Chapter One
Introduction

Vocabulary knowledge is a core component of language competence, and is an ever-lasting topic in language studies. The study of vocabulary acquisition, comprehension and production is especially preferred by researchers. One reason for the popularity of vocabulary study among researchers is its importance in language competence. As was pointed out by the great linguist Wilkins, without grammar very little can be conveyed, but without vocabulary nothing can be conveyed (Wilkins, 1972: 111). Another reason is that word processing is relatively clear and neat (Xu & Chen, 2014), compared to other linguistic components such as syntax. Unlike syntax, where linguists are often working hard to find out the proof of the existence of the invisible grammar structures and to disassociate the multiple effects of a series of factors, words leave substantial and physical traces either in the written form or the sound form, which greatly facilitates research design and experiment manipulation.

Because of its importance, vocabulary plays a vital role in the field of second language acquisition. Nowadays, with the integration with other disciplines such as psycholinguistics, neurolinguistics and cognitive sciences, second language vocabulary acquisition study has developed rapidly with a cognitive turn. It is not only a branch of the study of second language acquisition, as is regarded in a traditional way, but also a branch of the cognitive sciences (Gullberg & Indefrey, 2006; Traxler & Gernsbacher, 2006; Stemmer & Whitaker, 2008). With its importance in language competence and relative clarity in cognitive processing, vocabulary serves as a good window for linguists to inspect the cognitive

mechanism of language processing, as well as the relationship between language and brain. By studying second language learners' vocabulary as a breakthrough, linguists hope to reveal not only the essence of language, but also the secrets of our human brain.

With the cross-disciplinary integration, the vocabulary acquisition of second language has by far massively expanded its field of research and has nurtured a series of new hot issues. One of them is the bilingual lexical automatic activation, which refers to the phenomenon that when a bilingual use one language, the other language will automatically "pop out", no matter whether the bilingual would like to use it or not. This issue has attracted the interests of researchers of diverse backgrounds, such as linguistics, psychology, neurosciences and cognitive sciences. Different backgrounds have given rise to remarkable diversities and considerable controversies (Wu & Thierry, 2010).

Firstly, theoretical perspectives may be different. Some focus on bottom-up and top-down processing within the language system (e.g. the BIA model), while some others use the theory of inhibition-control cognitive mechanism to explain the bilingual lexical activation (e.g. the IC model). Some deserve to account for the bilingual interactive activation between levels in comprehension (e.g. the BIA+ Model), while some others have a focus on the language development and the interactions between L1 and L2 (e.g. the RHM). It is natural that different theoretical views may lead to different or even contradictive conclusions.

Secondly, different language materials have been used and participants with various backgrounds have been employed. Researchers can study different combinations of two languages, either closely related (e.g. English-French) or far away from each other (e.g. English-Chinese). By far, most of the models on bilingual representation and activation have been proposed by the researchers in the western countries based on the findings of alphabetic languages. These models may not be able to be applied to ideographic languages such as Chinese and Japanese. Recently, some studies on Chinese-English bilinguals (e.g. Li, 2013) and Chinese-Japanese bilinguals (e.g. Wang & Zhang, 2014) indeed have

found results that cannot be perfectly accounted for by the models based on alphabetic languages. Researchers can also use different types of words, such as homographs, interlexical neighbors and cognates. These different types of words may lead to different results. Besides, many linguistic features of words have a modulation effect on lexical processing, such as lexical frequency, length and concreteness, which may contribute to the complexity of the findings on bilingual activation. Moreover, different participants may be enrolled. They differ in the languages that they mastered, their proficiency in both languages, experience of language acquisition or learning and many other factors. The background of the participants has a huge impact on the final results of studies (e.g. Li, Zhang & MacWhinney, 2011).

Thirdly, different techniques have been used. In the early years, due to the limitations of research tools, natural observations were frequently used. Strictly speaking, this kind of study is in fact not real experimental study and is easy to be polluted by a lot of confounding variables. And then appeared the classic reaction time (RT) technique. By accurately recording the response time by millisecond, researchers can make a finer record and inference to the inner cognitive processes in language acquisition, comprehension and production (Wei & Luo, 2010). To date, most second language acquisition studies have used the RT technique (Zhang, 2014). However, the RT data recorded by behavioral measurement are only the "final decisions" and outcomes of a series of complex cognitive processes. The reaction times only reflect the final results of a series of cognitive processes, which themselves are difficult to be detected and disassociated. In order to detect the internal cognitive processes, new techniques are needed. Nowadays, more and more advanced techniques and tools have appeared, such as eye-tracking, event-related potentials (ERP), functional magnetic resonance imaging (fMRI) and near infra-red imaging (NIRI). They can record more information on language processing other than reaction times, e.g. eye's fixation durations, the latency and amplitude of brain potentials, the activated brain regions, and are hence superior to the sheer recording of reaction times.

