WORD ROOTS IN ENGLISH - LEARNING ENGLISH WORDS THROUGH FORM AND MEANING SIMILARITY

by

Wei Zheng

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Abstract

The research first proposes a vocabulary learning technique: the word part technique, and then tests its effectiveness in aiding vocabulary learning and retention.

The first part of the thesis centers around the idea that the knowledge of the first 2000 words language learners already possess may give them easier access to words of other frequency levels because the root parts of the low frequency new words share form and meaning similarities with the high frequency known words. The research addresses the issue at two stages: to quantify the information concerning the number of words able to be accessed through the analysis of the word roots, and to analyze the pedagogical usefulness of the accessible words.

A Comprehensive Etymological Dictionary of the English Language (Klein, 1966) was used as the source to show the possible formal and meaning connections among words. All the words in the first 2000 word list were first looked up individually and all the cognates provided under each of these words were collected and placed under each of the high frequency words if they meet the requirement that their roots share more than one letter and/or more than one phoneme with the roots of the first 2000 known words. After the data was roughly gathered, three criteria were applied to filter the data, namely, the frequency criterion, the meaning criterion and form criterion. In applying the frequency criterion, words with frequency levels lower than the tenth thousand were removed from the data. In applying the meaning criterion, hints were given to show the semantic relations between the higher frequency words and the first 2000 thousand words. The hints were then rated on the scale for measuring meaning transparency. Words that were rated at level 5 on the scale were considered inaccessible; words that were rated at levels 1, 2a, 2b, 2c, and 3a were considered easy to access. In applying the form criterion, calculations were done for each semantically accessible word to show their phonological similarity and orthographic similarity in relation to the known word. The words whose phonological or orthographical similarity scores were larger than 0.5 were considered to be phonologically or orthographically easy to access. Finally the

"find" function of Microsoft Word was used to check the data by picking up any words that might have been missed in the first round of data gathering.

The above procedures resulted in 2156 word families that are able to be accessed through the meaning and form relations with the first 2000 words in their root parts. Among the 2156 word families, 739 can be accessed easily and are therefore more pedagogically useful and 259 can be accessed, but with difficulty. 21 pedagogically useful form constants were selected because they can give access to more unknown lower frequency words than other form constants.

In the second part of the thesis, an experiment was conducted to test the effectiveness of the word part technique in comparison with the keyword technique and self-strategy learning. The results show that with the experienced Chinese EFL learners, the keyword technique is slightly inferior to the word part technique and the self-strategy learning.

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Part One

Chapter 1 Introduction

1.1Motivation of the present research

Vocabulary learning is an important component yet a challenging task in both English language learning and content-based study. There is empirical evidence that the receptive vocabulary of English-speaking university graduates is around 20,000 word families (Goulden, Nation & Read, 1990). The literature on L2 acquisition sets a minimum learning target of 8,000-9000 word families as the threshold for language learners to attain unsupported comprehension of unsimplified written texts and 6,000-7,000 word families for spoken texts (Nation, 2006). This threshold vocabulary level assumes that 98% text coverage is required for ESL learners to adequately comprehend English texts (Hirsh & Nation, 1992; Hu & Nation, 2001; Liu & Nation, 1985).

To aid language learners in tackling the difficulty of learning English vocabulary and to enhance their vocabulary growth, a large amount of research has been carried out in seeking and experimenting with effective vocabulary teaching and learning techniques. For example, inferring word meaning from context while learners are engaged in extensive reading has been encouraged and the guessing strategies have been taught to learners. Some other interventions or strategies that have been employed in L2 vocabulary teaching and learning include semantic mapping and semantic feature analysis, dictionary work, using word cards and collocation learning.

A vocabulary learning technique that has received special attention is the keyword method developed by Atkinson (1975). This mnemonic device employs an acoustic link and a visual image to strengthen the association between the form and meaning of words and hence enhance vocabulary learning and its long-term retention. The keyword method has been well researched and has been proved efficient by a large number of studies conducted in different learning contexts with different groups of learners learning different languages (Sagarra & Alba, 2006; Shapiro & Waters, 2005; Beaton, Bruneberg, Hyde, Shufflebottom & Sykes, 2005; Rodriguez and Sadoski, 2000; Avila & Sadoski, 1996; Beaton, Gruneberg & Ellis, 1995; Ellis & Beaton, 1993, 1995; Ulanoff & Pucci, 1993; Moore & Surber, 1992; Wang & Thomas, 1992; Pressley & Ahmad,

1986; Desrochers, Wieland & Cote, 1991; Pressley, Levin & Miller, 1982; Levin, McCormick, Miller, Berry & Pressley, 1982; Pressley, Levin & Miller, 1982; Pressley, Levin, Nakamura, Hope, Bispo & Toye, 1980; Delaney, 1978; Rohwer, Raines, Eoff & Wagner, 1977; Raugh & Atkinson, 1975).

Another long-standing vocabulary learning technique is word unit analysis which involves identifying and learning the meanings and functions of word parts, namely, prefixes, roots and suffixes. Word parts provide clues for deriving and remembering word meaning, and it has been a normal practice in both L1 and L2 vocabulary lessons to present root and affix lists of various lengths for students to memorize (Nattinger, 1988). In spite of this, word unit analysis as a learning technique remains understudied. To date there are only a few pieces of research into the frequency of use of the English prefixes and suffixes (Bauer & Nation, 1993; Bird, 1987, 1990; Becker, Dixon, Anderson-Inman, 1980; Roberts, 1956; Stauffer, 1942; Grinstead, 1924). Empirical research into the effectiveness of the word unit technique is hard to find.

