0.8	0.2	1.6	1	1.6	0.6

Number	Scores	PE HI L1L 1	PE HI L2L 2	PE HI 12	PE HI L2L 1	PE LO L1L 1	PE LO L2L 2	PE LO 12	PE LO L2L 1	RT HI L1L 1	RT HI L2L 2	RT HI 12	RT HI L2L 1	RT LO L1L 1	RT LO L2L 2	RT LO 12	RT LO L2L 1	RT UN L1L 1	RT UN L2L 2	RT UN 12	RT UN L2L 1	ER HI L1L 1	ER HI L2L 2	ER HI 12	ER HI L2L 1	ER LO L1L 1	ER LO L2L 2	ER LO 12	ER LO L2L 1	ER UN L1L 1	ER UN L2L 2	ER UN 12	ER UN L2L 1
18	44	265	84	351	10	189	-205	54	-186	600	873	700	886	676	1162	997	1082	865	957	1051	896	0	0.2	0.6	0.4	1	0.4	2.2	0.4	0.8	1.2	1	0.6
19	42	92	24	326	-31	69	61	127	-43	566	917	726	791	589	880	925	803	658	941	1052	760	0	0.4	0.2	0.2	0.2	0.4	1	0.6	1.2	0.8	2.6	0.4
20	41	154	65	343	-46	78	84	196	42	721	889	778	964	797	870	925	876	875	954	1121	918	0	0.8	0.2	0.2	0.6	0.6	2	0.2	0.2	0.8	1.2	1
21	41	32	55	422	3	-128	251	46	-128	615	1006	595	741	775	810	971	872	647	1061	1017	744	0	0	0.4	0.4	0.4	0.4	2	0.2	1.8	1.2	2.8	0.6
22	39	242	65	318	42	280	76	106	53	555	908	649	792	517	897	861	781	797	973	967	834	0	0.2	0.2	0	1	0.2	0.8	0.2	1.2	0.8	2.2	1.6
23	39	109	-15	237	97	-5	44	166	-480	747	887	742	885	861	828	813	1462	856	872	979	982	0	0.8	0	0	1	0.2	0	0.2	1.2	0.6	1	1.8
24	39	124	68	238	165	95	112	207	-145	803	915	806	861	832	871	837	1171	927	983	1044	1026	0	0.2	0	0	0.2	0.2	0.2	0	1	0.4	1.2	2

4.1.2 Low English-Mandarin Bilinguals

Number	Scores	PE HI L1L1	PE HI L2L2	PE HI 12	PE HI L2L1	PE LO L1L1	PE LO L2L2	PE LO 12	PE LO L2L1	RT HI L1L1	RT HI L2L2	RT HI 12	RT HI L2L1	RT LO L1L1	RT LO L2L2	RT LO 12	RT LO L2L1	RT UN L1L1	RT UN L2L2	RT UN 12	RT UN L2L1	ER HI L1L1	ER HI L2L2	ER HI 12	ER HI L2L1	ER LO L1L1	ER LO L2L2	ER LO 12	ER LO L2L1	ER UN L1L1	ER UN L2L2	ER UN 12	ER UN L2L1
1	18	41	-58	365	45	5	-99	250	38	745	800	630	998	608	698	888	1181	786	764	973	1024	0	2	0.2	3	1	2.8	0.6	0	1	1.6	0.8	3
2	19	111	-41	426	-50	65	-212	325	-108	724	742	687	691	724	719	903	723	835	701	1150	537	0.6	1.8	1.2	1	0.2	1.2	0.4	0.2	1.2	1.6	0.8	0.6
3	20	90	52	425	-62	198	40	226	-71	817	685	793	1140	770	806	895	599	907	812	1055	941	0.2	1	1	0	1.2	1.2	1.2	0	0.6	2	0.6	0.2
4	21	69	230	220	8	71	214	19	13	687	763	729	569	709	998	850	889	756	891	907	1025	0	1.4	2	1	0.8	1.2	2	0	1.8	3	1.6	0.4
5	22	-50	-83	296	-15	100	-87	186	-42	901	991	706	948	685	776	857	644	851	717	1089	826	0.2	1.2	2.2	1.4	0.4	0.8	3	0	1	1.2	2.2	0.4
6	23	-77	171	357	88	-92	215	191	-4	984	788	783	689	751	799	857	882	907	913	1086	963	0	2.2	2	0.2	0.2	2	1	0	0.6	2.2	3	0.2
7	22	-137	-31	204	5	-139	-65	60	-11	993	766	813	810	999	797	788	926	856	654	910	1003	0	1.4	1.8	0.2	0.2	3	1.2	0	0.8	3.6	1.2	0.2
8	23	-54	145	266	207	-44	102	192	-283	854	721	719	951	995	775	795	937	800	908	1049	898	0.4	1.4	1.2	0.2	0.8	2.8	1.2	0	0.6	3	1.6	0.6
9	24	26	-188	279	-427	36	-195	235	-10	950	515	736	1051	844	717	992	709	976	803	1092	713	0.2	2	1	0	0.4	2	1	0	1	2.2	1.8	0.2
10	26	152	77	288	338	155	89	219	308	729	655	822	1279	940	661	691	1012	881	865	1007	907	0	1.2	1	0	0.2	1.8	1.6	0	1.2	2	1.2	0
11	27	11	-108	230	47	-6	-141	171	106	841	547	678	1017	726	632	832	700	852	658	966	995	0.2	1.8	1	0	0.6	1.4	2.2	0.2	0.4	2.6	1.8	0.2
12	27	141	154	356	-50	108	78	186	-5	629	683	889	820	858	725	799	1052	770	875	1178	639	0	1.2	1	0.2	0	2.2	2.2	0	0.8	2	2.6	0.2
13	28	81	132	376	98	134	-128	363	26	688	902	714	958	662	816	792	1098	769	647	1054	908	0	1.8	1.2	0	0.4	1.2	1.8	0	0.2	1.8	3	0.2
14	28	44	42	151	9	59	-20	208	34	835	914	657	628	635	903	930	1072	879	697	1040	960	0	2.2	0.8	0	0	1.4	1.2	0.2	0.6	1.6	3	0.6
15	30	71	309	348	-249	70	195	263	-135	706	988	741	1001	820	752	963	959	777	856	1062	802	0.2	2	0.4	0	0	1.2	1.2	0	0.2	1.6	2.6	0.2
16	30	-41	244	281	-266	-37	295	146	304	908	715	641	913	707	821	994	901	867	927	938	1013	0	2	0.4	0.4	0	2	1.2	0	0.2	2.2	2.4	0.6
17	30	-49	-37	308	-112	-22	140	119	-107	778	861	768	953	904	861	666	900	729	865	1049	905	0	1.4	0.4	0	0.2	2.2	2.6	0	0.6	2.4	1.6	0.8
18	31	231	-10	323	-139	20	88	1	-19	633	806	612	845	751	621	985	-19	864	904	964	681	0	1.8	0.8	0	0.6	1.8	2.2	0	0.6	2.6	2.8	0.2
19	31	-119	-81	365	-175	-175	4	139	-269	837	681	754	986	844	910	768	-269	718	907	1133	783	0	2.8	0.4	0	1	2.2	1.4	0	0.8	3	2.6	0.2

Number	Scores	PE HI L1L 1	PE HI L2L 2	PE HI 12	PE HI L2L 1	PE LO L1L 1	PE LO L2L 2	PE LO 12	PE LO L2L 1	RT HI L1L 1	RT HI L2L 2	RT HI 12	RT HI L2L 1	RT LO L1L 1	RT LO L2L 2	RT LO 12	RT LO L2L 1	RT UN L1L 1	RT UN L2L 2	RT UN 12	RT UN L2L 1	ER HI L1L 1	ER HI L2L 2	ER HI 12	ER HI L2L 1	ER LO L1L 1	ER LO L2L 2	ER LO 12	ER LO L2L 1	ER UN L1L 1	ER UN L2L 2	ER UN 12	ER UN L2L 1
20	31	289	87	413	-11	253	50	359	-481	640	890	657	645	893	979	810	-481	929	802	1025	617	0	2.2	0.2	0	0.2	1.6	2	0	1.2	1.8	1.8	0.2
21	31	118	100	176	-78	-39	140	-55	-149	701	863	805	1012	676	587	757	-149	819	961	930	923	0	1.2	0.2	0.4	0.8	1.4	1.8	0	0.4	1.6	2.2	0.6
22	32	127	149	276	-46	182	94	165	-92	840	913	667	1012	858	1003	822	-92	967	955	933	867	0.2	1	0.2	0.8	0.2	1.4	0.8	0	1	1.6	2	0.8
23	33	235	207	137	49	162	267	132	101	674	772	723	868	785	1017	742	101	909	888	942	1002	0.2	1.8	0.4	0.2	1	1	1.2	0	0.6	1.2	1.6	0.4
24	33	233	74	403	-116	351	54	313	-171	625	677	825	967	747	841	760	-171	858	964	1070	729	1	2.8	0	0	0.6	1.2	1.2	0	1.2	1.6	1.8	0.2

4.2 Analysis of Means, Minimum, Maximun, Standard Error, and Standard Deviation

4.2.1 High English-Mandarin Bilinguals

	N	Range	Minimum	Maximum	Mean		Std. Deviation	Variance
	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Statistic
PEHI11	24	473.00	-208.00	265.00	94.9583	26.3328	129.0040	16642.042
PEHI22	24	322.00	-27.00	295.00	101.2917	19.9333	97.6527	9536.042
PEHI12	24	509.00	44.00	553.00	291.2500	24.2873	118.9831	14156.978
PEHI21	24	364.00	-199.00	165.00	3.5000	17.2176	84.3487	7114.696
PELO11	24	609.00	-329.00	280.00	30.2083	30.9591	151.6678	23003.129
PELO22	24	456.00	-205.00	251.00	87.5000	19.3731	94.9087	9007.652
PELO12	24	443.00	-3.00	440.00	180.7917	23.0471	112.9070	12747.998
PELO21	24	745.00	-480.00	265.00	-12.0833	35.9815	176.2725	31071.993
Valid N (listwise)	24							

4.2.2 Low English-Mandarin Bilinguals

	N	Range	Minimum	Maximum	Mean		Std. Deviation	Variance
	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Statistic
PEHI11	24	426.00	-137.00	289.00	64.2917	23.6898	116.0560	13468.998
PEHI22	24	497.00	-188.00	309.00	64.0000	25.8004	126.3955	15975.826
PEHI12	24	289.00	137.00	426.00	302.8750	17.3176	84.8386	7197.592
PEHI21	24	765.00	-427.00	338.00	-37.5833	31.7305	155.4472	24163.819
PELO11	24	526.00	-175.00	351.00	58.9583	25.1490	123.2045	15179.346
PELO22	24	507.00	-212.00	295.00	46.5833	29.0155	142.1466	20205.645
PELO12	24	418.00	-55.00	363.00	183.8750	21.7117	106.3650	11313.505
PELO21	24	789.00	-481.00	308.00	-42.7917	34.5965	169.4875	28725.998
Valid N (listwise)	24							

4.3 Tests of Within-Subjects Contrasts

Source	PRIME	TARGET	SF	Type III Sum of Squares	df	Mean Square	F	Sig.
PRIME	Linear			1490390.440	1	1490390.440	45.341	.000
PRIME * EX	Linear			39751.690	1	39751.690	1.209	.277
Error(PRIME)	Linear			1512056.995	46	32870.804		
TARGET		Linear		1810740.003	1	1810740.003	108.903	.000
TARGET * EX		Linear		156.315	1	156.315	.009	.923
Error(TARGET)		Linear		764845.307	46	16627.072		
SF			Linear	185372.315	1	185372.315	26.054	.000
SF * EX			Linear	4980.961	1	4980.961	.700	.407
Error(SF)			Linear	327289.849	46	7114.997		
PRIME * TARGET	Linear	Linear		155566.253	1	155566.253	6.319	.016
PRIME * TARGET * EX	Linear	Linear		796.378	1	796.378	.032	.858
Error (PRIME*TARGET)	Linear	Linear		1132412.495	46	24617.663		
PRIME * SF	Linear		Linear	91915.315	1	91915.315	10.987	.002
PRIME * SF * EX	Linear		Linear	2920.523	1	2920.523	.349	.558
Error(PRIME*SF)	Linear		Linear	384820.786	46	8365.669		
TARGET * SF		Linear	Linear	43243.815	1	43243.815	5.960	.019
TARGET * SF * EX		Linear	Linear	10075.753	1	10075.753	1.389	.245
Error(TARGET*SF)		Linear	Linear	333787.557	46	7256.251		
PRIME * TARGET * SF	Linear	Linear	Linear	33282.878	1	33282.878	4.126	.048
PRIME * TARGET * SF * EX	Linear	Linear	Linear	4367.253	1	4367.253	.541	.466
Error (PRIME*TARGET* SF)	Linear	Linear	Linear	371077.495	46	8066.902		