Different techniques may yield to different findings and come to different conclusions. For example, the findings of applied linguists in natural observations may be contradictive to the findings of psychologists in experiments (Ni *et al.*, 2015), the conclusions of a RT study may be modified or even rejected by applying the ERP technique to the same task (Guo *et al.*, 2012), and the findings of psychologists in an ERP experiment may conflict with fMRI data of neuroscientists on the same question (Kim *et al.*, 1997; Chee, Tan & Thiel, 1999; Rodriguez-Fornells *et al.*, 2002; Thierry & Wu, 2007). It is obvious that techniques have brought in great diversities and disputes in the field of bilingual activation.

Finally, different experimental paradigms and tasks have been selected. Researchers have developed various paradigms, such as the picture-word interference paradigm, language switching paradigm and cross-language priming paradigm. Different paradigms have their own advantages as well as limitations. Different tasks may involve unexpected processes in experiment. For example, some tasks using mixing stimuli from two languages or using inter-lingual homographs require participants to use two languages interchangeably, thus resulting in a bias towards alternative activation of both languages. Under this circumstance, the non-target language would be activated even if its activation is not necessarily automatic during daily second language comprehension and production (Thierry & Wu, 2007). The activation may only be a result of the task settings. If only one language is required in the experiment, the findings would be more reliable.

Diversities and controversies do not mean collapse and chaos. On the contrary, diversities and controversies suggest that contributions to the revelation of the "black box" of bilingual activation have been made from different perspectives. Taking all these pieces of findings together, researchers will better understand the phenomenon of bilingual activation.

To date, most studies have found out that the L1 may be automatically activated during the processing of L2 words. However, there are still some limitations of the previous findings. In terms of research participants,

Chinese learners of English have been paid too little attention. Empirically, there is no comprehensive and systematic study on the locus (conceptual level, lexical level and sub-lexical level) and time course of L1 automatic activation. Methodologically, most studies have only used the basic RT technique rather than the ERP technique, which has a high temporal resolution and is able to make a real time record of the cognitive processing. Besides, most studies have used cross-language tasks, which may lead to participants' controlled activation rather than automatic activation of L1, in that they provide an "artificial" dual-language context. Theoretically, most of the theoretical models were based on the studies on alphabetic languages, and these models may not fit the ideographic languages such as Chinese.

In order to solve these problems, the present study hopes to add a new empirical case to the list of experiment studies on bilingual lexical activation, by investigating the L1 Chinese automatic activation during L2 English processing of the Chinese-English bilinguals (Chinese learners of English). It will investigate the locus (conceptual level/lexical level/sub-lexical level) and the time course (early stages/late stages), and is hence a comprehensive and systematic study on L1 automatic activation during L2 processing. Methodologically, this study would like to use the advanced event-related potentials technique as well as the traditional reaction time technique to gather multi-dimensional data and hence come to more reliable conclusions. Besides, as is advised by some researchers to use tasks in a monolingual context, this study attempts to improve the experimental paradigm and task, in order to avoid conscious activation to the non-target language. Theoretically, this study also hopes to contribute to the modification and update of the theoretical models on bilingual activation. Pedagogically, it should be noted that there is a large amount of English learners in China, and the presen study can provide insightful hints on the English teaching and learning. Taking all these into consideration, this study will recruit high proficiency and unbalanced Chinese-English bilinguals (Chinese learners of English) as participants, employ the event-related potentials (ERP) technique and the reaction time (RT)

technique, attempt to use an improved experimental paradigm, and aim to investigate the locus and time course of Chinese-English bilinguals' L1 Chinese lexical automatic activation during L2 English word processing. This study hopes to provide more empirical evidence and theoretical modifications on bilingual lexical activation, as well as methodological hints to researchers and pedagogical hints to English teachers and learners.

The significance of the present study is as follows.

Theoretically, this study can deepen our understanding of the cognitive mechanism of L1 automatic activation during the processing of L2. Second language acquisition consists of dynamic processes and so does the lexical activation. Although previous models have made various assumptions on bilingual lexical representation and its activation, the mechanism of L1 automatic activation during the processing of L2 is still not that clear. This study attempts to find out the locus and time course of L1 automatic activation during L2 processing, by a comprehensive and systematic study from the highest conceptual level to the lowest sub-lexical level and from the early stages of processing to the late stages, in shallow and deep processing respectively. It is hoped that this study can not only validate the current theoretical models on bilingual activation but also contribute to the modification and update of them.

Empirically, the investigation into high proficiency yet unbalanced Chinese-English bilinguals can add in more empirical data to the study of bilingual activation. Most previous studies have investigated fluent balanced and influent unbalanced bilinguals. However, the fluent unbalanced bilinguals have been ignored to some extent. Meanwhile, the previous studies mainly focused on the second language learners in the western countries, but few studies have focused on Chinese learners of English. There is no reason to omit the high proficiency yet unbalanced Chinese-English bilinguals. The present study can provide more data on the universality of bilingual activation that has long been reported in other languages.