The present research focuses on the analysis of word roots as a pedagogical intervention and a learning technique to promote vocabulary learning. It attempts to systemize this vocabulary learning technique by working out the number of word families that can be accessed by means of root analysis based on the knowledge of the first 2000 English words. This aim was attained by identifying the form and meaning constants between the root parts of the low frequency to-be-learned words and the high frequency known words. It then used measures of the formal similarity, semantic transparency and usefulness of the extended word families to come up with a pedagogically useful list. Named the "word part" technique, this vocabulary learning technique uses both the spoken and written form similarity and the meaning similarity between the unknown words and known words to strengthen the form and meaning linking of the to-be-learned words in learners' memory and to facilitate word learning and retention. Because the word part technique is parallel to the keyword method in that both of them are intended to be mnemonics to help vocabulary learning and retention and that both of them use a known word as a linking word to access a new word, in the second phase of the current research, an empirical study was carried out to compare the relative effectiveness of the two learning methods.

1.2 The implications and applications of the research results

Bird (1987) describes the word part learning technique or learning vocabulary through analyzing word roots as a magic bullet. Bird enthusiastically advocated the learning approach saying that it has the power to generate 7000 words from the 1000 word elements so that the knowledge about word roots can radically reduce the learning load of English vocabulary learning. On the other hand, the authors of empirical studies concluded that instruction on the etymology of word roots had no significant effect on vocabulary growth in general (Carroll, 1940; Barnes, 1942; Otterman, 1955; Shepherd, 1974). The present study quantifies the number of words formally and semantically related to the high frequency known words, these words' levels of transparency in terms of meaning relation with the high frequency words, their levels of form similarity in relation to the high frequency known words, and these words' frequency of use. Thus, this study is able to provide a more precise picture of the facilitative effects of the technique on vocabulary learning.

The results of the research will have two applications in the teaching and learning of English as a second language: 1) word part information can be added to learner dictionaries to show the dictionary users the interrelations between the words by presenting information about the shared forms and meanings of words. 2) word part relationships can be described in a text with similar but more detailed information on word parts and word relations for the teachers to consult when teaching vocabulary.

Although learner dictionaries have undergone many improvements in their content and presentation to meet language learner's needs in language learning (as will be shown in the literature review), they still lack information about the meaning of the word roots, the form relationships and the meaning shared by the words of the same etymological origin. When the results of this study are incorporated into a learner dictionary, some additional lines of explanation could be provided as in the following examples for the word entries "supervise", "envy", "equivalent":

> If you supervise an activity or a person, you make sure that the activity is done correctly or that the person is doing a task or behaving correctly. □ *A team was sent to supervise the elections in Nicaragua*. (a dictionary item taken from *the Collins Cobuild Advanced Dictionary of American English*)
>
> -vis- = "see" as in "visit", go to **see**
>
> supervise: to **see** that the right thing is done

other related words: advise, advice, revise, visible, visual, envisage, envy, visa.

-vy- is a variant of -vis- = “see” as in “visit”, go to **see**
envy: see others' fortune with ill feelings
other related words: advise, advice, revise, visible, visual, supervise, envisage, visa

-equa-, -equi- = “equal” as in “equal”
equivalent: **equal** in value or meaning
other related words: adequate, equation, equity, equilibrium, equator, equitable, equivocal, iniquity

The three examples show that the added information for the dictionary entries includes, first, the form constants of a set of words which are intended to show learners the form relationships between words, e.g. *-vis-, -equa-, -equi-*; second, the meaning constants which are the meaning of the form constants which relate the forms of the word parts to their meanings , e.g. = “see”, = “equal”; third, the hints for the new word and/or the known word so that the meaning connection between them is shown, e.g. “visit”, to go to **see**; “supervise”: to **see** that the right thing is done; “equivalent”: **equal** in value or meaning; fourth, other formally and semantically related words so that when one word is looked up, learners can relate it not only with the known word but also with all the other related words, some of which may be already known or partly known. These four pieces of information are added to the learners dictionary in the hope of making the establishing of the form and meaning connection easier if learners are supported with the knowledge about the form and meaning of word parts and if the form and meaning relationships between known and unknown words are clarified for them.

The results of the research may also be useful in the form of a reference book for teachers. The reference book should contain more detailed information to guide the teaching practice in addition to the information provided in learner dictionaries. The following is an example that may appear in the reference book.

		flat -pla- = flat number of words accessed: **7** average accessibility: **+ average frequency: 3.6				
accessed words	**frequency**	**hints**	**meaning transparency**	**spoken form similarity**	**written form similarity**	**overall accessibility**

plain	**2**	flat country	2a	0.25	0.40	**
plane	**2**	flat or level surface	2a	0.25	0.40	**
plate	**2**	a flat dish	2a	0.50	0.60	***
plaice	**7**	a flat sea fish	2a	0.25	0.40	***
plateau	10	raised flat area	2a	0.60	0.43	**
*plot	3	a small flat area	2a	0.50	0.50	***
*flounder	7	a small flat fish	2a	0.33	0.25	**

Note: The sound /p/ in the lower frequency words changed to /f/ in FLAT according to Grimm's Law. Likewise, in FLOUNDER, /d/ changed to /t/ in FLAT. PLOT changed its vowel sound compared with PLATE, PLATEAU, etc.

In the book, related low frequency words are grouped under the known words (FLAT in the above example) through which the new words (listed on the left) are learned in order to provide the larger picture of the set of related words. For each set of words, the form constants and the meaning constants are provided at the beginning of the group (-pla- = flat). In addition to the information found in the dictionary version, the frequency levels of the use of words (column 2) are presented to show teachers the value of learning a particular word. Spoken and written form similarity scores and meaning transparency levels are provided as well, indicating the accessibility of the words from different dimensions. The overall accessibility level which takes into consideration both form and meaning is indicated with the star marks in the right-hand column to give teachers a more straightforward impression of the ease of learning certain words. The average frequency levels of a set of accessible words and their average accessibility are presented at the beginning together with the form and meaning constants to show the usefulness and the learnability of a certain form constant and its meaning. Notes are added at the end of each group of words. The notes fulfill three functions: to further explain the meaning constant, to further explain the form constant, and to explain the relationship between sets of words. The more detailed information provided in the notes is mainly intended to equip teachers with the knowledge they may need in their teaching. The information can be taught to the students as the teachers see appropriate and necessary. The note given at the end of the example provides useful information to clarify the relationships. Here are three more examples of such notes to show the range of their functions.

