DUAL CODING THEORY AND CHINESE: RECALL OF CONCRETE AND ABSTRACT SENTENCES IN CHINESE-ENGLISH BILINGUALS

A Dissertation

by

TSUEI-FEN CHEN

Submitted to the Office of Graduate Studies of
Texas A&M University
in partial fulfillment of the requirements for the degree of

DOCTOR OF PHILOSOPHY

August 2010

Major Subject: Curriculum and Instruction

Dual Coding Theory and Chinese: Recall of Concrete and Abstract Sentences in Chinese-English Bilinguals

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ABSTRACT

Dual Coding Theory and Chinese: Recall of Concrete and Abstract Sentences in Chinese-English Bilinguals. (August 2010)

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Theories of reading have seldom been examined across orthographies. In the present study, Dual Coding Theory (DCT), a general theory of cognition applied to literacy, was applied to Chinese sentences to investigate the effects of language concreteness and abstractness on immediate recall. Forty Chinese-English bilinguals read and recalled five concrete sentences and five matched abstract sentences. Of the ten sentences, five were English, and five were Chinese. Due to the characteristics of Chinese orthography, Chinese script may have a direct and more efficient access to meaning; hence, it is possible that concrete sentences in Chinese would not have the typical advantage over abstract sentences in recall found in other languages. However, the results showed that concrete Chinese sentences were recalled better than abstract Chinese sentences. A 2 (languages: Chinese vs. English) x 2 (sentence concreteness: concrete vs. abstract) analysis of variance with proportion of recall as the dependent variable showed that significant main effects were found for languages, F (1, 76) =11.68,

p = .001, η^2 = .13, and for concreteness, F (1, 76) = 38.12, p < .001, η^2 = 33. That is, Chinese was overall recalled significantly better than English, and concrete sentences were overall recalled significantly better than abstract sentences. There was no significant interaction. Concrete Chinese sentences were recalled 1.32 times as much as abstract Chinese sentences, thus confirming the concreteness effects in Chinese. The results of the study are consistent with those of previous studies on DCT in alphabetic languages, and they also provide evidence of concreteness effects across orthographies.

DEDICATION

To my sister

ACKNOWLEDGEMENTS

I would like to thank my committee chair, Dr. Sadoski, to whom I owe a great debt of gratitude. His knowledge and teaching inspired me to reading and theories of reading. Without his thorough guidance and unlimited patience, this dissertation would not have been possible.

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I thank my parents for their support during my stay in the U.S.A.

Finally, and most importantly, I would like to thank my dearest sister, Tsui-Ying, to whom this dissertation is dedicated. Thank you for being the best sister I can ever have.

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CHAPTER 1

INTRODUCTION

Statement of the problem

Theories of reading that have been developed have seldom been examined across orthographies, thus they could be biased since each language has a different history and employs different principles in its orthography. Most reading theories have been developed in alphabetic languages, and therefore it is important to conduct more research that examines reading theories across orthographies. As Chen (1992) pointed out, a general theory of reading should be able to account for the processing roles played by linguistic and orthographic features not found in the alphabetic languages.

Reading theories that have been developed have seldom been applied to Chinese. Chinese orthography is different from orthographies of alphabetic languages, and studies of Chinese mainly focus on character and word recognition. Chen (1992) said Chinese has unique and important features and is probably the most widely used language in the world; hence examining reading theories in Chinese should be able to reveal both universal and orthography-specific processes and help to build a genuinely comprehensive theory of reading.

This dissertation follows the style of *Language Learning*.

Purpose of the study

The present study applies Dual Coding Theory (DCT) to Chinese, specifically the concreteness effects proposed by DCT. DCT is a general theory of cognition that is developed by Paivio (1971, 1986, 1991, 2007) and applied to literacy by Sadoski and Paivio (1994, 2001, 2004, 2007).

Dual coding refers to two coding systems: the verbal system and the nonverbal system. The verbal system is specialized for language and the nonverbal system is specialized for knowledge of the world in the form of mental images. The two systems have additive effects on memory. DCT assumes that information encoded in both coding systems should be remembered better than information encoded in only one coding system. As a result, concrete language, which is more easily encoded and stored in both coding systems, is better remembered than abstract language, which is mainly encoded and stored in the nonverbal system. Recall of concrete material is typically much greater than that of matched abstract material (Sadoski & Paivio, 2001, 2004).

Chen and Juola (1982) suggested that different writing systems have different effects on visual coding and memory mechanisms, and memory processes can be affected by the writing system in which the words are presented. Chinese is a morphosyllabic language that originally adopted logographic principles in its writing system. Studies have revealed that logographic characters are found to produce more visual information in memory, whereas alphabetic words result in a more integrated code involving visual and phonological information. Travassoli (2001) found that different

languages show different abilities at retrieving representations. In his study, English-speaking participants were found to be better at retrieving words' auditory representations, whereas Chinese-speaking participants were better at retrieving words' visual representations. As to comprehension processes, studies have found that Chinese readers seem to engage more heavily in operations at the sentence level than analyses at character or word level, while readers of English tend to pay more attention to both the word and sentence levels of processing (Chen, 1996).

Even though studies have revealed that different writing systems probably activate different coding and memory systems at the perceptual level and early stages of reading, there is likely more convergence at the deep syntactic and semantic levels and later stages of processing. Leong and Mulcahy (1987) suggested that, for more complex information, cognitive processes such as parsing and integration are much more similar across orthographies.

Many studies have been conducted to examine DCT in English, but only few studies have applied it to Chinese. For example, Steffensen, Goetz, and Cheng (1999a, 1999b) used extended texts to investigate the affect and imagery of Chinese bilingual readers. The two studies found that imagery and affect occur during reading, even in the absence of total understanding, and that verbal and nonverbal processes were similar in first-and second-language reading. Ho and Chen (1993) investigated whether the relationship between concreteness and syntactic structures would be the same in Chinese. They used both concrete and abstract Chinese sentences in affirmative and negative

sentence structures. The study found that concrete-affirmative sentences and concrete-negative sentences were better recognized than abstract ones, consistent with DCT.

With Chinese orthography being quite different from orthographies of alphabetic languages, it is worth investigating whether concrete language in Chinese has the same effects as it does in English. As stated earlier, most of the studies on Chinese focus on character and word recognition. To further investigate reading beyond the word level, the present study applied DCT to English and Chinese sentences in order to understand the cognitive processes in Chinese at later stages of processing, and, hopefully, to help reveal both universal and orthography-specific processes associated with the reading of different orthographies and help to build a genuinely comprehensive theory of reading (Chen, 1996).

Research question

This study examined the recall of concrete and abstract sentences, both in English and in Chinese, by Chinese-English bilinguals. One overall research question served to guide the study: Will concrete sentences be recalled better than matched abstract sentences in both Chinese and English by Chinese bilingual readers?

CHAPTER II

REVIEW OF LITERATURE

Brief introduction of Chinese

Languages in the world are categorized as logographic-phonetic, syllabic, or alphabetic, according to the relationship between a script and the structure of its language (DeFrancis, 1989). Evolving from logographic and pictographic origins, Chinese is often categorized as morphosyllabic (DeFrancis, 1989; Coulmas, 1989), morphemic (Norman, 1988; Joshi, Hoien, Feng, Chengappa & Boulware-Gooden, 2006), or morphographic (Wang, Cheng, & Chen, 2006).

The beginning of Chinese writing can be dated back as early as the Shang dynasty, 1200 BC. Chinese script can be described at a number of different levels—strokes, radicals, characters, and words. Strokes are written in a prescribed order to form radicals, and radicals are written with general order—from top to bottom, from left to right, and from the outside to the inside—to form characters. Characters are the basic writing units of the Chinese writing system. Each character represents a morpheme morphologically and a phonological syllable.

