

# *Models of Mental Lexicon in Bilinguals with High and Low Second Language Experience\**

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*Four cross-language semantic priming tasks using kinship terms investigated whether the first and the second language 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. In Experiment 1 Thai-English bilinguals are tested. Experiment 2 concerned English-Thai bilinguals; in Experiment 3 Mandarin-English bilinguals; and Experiment 4 tested English-Mandarin. The findings support the view that the first and the second language semantic information is stored and retrieved from a shared semantic system in both high and low L2 experience 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/

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conceptual system. Thus L2 learners may overly rely on this body of knowledge when learning new L2 words (see Jenkin, Prior, Rinaldo, Wainwright-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 understand 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 Echaradt, & 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.

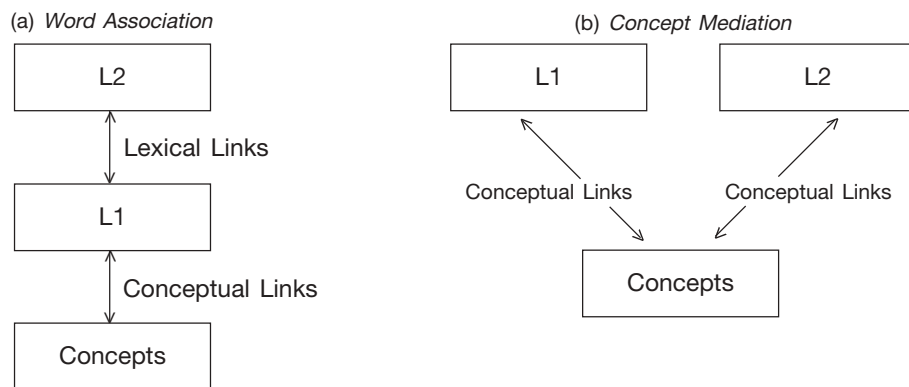


Figure 1 The Word Association ( a ) and Comcept Mediation Models ( b )

(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*

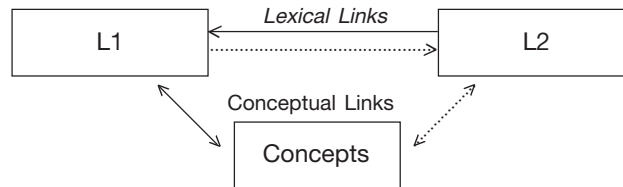


Figure 2 The Revised Model of the Bilingual Lexicon (adapted from Kroll & Stewart, 1994)

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**

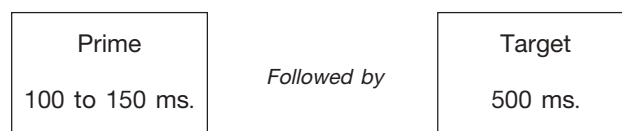
In the study of lexical access, various experimental methods have been employed, for example, free recall tasks (e.g., Kollers, 1966a), Stroop interference task (Magiste, 1984, 1985; Chen & Ho, 1986), and priming tasks (Ferrand & Grainger, 1994). The latter, priming tasks, are an effective way to investigate 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 to 150 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 the related 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 simultaneous 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 semantic 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 analysed 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 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 through root words in that language and C meaning this feature is presented through 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  $\oplus$  means that a feature can be implied from the values of other features. For example, the Mandarin term /tauN yE/ “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 ( $\oplus$  Lineal) for /tauN yE/.

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	L2 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	L2 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	L2 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	L2 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 role 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 beginning 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 described 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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