The first note below mainly explains the meaning of the form –co(u)r- whose meaning is not straightforward in the definitions. The second note explains the form patterns –ceiv- and -cept- when PERCEIVE and DECEIVE are grouped together with CONCEPT, PERCEPTION, DECEPTION, SUSCEPTIBLE and INTERCEPT headed by the known word ACCEPT. The third note is to explain the relationship of three groups of words which, though separately treated, are actually closely related in form and meaning.

Note: -co(u)r- means "heart"(Latin). "Heart" carries the idea of the centre and being brave and in agreement. We can see this in phrases like "to take heart" (be brave), "the heart of a place" (the centre) and "of one heart" (in agreement). So ENCOURAGE means "to give sb a brave heart". Although the form is not always clear, a common meaning of "heart" runs through its uses – ACCORD, CORE, CARDIAC, COURAGE.

Note: The noun forms of DECEIVE and PERCEIVE are DECEPTION and PERCEPTION (a change of -ceiv- to -cept-) as in the case of RECEIVE and RECEPTION below.

Note: The INCLUDE group and CONCLUSION group are closely related to the CLOSE group of words both in form and in meaning. Formally they all contain the letters –cl- or –cl-s-. Semantically they all have the meaning "close". While CONCLUSION is "the **close** of a speech", to INCLUDE is to "**close** sth within a group".

An index of all related words, an index of the form and meaning constants and an index of the usefulness of words could be included in such a book for convenience of reference.

1.3 Organization of the study

This study consists of two parts. The first part aims to identify a list of words within the first ten thousand frequency bands which can be learned through the analysis of word roots.

Chapter 1 states the motivation and describes the pedagogical significance of the present research in addition to an introduction of the organization of the thesis.

Chapter 2 is a review of literature related to the first part of the thesis. It consists of theories and research on word study and word learning from the morphological, etymological, psychological and pedagogical perspectives,

Chapter 3 presents the rationale for developing the scales for measuring the phonemic, orthographic and semantic similarity between the low frequency unknown words and the first two thousand words.

Chapter 4 sets out to discuss the principles and criteria applied in an attempt to fulfill the research goal of producing a list of pedagogically useful words which can be learned through the analysis of the form and meaning similarity of word pairs. This chapter also describes in detail the procedures that were followed in the course of coming up with the list of accessible words. The procedures include roughly gathering data from *A Comprehensive Etymological Dictionary of the English Language* (Klein, 1966), filtering the data by applying the frequency, meaning and form criteria sequentially, and finally data checking.

Chapter 5 reports in a synchronic manner the results of going through the research procedures described in Chapter 4. It also presents the quantified information of the words that are able to be accessed by the first 2000 words and presents a list of useful form constants

Chapter 6 discusses the results from three aspects: the reason for not being able to access a majority of the third to tenth 1000 words using the proposed technique; the relationship between word form, meaning and frequency of use; suggestions for applying the outcome of the present research to vocabulary teaching and learning to help vocabulary development.

Chapter 7 serves a transition to the second part of the thesis. It links the first part of the research up to the second part by specifying the differences and similarities between the word part technique proposed in the present study and the keyword method.

Chapter 8 incorporates a review of the previous research into the efficacies of the keyword method in comparison with other vocabulary learning strategies. It highlights the issues involved in optimizing and testing the keyword method.

Chapter 9 describes the design of the empirical study on the effectiveness of the word part technique relative to the keyword method and self-strategy learning. It includes an account of the considerations to ensure the reliability and validity of the experiments, the learning materials, testing material and scoring system, and the procedures of giving treatments and administering the pre-test, immediate post-tests and delayed posttests.

Chapter 10 presents the findings of the experiment after the test scores on the form recognition test, meaning recognition test and meaning translation test in the three conditions were compared.

Chapter 11 discusses significant findings of the empirical study. It focuses on the characteristics of the experienced L2 learners, the features of the learners' first language, the effect of the imageability of the target words and the effect of the test format on the efficacy of the three learning techniques.

Chapter 2 Literature Review

This chapter consists of a review of literature in three research areas, namely, the morphological study of words and morphological analysis as a means of vocabulary development; the etymological study of words and the application of etymological information to vocabulary learning; and form and meaning relationships between words as a factor affecting the ease of word learning. The first two areas of the literature are reviewed because the present study involves quantifying the form and meaning relationships of word roots as a means of aiding vocabulary learning and because it involves making use of the etymological information about word roots to establish form and meaning connections among words. However, the present study is not intended to be a morphological or etymological analysis of English word roots, but rather it aims to sort out a list of words which are closely related in form and meaning with high frequency words so that they are pedagogically useful and able to facilitate word learning and retention. Therefore the last part of this chapter will turn to the cognitive theory of levels of processing and empirical research on establishing form and meaning relationships to see how these relate to the ease of foreign word learning.

2.1 Morphological study of words and morphological knowledge in vocabulary growth

In this part of the literature review, theories on the morpheme will be reviewed first in order to clarify the difference between the nature of the present research and the morphological study of words and to define the term “roots” used in this study.

This is followed by a theoretical discussion of English native speakers’ mental representation of the derivatives. In spite of the psycholinguistic finding that bound roots, due to their semantic opaqueness, are not conscious knowledge for language users, the aim of the present study is to provide teachers and learners with this knowledge and to help learners become aware of the form and meaning relationships among words with bound roots and intentionally apply this knowledge in their vocabulary learning.

Since the psycholinguistic theory of morphological presentation provides the psychological basis for learning vocabulary through word structure analysis, applied

linguists have attempted to systemize and quantify knowledge about prefixes and suffixes and roots of words so that the information can be more accessible to language teachers and learners and can be used in an effective way. Work in this area will be reviewed and research gaps discussed.

Researchers in the field of language education have also carried out investigations to find out the extent to which language learners' growth of vocabulary might be accounted for by applying knowledge of morphological rules. This chapter next reviews the previous studies on the growth of derivational morphological knowledge in L1 and L2 learners showing the role of morphological analysis and instruction in morphological knowledge in vocabulary development.