4.4 Tests of Between-Subjects Effects

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Intercept	3014490.961	1	3014490.961	121.375	.000
EX	28239.190	1	28239.190	1.137	.292
Error	1142468.474	46	24836.271		

APPENDIX I

Lexical Access in Bilinguals using the Semantic Priming Tasks

Most of the current studies of bilingual mental lexicon have focused on the issue of what extent the bilingual's two languages form a single system or separate systems. Two models of connections between the first (L1) and the second languages (L2) are the interdependence and the independence models. The interdependence model proposes that there is a single common, language-independent, conceptual representation for words in L1 and L2 (McCormack, 1977; Potter, So, Von Echardt, & Feldman, 1984). The alternative independence model proposes that words within each of the bilingual's two languages form stronger associations than among words with the same or corresponding meaning between their two languages (e.g., Kolers, 1966b). In the other words, this model characterizes the bilingual mental lexicon in terms of two separate language-specific systems, separate (Paivio & Desrochers, 1980; Paivio & Lambert, 1981).

More recent studies have shifted their focus to the belief that bilinguals may have a mixed representational system in which some aspects of each level of language are shared across languages while others are language-specific (de Groot, 1992a, 1993). In this vein, a dominant model of the bilingual lexicon is the Revised Hierarchical Model (Kroll & Stewart, 1994). This model has shifted the investigation to the factors that determine how words in L1 and L2 are connected at the lexical and the conceptual levels. According to this model, words in L1 and L2 are interconnected via lexical links. Within this system, lexical links from words in L2 to words in L1 are stronger than those from words in L1 to words in L2. Thus, accessing the meanings of words in L2 via words with the same meanings in L1 should be faster than accessing the meanings of words in L1 via words with the same meanings in L2. In addition, this model assumes that words in both L1 and L2 directly access concepts in the conceptual system. However, links from words in L1 to the conceptual system are stronger than those from words in L2. Thus, words in L1 should be retrieved from the conceptual system faster than words in L2.

Experimental support for this hypothesis comes from the studies using cross-language Stroop tasks. For example, Chen and Ho (1986) demonstrated that bilinguals less proficient in L2, show more colour naming interference from L1 words than from L2 words when they were asked to respond in L2. However, the greater they also found that the proficiency in L2, the more interference from L2 words to L1 responses and the less interference from L1 words to L2 responses.

This model also concerns the pattern of L1 and L2 connections as a production of L2 experience. For example, McElree, Jia, and Litvak (2000) proposed that greater L2 experience may develop the links between L2 word forms and the conceptual system in terms of either the richer conceptual informations that can be retrieved from L2 forms or greater speed of the retrieval process in L2. That is low L2 experience bilinguals will

rely more on lexical links between L2 words and their L1 translations and these lexical links will remain even after conceptual links are later established between L2 words and concepts. Thus in higher L2 experience bilinguals, L2 words are related to their L1 equivalents through both lexical links and shared conceptual representations. The model further proposes that links may differ in strength: The lexical links from L2 to L1 are stronger than the reverse links, and links between L1 words and the concepts are stronger than between L2 words and concepts.

Evidence for this position comes from research comparing the level of L2 experience in bilinguals. Studies using cross-language Stroop tasks by Sudasna (1999) and Sudasna, Luksaneeyanawin, and Burnham (2000) also support the position that bilinguals with low L2 experience show more interference from L1 words than from L2 words when they were asked to respond in L2. However, high L2 experience, participants showed greater interference from L2 words to L1 responses and less interference from L1 words to L2 responses.

Nevertheless, the debate on whether bilinguals' two languages are distinguishable at the lexical level alone or also at the conceptual level has continued due to conflicting empirical evidence. Hummel (1993) proposed that the conflict of results relates to differing experimental paradigms with regard to materials and designs. In general, it is proposed that tasks that primarily require lexical representations such as lexical decision tasks (e.g., Kirsner et al., 1984) and repetition priming tasks (e.g. Gerard & Scarborough, 198) will provide evidence supporting the language-specific hypothesis. On the other hand, tasks that require conceptual representations such as semantic priming tasks (e.g., Chen & Ng, 1989; de Groot & Nas, 1991; Keatly et al. 1994) will provide evidence supporting the common conceptual representation hypothesis.

The main aim of the current set of experiments was to test both the organization and the retrieval process models of the bilingual mental lexicon by using cross-language semantic priming tasks.

The Tasks: Priming and Masked Priming Tasks

A widely used paradigm to test models of the bilingual lexicon is the priming task. Previous studies have shown that priming effects are stronger when the primes and the targets are related (phonologically, orthographically, semantically, or syntactically) than when they are unrelated, even when the participants are unaware of the primes. This suggests that some of the properties of the primes overlap with those of the targets such that processing the primes facilitates the processing of targets. It is this property of primes that is useful in delineating the relationships between words. For instance, priming effects can be found using primes and targets that are phonologically related, e.g. "real" and "reel", or syntactically and semantically related e.g. "boy" and "girl".

One important aspect of priming tasks is to ensure that the effect of primes on targets is not due to consciousness of the primes, and thus non-lexical strategies. To counter this problem, masked priming paradigm was developed by Forster and Davis (1984). Forster and Davis proposed that when primes are visually masked, primes should be virtually invisible and information about primes never reaches participants' consciousness. In this way, any obtained priming effects are not due to conscious appreciation of the relationship between primes and targets. In other words, observed effects are effects of the primes on the processing of the targets rather than post-access effects on targets.

However, there are problems in concluding that the masked priming paradigm affects the degree of *semantic* priming, as experiments do not have enough statistical power for detecting an effect of semantic relatedness on priming. Carr and Dagenbach (1990) found that for form priming, when people are induced to try to retrieve a masked prime's meaning, the masked prime produces a positive priming effect. Conversely, in semantic priming, masked priming produces negative priming effects. Moreover, other studies (de Groot, 1984, Stolz & Neely, 1995, Stolz, Carr, & Besner, 2000) have shown that the use of high versus low semantically-related primes and targets, failed to affect the strength of priming when primes were presented briefly (300 ms or less).

Apart from pattern masking, another issue in the cross-language priming paradigm is the direction of priming in an experiment. Several studies have found that cross-language priming occurs only when primes are presented in the bilinguals' L1 and targets in the bilinguals' L2 (Keatley, Spinks & de Gelder, 1994).

Keatly, Spinks and de Gelder (1994) found in a lexical decision task, that cross-language priming occurs only when the primes are in L1 and targets in L2. The asymmetry in cross-language priming can be accounted for by stronger connections from L1 to L2, than from L2 to L1. Asymmetric cross-language priming can also be accounted for by the Revised Hierarchical Model (Kroll, 1993; Kroll & Scholl, 1992; Kroll & Stewart, 1994). which proposes that the lexical level connections from L2 to L1 are stronger than are those from L1 to L2. It is assumed that L2 words will initially be mapped to L1 to gain access to concepts, but that processing from L1 to L2 is more likely to require conceptual mediation. Thus, a clear prediction of this model is that presentation of a word in L1 is more likely to activate its L2 conceptual representation than its L2 lexical representation. In contrast, presentation of an L2 word is more likely to activate the corresponding L1 lexical representation than its L1 conceptual representation.

The Languages: Thai, Chinese, and English

In order to investigate cross-language semantic priming effects in the current study, the stimulus sets, a category of words was selected and analysed linguistically. For the present study, kinship terms in Thai, English, and Chinese were used. Differences among these three languages may also be expected, in terms of writing systems and semantic systems.

With respect to the writing systems, Chinese has a logographic writing system, whereas, Thai and English have alphabetic systems. With respect to the effects of the writing system on L2 lexical access, Chinese logography is a system in which the basic unit in writing associates with a unit of meaning, a morpheme. There is no unit that encodes single phonemes, nor are there grapheme to phoneme conversion rules. Thus Chinese is a meaning based writing system, which is quite different from alphabetic writing systems. A number of studies (eg., Seidenberg & Mc-Clelland,1989, Perfetti & Zhang, 1995, Frost, 1998, Taft & van Graan, 1998, Zhou & Marslen-Wilson, 1999a) demonstrated that reading Chinese is expected to be very different from reading alphabetic languages. A Chinese reader can read words by going directly from writing units (characters) to meanings (eg., Wydell, Patterson, & Humphreys, 1993; Chen, Cheung, & Flores d'Arcais, 1995; Leck, Weekes, & Chen, 1995), whereas, in alphabetic writing, access to semantic and lexical information must arise via of phonological information. Thus alphabetic writing systems need simultanous availability of graphemic, phonological, and semantic information. So, whereas alphabetic writing systems encourage an explicit sublexical relationship between graphic and phonological forms, in a logographic writing systems, this process may be different.

An alternative explanation could be applied if one thinks of the access of a Chinese character including phonology as a constant. The character will thus access its associated phonological and semantic information either as a whole or with the useful parts and the sublexical graphic and phonological connections not playing a role. Thus, Chinese could present the opportunity for orthographic and phonological information to arise synchronously at the sublexical level (e.g., Perfetti & Zhang, 1995; Zhou & Marslen-Wilson, 1999a). In this way, Chinese words could access word meanings faster than alphabetic words. If this were so then there should be stronger semantic priming effects for Chinese than Thai or English words.

In order to exclude the effects of cognates and interlingual homographs on L2 access (eg., Cristoffanini, Kirner, & Milech, 1986; de Groot & nas, 1991; Dijkstra, van Jaarsveld, & Ten Brinke, 1998) from this study, Thai will be compared with English in Experiments 1 and 2. Thai and English both use alphabetic systems but the orthographic and phonological representations of these two languages are completely different. In experiments 3 and 4 Mandarin Chinese will be compared with English. In this case, Mandarin Chinese and English use different writing systems: Mandarin Chinese uses logographic and English uses alphabetic system.

The present study will also investigate the role of the degree of difference between L1 and L2 semantic systems. It has been claimed (eg., Lado, 1961; Corder, 1981) that the greater the degree of difference between L1 and L2, the more difficult the learning task will be.

For the current study, the language difference were examined via the issue of simpler versus more complex semantic systems in L1 and L2. The complexity of the systems of kinship terms depends on two aspects. First, there is a number of semantic features involved in describing and distinguishing the meanings of kinship terms in each language. For example, if the number of semantic features in Mandarin is larger than in Thai and English, then the system of Mandarin is more complex than of Thai and English. Second, there is a particular number of kinship terms in a particular language. For example, in both Thai and English there are six terms in the Ego's generation, whereas there are twenty terms in Mandarin. Thus, in this generation, the system of Mandarin lexicon.

For the present purposes, the systems of Thai, Mandarin Chinese, and English kinship terms are compared and presented in Table 1 below.

The Semantic Features Used in Describing Kinship Terms

As can be seen in Table 1, there are seven features used to describe the kinship systems. These six features can be grouped into two main types of features. First, a "Binary" feature is a feature, which can employ a positive (+) or a negative(-) value to show whether this feature is present as a property of a kinship term. For example, kinship terms may be male (+Male) or female (-Male). Second, a "Scalar" feature is a feature which has values which can be presented along a scale. For example, there could be up to seven generations in describing the meanings of kinship terms.