Based on the origins and development of the Chinese writing system, characters are classified into six categories: pictographs, simple ideograms, complex ideograms, phonetic compounds (i.e., logographic-phonetic compounds, semantic-phonetic compounds, or phonograms), phonetic loans, and derivatives. Pictographs are designed to represent objects; simple ideograms are formed by using pictograms to indicate ideas; complex ideograms are characters in which the meaning of a character is the

combination of the meanings of its parts. Together these three categories represent about ten percent of Chinese characters (Wang, 1981). A phonetic compound character is a character that consists of a phonetic component, which gives hints at the pronunciation of the character, and a semantic radical, which gives hints at the meaning. Take the character 櫻 (*cherry*) as an example. The left part of the character 木 (*tree*) suggests the meaning, while 嬰 (*baby*) gives hints at the pronunciation. Cheng (1992) estimated that 80 percent of Chinese characters are phonetic compounds, and some estimate as high as 90 percent (Wang, 1981; Coulmas, 1989). There are about 214 semantic radicals and, approximately, 895 phonetic components (DeFrancis, 1989). Phonetic loans are characters resulting from borrowing other characters for their phonetic value. Derivatives are characters that are used to represent a word of the same or similar meaning with different pronunciation. Characters of phonetic loans and of derivatives only represent a very small number of Chinese characters.

According to the Kangxi Dictionary, published in 1716, there are 47,035 characters, while the Hanyu Da Zidian, published in 1986, lists 56,000 characters (Kane, 2006). Recent Chinese dictionaries contain as many as 60,000 different characters (Hanley, 2005), yet the total number of characters estimated for modern day usage is around 4,574 (Perfetti, Liu, & Tan, 2005). A thousand common characters can account for 90 percent of the text occurrences in popular publication (as cited in Martin, 1972); knowledge of 2,400 characters would allow a reader to read 99 percent of the characters that appear in most texts (as cited in Hanley, 2005), and knowing 4,300 characters would be considered necessary for full literacy (Hue, 1992).

As for Chinese words, they are formed by combining characters, and are usually one-, two-, or three-characters, such as 水 (*water*), 氣球 (*balloon*), 太空船 (*spaceship*). Approximately 80 percent of Chinese words are multisyllabic, and it is estimated that around 60 percent of Chinese words are of two characters (Zhang & Peng, 1992; Chu & Leung, 2005).

Reading processes in Chinese and English: similarities and differences

Chinese and English have different orthographies. Chinese is a morphosyllabic language in which a character is a morpheme which corresponds to a syllable, whereas English is an alphabetic language in which graphemes correspond to phonemes. Being different in orthography, reading the two languages may be adapted to the characteristics of each language's writing system.

Eye movement studies indicate that readers of Chinese make shorter saccadic lengths than English readers do, and that eye movements are less variable and more regular for Chinese reading than for English reading (Chen, 1992). These could result from some of the characteristics of the Chinese script and its layout in print. The Chinese script is visually presented differently from the English script. In print, every Chinese character occupies a fixed, square space, whereas words in English vary in length, height, and form. Furthermore, no spaces exist between characters in print, while in English print, spaces are needed between words. As a result, Chinese texts are more compact and take less length to be covered by eyes, compared with the same content in English (Hoosain, 2002). Since the movement of eyes is affected by parafoveal information such

as spacing and word length to the right of the fixation in English (Chen, 1992), and that the length of the words is perhaps the most salient visual information for alphabetic script processing (Cheung, McBride-Chang, & Chow, 2006), English readers are able to make larger and more variable saccades than Chinese readers do.

Being different in orthography, learning to read Chinese and English requires different processes and skills. Forming connections between graphemes and phonemes has been proved to be vital in children learning to read English words (Ehri, 2005), whereas reading Chinese requires attending to characters as whole visual or morpholinguistic units. When learning to read Chinese, children have to rote memorize characters' visual-orthographic components and their associations with corresponding meanings and pronunciations (Siok & Fletcher, 2001). As a result, graphic information and visual processing skills have been shown to be crucial in Chinese character reading for both adults and children (Wang & Geva, 2003; Cheung, et al., 2006). Wang, Cheng, and Chen (2006) point out that when reading Chinese characters, children need to rely on understanding of the meaning of the syllable along with its visual-orthographic form.

In alphabetic languages, letters are meaningless symbols that represent sounds; whereas in Chinese, the semantic radical gives hints at the meaning of the character. Given that the Chinese script adopted logographic principles when it was first developed and that 80 to 90 percent of Chinese characters are phonetic compounds in which meanings and pronunciations are represented, Flores d'Arcais (1992) suggested that the Chinese script has a direct and more efficient access to meaning than alphabetic writing systems.

Though studies have yielded differences between reading Chinese and English and that learning to read English and Chinese may require different processes and skills, studies did find that the two languages share common reading processes. Graphemic, semantic, and phonological information are all activated in reading Chinese characters, the same as reading English words (e.g., Cheng, 1992; Perfetti, Zhang, & Berent, 1992). Chen (1993) also said that, in reading acquisition, the stages that children go through to become skilled readers are similar in both Chinese and English. And after examining studies on reading acquisition of Chinese, he concluded that Chinese reading shares much in common with English reading in terms of cognitive processes involved at different stages of reading proficiency (1993, p.112).

Dual coding theory

DCT is a general theory of cognition that has been extensively applied to literacy. This includes bilingualism (Paivio, 1986). For reviews of the application of this theory to various aspects of literacy and its empirical support from many researchers, see Sadoski & Paivio (1994, 2001, 2004, 2007) and Paivio (1971, 1986, 1991, 2007).

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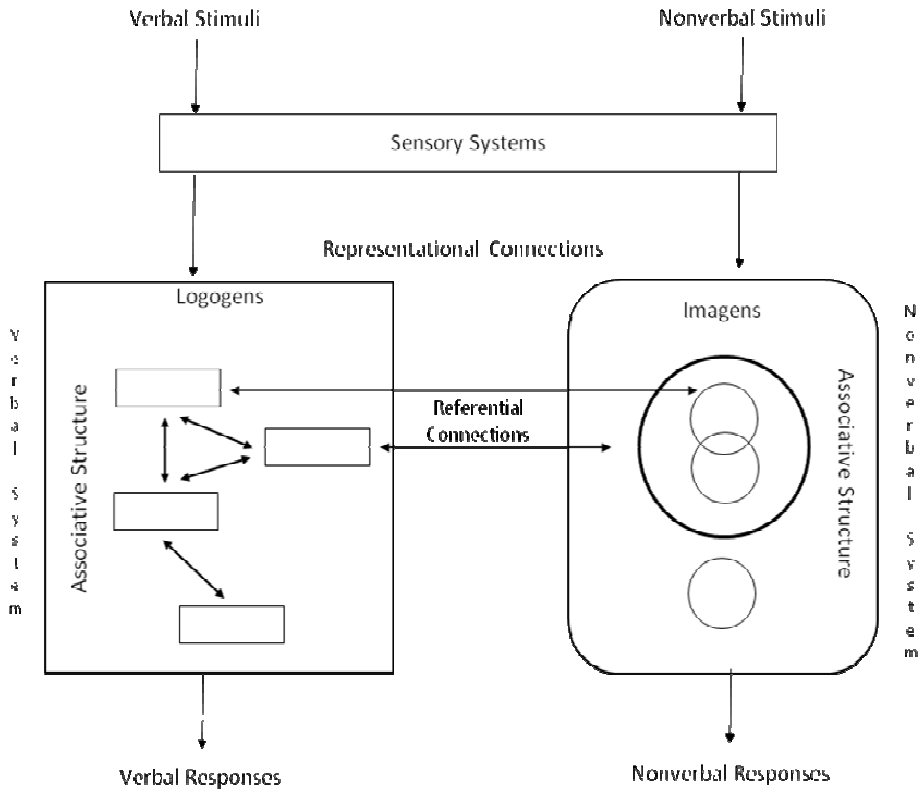