2.1.1 The morpheme

The morpheme is the fundamental unit of analysis in morphology. The standard definition of the morpheme is that it is "an abstraction: a class of 'morpheme alternates' or 'allomorphs', each with a determinate phonological form, having the same meaning and occurring in complementary distribution with one another" (Anderson, 1988, p. 152). Thus the morpheme is a family of signs, units of form and meaning. Inherited from structuralism, this notion views morphemes as elements or items or things that are combined to make up word forms. This was what Hockett (1958) called the item-and-arrangement approach to morphology. This one-to-one relationship between form and meaning proves to be problematic when it comes to many other morphological phenomena. As Anderson (1988) suggests, one difficulty with this notion of the morpheme is the identification of zero, subtractive, replacive, metathesizing, and other types of morphs. Other problems include accounting for infixes, empty morphs, superfluous morphs, cumulative morphs, reciprocal conditioning, structure without meaningful morphemes and portmanteau morphs. For example, in the word pair *fell/fall, to fell* "to make fall" may be said to be derived from *to fall* "move downwards" and the /e/ in *to fell* might be treated as an infix. However, the trouble with this account is that it is improper to define the infix to mean "to make X" (Plag, 2003, p. 23).

An alternative way to account for this morphological phenomenon is to say that it is the process of vowel change that adds the meaning of "to make X" to the word *to fell*. In this way, a form (*to fell*) is constructed from a basic or underlying form (*to fall*) by

means of a process (vowel alternation). This item-and -process approach to morphology (Hockett, 1958) is less restrictive and can describe some morphological phenomena more effectively than the item-and-arrangement view. However as Anderson (1988, p. 158) has pointed out, this approach "runs the risk of weakening" the basic notion in morphology, that is, the morpheme is the minimal unit of meaning and form and a morph is a form of the morpheme, because a unit of meaning and form or a morph cannot be a process.

Adopting the process view of the morpheme, phonologists have done a lot of work on the allomorphic realizations of morphemes and thus linked phonology with morphology (Spencer, 1991). In generative phonology, a unique underlying form or an underlier is believed to exist from which the allomorphs of a morpheme can be derived. The underlier is related to the alternants which are the actual pronunciations and therefore the surface forms. The connection is made through morphophonological processes or transformational rules which specify the phonological changes to morphs. The underlier may be one of the alternants or it may be abstract and does not take the form of any alternants or does not consist of the segments found in the alternants. Thus, the underlier of the alternating pair of vowels in the verb *obscene* and in the noun *obscenity* is /i:/ which is "long in duration like the diphthong(s) in the adjective(s), but of an articulatory quality more resembling the short vowel(s) in the noun(s)" (Coates, 2006, p. 324). In this sense, /i:/ is the underlier, an abstract entity representing the alternating pair of vowels.

This analytical technique is carried to the extreme by linguists such as Lightner (1975) who suggested that the abstractness of the underliers of the English morphs should be such that they can connect the word forms after the word forms have been traced to their origins. Therefore to Lightner, *quick* and *vivid* are allomorphs that realize the same morpheme (p. 631). Attempts have been made by some other linguists such as Hooper (1976) and Kiparsky (1974) to limit abstractness. However, as Bauer (2003, p. 155) points out, "there is no obvious and clearly defined middle ground" between extreme abstractness and extreme concreteness. This is shown by the research conducted by Derwing (1976) who after testing native speakers' reactions to phonemic and semantic transparency came to the conclusion that both semantic relatedness and phonemic relatedness occur along a cline and that no dividing line is easily drawn anywhere along the continuum.

In view of the problems posed by the morpheme-based theory in morphology, Aronoff (1976) challenges directly the notion of the morpheme as the minimal sign. One of the examples he uses to support his argument concerns the morphemic status of *–ceive*. In words like *receive, deceive, conceive* and *perceive*, the root *–ceive* may not qualify as a morpheme because it is hard to say that the root *–ceive* carries a particular meaning which is related to the meaning of the word or to any sense of a word in the group (Aronoff, 1976, p. 14). In nominalized forms of those words, however, *-ceive* in these words is replaced by the segment *–cept*. Aronoff concludes that the morpheme cannot be the minimal linguistic unit of form and meaning. Meaning is not essential to the morpheme, but rather it is the phonological rule that makes *–ceive* recognizable. He redefines the morpheme as "a phonetic string which can be connected to a linguistic entity outside that string" (p. 15) He proposes a word-based theory which emphasizes that morphology is based on words not on morphemes. While in morpheme-based morphology, the relationship between morphologically related words is expressed by segmenting words into components, word-based morphology captures this relationship by using word schema rules to represent the semantic and phonological similarity between words. The word-based approach has advantages over the morpheme-based approach in that it is more straightforward in accounting for some morphological phenomena that are difficult for a morpheme-based model, such as the non-concatenative processes, zero-morphs, subtraction, suppletion, backformation, etc. In spite of this, it is argued by some linguists that the morpheme is indispensable for morphology. One argument for the existence of morphemes is that it will be hard to account for some linguistic phenomena without referring to "the word-internal morphological structure" (Plag, 2003, p. 189). For instance, "-ation" or "-ication" taken by the derived verbs such as 'personalize", "colonize" and "personify" is determined by the suffix of the derived verbs "–ize" or "-ify". Accounting for this process would be more difficult without referring to the internal morphological structure of the base. Moreover, psychological evidence exists to show that morphemes are real entities in language users' mental lexicons. The generally held view is that morpheme-base morphology and word-based morphology should be in a complementary relationship rather than having one replaced by the other.