1. Generation Differences

For the present purposes, the "generation differences" is a scalar feature. There are seven generations used to describe kinship systems:

- Generation 0 is Ego's generation or the beginning point of view in describing a system of kinship terms. Relatives in this generation are the same generation as Ego.
- Generation +1 is the first generation above Ego's generation.
- Generation +2 is the secondgeneration above Ego's generation.
- Generation +3 is the third generation above Ego's generation.
- Generation -1 is the first generation below Ego's generation.
- Generation -2 is the second generation below Ego's generation.
- Generation -3 is the third generation below Ego's generation.

2. Lineality

In the present study, "lineality" is defined as "Ego's direct relatives and their descendants" (Keesing 1975). The feature of "lineality" is a binary feature. There are the kinship terms meaning lineal relatives (+Lineal) and the kinship terms meaning non-lineal relatives (-Lineal).

3. Sex

The semantic feature of "sex" is binary. There are the kinship terms meaning male relatives (+Male) and the kinship terms meaning female relatives (-Male).

4. Paternal Side

The semantic feature of "Paternal side" is binary. There are kinship terms meaning relatives related to the father's side (+Paternal) and kinship terms meaning relatives related to the mother side (-Paternal).

5. Relative Age

The relative age is a binary. Relatives, who are older than the person at the beginning point in describing kinship terms in a generation are (+Old) whereas than who are younger are (-Old).

6. Relation to Paternal Side

The relation to Paternal side is binary. Relatives, who are related to the Paternal side through male lines are (+Male Line). Relatives who are related to the Paternal side through female line, are (-Male Line).

Values in Describing Kinship Terms

The systems of kinship terms will now be presented in Table 1 using the above features. The features will be presented in the columns and the languages will be presented in the rows. The first part of cells concerning which features are represented through root or compound kinship terms in that language. In the cells, the features will be given either value *R* meaning this feature is presented throught root words in that language and *C* meaning this feature is presented throught compound words. The second part of cells concerning the values that how these features are presented in the kinship terms of a language. In the cells, two values will be used in describing kinship terms: *Plus or Minus Value (+/-)* means that this feature can be specific *(+)* or *(-)* in a language and *Redundant Value* ⊕ means that a feature can be implied from the values of other features. For example, the Mandarin term /taŋ ge/ "Ego's father's brother's older son" is (+Paternal), (+Male Line), and (+Lineal). However, (+Lineal) can be implied from (+Paternal), and (+Male Line). Thus, the feature of lineality will be (⊕ Lineal) for /taŋ ge/.

Measures of Kinship Systems	Complexity	Lexical Weight	Features through Root&Compound Words						Valence Features				
			Generation	Lineality	Sex	Paternal Sides	Relation to	Relative Age	Generation	Lineality	Sex	Paternal Sides	Relation to
Generation -3													
Thai	5	6-7	R	R	R	C	R	R	+/-	±	+/-	+/-	+/-
Chinese	4	3	C	C	R	R	R	R	+/-	⊕	+/-	+/-	+/-
English	5	5-7	C	R	R	R	R	R	+/-	+/-	+/-	+/-	+/-
Generation -2													
Thai	5	6-7	R	R		C	R	R	+/-	±	+/-	+/-	+/-
Chinese	4	3	C	C	R	R	R	R	+/-	⊕	+/-	+/-	+/-
English	5	5-7	C	R	R	R	R	R	+/-	+/-	+/-	+/-	+/-
Generation -1													
Thai	6	3-4	R	R	C	R	R	R	+/-	±	±	+/-	+/-
Chinese	6	3	C	C	R	R	R	R	+/-	+/-	+/-	+/-	+/-
English	5	3-7	R	R	R	R	R	R	+/-	+/-	+/-	+/-	+/-
Generation o													
Thai	7	5-6	R	R	C	R	R	R	+/-	+/-	+/-	+/-	+/-
Chinese	20	3-4	R	R	R	C	C	R	+/-	+/-	+/-	+/-	+/-
English	7	4-5	R	R	R	R		C	+/-	+/-	+/-	+/-	+/-
Generation +1													
Thai	6	3-5	R	R	R	R	R	R	+/-	±	±	+/-	+/-
Chinese	7	3-6	R	R	R	R	R	R	+/-	+/-	+/-	+/-	+/-
English	5	3-5	R	R	R	R	R	R	+/-	+/-	+/-	+/-	+/-
Generation +2													
Thai	4	5	R	R	R	R	R	R	+/-	±	+/-	+/-	+/-
Chinese	4	3	C	R	R	R	R	R	+/-	⊕	+/-	+/-	+/-
English	5	5-6	C	R	R	R	R	R	+/-	+/-	+/-	+/-	+/-
Generation -3													
Thai	5	5-6	R	R	C	C	R	R	+/-	±	+/-	+/-	+/-
Chinese	4	3	C	C	R	C	R	R	+/-	⊕	+/-	+/-	+/-
English	5	5-6	C	R	R	R	R	R	+/-	+/-	+/-	+/-	+/-

Table 1 The Summary of the Relative Complexity (in number of terms), Lexical Weight (in number of sematic features), Semantic Features through Root and Compound Terms, and Feature Valence in Thai, Chinese, and English Kinship Systems

As can be seen in the table, The results of analysis show that the system of Chinese kinship terms is the more complex than Thai or English. The assumption is that bilinguals, whose L1 is more complex than L2, will find it easier to develop their L2 proficiency than those whose L1 is simpler than L2. Thus, the prediction for the present study should be that the English native speakers will find it more difficult to access Thai or Chinese than will Thai or Chinese native speakers to access English. If so, then the English-Thai bilinguals (English as L1 and Thai as L2) and the English-Chinese bilinguals (English as L1 and Mandarin Chinese as L2) should find it more difficult to respond to Thai or Chinese words than would Thai-English (Thai as L1 and English as L2) and Chinese-English bilinguals (Mandarin Chinese as L1 and English as L2).

Consistent with the analysed systems of Thai, Chinese, and English kinship terms, the lists of stimulus items using in the present priming study will be prepared.

The Present Study

The present study investigates the storage and the retrieval process of lexical items in a bilingual's two languages. In addition, the bilinguals L2 experience is systematically varied in each study with high and low L2 experience groups. Four experiments on cross-language semantic priming are presented. The design for the four experiments is the same but the participants differ. In Experiment 1 Thai-English (TE) bilinguals with Thai as L1 and English as L2 are tested. Experiment 2 concerns English-Thai bilinguals (L1 English, L2 Thai, ET); Experiment 3 Chinese-English bilinguals (L1 Chinese, L2 English, CE); and Experiment 4 English-Chinese bilinguals (L1 English, L2 Chinese, EC).

Experiment 1: Thai-English Bilinguals

Method

Participants

Forty-eight Thai-English bilingual speakers (TE, hereafter) were placed into two groups on the basis of their L2 experience. L2 experience was measured with the English Language Experience Questionnaire (see Appendix x). Those 24 participants with the highest scores (mean score = 60) were placed in the high L2 experience group (Hi group, hereafter) and the other 24 participants with lower scores scores (mean score = 29.5) were placed in the low L2 experience group (Lo group, hereafter).

Stimuli and Design

Four language conditions were used. There are the experimental sets of within Thai (L1-L1, hereafter), within English (L2-L2, hereafter), between Thai-English (L1-L2, hereafter), and between English-Thai (L2-L1, hereafter) priming conditions. In each language condition, there are 60 prime-target pairs. Half of the targets are kinship terms in the target language and the other half are not kinship terms For each target, there are three levels of semantic relation between prime and target (a) primes and targets differ by one semantic feature (Hi related pairs, hereafter), (b) primes and targets differ by more than one semantic feature (Lo related pairs, hereafter), and (c) primes and targets are semantically unrelated (Unrelated pairs, hereafter). Non-kinship terms, all similar in frequency and in the number of syllables to the targets served as the unrelated targets. These are preceded by the same primes as those preceding the kinship terms.

For the L1-L1 condition, there are 60 Thai prime-target pairs. The primes and the targets were selected according to the following procedure. Thirty Thai kinship terms were chosen from the Thai Word Frequency Corpus (see Appendix x) as the targets. Thai terms served as the Hi, the Lo related and the unrelated primes. Thirty Thai non-kinship terms, all similar in frequency and in the number of syllables to the targets, served as the unrelated targets.

For the L1-L2 condition, the same 60 Thai primes were used and 60 different Thai primes were used. The 30 targets were all English kinship terms which were translations of the Thai targets in the L1-L1 condition. The 30 unrelated English targets were translations of the Thai targets in the L1-L1 condition.

For the L2-L2 condition, there were 60 English prime-target pairs. Thirty English kinship terms were chosen from the Brown Corpus as targets. English kinship terms serve as the Hi, the Lo related and the unrelated primes. These words will be selected from the English word frequency table of Francis and Kucera (1982). In addition, English non-kinship terms, all similar in frequency and in the number of syllables to the targets, will serve as the unrelated targets.

For the L2-L1 condition, there are 60 English prime-Thai target pairs. The thirty Thai kinship term targets were translation pairs of English kinship terms in the L2-L2 condition. The semantically related and unrelated primes are the same as those in the L2-L2 condition. The Thai translation pairs of English non-kinship terms in the L2-L2 condition served as the unrelated targets.

The experimental design is rolling-design. Three lists of stimulus items were constructed such that no target appears more than once in a list. For example, targets with Hi related primes in the List 1 are preceded by Lo related primes in List 2, by unrelated primes in List 3.

The experiment involves a 2 x (2x2x3) design with one between- participant factor, language experience group (high and low English experience), and three within-participant factors, the priming language (L1 or L2), the target language (L1 or L2), and

the semantic relatedness between primes and targets (Hi related, Lo related and Unrelated).

Procedure

All participants were tested individually. The participants in each language experience group were assigned to the list conditions randomly: in each language experience group.They were asked to decide whether the targets were kinship terms or not by pressing one of the two shift keys on the keyboard appropriatedly labelled. The participants were asked to press the right key if the targets were kinship terms and the left key if the targets are not kinship terms They were asked to respond as quickly and accurately as possible. Instruction and ten practice items are given before the experimental items

The stimuli were all presented in the centre of a computer screen. In each condition there were 60 test trials. Each test trial consisted of a sequence of events as follows: a prime for 150 ms, a blank interval for 50 ms, and a target for 500 ms The presentation of the stimuli and the collection and the analysis of data were conducted out using the DMDX software developed by Kenneth I. Forster and Jonathan C. Forster at the University of Arizona in 1999. This is a windows compatible version of the DMASTR software first developed by K.I. Forster & others at Monash University in 1981.

Results and Discussion

In this and all later experiments, incorrect responses were removed from the data set. Reaction time (RT) in the tasks greater than 2000 ms and less than 200 ms were also removed. This accounted for less than 2% of the data and did not change the overall pattern of results. The mean RT, percentage errors, and degrees of priming effects are presented in Table 2.

Table 2 Mean Reaction Time (RT; in milliseconds), Priming Effects, and Percent Errors for Thai-English Speakers with High and Low English language Experience in Experiment 1.

Conditions			English Language Experience Groups			
			Hi		Lo	
PRIMES	TARGETS	Semantic Related	RTs	Errors	RTs	Errors
Thai (L1)	Thai (L1)	Unrelated	629.1	1.3	643.5	1.2
		Hi Related	568	.2	588.7	.2
		Priming	*59.7*		*86.2*	
		Lo Related	590.7	.6	615.5	.5
		Priming	*33.7*		*55.3*	
	English (L2)	Unrelated	743	1.1	726	1.7
		Hi Related	693.5	.2	692.5	.5
		Priming	*30.5*		*79.5*	
		Lo Related	712.1	.7	700.8	1.3
		Priming	*28.5*		*63*	
English (L2)	Thai (L1)	Unrelated	630.6	.9	659.4	.7
		Hi Related	622.2	.3	627.9	.2
		Priming	*36.2*		*35.6*	
		Lo Related	617.5	.3	635.8	.1
		Priming	*35*		*16.7*	
	English (L2)	Unrelated	713.1	1.1	702.4	1.7
		Hi Related	664	1	675	1.2
		Priming	*46.2*		*65.3*	
		Lo Related	663	.6	659	1.2
		Priming	*39.5*		*18.7*	

As can be seen in Table 2, there was the little evidence for priming effects in TE bilinguals. A 2 x (2 x 2 x 2) analysis of valiance (ANOVA) was conducted with L2 experience group as the between subject factor, and priming languages, target languages, and semantic relatedness as the within subject factors. The ANOVA revealed that there were no significant main effects or significant interactions, all Fs < 1. Thus for the TE participants neither L2 Experience, Priming Languages, Target Languages, or Semantic Relatedness affected the degree of semantic priming; semantic priming was statistically equivalent for all conditions.