Figure 1 Dual Coding Model

Figure 1 is the general model of dual coding. A central assumption of DCT is that our knowledge derives from perceptual, behavioral, and affective experiences with the world, and these experiences become internalized by two functionally independent but interconnected coding systems: a nonverbal system and a verbal system. The nonverbal system is specialized for dealing with nonlinguistic objects, and the verbal system specializes for dealing with language. Logogens (i.e., verbal mental representations) and imagens (i.e., nonverbal mental representations) are the structural and functional units of DCT. The verbal coding system internalizes external verbal

information into logogens in our memory, and the nonverbal coding system internalizes external stimuli such as objects, events or scenes, into imagens. Logogens vary in size and are hierarchically organized in the verbal system (e.g., phonemes, letters, words, common phrases); imagens are organized into synchronous hierarchies or nested sets in the nonverbal system (e.g., eyes, nose, mouth make up a face).

Though logogens in DCT are linguistic representations, they are not semantically meaningful. The meanings of logogens derive from their connections to verbal or other nonverbal representations. There are three levels of processing in DCT—representational, associative, and referential. Representational processing involves recognition, and associative and referential processing involve meaningful connections. Representational processing is the connections between sensory detection and the initial activation of logogens or imagens; associative processing is the correspondences of the units within the verbal or nonverbal system; referential processing is the association of the units between the verbal and nonverbal systems, that is, logogens to imagens, or imagens to logogens. In the process of referential connections, one logogen can activate no imagens, one imagen, or more than one imagen, and vice versa. All comprehension and memory derive from the activity of these representations and processes.

Imagery and concreteness

Imagery can serve as memory aid, and from the beginning, Paivio (1969) suggested that the availability of imagery varies directly with language concreteness or image-evoking value. According to DCT, concrete words are encoded into the verbal

code and imaginal code, whereas abstract words are mainly encoded into the verbal code. The additional imaginal codes stored in the nonverbal system serve as memory aids which enhance retrieval performance. As Paivio (1971, 1986, 1991) described, the verbal and nonverbal codes corresponding to the same object can have additive effects on recall. Paivio (2007) furthermore elaborated that "word concreteness reflects the directness of connections from a logogen to related imagens, and the connections are most direct for object labels (e.g., horse) and least direct for highly abstract words (e.g., truth)" (p.46). Numerous studies have been conducted to test these assumptions of DCT, and the results yielded consistent support for the assumptions (reviewed in Paivio, 1971, 1986, 1991, 2007; Sadoski & Paivio, 1994, 2001, 2004).

Dual coding theory and sentence processing

In addition to studies on words and word pairs, studies on sentence and text processing have confirmed the assumptions of DCT as well. The study conducted by Begg and Paivio (1969) on concreteness and imagery in sentence meaning was the first study that extended DCT to sentence level. The findings of the study suggest that concrete sentences are coded and stored primarily as nonverbal images that retain the meaning but not the wording of the sentences, whereas abstract sentences are stored primarily in their verbal form. Paivio and Begg (1971) investigated the relation between imagery and the comprehension of sentences. The results showed that it took longer to generate images to abstract than to concrete sentences. Jorgensen and Kintsch (1973) investigated whether imagery was used in evaluating the acceptability of sentences—

sentences that were either very hard or very easy to form images. The results found high image value sentences were evaluated more rapidly than low image value sentences, that is, imagery was used in subjects' comprehension process. Jorgensen and Kintsch stated that information coded as imagery is highly accessible in memory. Klee and Eysenc (1973) studied the comprehension latencies of sentences varying in concreteness and meaningfulness, and the results found that concrete and abstract sentences are processed in different ways. They suggested that comprehension of isolated concrete sentences seems to involve imaginal coding to a greater extent than abstract sentences, while isolated abstract sentences rely for understanding upon access to mainly verbal processes.

Davies and Procotor (1976) conducted studies that examined the recall of concrete and abstract sentences as a function of an interpolated task, and the results were that concrete sentences were better recalled than abstract sentences. Davies and Procotor pointed out that mental imagery plays a role in the internalization of concrete materials but that abstract sentences are mediated by an essentially verbal process. Holmes and Langford (1976) investigated the effect of concreteness on sentence comprehension and recall between abstract and concrete sentences. The study showed that concrete sentences were easier to comprehend and easier to retrieve from memory than abstract sentences. Anderson, Goetz, Pichert, and Halff (1977) used the subject noun phrase as a cue for recall of sentences that had been read. The results found that a concrete noun is a good conceptual peg, and Anderson et al. thought so because a concrete phrase has a specific, stable encoding and tends to redintegrate the whole sentence. Marschark and Paivio (1977) investigated whether abstract and concrete sentences can be processed in

an integrated or holistic manner and found that concrete sentences were recalled better than abstract sentences. O'Neill and Paivio (1978) also found that concrete sentences received higher imagery ratings and higher recall scores than abstract sentences. Eddy and Glass (1981) conducted a study to clarify the role imagery plays in sentence understanding, and the results suggested that imagery plays a significant role in the comprehension of concrete sentences. The researchers said that imagery is a necessary part of the comprehension process for concrete sentences. Smith (1981) found that recognition memory for spoken concrete sentences was superior than abstract sentences, provided that the sentences were affirmative. Sadoski, Goetz, and Fritz (1993a, 1993b) used matched sets of concrete and abstract sentences for immediate and delayed recall, and found that concrete sentences were recalled more than twice as well as than abstract sentences. The results also showed that concreteness was highly predictive of both comprehension ratings and recall.

The aforementioned review of studies on concrete and abstract sentences yield the results that concrete sentences are recalled better and evoke more imagery than abstract sentences. A concrete sentence is encoded verbally but is also transformed into the nonverbal code (i.e., imaginal code) which permits the organization of the sentence into a single unit or a complex image. The information contained in an abstract sentence, on the other hand, remains linked to the sequentially organized verbal units. The dual coding of a concrete sentence is able to reduce the memory load for meaning and supplies more retrieval routes as well. However, all these studies were conducted in English.

Dual coding theory and models of Chinese word processing

Most studies of Chinese reading have focused on character and word recognition, and some models of Chinese word reading have been proposed. Of the models that are proposed, two are partially consistent with DCT—one is the multilevel interactive-activation model by Taft, Liu, and Zhu (1999), and the other is the interactive constituency model by Perfetti and Tan (1999).

The multilevel interactive-activation model consists of orthographic units, phonological units, and semantic units. The orthographic units include strokes, radicals, morphemes (characters), and compound words. They are hierarchically organized; that is, stroke units feed their activation to radicals that contain those strokes, and radicals feed their activation to the morphemes that contain those radicals. In this model, there are no orthographic or phonological representations of complete words. That is, at the character level, a character can activate other characters that are associated with the character.

In this model, Taft et al. (1999) propose that there is a lemma level in which there are lemmas that link form and meaning together similar to the concept of the lexicon. So a character 櫻 (*cherry*) would send activation to a lemma unit that represents the form that is pronounced as /*ying/* and means *cherry*, as well as to all other lemma units that are related to 櫻. Lemmas in the multilevel interactive-activation model partly parallel *mental models* described in DCT. Mental models of words in DCT are activated sets of logogens and imagens or the combinations of logogens and imagens that represent the form and meaning of a word in a given context. Therefore, the activation of lemma units parallels the representational processing and the associative processing in

the verbal system. An important difference is that a lemma is a theoretically abstract entity, whereas logogens and imagens in DCT are specific to a sensory modality (e.g., visual, auditory).