The present study aims to analyze the form and meaning of the root part of words and explore the form and meaning relationships between the first two thousand words and lower frequency words in order to find a list of words which are closely related in

form and meaning to make the learning of lower frequency words easier. Thus it is essentially not a morphological study of words. When the term "root" is used, this is not intended to be the morphological sense of root – "that part of a word-form which remains when all inflectional and derivational affixes have been removed" (Bauer, 2003, p. 340). Its usage in this study will intersect with the morphological usage at times, but it will also be based on history and thus have etymological facets. Because form and meaning similarity between the first 2000 words and the lower frequency words is what the study is seeking out, occasionally the form constants presented for a group of words which share the same meaning are not even limited to their root parts. Then the term "root" is extended occasionally to refer to the form constants which consist of the root in the morphological sense or etymological sense plus suffixes or prefixes which do not impart obvious meaning to the current meaning of words. The term "root" is therefore only vaguely used in the present study, not specifically morphologically.

The term "root" is so used because the research is not going to argue that the group of words *depend, pendant* and *ponder* share the same morpheme which is realized by the allomorphs *pend* and *pond*. Rather the analysis of this group of words will lead to the result that the new word *pendant* is more similar in form and in meaning to the known word *depend* than *ponder* and therefore is easier to access through the known word *depend*. Likewise the purpose of analyzing the pair *mother/maternity* is not to show that a single morpheme is involved though they do not share much formal similarity. Rather this word pair is going to be presented as high in meaning transparency but low in form transparency. This means that more effort will be required on the part of the language learners to acquire the spelling of the new word *maternity*, or to establish the form-meaning connection. For the group of words headed by *provide*/*proviso/improvise/provident*, *-provid-* and *-provis-* are presented as the form constants of the group with the meaning constant of "provide" (*proviso*: a condition provided in a legal document; *improvise*: provide sth for the occasion without preparation; *provident*: careful and showing the ability to provide care for the future) although the etymological root is *-vid-* or *-vis-* meaning "see".

2.1.2 Mental representation of morphological structures

An important concern in psycholinguistics is the role of morphology in language processing. Research has especially addressed the question of whether complex lexical forms are stored separately as whole forms in the mental lexicon or whether they are represented in morphologically decomposed forms as bases plus affixes and therefore accessed through the word components. Evidence for this question mainly comes from two research paradigms – priming experiments and experiments examining the effects of base and surface frequency (Marslen-Wilson, 2006).

The priming tasks involve first presenting experimental subjects with a stimulus as a prime and then following this prime with a stimulus as a target. The subjects are asked to name the target word or to decide whether the target is a word or a nonword. The underlying assumption of priming tasks is that if two words share a common morpheme which is stored at a certain processing level, the prime word will activate the morpheme and speed the response time to the target word. For example, *short* and *shorten* have the morpheme {short} in common, hearing or seeing *short* will quicken subjects' response to *shorten*, which is viewed as clear evidence that word parts not the whole words are represented in the mental lexicon and that words are accessed through morphemes.

This basic research paradigm can take different forms. Researchers have manipulated different variants to suit their research purposes. For instance, different lags of the stimulus onset asynchrony (SOA) are used, varying from as short as 43ms (Rastle, Davis & Marslen-Wilson, 2000) to as long as 50 items (Stolz & Feldman, 1995). If the prime is presented for a long time, that is, if SOA is long, subjects may have time to reflect on the prime and develop expectations for the subsequent target. Using short SOA can "eliminate the strategic and episodic components that may contaminate the long-lag priming paradigm" (Rastle, Davis, Marslen-Wilson & Tyler, 2000, p. 509) (there is a long lag between the appearance of the prime and the target which are separated by a number of intervening lexical items).

In the research paradigm of examining frequency effects, the basic idea of selecting target words is to match the base frequency, the surface frequency (Bertram, Baayen & Schreuder, 2000; de Jong, Schreuder & Baayen, 2000), the cumulative root frequency or the frequency of the related word family (Nagy, Anderson, Schommer, Scott & Stallman, 1989). Then words are paired matching for other types of frequency to contrast with one type of frequency. In some studies, the family size of targets, either

the token counts or type counts or both is contrasted (de Jong, Schreuder & Baayen, 2000). Word lengths are also controlled. In the experiments, subjects are instructed to carry out a lexical decision task where they respond to the stimuli presented to them on the computer screen by deciding quickly whether a stimulus is a real word or not. The logic of these experiments is that when pairs of words are closely matched, for example on surface frequency but differ markedly on cumulative root frequency, words with high cumulative root frequency will be recognized as words faster and more accurately than words with low cumulative frequency if response speed and accuracy are influenced by the cumulative root frequency. This effect will be considered as evidence that words are represented and processed through the morphemic structure. If no difference in the response time and accuracy is observed, the conclusion would be that morphemes are not represented in the mental lexicon and do not have an effect on word processing.

Three basic approaches have been proposed to the question of how complex lexical forms are mentally represented and accessed. In the first approach, it is maintained that derivatives are typically represented in decomposed forms, but are accessed both as unitary forms and as decomposed forms. In the second approach, derivatives are seen as represented in fully decomposed morphological structures and accessed on the basis of their constituents. The third approach is the full listing one in which all words are represented, irrespective of their morphological constituency; morphological organization therefore does not play an independent role in representation.

The dual route account of representation expressed in the first approach is mainly supported by evidence emerging from the research paradigm of examining the frequency effect despite different models having been proposed within this theoretical framework (Taft & Foster, 1975; Taft 1979, 1994; Laudanna & Burani, 1985; Caramazza, Laudanna & Romani, 1988; Baayen, Lieber & Schreuder, 1997; de Jong, Schreuder & Baayen, 2000). For instance, Taft (1979) argues that the surface frequency of a complex word plays a role in the central lexicon and that stem frequency effects play a role at the access level. The morphemes are listed in the central mental lexicon. Words with the same cumulative stem frequency become available to the central system in the same amount of time. Complex words are decomposed before full word forms are searched for in the central lexicon.