Experiment 2: English-Thai Bilinguals

Method

Participants

Forty-eight English-Thai bilingual speakers were placed in two groups on the basis of their L2 experience as measured by the Thai Language Experience Questionnaire (see Appendix x). Those 24 participants with the highest scores scores (mean score = 35.3) were placed in the Hi group and those 24 participants with the lowest scores scores (mean score = 10.3) were placed in the Lo group.

Stimuli and Design

Experiment 2 consists of four language conditions, experimental sets of within English (L1-L1), within Thai (L2-L2,), between English-Thai (L1-L2), and between Thai-English (L2-L1) prime-target conditions. The experimental design is tha same as in Experiment 1.

For the L1-L1 condition, the primes and the targets are the same set as in Experiment 1: L2-L2 condition. For the L1-L2 condition, the primes and the targets are the same set as in Experiment 1: L2-L1 condition.For the L2-L2 condition, the primes and the targets are the same set as in Experiment 1: L1-L1 condition. Finally, for the L2-L1 condition, the primes and the targets are the same set as in Experiment 1: L1-L2 condition.

The design is as in Experiment 1.

Procedure

The procedure is identical to the procedure described in Experiment 1.

Results and Discussion

The priming effects were computed by the same procedure as in Experiment 1. The results are presented in Table 3 below.

Table 3 Mean Reaction Time (RT; in milliseconds), Priming Effects, and Percent Errors for English-Thai Speakers with High and Low English language Experience in Experiment 2.

Conditions			Thai Language Experience Groups			
			Hi		Lo	
PRIMES	TARGETS	Semantic Related	RT	Errors	RT	Errors
English (L1)	English (L1)	Unrelated	808.3	.9	845	1
		Hi Related	723.7	.1	775.8	.5
		Priming	*60.8*		*69.2*	
		Lo Related	762.3	.5	779	.7
		Priming	*37.8*		*65.2*	
	Thai (L2)	Unrelated	1300.5	1.3	1625.7	1.6
		Hi Related	1230.2	.5	1518.8	.8
		Priming	*760.3*		*144.3*	
		Lo Related	1352.8	1	1481.4	1.4
		Priming	*614.5*		*106.9*	
Thai (L2)	English (L1)	Unrelated	743	.6	812.2	.5
		Hi Related	731.7	.1	843.6	.4
		Priming	*2.4*		*-31.5*	
		Lo Related	744.7	.2	851.3	.1
		Priming	*-9.5*		*-39.1*	
	Thai (L2)	Unrelated	1009.2	1	1222.1	1.5
		Hi Related	983.2	.8	1184.7	1.3
		Priming	*85.1*		*37.5*	
		Lo Related	1009.2	.7	1185.8	1.1
		Priming	*84.2*		*36.4*	

The results of ET bilinguals are presented in Table 3. A 2 x (2 x 2 x 2) analysis of valiance (ANOVA) was conducted with L2 experience group as the between subject factor, and priming languages, target languages, and semantic relatedness as the within subject factors. The ANOVA revealed no main effect or interaction of semantic relatedness. There was a significant main effect of the between-subject factor, L2 Experience, $F(1, 46) = 9.873$, $p<.05$ with greater priming effects in the Hi (mean = 204.5) than in the Lo (mean = 48.6) L2 experience group.

There was also a significant difference in the effect of priming language, $F(1, 46) = 10.592$, $p<.05$, indicating that the priming effect for L1 primes was stronger than for L2 primes. There was also a significant effect of target language, $F(1, 46) = 18.191$, $p<.05$, indicating that the priming effect for L2 targets was stronger than for L1 targets. Of greater interest, however, these main effects were qualified by a significant interaction between L2 Experience and Priming Language, $F(1, 46) = 3.187$, $p<.05$ and between L2 Experience and Target Language, $F(1, 46) = 8.793$, $p<.05$.

As can be seen, the degree of priming occurring for the main effects of Priming Language or Target Language were accentuated with high L2 experience.

Experiment 3: Chinese-English Bilinguals

Method

Participants

Forty-eight Chinese-English bilingual speakers were placed in two groups on the basis of their L2 experience as measured by the English Language Experience Questionnaire (see Appendix). Those 24 participants with the highest scores scores (mean score = 49.6) were placed in the Hi group and those 24 participants with the lowest scores scores (mean score = 22) were placed in the Lo group.

Stimuli and Design

Experiment 3 consists of four language conditions: within Chinese Chinese (L1-L1), within English (L2-L2,), between Chinese-English (L1-L2), and between English-Chinese (L2-L1) priming conditions. The experimental design is the same as in Experiment 1.

For the L1-L1 condition, there are 60 Chinese prime-target pairs. The primes and the targets were selected according to the following procedures. Thirty Chinese kinship terms will be chosen from the Chinese Word Frequency Corpus as the targets (Department of Computer Science and Information Engineering, National Chiao-Tung University, Taiwan, 1993). Chinese kinship terms with one and more than one different semantic feature, serve as the Hi and the Lo related primes respectively. Chinese non-kinship terms serve as the unrelated primes. These words were selected from Chinese word frequency corpus (1993). In addition, Thirty Chinese non-kinship terms, all similar in frequency and in the number of syllables to the targets, served as the unrelated targets.

For the L1-L2 condition, there are 60 Chinese prime-English target pairs. Thirty English kinship terms, which are translation pairs of Chinese kinship terms in the L1-L1 condition served as the kinship targets. The semantically related primes, the unrelated primes are the same as in the L1-L1 condition. The English translation pairs of Chinese non-kinship terms in the L1-L1 condition served as the unrelated targets.

For the L2-L2 condition, the primes and the targets are the same set as in Experiment 1: L2-L2 condition.

For the L2-L1 condition, there are 60 English prime-Chinese target pairs. Thirty Chinese kinship terms, which are translation pairs of English kinship terms in the L2-L2 condition served as the kinship targets. The semantically related primes, and the

unrelated primes are the same as in the L2-L2 condition. The Chinese translation pairs of English non-kinship terms in the L2-L2 condition served as the unrelated targets.

As in the Experiment 1, a rolling design was used and the experiment involves a 2x(2x2x3) design with one between- participant factor, Language Experience Group (high and low English experience), and three within-participant factors, Priming Languages (L1 or L2), Target Languages (L1 or L2), and Semantic Relatedness between primes and targets (Hi related, Lo related, and Unrelated).

Procedure

The procedure is identical to the procedure described in Experiment 1.

Results and Discussion

The priming effects were computed by the same procedure as in Experiment 1. The results are presented in Table 4 below.

Table 4 Mean Reaction Time (RT; in milliseconds), Priming Effects, and Percent Errors for Chinese-English Speakers with High and Low English language Experience in experiment 3.

Conditions			English Language Experience Groups			
			Hi		Lo	
PRIMES	TARGETS	Semantic Related	RT	Errors	RT	Errors
Chinese (L1)	Chinese (L1)	Unrelated	687.2	.8	738.8	.4
		Hi Related	528.3	.1	586.9	.1
		Priming	*159*		*151.8*	
		Lo Related	565.7	.3	627.8	.2
		Priming	*121.5*		*110.9*	
	English (L2)	Unrelated	810.5	.6	761.9	1.8
		Hi Related	773.8	.1	697.1	1.5
		Priming	*36.7*		*64.8*	
		Lo Related	780.9	.3	709	.9
		Priming	*29.6*		*53*	
English (L2)	Chinese (L1)	Unrelated	752.9	.9	683.75	.2
		Hi Related	628.8	.3	681.6	.1
		Priming	*38.8*		*2.2*	
		Lo Related	635.6	.6	682	.1
		Priming	*32*		*1.7*	
	English (L2)	Unrelated	667.6	.7	769.8	1.4
		Hi Related	697	.1	720.3	.7
		Priming	*55.8*		*49.5*	
		Lo Related	703.5	.3	720.7	1
		Priming	*49.4*		*49.1*	

A 2 x (2 x 2 x 2) analysis of variance (ANOVA) was conducted with L2 experience group as the between subject factor, and priming languages, target languages, and semantic relatedness as the within subject factors.

There was no significant effect of Semantic Relatedness, or its interactions. The only significant main effect; Priming Language, $F(1, 46) = 8.388$, $p<.05$, such that the priming effect for L1 priming (90.9 ms) was stronger than for L2 priming (34.8 ms). This Priming Language effect was qualified by a significant interaction between Priming Language and Target Language, $F(1, 46) = 15.863$, $p<.05$. As can be seen this interaction is due to the degree of priming occuring for L1 primes being facilitated by L1 Targets, whereas, for L2 primes the priming effect is reduced by L1 Targets. Thus priming is greatest for the within-language prime-target pairs, L1-L1 and L2-L2 with the overall degree for priming being greater for L1-L2 (Chinese-English) than for L2-L1 (English-Chinese) pairs.

Experiment 4: English-Chinese Bilinguals

Method

Participants

Forty-eight English-Chinese bilingual speakers were placed in two groups on the basis of their L2 experience as measured by the Chinese Language Experience Questionnaire (see Appendix). Those 24 participants with the highest scores scores (mean score = 48) were placed in the Hi group and those 24 participants with the lowest scores scores (mean score = 26.7) were placed in the Lo group.

Stimuli and Design

Experiment 4 consists of four language conditions, experimental sets of within English (L1-L1), within Chinese (L2-L2,), between English-Chinese (L1-L2), and between Chinese-English (L2-L1) prime-target conditions. The experimental design is tha same as in Experiment 1.

For the L1-L1 condition, the primes and the targets are the same set as in Experiment 3: L2-L2 condition. For the L1-L2 condition, the primes and the targets are the same set as in Experiment 3: L2-L1 condition. For the L2-L2 condition, the primes and the targets are the same set as in Experiment 3: L1-L1 condition. Finally, for the L2-L1 condition, the primes and the targets are the same set as in Experiment 3: L1-L2 condition.

. As in Experiment 1, a rolling design was used and the experiment involves a 2x (2x2x3) design with one between-participant factor, language experience group (high and low English experience), and three within-participant factors, the priming language

(L1 or L2), the target language (L1 or L2), and the semantic relation between primes and targets (Unrelated, Hi related, and Lo related).

Procedure

The procedure is identical to the procedure described in Experiment 1.

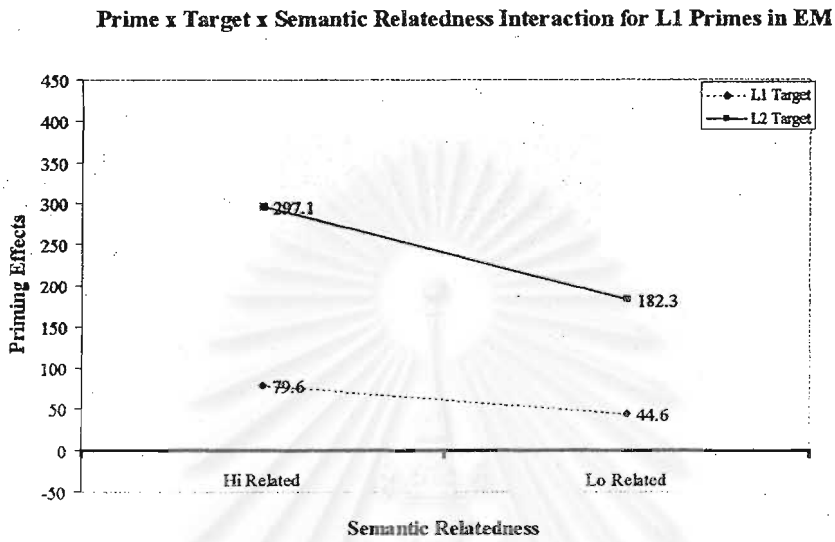
Results and Discussion

The priming effects were computed by the same procedure as in Experiment 1. The results are presented in Table 5 below.