The interactive constituency model assumes four separate constituent representation subsystems: the character orthographic subsystem, the noncharacter orthographic subsystem, the phonological subsystem, and the meaning subsystem. Each constituent subsystem consists of a set of representation units or nodes. A node whose activation value exceeds its threshold excites other nodes with which it is consistent and inhibits nodes with which it is not consistent.

In this model, feature analysis is the first stage of visual character recognition. In the case of Chinese, the character strokes serve as the basic features, once the features are detected, they begin sending activation to the orthographic units (i.e., phonetic radicals, semantic radicals, simple characters, and compound characters) in the character orthographic lexicon (i.e., simple and compound characters, phonetics and semantic radicals that are legal characters) and in the noncharacter orthographic lexicon (i.e., phonetic and semantic radicals that are not independent characters). When an orthographic unit in the character orthographic lexicon exceeds threshold, it sends activation to the phonological units, the meaning system, and the corresponding units in the noncharacter orthographic lexicon simultaneously, leading to the activation of phonological units and/or relevant meaning representations and to the interaction of character orthographic units with noncharacter orthographic units. This model also is somewhat parallel with DCT at the levels of representational processing and the

associative processing in the verbal system. However, there are differences as well. In DCT, familiar logogens can be recognized as wholes without extensive feature analysis, and the meaning system is more specified.

Although the two models are somewhat consistent with DCT in word-level processing, they did not extend to sentence- or text- level processing. Therefore, they are not able to explain how meaning is constructed when reading is performed.

Though a considerable number of studies of DCT have been conducted in alphabetic languages, it has not been extensively applied to other writing systems. In the present study, DCT is applied to Chinese at the sentence level to investigate sentence processing and comprehension in Chinese as well as English. Studies on Chinese sentence processing and comprehension have been conducted from syntactic and semantic perspectives; yet, no one unified theory has been developed. The research question of the study is to investigate if concrete and abstract sentences can be recalled equally well in Chinese and in English.

CHAPTER III

METHODOLOGY

Study I: Sentence rating norms

To develop materials for a recall study, a sentence rating study was conducted both in the U.S.A. and Taiwan. Participants in the sentence rating study had to rate 40 sentences for three qualities: comprehensibility, familiarity, and concreteness.

Participants

Forty-seven third year undergraduate students (male: 1, female: 46) from Texas A&M University and forty-nine second and third year undergraduate students (male: 23, female: 23, 3 did not specify) from southern Taiwan participated in the study. Participants from Texas A&M received extra credit points for their participation, while participants from Taiwan participated as part of regular class activities.

Materials

The sentences used for the rating norms were 20 concrete English sentences, 20 abstract English sentences, and 40 Chinese (i.e., Mandarin Chinese) sentences, which were the translations of the English sentences. All the concrete and abstract English sentences (see Appendix A) were composed by the researcher, and the Chinese translations of the English sentences (see Appendix B) were translated by a native Chinese speaker who is now studying for doctoral degree at Texas A&M University. In order to validate the Chinese translations, a native Chinese speaker in Taiwan, who had

never seen the original English sentences and is fluent in English and Chinese, back translated the Chinese sentences into English. The back-translated versions compared with the original English versions quite accurately and in many cases exactly. The back translations are given in Appendix C.

The most common word order of Chinese sentences is subject verb object (SVO) (Kane, 2006; Miao, 1981), the same as in English (Roland, Dick, & Elman, 2007). All the English sentences in this study were affirmative and of SVO or SV word order, as were the Chinese sentences.

For the English version, the concrete and abstract sentence sets were equated for length, word count, and readability. The total word counts were 179 in the concrete set and 179 in the abstract set. Average words per sentence in the two sentence sets were 8.9 and 8.9, respectively. Average characters per word were 4.7 in the concrete set and 4.6 in the abstract set. Average syllables per sentence in the concrete and abstract sets were 12.4 and 14.2, respectively. All the words that appeared in the sentences fell from levels K/1 to Grade 13, according to word corpora of *The Educator's Word Frequency Guide* (Zeno, Ivens, Millard, & Duvuri, 1995), except for words *candlelight*, *cherry blossoms*, *Christmas Eve*, *Internet*, *Spider-Man*, *Statue of Liberty*, *superhero*, *teddy bear*, and *unfounded*. Readability of the English sentence sets was measured. On a 100-point Flesch (1948) scale, the reading ease was 51.2 for concrete sentences and 50.7 for abstract sentences. For the Flesch-Kincaid (as cited in Klare, 1984) grade level, it was 8.3 in the concrete set and 8.4 in the abstract set. Readability formulas for Chinese were not available as they were in English.

The total numbers of Chinese characters in the concrete and abstract sentence sets were 240 and 242, respectively; thus the average characters per sentence in the two sets were 12 and 12.1, respectively. Though English and Chinese are of two different orthographies, it is estimated that 1.5 Chinese characters are equivalent to one English word (Sun, 1993; Sun, Morita, & Stark, 1985). Calculated by the formula: 1.5 Chinese characters = 1 English word, the average characters per concrete Chinese sentence equaled 8.0 English words, and the average characters per abstract Chinese sentence equaled 8.1 English words. Both numbers were close to the average words per sentence in English concrete and abstract sets, 8.9 and 8.9, respectively, with no advantage for the concrete or abstract set.

Procedure

Participants were asked to rate each of the 40 sentences for three qualities on 7-point bipolar scales. The qualities, with their scale anchors, were the following: (a) content comprehensibility, 1 (*very hard for me to understand*) to 7 (*very easy for me to understand*); (b) content familiarity, 1 (*not familiar to me in content*) to 7 (*very familiar to me in content*); (c) concreteness, 1 (*very abstract, hard for me to form mental images of this*) to 7 (*very concrete, easy for me to form mental images of this*). The scales have produced high reliability when used in previous sentence rating studies (Sadoski et al., 1993a, Sadoski, Goetz, & Rodriguez, 2000). A sample of the rating form is given in Appendix D.

Every participant had to rate a total of six sheets of rating forms, with each form containing twenty sentences. Of the six rating forms, three were for the three qualities of the concrete sentences and three for the abstract sentences. The order of the three qualities and the order of the concrete and abstract sets were randomly determined for each participant. Participants only rated the forms of his/her native language and were given the forms in random order. Before they read and rated the sentences, participants were asked to read the instructions given on the top of every page.

Study II: Recall of concrete and abstract sentences in Chinese-English bilinguals

The purpose of study II was to investigate the effects of concreteness and abstractness on immediate recall of sentences in Chinese-English bilinguals. Participants had to read and recall five concrete sentences and five abstract sentences. Of the ten sentences, five were English, and five were Chinese.

Participants

Forty undergraduates whose major was English language and literature from Kaohsiung Normal University in southern Taiwan participated in this experiment. They were all native speakers of Chinese and were not participants in the study of sentence rating norms. The mean ages of the participants were 21 years, 9 months. Of the forty participants, 37 were female, and 3 were male. Most of them started learning English at 11 years of age (M=10.85, SD=2.18). To have an understanding of participants' language ability, their scores of Chinese and English on Taiwan's college entrance exam

were collected by self report. The English test is a broad test of language ability that uses multiple choice items and vocabulary and also a writing sample. The Chinese test is a broad test of language ability with emphasis on syntax and rhetoric. The test includes multiple choice items and a writing sample. Total scores were used. The score of Taiwan's college entrance exam ranged from 0-108 for Chinese and 0-100 for English. The participants' mean score for Chinese was 68.36 (SD = 9.36, n = 33) and 76.42 (SD = 7.05, n = 36) for English, which were on the top 50 percent and top 30 percent, respectively (http://www.ceec.edu.tw/AbilityExam/AbilityExamStat/95AbExamStat/).