The dual route account of lexical representation and processing was echoed by Stanner, Neiser, Hernon and Hall (1979) who, using the long-term repetition priming variant, investigated the priming effect of verbs on their suffixed derivatives (nominal verbs). Only partial priming was found between the stem verbs and the suffixed derivatives. Stanners, Neiser and Painton (1979) found that words having bound stems (Bound stems are used in morphological representation studies to refer to roots with an opaque meaning rather than those with a clear meaning) like *progress* access both their unitary memory representation and the memory representations of words with which they share a prefix. That is, the word *progress* would activate the representation for *progress* as well as the representations for words such as *regress* or *ingress*. However they also found the bound stem -*gress*- produces partial priming for *regress*. They interpreted the contradiction to mean that there were both separate listings of every word containing a bound stem and the bound morpheme stem which might partially activate words with it.

However, the finding of partial priming for suffixed word pairs was not confirmed by Fowler, Napps and Feldman (1985) who found equally strong priming for suffixed derivatives after both auditory and visual primes when the episodic effects were better controlled than in Stanner, Neiser, Hernon and Hall (1979) experiments. They also did not confirm the role played by pronunciation overlap between prime and target in the priming effect as proposed by Stanner, Neiser, Hernon and Hall (1979). Their conclusion is that the priming effect is equally strong when the orthographic or phonological representations of affixed primes and morphologically related targets did not fully overlap.

Fowler, Napps and Feldman's (1985) conclusions received support from Marslen-Wilson, a representative of the fully decompositional approach to lexical representation and processing. Marslen-Wilson, Waksler and Older (1994) incorporated into the design of the experiments such variables as morphological relationships (whether a prime and a target are a stem and a derivative, a derivative and a stem, or a derivative and a derivative), the position of affixes (whether the affix is a prefix or a suffix), and the semantic transparency or phonological transparency of the morphological relationship. Their findings can be summarized as the following:

1) The consistent pattern in all their six experiments is that priming exists for prefixed derivational words with free stems irrespective of the morphological relationship between prime and target (e.g. *insincere/sincere, unfasten/refasten*).

2) The facilitative effect also exists for suffixed pairs, but only for the prime-target pairs where the prime is a free stem and the target a related suffixed form (e.g. *friend/friendly, punish/punishment*). A finding which is inconsistent with Fowler et al's (1985) result is that two suffixed forms do not prime each other even if they are semantically related and share the same stem (*successful/successor*). The researchers attribute this result to the competitive effects of suffixes in words. However, Bauer (2001) does not consider this justification to be convincing enough because new words are commonly coined "precisely in contexts where the suffixes are being contrasted" (p. 109).

3) Like Fowler et al (1985), Marslen-Wilson et al (1994) proved the independence of morphological processing from phonological transparency. Their experiments show that phonemic overlap between primes and targets does not by itself produce priming, and the amount of priming is not affected by variations in the phonological transparency of the relation between prime and target as long as they are morphologically related forms.

4) In Marslen-Wilson et al's study, a consistent finding across all six experiments is that semantically opaque pairs such as *progress/regress*, *release/lease* do not prime regardless of the morphological relationship of the word pairs and of the position of affixes. Their conclusion is that in the central lexical representation "semantically opaque, morphologically complex words in English are represented as morphologically simple" (p. 27). Words like *apartment* or *discover* might be morphologically decomposable on linguistic, etymological, and phonological grounds, but they are represented in no different way from monomorphemic words like *dark* or *celery.* The obvious reason for this conclusion is that the ordinary language user with no diachronic knowledge of a word "will only mentally represent it as morphologically complex if this gives the right compositional semantics" (p. 27).

Following Marslen-Wilson et al's (1994) study on the mental representation of bound stem words, a large amount of research was carried out into the role that semantic transparency plays in determining whether central lexical representations are morphologically structured or not. A different picture emerges when Marslen-Wilson et al's (1994) cross-modal priming methodology which is sensitive to semantic similarity is replaced with priming tasks where the prime is masked and presented with short stimulus onset asynchrony (SOA) so as not to allow the awareness of semantic similarity to occur (Stolz & Feldman, 1995, Rastle, Davis, Marslen-Wilson & Tyler,

2000; Raveh & Rueckl, 2000; Forster and Azuma, 2000; Feldman & Prostko, 2002; Pastizzo & Feldman, 2004; Feldman, Soltano, Pastizzo & Francis, 2004; Marslen-Wilson, Bozic & Randall, 2008). All these studies make a strong case for the reality of the priming effects with bound stems despite their semantic opacity: not only pairs like *fold/unfold* primed each other, but also priming effects were shown to be equally strong for pairs like *survive/revive* in the forward masked experiments (Forster and Azuma, 2000).

The priming effects obtained in the English masked priming method with short SOA suggest that while bound stems are not represented at the central lexicon, there exists a level of representation that decomposes morphological structure and this information is accessed at the first moments of word recognition which is blind to semantic transparency.

Since English words that are derivationally morphologically related almost all have an orthographic or phonological overlap and a semantic relationship, priming between derivationally related words could be due to any combination of the morphological, orthographic, or semantic similarities between prime and target (Rastle, Davis, Marslen-Wilson & Tyler 2000). The fully decompositional account of word representation and processing has been challenged with the question of whether the priming effects between morphologically related items are morphological effects rather than the effects of semantic and orthographic or phonologic similarity between items. The proponents of the full listing account of lexical representation take the distributed connectionist approach to argue that the priming effects are not morphological, but are degraded effects as a function of degree of semantic and formal similarity. Plaut and Gonnerman (2000) used a short SOA and found that for morphologically related word pairs, stronger priming emerged with highly semantically related pairs, such as *boldly/bold*, than for moderately semantically related pairs like *lately/late*. For pairs like *hard/hardly* which are morphologically related but semantically unrelated, no priming effects were observed. They took the result as evidence for the argument that priming effects were due to meaning similarity between derived words.