Table 5 Mean Reaction Time (RT; in milliseconds), Priming Effects, and Percent Errors for English-Chinese Speakers with High and Low Chinese language Experience in Experiment 4.

Conditions			Chinese Language Experience Groups			
			Hi		Lo	
PRIMES	TARGETS	Semantic Related	RT	Errors	RT	Errors
English (L1)	English (L1)	Unrelated	769.1	.7	844.3	.8
		Hi Related	674.2	0	780	.5
		Priming	*95*		*64.3*	
		Lo Related	738.9	.4	787.1	.1
		Priming	*30.2*		*59*	
	Chinese (L2)	Unrelated	979.6	1.3	1025.1	1.9
		Hi Related	688.3	.3	731.2	1.5
		Priming	*291.3*		*302.9*	
		Lo Related	798.8	.9	839	.9
		Priming	*180.8*		*183.9*	
Chinese (L2)	English (L1)	Unrelated	820	.8	860.9	2
		Hi Related	816.5	.3	906.3	1.8
		Priming	*3.5*		*-37.6*	
		Lo Related	832	.4	587.7	1.7
		Priming	*-12.1*		*-42.8*	
	Chinese (L2)	Unrelated	986.6	.9	830.6	.5
		Hi Related	885.3	.3	776.6	.4
		Priming	*101.3*		*64*	
		Lo Related	895	.3	800.6	1.7
		Priming	*87.5*		*46.6*	

A 2 x (2 x 2 x 2) analysis of variance (ANOVA) was conducted with L2 experience group as the between subject factor, and priming languages, target languages, and semantic relatedness as the within subject factors. There was a main effect of Priming Language, $F(1, 46) = 45.341$, $p < .05$, such that the priming effect for L1 primes (mean =150.9 ms) was stronger than for L2 primes (mean = 26.3 ms). The effect of Target Language was also significant, $F(1, 46) = 108.903$, $p<.05$, indicating that the priming effect for L2 targets (mean = 157.3) was stronger than for L1 targets (mean = 19.9). The effect of Priming Language was qualified by a significant interaction between Priming Language and Target Language, $F(1, 46) = 6.319$, $p<.05$, due to greatest for L2 Targets (see Figure x). In addition, there was a significant main effect of Semantic relatedness, $F(2, 45) = 26.054$, $< .05$, with greater priming effects for Hi related pairs (110.6) than for the Lo related pairs (66.6) and significant interactions between Priming Language and Semantic relatedness, $F(2, 45) = 10.987$, $p<.05$, between Target Language and Semantic relatedness, $F(2, 45) = 5.96$, $p<.05$, and between Priming Language, Target Language and Semantic relatedness, $F(2, 45) = 4.126$, $p<.05$.



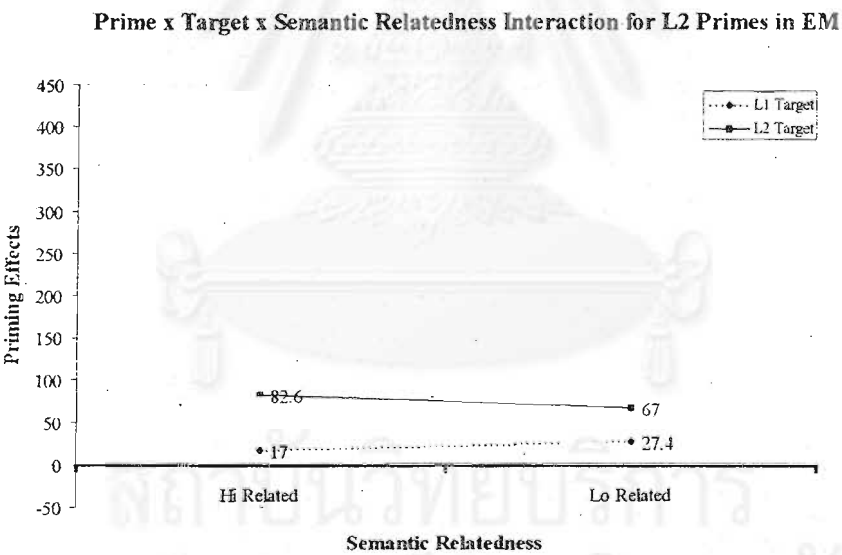


Figure 1 The Interaction between Priming Language, Target Language, and Semantic relatedness. The Result of L1 Priming is presented in Figure 1a and L2 Priming in Figure 1b

As can be seen in Figure 1, these results indicate that the degree of priming from the main effects of Priming Language, Target Language, and their interaction (Experiments 1 and 3) are qualified by the effect of Semantic Relatedness. That is, priming effects were greater for the Hi related items. As can be seen there is generally greater priming for L2 primes, and for L2 targets, irrespective of Semantic Relatedness. However, for Hi Semantic Relatedness, the degree of facilitation for L2 targets or in L1 targets is extremely high, compared to for Lo Semantic Relatedness.

General Discussion

The purpose of the present study was to investigate whether L1 and L2 semantic information is stored and retrieved from a shared semantic system or via two language specific semantic systems in bilinguals with high and low L2 experience. The results of Experiments 1 to 4 demonstrate cross-language priming effects supporting the notion that the semantic representations of words in a bilingual's two languages are integrated within a shared conceptual system. The hypothesis that words in different languages are stored apart from one another in language-specific conceptual representation systems is not supported by the results of present study.

To illustrate this claim and compare the results of the four experiments the Priming Language x Target Language Interaction are shown in Figure 2 below.

As can be seen in Figure 2a and 2c, the interaction of Priming Language and Target Language in TE and ME bilinguals (Experiments 1 and 3) described a similar pattern. That is, L1 Primes produced slightly stronger effects than L2 Primes and L1 Targets produced slightly stronger effects than L2 Targets. In addition, the L1 Prime effect was increased by L1 Target but reduced by L2 Target, and the effect of L2 Primes was increased by L2 Targets but reduced by L1 Targets. That is priming was generally better within than between languages.

The interaction of Priming Language and Target Language in ET and EM bilinguals also illustrate a similar pattern, but one which is quite different from the pattern obtained in TE and ME bilinguals. For ET and EM bilinguals L1 Primes produced stronger effects than L2 Primes and L2 targets produced stronger effects than L1 targets. Thus, the L1 priming effect was accentuated by L2 Targets but reduced by L1 Targets; and the L2 priming effect was increased by L2 Targets but reduced by L1 Targets.

The results of the experiments 1 and 3 confirm the findings of previous studies in that primes or targets in L1 will produce stronger effects than primes or targets in L2 (although note that the priming effects in Experiment 1 were not significant).

Moreover, they also support findings that the effect of L1 Primes is increased by L1 targets, but reduced by L2 Targets, whereas, the effect of L2 Priming is increased by L2 Targets but reduced by L1 Targets. Thus, there was stronger priming effect in the

L1-L2 condition than in the L2-L1 condition. The present data are consistent with the revised hierarchical models proposed by Kroll and Stewart (1994).

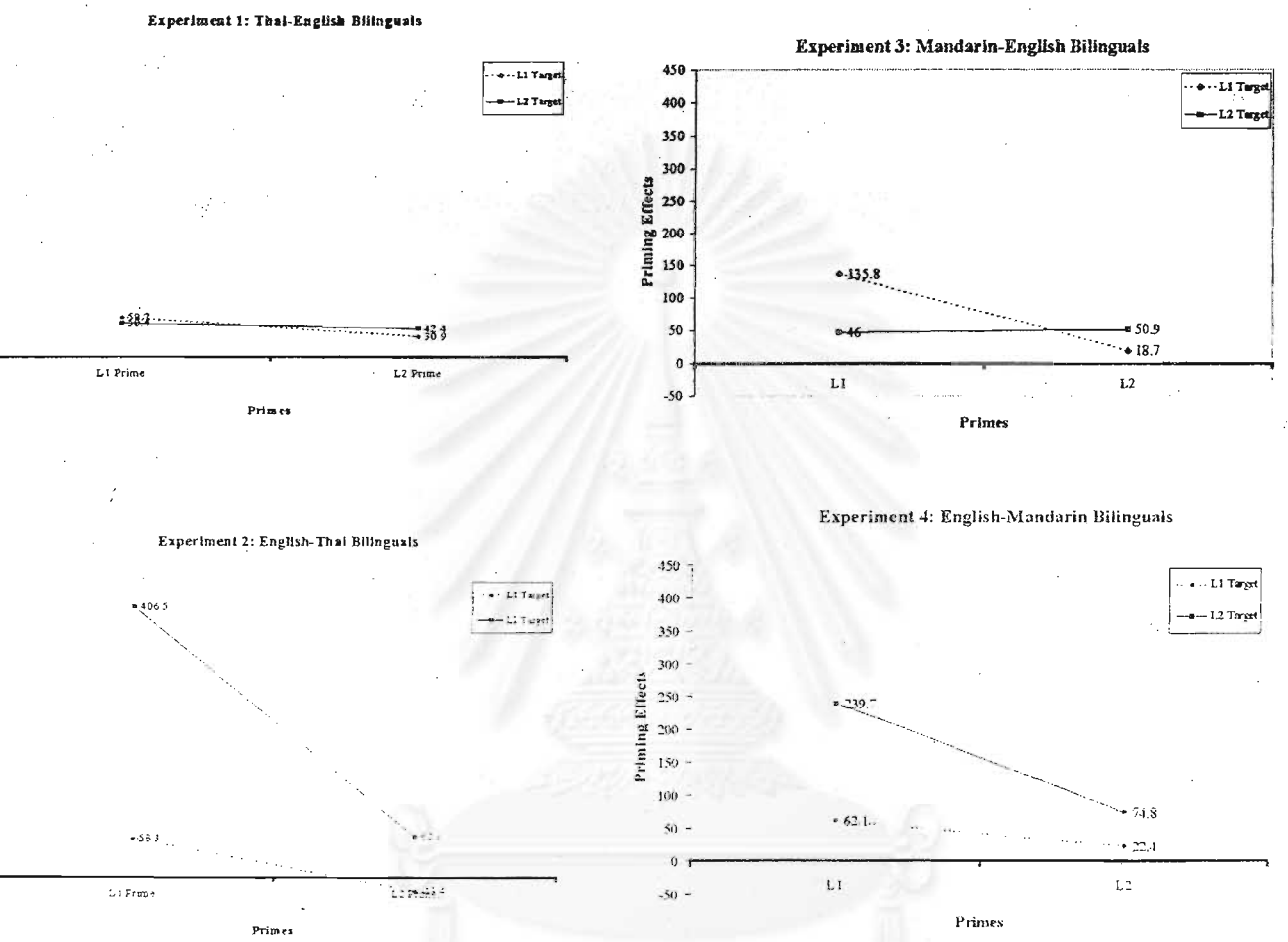


Figure 2 The Interaction between Priming Language and Target Language for TE (Figure 2a), ET (Figure 2b), ME (Figure 2c), and EM (Figure 2d)

In the present studies, an effect of L2 Experience was obtained only in Experiment 2 and the effect of Semantic Relatedness was obtained in only Experiment 4. Thus, in general the effect of Hi and Lo L2 Experience and Hi and Lo Semantic Relatedness did not greatly affect the results.

Nevertheless, the pattern of priming effects observed in Experiment 2 is relevant to the hypothesis that bilinguals with different L2 experience will have a different mode of L2 lexical access.