Materials

The sentences used for the recall experiment were five concrete English sentences, five abstract English sentences, and ten Chinese sentences, which were the translations of the English sentences. These concrete and abstract sentence sets were selected from the sentence rating study based on the requirement that they differed substantially in concreteness, but not in comprehensibility and familiarity (note: data are reported in chapter 4). Appendix E is the list of the sentences selected for the recall study.

Words that appeared in those selected English sentences were vocabulary words that were included in the English reference word list used for the English test on the college entrance examination of Taiwan (http://www.ceec.edu.tw/Research/ResearchList.htm). That is, words that appeared in these English sentences did not exceed typical English vocabulary in Taiwan. The Flesch reading ease of the selected English sentences was 77.4 for concrete sentences and 61.3

for abstract sentences. The Flesch-Kincaid grade level for the concrete set was 4.5 and 6.7 for the abstract set.

Sentences that were used for the study were arranged in four types of order to counterbalance languages (i.e., English and Chinese) and sentence types (i.e., concrete and abstract). The four types of order were: (1) five concrete English sentences followed by five abstract Chinese sentences; (2) five abstract English sentences followed by five concrete Chinese sentences; (3) five concrete Chinese sentences followed by five abstract English sentences; (4) five abstract Chinese sentences followed by five concrete English sentences. An example of one type of order was given in Appendix F. With these arrangements, English and Chinese sentences appeared equally often in all of the permissible positions, and so did the concrete and abstract sentences.

In addition to counterbalancing the languages and the sentence types, each of the sentences in the concrete and abstract set was counterbalanced as well by appearing in all of the permissible position equally often. Thus there were five orders of sentence arrangement within each concrete and abstract set (see Appendix G), and this resulted in a perfect counterbalancing arrangement.

Procedure

The recall form was five sheets of paper stapled as a booklet. The cover sheet of the booklet was blank so that participants were not able to read the sentences while being given instructions. Each page that contained the sentences was followed by a blank page, which was used as the recall sheet.

Every participant was randomly assigned to one of four groups that received either concrete English-abstract Chinese, abstract English-concrete Chinese, concrete Chinese-abstract English, or abstract Chinese-concrete English sentence order and was presented with an envelope containing the booklet. The researcher of the study gave oral instructions of the procedures to the subjects. The oral instructions were that they are going to read five sentences on a page in thirty seconds, recall the sentences by writing as much as they could remember on the blank sheet in three minutes, and repeat what they have done for another five sentences. Times were announced by the proctor in the room. Every sheet of paper had to be torn off from the booklet and put back into the envelope following each procedure. All procedures were accomplished in one normally scheduled class.

Scoring

Recall was scored by idea units, operationally defined as independent clause kernels or instances of modification of those kernels (Sadoski, Goetz, & Fritz, 1993a). The concrete English set consisted of 13 idea units, and so did the concrete Chinese set since sentences of both languages in the study shared the same syntactic structures (see Appendix H). The abstract English and Chinese set each had 14 idea units (see Appendix I). Each idea unit was scored as one point for full recall of the idea unit, half a point for partial recall of the idea unit, and 0 points for no recall of the idea unit. Two independent raters scored the recalls.

CHAPTER IV

RESULTS

Study I: Sentence rating norms

The coefficient alpha reliabilities of the ratings of the 40 sentences for comprehensibility, familiarity, and concreteness in English and Chinese were computed and presented in Table 1.

Table 1 Coefficient Alpha Reliability of the English and Chinese Sentences for Ratings of Comprehensibility, Familiarity, and Concreteness

	English		Chinese	
	Concrete	Abstract	Concrete	Abstract
Comprehensibility	.85	.89	.88	.88
Familiarity	.96	.90	.88	.85
Concreteness	.89	.87	.87	.83

Note: N = 47 raters for English, and N = 49 raters for Chinese.

All the reliability values ranged from .83-.96. The overall mean for reliability ratings was .88.

Five concrete English sentences, five abstract English sentences, and their Chinese translations were selected for the recall study. Table 2 gives the coefficient alpha reliabilities of the selected sentences.

Table 2 Coefficient Alpha Reliability of the Selected English and Chinese Sentences for Ratings of Comprehensibility, Familiarity, and Concreteness

	English		Chinese	
	Concrete	Abstract	Concrete	Abstract
Comprehensibility	.61	.71	.71	.68
Familiarity	.50	.80	.78	.75
Concreteness	.51	.83	.65	.73

Note: N = 47 raters for English, and N = 49 raters for Chinese.

Most of the reliability values are near or above .70, except for those of the concrete English sentences. However, using the Spearman-Brown formula (Cronbach, 1960), the predicted reliability values generated from the selected five concrete English sentences for a set four times the length were very close to those of the respective full set of 20 sentences. That is, the lower reliabilities of the selected sentences were due to the smaller number of items rather than any selection bias.

For sentences to be selected, they had to meet the requirements that they differed in concreteness but were comparable in comprehensibility and familiarity. Table 3 gives means, standard deviations, and t-tests for comprehensibility, familiarity, and concreteness ratings of the selected concrete and abstract sentences in English and Chinese. The means and standard deviations for comprehensibility, familiarity, and concreteness ratings of the 40 English and Chinese sentences are given in Appendix J.

Table 3 Means, Standard Deviations, and t-tests for Comprehensibility, Familiarity, and Concreteness of Selected Concrete and Abstract Sentences in English and Chinese

	Concrete		Abstract				
	M	*SD*	*M*	*SD*	*t*	*df*	*p* <
English							
Comprehensibility	6.51	.62	6.34	.78	-1.62	46	.11
Familiarity	5.97	.73	6.16	.92	1.47	46	.15
Concreteness	6.33	.66	5.22	1.44	-5.30	46	.00
Chinese							
Comprehensibility	5.49	1.09	5.78	1.01	1.89	48	.07
Familiarity	5.36	1.29	5.51	1.14	.92	48	.37
Concreteness	5.54	1.08	5.08	1.31	-2.43	48	.02

Note: N=47 for English, N=49 for Chinese

The selected concrete and abstract sets of both languages met the requirements that they differed significantly only in the concreteness rating and were equivalent in the comprehensibility and familiarity ratings. For the English sentences, the difference of the

means between concrete and abstract sets on the concreteness rating was statistically significant (t = -5.30, p < .00), whereas the differences of the means on comprehensibility and familiarity ratings were not statistically significant. For the selected Chinese sentences, the difference of the means between the concrete and abstract sets on the concreteness rating was statistically significant (t = -2.43, p = .02), but the differences of the means on the comprehensibility and familiarity ratings were not statistically significant. The ratings for the Chinese sentences tended to be lower than the English sentences. Possible reasons for this will be discussed in a later section.

Study II: Recall of concrete and abstract sentences in Chinese-English bilinguals

Forty Chinese-English bilingual participants recalled 5 concrete English sentences, 5 abstract English sentences, and 10 Chinese translations of the English counterparts. The readability differed between the selected English concrete and abstract sentences, but readability, using Flesch-Kincaid grade level, was not significantly correlated with recall in the study (r = .-12, p = .44).

The recall of the sentences was scored by idea units. The total idea units of concrete and abstract sentence sets were 13 and 14, respectively, in both languages. Participants were scored one point for full recall of the idea unit, half a point for partial recall of the idea unit, and 0 points for no recall of the idea unit. Every participant's total idea units recalled in each of the concrete and abstract set were divided by 13 and 14, respectively, to yield proportions. Two independent raters coded a randomly selected

10% of the protocols. Interrater reliability was r = .97 for English and r = .98 for Chinese.