Methodologically, this study attempts to modify and improve the

experimental paradigm and tasks, by manipulating the position of hidden character repetition and the stimulus onset asynchrony (SOA). The design of experiment is very critical in order to disassociate the modulation of different variables. In bilingual activation studies, a major critique to most previous paradigms is that words from both languages are used in an experiment; hence the observed L1 automatic activation may not be really automatic but a result of the experimental task bias itself. Thierry & Wu (2007) have developed a hidden repetition paradigm, which succeeds in examining L1 automatic activation in a L2-only context. However, it fails to manipulate the position of hidden repetition. Therefore, it cannot examine the different roles that the first and second morpheme play, which is highly related with the issue of the locus of L1 automatic activation, determining whether or not there is L1 automatic activation at the sub-lexical level. Besides, the SOA is not randomly chosen but is very critical in that it is related with the issue of depth of processing of L1 automatic activation. The present study made some attempts in improving Thierry & Wu's (2007) hidden repetition paradigm and to use a masked and a normal task to test the unconscious and conscious processing. These attempts are hoped to be effective in revealing more secrets of L1 automatic activation during L2 processing.

In order to obtain sufficient data, the present study decides to use the advanced ERP technique as well as the traditional RT technique. These techniques are superior to the interview or think-aloud protocol methods in several aspects. First, they have very high temporal resolution. The RT technique can record the responses by millisecond. The ERP technique can even track the inner cognitive activities along the axis of time, as cognitive processes unfold. Second, variables can be rigorously manipulated or controlled. In second language acquisition, there are a lot of linguistic, social and psychological variables that affect language acquisition, comprehension and production. By carrying out experiment combining RT and ERP techniques, the variables that are to be studied can be well manipulated and the irrelevant variables can be strictly controlled or eliminated. Therefore, the obtained results are very neat and

easy to be accounted for, rather than in a mess.

Pedagogically, the findings in this study will benefit English teaching and learning in China. Nowadays there is a large amount of learners of English in China, and studies on Chinese-English bilinguals' lexical activation can shed light on English teaching and learning in China. Based on the findings in the present study, teachers can know more about the students' inner activities in processing L2 and accordingly choose an appropriate way of instruction. Students can know their status in terms of L1 automatic activation during L2 processing, and adjust their strategies so as to be more efficient in English learning.

Chapter Two
Theoretical and Empirical Background

This chapter is a review of the theoretical and empirical background on bilingual lexical activation. First, several key terms are discussed and defined. Second, the theories on mental lexicon from the monolingual perspective are briefly reviewed as a prerequisite to the studies from the bilingual perspective. Third, the theoretical models on bilingual lexical processing are reviewed and discussed. In the end, the empirical studies on bilingual activation using different experimental tasks are discussed. The unresolved problems and issues in the previous studies are discussed and the present study is justified.

2.1 Definition of Key Terms

2.1.1 Bilinguals

Researchers have made various definitions on who can be termed a bilingual. Among these definitions there are two core criteria: language fluency and language use. According to the definitions based on language fluency, bilinguals are those who are able to use two languages habitually, fluently, correctly and without an accent (Paradis, 1986; Grosjean & Li, 2013). Obviously, this is a strict version of definition, for it requires a rather high and balanced proficiency in both languages. According to this kind of definitions, few people can be labeled as bilinguals. On one hand, the proficiency of two languages cannot be perfectly symmetric. More

often than not people have a dominant language and a relatively weaker language. On the other hand, people may have unbalanced proficiency in skills of listening, speaking, reading and writing, even within the same language. If the strict version of definition were adopted, the majority of language learners and speakers would be excluded, making the scope of bilingualism study too narrow.

The other kind of definitions are based on the criterion of language use, which get around the problems caused by setting fluency as a decisive criterion. The criterion of language use comes to a broad version of definition. For example, Grosjean (1982) termed bilinguals as those who need and use two or more languages or dialects in daily life. It can be seen from this definition that not only the use of two or more languages is included, but also the use of two or more dialects is encompassed. Clearly, this definition widely extends the scope of bilingualism study and the population to be studied, and is more realistic than the definition based on language fluency.

That said, the criterion of language use alone is not sufficient to describe a bilingual. Knowing how frequently one uses a language cannot tell us how proficient his or her language proficiency is, while the language proficiency is an important factor in psycholinguistic and bilingualism studies. Therefore, some researchers attempt to combine the two factors, i.e. to consider language fluency and language use at the same time. For example, Grosjean (2013) developed a "grid approach" to help describe the language status of a bilingual. In this sense, bilinguals' languages can be described along two dimensions. Along the vertical axis, language use is presented from "never used" to "daily use". Along the horizontal axis, language proficiency is presented from "low fluency" to "high fluency". Besides, the trace of language development can be seen clearly from such grids recorded at different times. According to this definition, almost everyone who knows and uses two or more languages or dialects can be considered a bilingual.

In this study, the participants have passed TEM-8 but do not use English frequently. According to Grosjean's (2013) definition, they can be termed high proficiency and unbalanced bilinguals.