The effect of Semantic relatedness, which reaches significance in only Experiment 4, repeats a previous finding from semantic priming study in that there was stronger effects when the primes and the targets were semantically related than when they were unrelated (eg. Seidenberg &McClellan, 1989). However, it is very difficult to sustain any general arguments regarding the effects of L2 Experience and Semantic Relatedness in the present study because these two main effects are not consistently found across the four experiments.

The Collaborate of L2 Experience and the Neighborhood Effects in L2 Lexical Access

More generally with respect to Experiments 2 and 4, is why were they stronger priming effects for targets in L2 (Thai in Experiment 2 and Mandarin in Experiment 4)? There are no reports of stronger priming effects for L2 targets than for L1 targets in previous studies. It might be due to English being the L1 in these two experiments or it might be argued that the stronger effects observed in L2 than in L1 targets results more from the types of lexical access that are performed in L2 compare with L1.

In order to explain this result, the notion of neighborhood effects may be applied to the present study. According to the previous studies of orthographic and phonological neighborhood effects (eg., Sears, Hino & Lupker, 1993; Snodgrass & Mintzer, 1993), the number of orthographic and phonological neighborhood words that a target words has (N) can facilitate accessing that target word. That is, when N increases, RT to access is faster in both within and between-language conditions.

To help describe the analysis of neighborhood. For this study, let us propose the term *semantic neighborhood*. For the present study, semantic neighbors are defined as the words of identical meanings and identical morphological units (in number of units), which can be generated by a single semantic feature substitution. Accordingly, the word /a0/ 'father's younger brother or sister', /luŋ0/ 'father's oldeer brother' , /pa2/ 'father's older sister', /mæ2/ 'motyer' and /pu1/ 'father's father' are the semantic neighbors of /pɔ2/ 'father' in Thai, whereas, there is only one semantic neigbor of /fɑthər/ 'father' in English, that is - /mɑthər/ 'mother'.

In the present study, the analysis of kinship terms in Thai, Chinese, and English showed that are more kinship terms within both Thai and Mandarin than within English. This implies that for a particular Thai or Chinese kinship term, there are more semantically neighborhood words than in English. Given that words with a high number of neigborhoods will generate higher degree of lexical activation, then increasing the number of neighborhood words may facilitate faster reaction times in access. Thus the reaction times in accessing Thai and Chinese terms should be faster than in English and leading to greater priming effects in L2 targets, either in Thai or Chinese.

The more interesting point is that the mean scores obtained from L2 experience questionnaires in Experiment 2 and 4 are lower than those in Experiment 1 and 3 but the degree of priming effects in L2 targets in Experiment 2 and 4 are stronger than those in

Experiment 1 and 3. In this study, we will attempt to explain these results that the beginning L2 learners or the low L2 experience bilinguals will rely on context in accessing L2 words more than the high L2 experience bilinguals (Hulstijn, 1997). That is high L2 experience bilinguals will rely on word forms themselves, regardless of the context of L2 words. Thus, we can further imply that the greater the number of semantic neighborhood words, the greater the imagery and the more context there is to facilitate accessing the meanings of L2 words. Finally, the more facilitated L2 accessing led to stronger priming effects in the ET and EM participants, whose L2 experience is lower than TE and CE participants.

These research questions may lead to the discovering that there are more complicated factors and interactions between factors determining L2 lexical access, than previous studies in L2 lexical access indicated. The findings of the present study may reflect the different patterns of priming effects in L2, which may lead to further interesting studies of these issues.

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APPENDIX J

Models of Lexical Access in Bilinguals

Introduction

The nature of the bilingual lexicon is a basic issue in bilingual research. The main focus is how lexical and conceptual information are represented and accessed by bilingual speakers. The first part of this paper concerns the major theoretical viewpoints on the lexical access models in bilinguals. The second part of this paper reports new empirical research on lexical access in bilinguals using cross-language semantic priming.

There are several considerations that apply specifically to learning a second language (L2) as an adult. These relate to aspects of the learning situation, both external and internal to the learner. A prominent internal factor is that an L2 is learned in the context of an established L1 semantic/conceptual system. Thus L2 learners may overly rely on this body of knowledge when learning new L2 words (see Jenkin, Prior, Rinaldo, Wain-Wright-Sharp & Bialystock, 1993). This may lead to a failure to understand the full range of semantic relationships involved in the L2 semantic system. A prominent external factor influencing L2 learning that reinforces the above internal constraint, is that L2 learning often takes place in an institutional context that often limits the quantity and quality of exposure to L2 semantic context. These limitations in the learning situation may have consequences for the type of L2 representation developed and the type of processing that this representation engages. These consequences will be explored below.

Theoretical Models of Lexical Access in Bilinguals

The aim of what has become a research tradition in psycholinguistics has been to understanding how the mental representation of a bilingual speaker's two languages are stored and retrieved. Models of lexical access in bilinguals can be divided into two overlapping domains: Lexical organization and lexical processing and retrieval.

With respect to word organization, two models of bilingual lexical access have traditionally been the focus of research. Kolers (1963) raised two important hypotheses concerning the bilingual lexicon: (a) the Independence hypothesis and (b) the Interdependence hypotheses. With respect to word retrieval processes, a distinction has been made between (a) Word Association and (b) Concept Mediation models (Potter, So, Von Eckardt, & Feldman, 1984; Kroll & Curley, 1988).

Organization of Word Knowledge in the Bilingual Lexicon

a) The Independence Hypothesis

The independence hypothesis assumes that within language lexical associations are more strongly linked than across language translation equivalents. In effect this means that there is no direct connection between the lexical forms of each language. Support for this dissociation comes from experiments contrasting performance on single and mixed language lists. For example, Kolers (1966b) found that English-French bilinguals took less time to read passages that were written in either of their two languages, than passages that were written in both languages, (i.e., some words were written in English and some in French). In addition, Kintsch (1970) reported better recognition memory when subjects were tested on the same word list that they were familiarized with, than when they were tested on translated versions of the familiarized list.

b) The Interdependence Hypothesis

The interdependence hypothesis assumes that the corresponding words in two languages are closely stored in terms of their word forms. Supporting evidence for the interdependent hypothesis in bilinguals is derived from experiments demonstrating cross-language Stroop interference effects (eg. Chen and Ho, 1986; Tzelgov et al., 1990; Sudasna, Luksaneeyanawin, & Burnham, 2001).

In the traditional Stroop tasks (Stroop, 1935) colour words, such as the words "BLUE" are written in non-matching ink colours, e.g. red in this case. Participants asked to name the ink colour (red) in such conflicting conditions are found to do so more slowly than in matching conditions in which the colour word and ink colour match, e.g. "RED" written in red ink. The Stroop effect indicates that people read words even when it is not conducive to performing the task at hand. Cross-language Stroop effects, in which the stimuli are in one language (the participant's L1 or L2) but the response to the ink colour is required in the participant's other language, show similar interference effects to the traditional within language Stroop effect, providing support for the interdependence hypothesis of the bilingual lexicon.

The Retrieval of Word Knowledge in the Bilingual Lexicon

Potter, So, Von Echardt, & Feldman (1984) proposed two hypotheses concerning the nature of the bilingual mental lexicon, the Word Association, and the Concept Mediation hypotheses. These are shown sematically in Figure 1, and described in below.

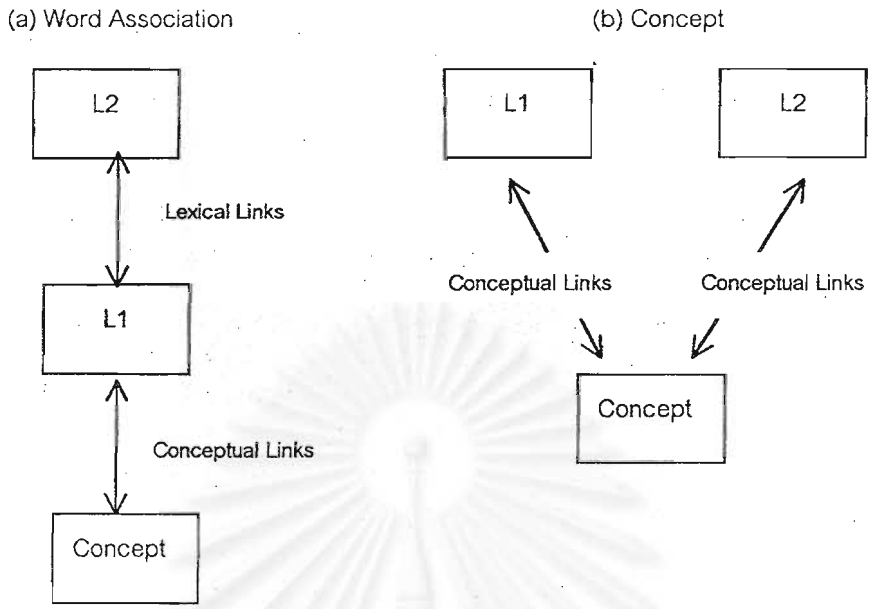


Figure 1 The Word Association (a) and Concept Mediation Models (b) (adapted from Potter et al., 1984)

(a) Word Association Model

According to the Word Association model, words and concepts in L1 and L2 are stored in and retrieved from a single interlingual lexical and semantic system. That is, words in L1 and L2 share the same (L1) semantic system. However, whereas words presented in L1 can directly access concepts from the semantic system, words presented in L2 can only access concepts from the semantic system via words with the same meaning in L1.

b) Concept Mediation Model

In contrast to the Word Association model, in the Concept mediation model words in L1 and L2 are stored in and retrieved from two intralingual lexical systems. Thus, concepts in L1 and L2 are stored in and retrieved from the same semantic system. So, words in both languages directly access concepts from the language-general semantic system. The concept mediation model proposes that those word forms in L1 and L2 independently occur in the same semantic system.

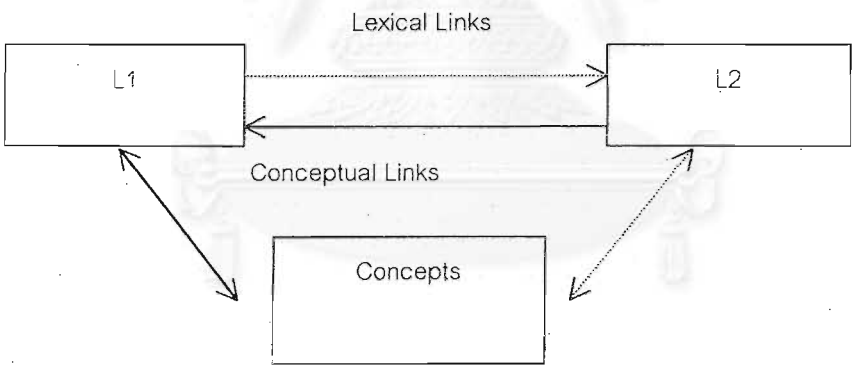
The word association model (Dalrymple-Alford, 1968; Rosenberg & Simon, 1977) and the concept mediation model (Kintsch, 1970; Gerard & Scarborough, 1989) have both been supported by research. For instance, to examine the word association and concept mediation hypotheses, Talamas, and Kroll (1993) asked reasonably fluent bilinguals to perform a translation recognition task in which they had to decide whether pairs of words, one member of the pair from each language, were translation equivalents. They found longer reaction times in both form-related word pairs and meaning-related word pairs than in unrelated word pairs. They also found that the less fluent bilinguals

produced longer reaction times in the form-related than in the meaning-related word pairs suggesting that in less fluent bilinguals, the lexicon be structured somewhat like the word association model. On the other hand, more fluent bilinguals produced longer reaction times in the meaning-related than in the form-related word pairs suggesting a closer match of their lexicon with the concept mediation hypothesis. The implication is that fluency in L2 determines whether the lexicon is organized in terms of the word association or concept mediation hypothesis.