To sum up, psycholinguists take different views on how lexical items are represented and processed in the mental lexicon. With helping teaching and learning as the aim, it is not the interest of the present research to argue for or against any of the accounts of the lexical representation systems. If, according to the fully decomposed view, semantic transparency plays a major role in determining whether words are

represented in morphologically decomposed form, only semantic transparent stems, but not semantically opaque stems, are centrally represented. That means native users of the English language are largely not aware of the bound stems and do not have knowledge of those morphological structures. However, this conclusion should not be taken to mean that ESL learners need not make use of this knowledge. Rather it points to the necessity to help L2 learners to go beyond the knowledge of the native language users by providing useful information on the form and semantic content of the bound stems. As will be argued in the following review, we believe consciously acquiring etymological knowledge about words enhances language learning as well because the etymological knowledge can make the form-meaning connection easier in vocabulary learning. Although the present study is not morphological in nature, some of the form constants identified as shared by words are bound stems.

As was mentioned in the review of the full listing approach to lexical representation and processing, the connectionists argue that the priming effects with the semantically opaque word pairs in word recognition tasks should be subsumed in the effects of form and meaning overlap because "morphology is a characterization of the learned mapping between the surface forms of words (orthography, phonology) and their meanings (semantics)" (Plaut & Gonnerman, 2000, p. 448). This view actually justifies the present research from the psycholinguistic perspective. As was pointed out, the present study is not intended to be a morphological study of word parts. Instead we are seeking form and meaning similarity between known words and new words to pave the way for establishing form-meaning linking as a mnemonic device. Although the research is not intended to provide evidence for a connectionist account of lexical mental representation, it is at least in line with the psycholinguistic evidence that the priming effects in word recognition are created by form and meaning overlap between word pairs. Taking advantage of the form and meaning overlap between morphologically related words may be facilitating to word learning.

2.1.3 The study of English word parts

If the morphological structure of words has psychological reality, then morphological knowledge has a role to play in L1 and L2 language acquisition. Quite a number of studies exist that attempted to provide frequency information about English

affixes with language acquisition as their purpose. Among these studies, Thorndike's (1941) L2 study of the English suffixes is the most detailed and pedagogically oriented. His research produced a reference book on suffixes for teachers. The teacher's reference book after presenting a list of words under each suffix that ends the words, provides information about the suffixes from four aspects:

1) The frequency and range of use of the word in reading.

2) The ease of recognizing words which consist of a root and a suffix. The estimations of the ease of recognition are based on Thorndike's investigation of the ability of ordinary American sixteen-year-olds to recognize the words as containing the suffix. The index he gave to a word concerning its ease of recognition is the percentage of the students who successfully analyzed the words.

3) The ease of inferring the meaning of the word by making use of the meaning of its root and the meanings of the suffix. The indexes of the ease of meaning inference also come from the knowledge of the 16-year-old American students.

4) Statements giving the meaning or meanings that the suffix has in that word and the frequency of each meaning of the suffix.

Thorndike's classic study of the English suffixes, as he stated, can help teachers to discriminate meanings of suffixes which are treated in an oversimplified manner in dictionaries and enable teachers to teach what is the most appropriate for learners.

The English prefixes were also studied by Stauffer (1942) who examined 61 basic forms of prefixes by using Thorndike's Teacher's Word Book of 20,000 Words (1932). He listed the most frequently used 15 prefixes which account for 82% of the total occurrences of prefixes. He also provided information about the frequency of occurrence of the 15 suffixes in Thorndike's word list, their rating in Thorndike's list and illustrative words. He intended to "give the busy teachers a clue as to which prefixes to teach in order that they may use their time most effectively" (p. 456).

Bock (1948), unaware of Stauffer's work, also counted the number of Latin prefixes and suffixes that are frequently used in the formation of English words. She found that of the 20,000 general word types for high-school students, 6,971 are formed by using Latin prefixes or suffixes, or prefixes and suffixes. Harwood and Wright (1956) added the dimension of the relationship between suffixes and word classes to their research on the major suffixes and the criterion of free or bound word base to which a suffix is attached.

Becker, Dixon and Anderson-Inman (1980) conducted an affix and root word analysis of a set of 25,782 words which did not include proper nouns, two-word compounds, or technical words and produce a listing of affixes and roots in order of their frequency of appearance in the 25,782 words. The most frequent affix was *ed*, which was followed by high frequency suffixes like *–ing, -y, -ate, -er, -ion,-ly*. The high frequency roots were *sta*, *logy*, and *man*. The analysis also revealed that of the 6,531 different affixes and roots from the analyzed list of words, approximately 800 appear in 10 or more words while approximately 3000 are used very infrequently, occurring in only 1 or 2 words. Therefore vocabulary instruction would have good results if focused on the most productive and frequently occurring affixes and roots.

Bauer and Nation (1993) arranged the English affixes into a graded series of 7 levels that can serve as a basis for systematic teaching and learning of the affixes for reading English texts. In establishing the set of levels of the affixes, they used the criteria of frequency, regularity, productivity and predictability. At the first level, each form is a different word. The second level includes inflectional suffixes while the third level contains the most frequent and regular derivational affixes. The fourth level consists of frequent, orthographically regular affixes. The regular but infrequent affixes are assigned to level 5, and the frequent but irregular affixes belong to level 6. The last level contains classical roots and affixes. The researchers also provided a list of the affixes at each level and individually discussed the affixes in terms of their meaning, productivity, regularity and usage. The setting up of the levels of the affixes has wide applications. Most importantly, it is very helpful to teachers when they set goals and stages for vocabulary teaching. It also benefits dictionary making by providing guidelines for the treatment of affixes.