Two separate one-way analysis of variance (ANOVA) using data collected from the recall by Chinese-English bilingual subjects were conducted to investigate if concrete sentences were recalled more than abstract sentences in both languages. Table 4 gives summaries of the analyses.

Table 4 Means, Standard Deviations and ANOVA Results for Proportions of Recall in Concrete and Abstract Sentences

	Concrete		Abstract					
	M	*SD*	*M*	*SD*	*F*	*df*	*p*	*d*
English	.76	.19	.48	.14	28.62	39	.000	1.29
Chinese	.86	.18	.65	.19	12.24	39	.001	.97

Note. N = 40.

For English sentences, the means for proportion of recall were .76 in the concrete set and .48 in the abstract set. For Chinese sentences, the means for proportion of recall were .86 in the concrete set and .65 in the abstract set. The results of the ANOVAs showed that there was a significant difference in recall between the concrete and abstract sets in English, F (1, 39) =28.62, p < .001, and in Chinese, F (1, 39) = 12.24, p = .001. Concrete English sentences were recalled 1.58 times as much as abstract English sentences; the effect size of the difference between the concrete and abstract sets in English was d = 1.29 (effect sizes determined by dividing the difference between means by the pooled standard deviation). Concrete Chinese sentences were found to be recalled 1.32 times as much as abstract Chinese sentences; the effect size was d = .97.

Because the Chinese sentences tended to be recalled better than the English sentences, an additional analysis was conducted to investigate any interaction between

language and concreteness. A 2 (languages: Chinese vs. English) x 2 (sentence concreteness: concrete vs. abstract) ANOVA with proportion of recall as the dependent variable was conducted. Summary of the analysis is given in Table 5.

Table 5 Analysis of Variance between Languages, Concreteness, and Interaction between Languages and Concreteness in Proportion of Recall

Source	*MS*	*df*	*F*	*p*	η^2
Languages	.36	1	11.68	.001	.13
Concreteness	1.17	1	38.12	.000	.33
Languages*concreteness	.03	1	.92	.339	.01
Error	.031	76			

Note. N = 40.

Significant main effects were found for languages, F (1, 76) =11.68, p = .001, η^2 = .13, and for concreteness, F (1, 76) = 38.12, p < .001, η^2 = 33. That is, Chinese was overall recalled significantly better than English, and concrete sentences were overall recalled significantly better than abstract sentences, duplicating the results in Table 4. No significant interaction effect was found.

CHAPTER V

DISCUSSION AND CONCLUSION

Discussion

The results of this study found that the Chinese-English bilinguals recalled concrete sentences better than abstract sentences, regardless of languages. The results of the study concur with similar concreteness effects found in previous studies in English (e.g., Klee & Eysenck, 1973; Davies & Proctor, 1976; Holmes & Langford, 1976; Anderson, et al., 1977; Marschark & Paivio, 1977; O'Neill & Paivio, 1978; Sadoski, et al., 1993a, 1993b). The results also support the predictions of DCT when applied to a non-alphabetic language.

Previous studies of DCT on concrete and abstract sentence recall mainly used English-speaking participants, whereas the present study used Chinese-English bilingual participants to recall both Chinese and English sentences to examine DCT across orthographies. This examination was important because of possibly critical differences in orthography that could affect comprehension and recall. Chinese orthography is different from orthographies of alphabetic languages. Chinese characters are morphemes and correspond to syllables, while graphemes in alphabetic languages correspond to phonemes. In Chinese, 80 to 90 percent of characters are phonetic compounds in which meaning and pronunciation are represented, while letters in alphabetic languages are meaningless symbols that represent sounds. Therefore, the Chinese script may have a direct and more efficient access to meaning, compared to alphabetic languages. In addition, due to the characteristics of Chinese orthography, children learning to read

Chinese characters heavily rely on understanding the meaning of the syllable along with its visual-orthographic form. Because of these characteristics of Chinese orthography, it is possible that concrete sentences in Chinese would not have an advantage over abstract sentences in recall since most characters in Chinese, regardless of concrete or abstract content, convey or have a more direct access to meaning. However, the study results showed that concrete Chinese sentences were recalled 1.32 times as much as abstract Chinese sentences, thus supporting the concreteness effects assumed by DCT. However, the effect size in Chinese was somewhat smaller than that in English, so there may be a small effect of orthography.

In addition to recalling Chinese sentences, the Chinese-English bilingual participants recalled English sentences as well. The results showed that the bilingual participants recalled concrete English sentences better than abstract English ones; concrete English sentences was recalled 1.58 times as much as abstract English sentences. This result is generally consistent with previous studies on recall of concrete and abstract English sentences (e. g., Sadoski et al., 1993a).

Finally, Chinese-English bilinguals recalled significantly more in Chinese than in English. This was not a main focus of the present study, and reasons for this will be proposed later.

From the perspective of theories of reading Chinese, two models for Chinese reading were introduced in the literature review—the multilevel interactive-activation model by Taft et al. (1999) and the interactive constituency model by Perfetti and Tan (1999). The two models explain character processing and word identification in Chinese

since characters are the basic processing units in Chinese reading; however, they do not explain why concrete sentences might be recalled better than abstract sentences in Chinese given that the Chinese script has more access to meaning. Therefore, the findings of this study and DCT have implications for extensions of those theories.

Conclusion

DCT proposes that information encoded in both the verbal and nonverbal system should be remembered better than information encoded in only one coding system. As a result, concrete language is better remembered and recalled than abstract language because concrete language is coded and stored in both the verbal and nonverbal systems. Though this hypothesis of DCT has been consistently demonstrated in alphabetic languages, it has never before been examined in Chinese at the sentence level. As stated earlier, reading theories that have been developed have seldom been examined across orthographies, and they should be in order to develop a genuinely comprehensive theory of reading. The results of the present study show that DCT, a general theory of cognition applied to literacy, is able to explain some comprehension and recall processes in Chinese, a language whose orthography that is rather different from orthographies of alphabetic languages.

Limitations and suggestions for future study

Previous studies of concreteness effects used English-speaking participants, whereas the present study used Chinese-English bilinguals to recall Chinese and English

sentences. As a result, some differences in rating patterns and recall performance occurred. The selected sentences of both languages all met the requirements that they differ in concreteness but are comparable in comprehensibility and familiarity; however, they did not have the same mean ratings. Based on the data shown in Table 3, concrete and abstract English sentences were all rated higher for the three qualities than concrete and abstract Chinese sentences.

Factors that could affect the responses in the rating norm study could be linguistic or cultural since it involves two languages and two ethnic groups. For the linguistic factor, the sentences were composed in English and then were translated into Chinese and back translated into English. The back-translated version compared with the original English version quite accurately, and the word counts between the English and Chinese sentences were almost equivalent as well. In general, measurement equivalence is well controlled; hence, the influence of linguistic factors was minimized. As for the cultural factor, Scott, et al. (2007) studied whether cultural factors could explain international differences in response to a questionnaire. The results showed that respondents from East Asia are more likely to agree with questions and less likely to choose extreme values from rating scales. In the present study, the researcher found that more English-speaking participants chose extreme values than Chinese-speaking participants did; hence the observed differences in ratings between the two language groups could be due to the cultural factor. Researchers in the future may pay attention to the cultural differences in rating forms.

As noted earlier, Chinese-English bilinguals recalled significantly more in Chinese than in English. This may be due to Chinese being their first language (Magiste, 1979), to orthography effects (e.g., Flores d'Arcais, 1992), or a combination. Further research is needed to determine the reasons.

In the present study, the most common word order of sentences, SVO or SV, was used for both languages. For future studies, researchers can use sentences with different word orders to examine whether the same results could be found.