Lexical Access in Bilingual Speakers with Different L2 Proficiency:

The Revised Hierarchical Hypothesis

More recent studies have generally acknowledged the presence of different types of storage and retrieval process and the research focus has shifted to investigating the factors that play a role in the models of bilingual lexical access.
Previous works (Chen & Ho, 1986; Chen & Leung, 1989; Kroll & Curleg, 1988; Potter et al., 1984) studied bilinguals with differing L2 proficiency. Results of these studies suggest that for bilinguals with low L2 proficiency, words in L2 access the meanings through words in L1, that is, in terms of the word association hypothesis. For bilinguals with high L2 proficiency, words in L2 directly access meaning. On the basis of these studies, a third hypothesis of the bilingual lexicon has been proposed, the Revised Hierarchical Hypothesis (Kroll & Stewart, 1992) as shown in Figure 2.



The Revised Hierarchical Hypothesis

Figure 2 The Revised Model of the Bilingual Lexicon (adapted from Kroll & Stewart, 1994)

According to the Revised Hierarchical Hypothesis, words in L1 and L2 are interconnected via lexical links. However, lexical links from words in L2 to words in L1 are stronger than those from words in L1 to words in L2. Thus, accessing the meanings of words in L2 via words with the same meanings in L1 is faster than accessing the meanings of words in L1 via words with the same meanings in L2. In addition, this

hypothesis assumes that words in both L1 and L2 directly access concepts from the semantic system. However, the conceptual links from words in L1 to the semantic system are stronger than those from words in L2. Thus, words in L1 are retrieved from the semantic system faster than words in L2. Experimental support for this hypothesis comes from studies using cross-language Stroop tasks and word translation studies. For example, Chen and Ho (1986) demonstrated that when the bilinguals were low proficient in L2, they show more interference from L1 words than from L2 words when they were asked to respond in L2. However, when they became more proficient in L2, they showed more interference from L2 words to L1 responses and less interference from L1 words to L2 responses.

In the following section, studies testing both the organization and the retrieval process models of the bilingual mental lexicon by using cross-language semantic priming tasks will be described, but first some discussion of semantic priming is required.

Semantic Priming

In the study of lexical access, various experimental methods have been employed, for example, free recall tasks (e.g., Kolers, 1966a), Stroop interference task (Magiste, 1984, 1985; Chen & Ho, 1986), and priming tasks (Ferrand & Grainger, 1994). The latter, priming tasks, are an effective way to investigate both the monolingual and the bilingual lexicons. Previous studies (e.g., Bijeljac-Babic, Biardeau, & Grainger, 1997; Grainger & Ferrand, 1994) have shown that priming tasks are an important source of evidence for the mechanics of lexical access.

In a priming task, participants are presented with a sequence of stimulus items, as shown in Figure 3. A sequence consists of a briefly-presented word or "prime" for 100 to150 ms, followed by another word or "target" for 500 ms. Participants are asked to make a response to the target that recruits lexical knowledge. In the masked priming procedure, participants are conscious of the target but cannot report the prime. However, the work to be reported below did not use the masked but rather the rapid priming method where the SOA between the prime and target was brief but long enough for participants still to be aware of the prime stimuli. The use of short prime-target SOA is thought to mitigate the effects of deliberative strategic processing but in this case does not involve masking which may itself evoke a monolingual mode of processing. There are various response methods that have been used to indicate priming effects. One of the most frequently used is the lexical decision task, in which participants are required to decide whether the target is a word or not, with word and non-word targets being equally probable on each trial.

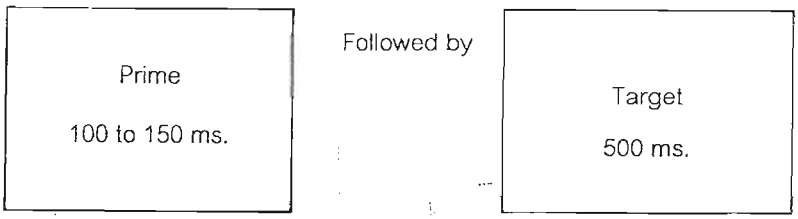


Figure 3 The sequence of the stimulus items in the rapid version of the Priming Task.

Previous studies have shown that priming effects are stronger when the primes and the targets are related (phonologically, orthographically, semantically, or syntactically) than when they are unrelated even when the participants are unaware of the primes. This suggests that some of the properties of the primes overlap with those of the targets such that processing of the primes facilitates the processing of the targets. It is this property of primes that is useful in delineating the relationships between words. For instance, priming effects can be found using primes and targets that are phonologically related, e.g. "real" and "reel", or syntactically and semantically related e.g. "boy" and "girl". The concern of the current paper is with semantic processing and this is investigated via a set of experiments that used a semantic priming task, in which the primes and the targets are semantically related. In this, a priming effect is obtained by measuring the reaction time (RT) to make a decision about the semantic properties of a target preceded by a semantically related prime, and subtracting from this the time to make a semantic decision about a control stimulus, a target semantically unrelated to its prime.

This is in line with monolingual studies (Lowe, 1999; Taft, 1991), which have shown that priming effects are stronger if targets follow primes that are in the same semantic category. For example, lexical decision on the target "man" is faster when it is followed by a prime such as "boy" compared with when it has been followed by an unrelated prime such as "car". This is thought to be because when the participants see the primes, they retrieve semantic information about them. If the primes and the targets are related, then those semantic properties of the targets that overlap with the semantic properties of the primes have already been accessed before the subjects see the target. As a result, when the participants see the targets, they can retrieve and respond to them faster. In this way it can be seen that the priming effect, as measured by RT to respond to a related vs an unrelated target, is inversely related to the semantic relatedness of that word and its prime. Thus priming effects can be used to measure the nature of the semantic system in the mental lexicon. However, many recent studies have pointed to problems with the use of lexical decision as a measure of lexical access (Kroll, 1993; Taft, 1991). The problem is that as lexical decision is a binary choice task, there are a variety of post-access decision mechanisms that come into play, such as the familiarity of the targets to the participants. Thus if a word is familiar, it is more likely that participants will decide that it is a "word" than if a target is unfamiliar to the participants. A method to investigate semantic structure that may be more appropriate is the 'semantic categorization' task, in which the subjects are asked to decide whether the targets are a member of a particular semantic class. For example, subjects may be required to decide whether the word "apple" is a member of the semantic field "fruit". In the experiments described below, we use the semantic categorization task to measure priming effects.

Studies Using the Cross-Language Semantic Priming Task

In the following section we report the results of four experiments that used rapid priming in conjunction with a semantic classification task (in this case, whether the target was a kinship term or not). In each experiment, there were four prime-target conditions, within L1, within L2, L1 prime - L2 target, and L2 prime -L1 target, each with 60 prime-target pairs. Half of the targets were kinship terms in the target language and the other half are not kinship terms. For each target, there were three levels of semantic relation between prime and target: (a) primes and targets differing by one semantic feature (Hi related pairs, hereafter), (b) primes and targets differing by more than one semantic feature (Lo related pairs, hereafter), and (c) semantically unrelated primes and targets (Unrelated pairs, hereafter). Non-kinship terms, all similar in frequency and in the number of syllables to the targets served as foils in the kinship semantic judgment task. These are preceded by the same primes as those preceding the kinship terms. In Experiment 1 Thai-English bilinguals with Thai as L1 and English as L2 are tested. Experiment 2 concerned English-Thai bilinguals (L1 English, L2 Thai); in Experiment 3 Mandarin-English bilinguals were tested (L1 Mandarin, L2 English); and Experiment 4 tested English-Mandarin (L1 English, L2 Mandarin). Incorrect responses and reaction times greater than 2000 ms and less than 200 ms were removed from the data. This accounted for less than 2% of the data and did not change the overall pattern of results. Priming effects were computed by subtracting the Mean RT in therelated conditions from the mean RT in its corresponding unrelated condition.

Predictions

In order to investigate cross-language semantic priming effects in the current study, the stimulus sets, a category of words, namely kinship terms in Thai, English, and Chinese was selected. Differences among kinship terms in these three languages may be expected, in terms of writing systems and semantic systems. With respect to the effects of the writing system on L2 lexical access, Chinese logography is a system in which the basic unit in writing associates with a unit of meaning, a morpheme. There is no unit that encodes single phonemes, nor are there grapheme to phoneme conversion rules. Thus Chinese is a meaning based writing system, which is quite different from alphabetic writing systems. In contrast, in alphabetic writing systems (such as Thai and English), access to semantic and lexical information must arise via of phonological information. Thus alphabetic writing systems need simultanous availability of graphemic, phonological, and semantic information. So, whereas alphabetic writing systems encourage an explicit sublexical relationship between graphic and phonological forms, in a logographic writing systems, this process may be different. In order to exclude the effects of cognates and interlingual homographs on L2 access from this study, accessing Thai kinship terms will be compared with accessing English terms in Experiments 1 and 2. Thai and English languages both use alphabetic systems but the orthographic and phonological representations of these two languages are completely

different. In Experiments 3 and 4 accessing Mandarin Chinese terms will be compared with accessing English terms. In this case, Mandarin Chinese and English languages use different writing systems: Mandarin Chinese uses logographic and English uses alphabetic system. The present study will also investigate the role of the degree of difference between prime and target semantic relation. It has been claimed that the greater semantically relation between primes and targets, the faster reaction times and stronger priming effects. For the present purposes, the systems of Thai, Mandarin Chinese, and English kinship terms are linguistic analysised respect to the following analysis methods

The Semantic Features Used in Describing Kinship Terms

In order to analyze the meanings of kinship terms, there are seven features used to describe the kinship systems. These six features can be grouped into two main types of features. First, a "Binary" feature is a feature, which can employ a positive (+) or a negative (-) value to show whether this feature is present as a property of a kinship term. For example, kinship terms may be male (+Male) or female (-Male). Second, a "Scalar" feature is a feature which has values which can be presented along a scale. For example, there could be up to seven generations in describing the meanings of kinship terms.

1. Generation Differences

For the present purposes, the "generation differences" is a scalar feature. There are seven generations used to describe kinship systems:

- Generation 0 is Ego's generation or the beginning point of view in describing a system of kinship terms. Relatives in this generation are the same generation as Ego.
- Generation +1 is the first generation above Ego's generation.
- Generation +2 is the second generation above Ego's generation.
- Generation +3 is the third generation above Ego's generation.
- Generation -1 is the first generation below Ego's generation.
- Generation -2 is the second generation below Ego's generation.
- Generation -3 is the third generation below Ego's generation.

2. Lineality

In the present study, "lineality" is defined as "Ego's direct relatives and their descendants" (Keesing 1975). The feature of "lineality" is a binary feature. There are the kinship terms meaning lineal relatives (+Lineal) and the kinship terms meaning non-lineal relatives (-Lineal).

3. Sex

The semantic feature of "sex" is binary. There are the kinship terms meaning male relatives (+Male) and the kinship terms meaning female relatives (-Male).

4. Paternal Side

The semantic feature of "Paternal side" is binary. There are kinship terms meaning relatives related to the father's side (+Paternal) and kinship terms meaning relatives related to the mother side (-Paternal).

5. Relative Age

The relative age is a binary. Relatives, who are older than the person at the beginning point in describing kinship terms in a generation are (+Old) whereas than who are younger are (-Old).

6. Relation to Paternal Side

The relation to Paternal side is binary. Relatives, who are related to the Paternal side through male lines are (+Male Line). Relatives who are related to the Paternal side through female line, are (-Male Line).

Values in Describing Kinship Terms

The systems of kinship terms will now be presented in Table 1 using the above features. The features will be presented in the columns and the languages will be presented in the rows. The first part of cells concerning which features is represented through root or compound kinship terms in that language. In the cells, the features will be given either value *R* meaning this feature is presented throught root words in that language and *C* meaning this feature is presented throught compound words.

The second part of cells concerning the values that how these features are presented in the kinship terms of a language. In the cells, two values will be used in describing kinship terms: *Plus or Minus Value (+/-)* means that this feature can be specific *(+)* or *(-)* in a language and *Redundant Value* ⊕ means that a feature can be implied from the values of other features. For example, the Mandarin term /taŋ ge/ "Ego's father's brother's older son" is (+Paternal), (+Male Line), and (+Lineal). However, (+Lineal)

can be implied from (+Paternal), and (+Male Line). Thus, the feature of lineality will be (⊕ Lineal) for /taŋ ge/.

Consistent with the analysed systems of Thai, Chinese, and English kinship terms, the lists of stimulus items using in the present priming study will be prepared. The strong hypothesis addressed in this research was whether L1 and L2 semantic information are stored and retrieved from a shared semantic system, or from two language specific semantic systems in bilinguals with high and low second language experience. To answer this question, the following two specific predictions were made: (1) If high L2 experience bilinguals store and access L1 and L2 words from two language-specific conceptual representations, then cross-language priming effects should not be obtained. (2) If only low L2 experience bilinguals store and access L1 and L2 words from a common conceptual representation, while high L2 experience bilinguals have separate lexicons, then cross-language priming effects will be obtained for Lo, but not Hi, L2 Experience participants. A weaker version of the hypothesis would be that cross-language priming would be weaker than within-language priming for the Hi L2 Experience participants. Another hypothesis in this research, over and above the L1 / L2 effects was whether the different degree of semantic relation between prime and target causes the different degrees of priming. To address this question, the specific prediction was that primes and targets differing by one semantic feature should result in greater degree of priming than primes and targets differing by more than one semantic feature, and in turn for semantically unrelated primes and targets.The priming results for each condition across the experiments are presented in Table 1.

Table 1 (a) – (d) Priming Effects for Experiments 1, 2, 3, and 4.

1a) Experiment 1: Thai-English Bilinguals

Primes	L 2 Experience	Targets			
		Thai (L1)		English (L2)	
		Hi Related	Lo Related	Hi Related	Lo Related
Thai (L1)	High	60	34	31	29
	Low	86	55	80	63
English (L2)	High	36	35	46	40
	Low	36	17	65	19

1b) Experiment 2: English-Thai Bilinguals

Primes	L 2 Experience	Targets			
		English (L1)		Thai (L2)	
		Hi Related	Lo Related	Hi Related	Lo Related
English (L1)	High	61	38	760	615
	Low	69	65	144	107
Thai (L2)	High	2	-10	85	84
	Low	-32	-39	38	36

1c) Experiment 3: Mandarin-English Bilinguals

Primes	L 2 Experience	Targets			
		Mandarin (L1)		English (L2)	
		Hi Related	Lo Related	Hi Related	Lo Related
Mandarin (L1)	High	159	121.5	36.7	29.6
	Low	151.8	110.9	64.8	53
English (L2)	High	38.8	32	55.8	49.4
	Low	2.2	1.7	49.5	49.1

1d) Experiment 1: English-Mandarin Bilinguals

Primes	L 2 Experience	Targets			
		English (L1)		Mandarin (L2)	
		Hi Related	Lo Related	Hi Related	Lo Related
English (L1)	High	95	30.2	291.3	180.8
	Low	64.3	59	302.9	183.9
Mandarin (L2)	High	3.5	-12.1	101.3	87.5
	Low	-37.6	-42.8	64	46.6

The main results of the priming studies can be summarized as follows: (1) There were cross-language priming effects in both the Hi and the Lo L2 experience groups in experiments 2, 3, and 4, with English-Thai, Thai-Mandarin, and Mandarin-Thai bilinguals, but this effect failed to reach significance in Experiment 1 with Thai-English bilinguals. (2) There were significantly stronger priming effects for L1 primes than for L2 primes. (3) There were interactions between Prime Language and Target Language, indicating an asymmetry in cross-language priming effects between L1-L2 and L2-L1 conditions. (4) There were no consistent effects of L2 Experience (Hi versus Lo) or degree of Semantic Relatedness; the main effect of L2 Experience was significant only for the results of Experiment 2 with ET bilinguals. The effect of Semantic Relatedness was significant only for the results of Experiment 4 with EM bilinguals, showing that

high semantically related prime-target pairs produced stronger effects than low semantically related pairs.

The results of these studies provide support for the hypothesis that there is a common conceptual representation in bilinguals. In accord with the Revised Hierarchical Model proposed by Kroll and Stewart (1994), words in L1 and L2 are stored and retrieved from a common conceptual system. However, there is a different retrieval process for L1 and L2 words.

According to this model, there are two types of links between words and the conceptual system: lexical and conceptual links. These two types of links are established between words and the conceptual system, irrespective of whether they are L1 or L2 words. Nevertheless, accessing L1 words will rely more on conceptual links and accessing L2 words will rely more on lexical links, especially in beginning L2 learners. Moreover, this model further proposes that links may differ in strength. That is, the lexical links from L2 to L1 words with the same meanings are stronger than the reverse links, and the conceptual links between L1 words and concepts are stronger than between L2 words and concepts.

The prediction from this model is that accessing words via conceptual links will produce stronger semantic priming effects than via lexical links. The presentation of L1 words is more likely to activate its corresponding conceptual representation in both L1 and L2 than the representation of L2 words. In contrast, presentation of L2 words is more likely to activate the corresponding L1 words than a concept. The pattern of results in the present study supports this model, that is L1 primes produced stronger semantic priming effects than do L2 primes.

A problem in the present studies is that for Experiments 2 (ET) and 4 (ME), L2 targets produced clearly stronger effects than L1 targets did. One possible explanation for the results of Experiment 4, in which English is L1 and Mandarin is L2, uses the notion of the time course of semantic activation in a logographic writing system. However, this notion cannot be used to explain the data in Experiment 2, when English is L1 and Thai is L2, so no general explanation is evident.

The results show cross-language priming asymmetries (e.g. Altarriba, 1992; Chen & Ng, 1989; Frenck & Pynte, 1987; Jin, 1990; Gollan, Forster, and Frost, 1997; Jiang, 1999). That is, cross-language priming was larger when the primes were in L1 and the targets in L2, than when the primes were in L2 and the targets in L1.

According to the Revised Hierarchical Model, asymmetrical cross-language priming can be attributed to different kinds of connections to a shared conceptual representational system. When the language order is L1-L2, the connections are assumed to be conceptual, whereas when the language order is L2-L1, the connections are assumed to

be lexical. Thus, the conceptual connections should produce stronger semantic priming effects than the lexical connections.

Although the present study very clearly shows that the order of presenting prime and target languages affects the degree of semantic priming, they are less clear in demonstrating the effects of L2 Experience and Semantic Relatedness responsible for semantic priming. In the remainder of this paper, we will consider the claim that L2 Experience and Semantic Relatedness influence lexical access and semantic priming effects.

As outlined above, the revised hierarchical model posits that there is the development in the strength of links between lexical and conceptual systems as the bilingual becomes more proficient in L2. Recent studies on bilingual lexical organization (e.g., Kroll & de Groot, 1997; McElree, Jia, & Litvak, 2000) have assumed that L2 experience is an index of L2 proficiency. Minimally, L2 experience must strengthen and enrich the conceptual links between L2 word forms and meanings.

In other words, the development of conceptual links between L2 words and the conceptual system as the function of L2 experience will increase the probability that conceptual information can be retrieved. Thus, this could lead to improvements in priming effects in semantic priming tasks.

However, only in Experiment 2 (ET) was there a significant main effect of L2 experience on priming. A possible explanation is that there are the other factors, rather than the effect of L2 experience, which play a roles in the development of L2 proficiency. According to previous studies of L2 proficiency (e.g., Haugen, 1956, 1961; Edwards, 1994; Ellis, 1994) the following factors may play some part: (1) age of begining to learn L2; (2) attitude and motivation toward L2; and (3) personality. Only the results of Experiment 4 (EM) showed a significant effect of Semantic Relatedness on priming.

Previous studies (eg, Seidenberg & McClellan, 1989) suggest that different degrees of semantic relations between primes and targets showed results in different degree of priming effects. That is, high semantically related prime-target pairs should produce stronger effects than low semantically related pairs. A possible explanation for the current inconsistent effect of Semantic Relatedness is that the degree of difference between the levels of semanticity in the Hi, the Lo, and the unrelated pairs may have been too small to have a significant effect on behaviour.

Conclusion

To determine whether L1 and L2 semantic information is stored and retrieved from a shared semantic system or two language specific semantic systems in bilinguals with high and low L2 experience, previous studies (eg., Chen & Ng, 1989) proposed that experiments on cross-language semantic priming would provide support for the notion that words in bilinguals' two languages share a common conceptual representation. The results of the four experiments here bear on this issue and are summarized below.

Cross-language priming from semantic related pairs was found in both L1-L2 and L2-L1 conditions, but the magnitude of priming effects was greater in the L1-L2 conditions. These findings are consistent with the pattern of cross-language priming that the effect from L1-L2 is strong and consistent but from L2-L1 is weak and inconsistent (eg. De Groot and Nas, 1991).

The results of the four studies demonstrated cross-language priming effects supporting the notion that the semantic representations of words in a bilingual's two languages are integrated within a shared conceptual representation system. Thus, the hypothesis that words in different languages are stored apart from one another in language-specific conceptual representation systems can not account for by the results of present studies. The results of the Experiments 1 (TE) and 3 (ME) support the findings of previous studies in that primes or targets in L1 will produce stronger effects than primes or targets in L2 (although the priming effects in Experiment 1 TE were not significant).

Moreover, they also support the findings that the effect of L1 primes is increased by L1 targets, but reduced by L2 targets, whereas the effect of L2 priming is increased by L2 targets but reduced by L1 targets. Thus, there was a stronger priming effect in the L1-L2 condition than in the L2-L1 condition.

For the results of Experiments 2 ET and 4 EM, a critical question that must be addressed is why there were stronger priming effects for targets in L2. There are no reports of stronger priming effects for L2 targets than for L1 targets in previous studies. It might be due to the other factors effecting on the processing of L2 words (Jiang, 2000), for example, the factors of L2 learning context, that is the meanings of L2 words is learned by providing its L1 semantic equivalence or is learned in L2 context and how bilinguals reliance on L1 words in accessing L2, that is whether the learners are encourage to rely on L1 words in accessing L2.

In addition, there are also the factors such as whether the learners store a word in their mental lexicon or their episodic memory or how they pay attention to the difference of meanings between L1 and L2 kinship terms. For the present study, however, it is not clear how these other factors influence the findings. This is because these factors are not settled in our Second Language Experience Questionnaires. Thus, the latter studies should be conducted to answer these questions.

In the present studies, the effect of L2 Experience was obtained only in Experiment ET and the effect of Semantic Relatedness was obtained in only Experiment EM. Nevertheless, the pattern of priming effects observed in Experiment ET is relevant to the hypothesis that bilinguals with different L2 experience will have a different mode of L2 lexical access.

The effect of semantic relatedness, which reached significance in only Experiment EM, replicates a previous finding from a semantic priming study in that there was stronger effects when the primes and the targets were semantically related as compared to unrelated (Seidenberg & McClellan, 1989). However, it is very difficult to sustain any general argument regarding the effects of L2 Experience and Semantic Relatedness in the present study because these two main effects are not consistently found across the four experiments.

The studies desbribed here has several implications for models of lexical access in bilinguals. The results provide support for the hypothesis that there is a common conceptual representation in bilinguals. Nevertheless, accessing L1 words will rely more on conceptual links and accessing L2 words will rely more on lexical links, especially in beginning L2 learners. The clear prediction is that accessing words via conceptual links will produce stronger semantic priming effects than via lexical links. The presentation of L1 words is more likely to activate their corresponding conceptual representations in both L1 and L2 than is the presentation of L2 words. In contrast, presentation of L2 words is more likely to activate the corresponding L1 words than a concept.

The pattern of results in the present study supports this prediction. it should be noted that if accessing words via conceptual links produces stronger effects than via lexical links, accessing L1 targets should produce stronger effects than accessing L2 targets on every occasion.It is clearly the case that in Experiments 1 and 3 there were stronger priming effects for L1 targets than for L2 targets, whereas in Experiments 2 and 4 there were stronger priming effects for L2 targets than for L1 targets. It might be due to various factors influencing L2 lexical representations and lexical access (e.g., Jenkin, Prior, Rinaldo, Wain-Wright-Sharp & Bialystock, 1993; Jiang, 2000). The latter studies should be designed to investigate the other factors effecting on the L2 lexical access and the pattern of cross-language semantic priming effects.

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