Implications for education

In the present study, the Chinese-English bilingual participants recalled sentences in Chinese and English, and the results showed that Chinese is recalled better than English. Even though the participants in the recall study are undergraduates majoring in English and have been studying English for more than 10 years, the performance on recall between English and Chinese sentences was different. This could be because participants are more familiar with their native language and that Chinese is the more dominant language of the two for the participants, as suggested by Magiste (1979). First language dominance may be difficult to overcome, but bilingual educators may wish to consider increased efforts to produce second language proficiency where needed.

Concreteness may be an asset in learning a second language. Though English sentences were not recalled the same as Chinese, concrete English sentences were still recalled much better than abstract English ones. In Taiwan, English is taught from Grade 3. Anderson (1974) suggested that teachers, authors, and curriculum developers can be

as specific and concrete as possible to facilitate learning. Sadoski et al. (1993a) also suggest that concrete information in sentences and paragraphs should be used more often than abstract concepts in designing text to ensure comprehensibility, interestingness, and memory. These suggestions may apply to learning second languages regardless of the orthography.

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APPENDIX A

ABSTRACT AND CONCRETE ENGLISH SENTENCES USED FOR STUDY I

Abstract sentences:

1. The speed of light exceeds the speed of sound.
2. Great responsibility comes with great power.
3. The new government is facing a fundamental crisis.
4. The long-term effects can be very harmful.
5. Philosophy is about logical thinking.
6. The basic idea stays the same.
7. The evaluation of the program is held by a committee.
8. Superstitions are unfounded beliefs.
9. The stock market is going beyond our expectations.
10. Many of the laws of the Universe are still unknown to us.
11. Spring is the season of renewed spirit and growth.
12. Success is a combination of hard work and luck.
13. No standard was set for the judgment yet.
14. The value of the first number is twice that of the second number.
15. Tolerance for ambiguity can vary among individuals.
16. The election ensured a secure future.
17. The result of the application is hard to predict.
18. Opportunity can be missed because of carelessness.
19. The sense of achievement is beyond description.
20. This whole new concept has made a revolutionary change.

Concrete sentences:

1. The candlelight lit up the dark room.
2. The Internet may replace newspapers soon.
3. A leather sofa is more comfortable than a wooden chair.
4. The train went through the tunnel under the mountain.
5. The solar system has eight planets spinning around the sun.
6. Santa Claus delivers presents on Christmas Eve.
7. Elephants recognize themselves in the mirror.
8. Many automobiles were flooded in the pouring rain.
9. The Statue of Liberty holds a torch in her right hand.
10. Kids gathered on the beach waiting to fly kites**.**
11. The cherry blossoms in Japan attract many tourists.
12. Fans eagerly awaited the arrival of the movie star.
13. Firefighters came immediately after the elevator caught fire.
14. The teddy bear is the most beloved stuffed animal.
15. The end of the hallway leads to the rose garden.
16. The moon reflected brightly on the lake.
17. Diamond is the hardest material.
18**.** The magician disappeared on the stage.
19. The reddening leaves suggest that autumn has arrived.
20. Spider-Man is a popular superhero character.

APPENDIX B

ABSTRACT AND CONCRETE CHINESE SENTENCES USED FOR STUDY I

Abstract sentences:

1. 光速超過音速。
2. 有巨大的權力就有巨大的責任。
3. 新政府正面臨一個根本的危機。
4. 長期的效應可能非常有害。
5. 哲學是關於邏輯思考。
6. 基本概念保持一樣。
7. 這一計劃的評估由委員會舉行。
8. 迷信是沒有根據的信念。
9. 股市發展超乎我們預期。
10. 仍然有許多我們未知的宇宙法則。
11. 春天是氣象回春、萬物滋長的季節。
12. 成功是努力與運氣的結合。
13. 評論的標準還沒設立。
14. 第一個數字的數值是第二個數字的數值的兩倍。
15. 對模稜兩可的忍受度每個人不一樣。
16. 這次選舉確保了安定的未來。
17. 應用的結果難以預測。
18. 魯莽可是會喪失良機的。
19. 成就感難以言喻。
20. 這個全新的概念造成了革命性的改變。

Concrete sentences:

1. 燭光照亮了黑暗的房間。
2. 網路可能很快就取代報紙。
3. 皮沙發比木製的椅子還舒服。
4. 火車通過了山裡的隧道。
5. 太陽系有八顆行星繞著太陽轉。
6. 聖誕老人在耶誕夜送禮物。
7. 大象認得鏡子裡的自己。
8. 很多車子在大雨中都泡水了。
9. 自由女神像的右手握著火把。
10. 孩子們聚集在沙灘上等著放風箏。
11. 日本的櫻花吸引許多遊客。
12. 影迷們引頸期盼著電影明星的到來。
13. 救火隊員在電梯一著火後就馬上趕來。
14. 泰迪熊是最受喜愛的填充玩具。
15. 走廊的盡頭通往玫瑰花園。

(Appendix B continues)

16.月亮明亮地反射在湖面上。
17.鑽石是最硬的物質。
18.魔術師在舞台上消失了。
19.紅了的葉子代表秋天已經來了。
20.蜘蛛人是個受歡迎的超級英雄人物。

APPENDIX C

BACK TRANSLATIONS OF THE CHINESE SENTENCES INTO ENGLISH

Abstract sentences:

1. The light speed is higher than sound speed.
2. A gigantic power makes a gigantic responsibility.
3. The new government is facing a fundamental crisis.
4. The long-term effects could be very harmful.
5. Philosophy is about logical thinking.
6. The fundamental concept is kept the same.
7. The assessment of this program is held by the committee.
8. Superstition is the belief that has no root.
9. The growth of stock market is beyond our expectation.
10. There are still a number of unknown laws of the universe.
11. Spring is the season that rejuvenates the atmosphere and nourishes creatures.
12. Success is the combination of diligence and luck.
13. The criteria for evaluation have not been set up yet.
14. The initial numerical value is twice the size of the second digital value.
15. The tolerance of ambiguity is different from person to person
16. This election ensured a secure future.
17. The result of the application is hard to predict.
18. Recklessness takes the risk of losing opportunities.
19. The sense of achievement is beyond description.
20. This brand new concept makes a revolutionary change.

Concrete sentences:

1. The candlelight brightened the dark room.
2. The Internet may replace newspapers in no time.
3. Leather sofa is more comfortable than wooden chair.
4. The train went through the tunnel under the mountain.
5. There are eight planets orbiting around the sun in the solar system.
6. Santa Claus gives away gifts on Christmas Eve.
7. The elephant recognizes himself in the mirror.
8. A lot of cars are flooded in the thunder shower.
9. The Statue of Liberty holds a torch in her right hand.
10. The children gathered on the beach waiting to fly kites.
11. The Japanese cherry blossoms attract many visitors.
12. The fans are longing for the arrival of the movie star.
13. The firefighters arrived right after the elevator caught fire.
14. Teddy bears are the most beloved stuffed animal toys.
15. The end of the hallway leads to the garden of roses.
16. The moon reflects brightly on the lake.
17. Diamond is the hardest material.
18. The magician disappeared on the stage.
19. The red leaves mean that autumn is here.
20. Spider-Man is a popular superhero character.

APPENDIX D

THE RATING FORM OF CONCRETE ENGLISH SENTENCES FOR CONCRETENESS

Please rate each of the following sentences by circling a number based on how concrete it is. 1 (very abstract, hard for me to form mental images of this) 7 (very concrete, easy for me to form mental images of this)

1. The candlelight lit up the dark room.
   1 2 3 4 5 6 7
2. The Internet may replace newspapers soon.
   1 2 3 4 5 6 7
3. A leather sofa is more comfortable than a wooden chair.
   1 2 3 4 5 6 7
4. The train went through the tunnel under the mountain.
   1 2 3 4 5 6 7
5. The solar system has eight planets spinning around the sun.
   1 2 3 4 5 6 7
6. Santa Claus delivers presents on Christmas Eve.
   1 2 3 4 5 6 7
7. Elephants recognize themselves in the mirror.
   1 2 3 4 5 6 7
8. Many automobiles were flooded in the pouring rain.
   1 2 3 4 5 6 7
9. The Statue of Liberty holds a torch in her right hand.
   1 2 3 4 5 6 7
10. Kids gathered on the beach waiting to fly kites.
    1 2 3 4 5 6 7
11. The cherry blossoms in Japan attract many tourists.
    1 2 3 4 5 6 7
12. Fans eagerly awaited the arrival of the movie star.
    1 2 3 4 5 6 7
13. Firefighters came immediately after the elevator caught fire.
    1 2 3 4 5 6 7
14. The teddy bear is the most beloved stuffed animal.
    1 2 3 4 5 6 7
15. The end of the hallway leads to the rose garden.
    1 2 3 4 5 6 7
16. The moon reflected brightly on the lake.
    1 2 3 4 5 6 7
17. Diamond is the hardest material.
    1 2 3 4 5 6 7
18. The magician disappeared on the stage.
    1 2 3 4 5 6 7

(Appendix D continues)

19. The reddening leaves suggest that autumn has arrived.
1 2 3 4 5 6 7
20. Spider-Man is a popular superhero character.
1 2 3 4 5 6 7

APPENDIX E

SENTENCES USED FOR THE RECALL STUDY

Concrete English set:
The train went through the tunnel under the mountain.
Elephants recognize themselves in the mirror.
The Statue of Liberty holds a torch in her right hand.
The end of the hallway leads to the rose garden.
The magician disappeared on the stage.

Abstract English set:
Great responsibility comes with great power.
The long-term effects can be very harmful.
Success is a combination of hard work and luck.
The value of the first number is twice that of the second number.
Opportunity can be missed because of carelessness.

Concrete Chinese set:
火車通過了山裡的隧道。
大象認得鏡子裡的自己。
自由女神像的右手握著火把。
走廊的盡頭通往玫瑰花園。
魔術師在舞台上消失了。

Abstract Chinese set:
有巨大的權力就有巨大的責任。
長期的效應可能非常有害。
成功是努力與運氣的結合。
第一個數字的數值是第二個數字的數值的兩倍。
魯莽可是會喪失良機的。

APPENDIX F

AN EXAMPLE OF THE LANGUAGES AND SENTENCES ARRANGEMENT FOR THE RECALL TEST

Arrangement (1): Concrete English sentences followed by abstract Chinese sentences

1. The train went through the tunnel under the mountain.
2. Elephants recognize themselves in the mirror.
3. The Statue of Liberty holds a torch in her right hand.
4. The end of the hallway leads to the rose garden.
5. The magician disappeared on the stage.

1. 有巨大的權力就有巨大的責任。
2 長期的效應可能非常有害。
3. 成功是努力與運氣的結合。
4. 第一個數字的數值是第二個數字的數值的兩倍。
5. 魯莽可是會喪失良機的。

APPENDIX G

LISTS OF SENTENCE ARRANGEMENT WITHIN THE CONCRETE SET FOR THE RECALL TEST

1. The train went through the tunnel under the mountain.
2. Elephant recognize themselves in the mirror.
3. The Statue of Liberty holds a torch in her right hand.
4. The end of the hallway leads to the rose garden.
5. The magician disappeared on the stage.

1. Elephants recognize themselves in the mirror.
2. The Statue of Liberty holds a torch in her right hand.
3. The end of the hallway leads to the rose garden.
4. The magician disappeared on the stage.
5. The train went through the tunnel under the mountain.

1. The Statue of Liberty holds a torch in her right hand.
2. The end of the hallway leads to the rose garden.
3. The magician disappeared on the stage.
4. The train went through the tunnel under the mountain.
5. Elephants recognize themselves in the mirror.

1. The end of the hallway leads to the rose garden.
2. The magician disappeared on the stage.
3. The train went through the tunnel under the mountain.
4. Elephants recognize themselves in the mirror.
5. The Statue of Liberty holds a torch in her right hand.

1. The magician disappeared on the stage.
2. The train went through the tunnel under the mountain.
3. Elephants recognize themselves in the mirror.
4. The Statue of Liberty holds a torch in her right hand.
5. The end of the hallway leads to the rose garden.

APPENDIX H

IDEA UNITS OF CONCRETE SENTENCES

English sentences:

1.The train went through the tunnel under the mountain.
kernel: the train went modifier: through the tunnel
modifier: under the mountain

2. Elephants recognize themselves in the mirror.
kernel: elephants recognize themselves modifier: in the mirror

3. The Statue of Liberty holds a torch in her right hand.
kernel: The Statue (of Liberty) holds a torch modifier: in her hand
modifier: right

4. The end of the hallway leads to the rose garden.
kernel: the end leads modifier: of the hallway
modifier: to the garden modifier: rose

5. The magician disappeared on the stage.
kernel: the magician disappeared modifier: on the stage

Chinese sentences:

1. 火車通過了山裡的隧道。
kernel: 火車通過了 modifier: 隧道 modifier: 山裡的

2. 大象認得鏡子裡的自己。
kernel: 大象認得自己 modifier: 鏡子裡的

3. 自由女神像的右手握著火把。
kernel: 自由女神像握著火把 modifier: 手 modifier: 右

4. 走廊的盡頭通往玫瑰花園。
kernel: 盡頭通往花園 modifier: 走廊 modifier: 玫瑰

5. 魔術師在舞台上消失了。
kernel: 魔術師消失了 modifier: 在舞台上

APPENDIX I

IDEA UNITS OF ABSTRACT SENTENCES

English sentences:

1. Great responsibility comes with great power.
kernel: responsibility comes modifier: with power modifier: great
modifier: great

2. The long-term effects can be very harmful.
kernel: the effects can be harmful modifier: long-term
modifier: very

3. Success is a combination of hard work and luck.
kernel: success is a combination modifier: of hard work modifier: of luck

4. The value of the first number is twice that of the second number.
kernel: the value is twice modifier: of the first number
modifier: of the second number

5. Opportunity can be missed because of carelessness.
kernel: opportunity can be missed modifier: because of carelessness

Chinese sentences:

1. 有巨大的權力就有巨大的責任。
kernel: 有權力就有責任 modifier: 巨大的 modifier: 巨大的

2 長期的效應可能非常有害。
kernel: 效應可能有害 modifier: 長期的 modifier: 非常

3. 成功是努力與運氣的結合。
kernel: 成功是結合 modifier: 努力 modifier: 運氣

4. 第一個數字的數值是第二個數字的數值的兩倍。
kernel: 數值是兩倍 modifier: 第一個數字 modifier: 第二個數字

5. 魯莽可是會喪失良機的。
kernel: 良機會喪失 modifier: 魯莽

APPENDIX J

Table 6 Means and Standard Deviations for Comprehensibility, Familiarity, and Concreteness Ratings of the 40 English and Chinese Sentences

	Abstract sentences		Concrete sentences	
	M	SD	M	SD
English				
Comprehensibility	5.68	.97	6.70	.45
Familiarity	5.52	1.12	6.40	.49
Concreteness	4.67	1.38	6.40	.56
Chinese				
Comprehensibility	5.63	1.02	5.88	.87
Familiarity	5.44	1.14	5.70	1.09
Concreteness	5.04	1.28	5.79	.93

Note. n=47 for English, n=49 for Chinese.
Rating range 1-7.

VITA

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