A few researchers (Grinstead, 1924; Roberts, 1956; Bird, 1987, 1990) shed light on the proportion of the elements of Anglo-Saxon, Latin, Greek, Celtic and other sources in the English language. Their studies emphasized the important role of the Latin element in the English language. Bird (1987) analyzed closely the ranked vocabulary list of items in the LOB corpus presented by Johansson and Hofland (1989). The three findings that emerged from his analysis were (1) 983 roots and some non-roots consisting of 6981.6 words under study. This means that the roughly 1000 roots and non-roots can generate the first 7,000 word types. The generative power is 1:7. (2) The Anglo-Saxon and Latin elements are the major input of the modern English Language. While 57% of the first 1000 English words originated in the Anglo-Saxon language,

36% originated from Latin. The proportion of the Latin element increases after the first 1000 words. (3) Roots of Latin origin are more productive in English than roots of Anglo-Saxon origin. The Latin root to word ratio accelerates after the first 1000 words with a ratio of 1:2.56 in the first 1000 list and 1:52 in the seventh 1000 word list. Based on the results of his research, Bird argued for the benefits of learning the English language by taking advantage of the generative power of the roots. The learner must first master the most frequent and productive roots and non-roots of native and Latin origins in order to be successful in language learning, including the learning of the related European languages like German, Swedish, Dutch, French, Italian, Spanish, etc. "If a learner is exposed to known and simple root and non-root morphemes in a well-selected and well-graded order, then much of the hard work and pain can be taken out of language learning" (p.11). To help this approach to language learning work out, Bird compiled "The First Handbook of the Roots of English" (1990) to make the language learner conscious of the interrelationship between roots and words. It contains the alphabetically arranged roots from Anglo-Saxon, Latin and Greek origins. The 7,476 items in the LOB Corpus and other items within the 10 per million or higher frequency range in the Brown Corpus were derived from these roots. The book also gives one or two representatives for every Germanic and Latin root.

The review of the related literature points to the value of word parts in the learning of language. It also reveals two gaps in the field of word part study. First, more attention and effort have been directed to English affixes than to roots. Most research is interested in quantifying information concerning prefixes and suffixes, counting the frequently used prefixes and suffixes, grading the frequently used affixes according to frequency or productivity, and providing guidance for teaching them. Only two studies, Becker, Dixon and Anderson-Inman (1980) and Bird (1987, 1990) involve roots. Second, the information provided by Becker et al's (1980) and Bird's (1987, 1990) research is far from adequate to help language teaching and learning. Becker et al simply list the frequently used root morphemes together with the prefixes and suffixes, while Bird seems too ambitious to make his approach practical. He intended to reveal to the language learner the interrelationship between roots and words so that they can use the information to efficiently master all the 10,000 important words in the English language and perhaps other related European languages as well. He then simply provides a list of all the roots of the 10,000 words and one or two representatives containing a root. However a huge gap still exists between the information he provides and the learner's

ability to make use of his information. The learner may not be able to see the connection between the meaning of the root and the meaning of its representative words, for example. The learner cannot know what other words, apart from the one or two representative words, are related to the root. More importantly, the learner will drown in the sea of the roots and words in Bird's book because there is no information to show which roots are more helpful and therefore more worth learning than others, and how they are related to what he has learned and what he has yet to learn.

2.1.4 Research on L1 and L2 learners' knowledge of derivational morphology

Morphological generalization or word structure analysis is an explanation for vocabulary growth in addition to direct instruction and incidental acquisition. Researchers have investigated the relationship between learners' vocabulary development and their ability at morphological analysis.

Derwing (1976) and Derwing and Baker (1979, 1986) looked at children and college students' recognition of derivational morphological relations by asking them whether they think the derived form of a word pair (*precious, lawyer*) "came from" the "underived" form of the pair (*price, law*). A consistent developmental trend of increasing awareness of morphological relations is identified from elementary school through college. The results show that adults tend to consider both semantic and phonemic similarity necessary for their decision of morphological relatedness. In contrast, for young children, either a high degree of semantic similarity or a high degree of phonemic similarity is required for their judgment.

Freyd and Baron (1982) investigated whether good word-learners (high-ability fifth-grade children) are more likely than average word-learners (average-ability eighth-grade children) to analyze words into roots and suffixes to figure out meanings. The two groups performed equivalently on the simple word list, but the good word-learners were superior on the derived words. High-ability learners recalled related word pairs more easily than unrelated pairs, but average-ability learners performed equally well on both types of pairs. The results led Freyd and Baron to conclude that higher achieving students use derivational rules, whereas average students do not. They then trained some word-learners in the use of the meanings of suffixes to define words. When both trained and untrained students were tested on a list of simple and derived

words, the untrained group did not improve on either word type. However, the trained group did not show significant improvement on derived words when raw scores were compared. The improvement however was even weaker when the comparison was based on their standardized score. The researchers attribute the low achievement of the trained students to the short duration of their training, considering it insufficient and to the fact that subjects had too little time to practice what they had been taught.

Wysocki and Jenkins (1987) looked at fourth, sixth and eighth grade students with the intention of seeing whether the students were able to use knowledge of suffixes and contextual information to determine the meaning of unknown words after the training sessions. In their experiments, training sessions were offered first involving learning the low-frequency stimulus words and their definitions (e.g., *clandestineness – secrecy*). The subjects were later tested on a matched set of transfer words with the same roots (e.g., *incipience/ incipient*). Their definitions for the taught transfer words and those for the control transfer words were compared. The results show that when a strict criterion (giving credit to a correct meaning plus appropriate syntax) is used for scoring definitions of the transfer words, only weak evidence for morphological analysis as a generative tool for vocabulary growth can be obtained, but when a lenient criterion is used, the evidence supporting morphological generalization is somewhat stronger. They suggest that the students' success in deriving the meaning of unfamiliar words is affected by several factors including prior experience with the related words, the strength of the surrounding sentence contexts, students' grades and the scoring procedures.

Tyler and Nagy (1989) developed multiple-choice tests and administered them to children in grades 4, 6 and 8. They found that relational knowledge (the ability to recognize morphological relations between words) developed at all grade levels for both neutral (suffixes attached to independent words) and nonneutral suffixes (suffixes often attached to bound morphemes). Syntactic knowledge (knowing that suffixes mark words for part of speech) was found to grow more slowly with a clear increase at grade 8. Distributional knowledge (knowing derivational affixes are constrained to go with certain stems) appeared to be the last to develop. Grade 6 children made increased overgeneralization errors in this aspect of morphological knowledge. Also children's performance differed in distributional knowledge on words with neutral as opposed to nonneutral suffixes.

Like Tyler and Nagy who critiqued the extraneous demands in the tests

administered in the studies of Freyd and Baron (1982) and Wysocki and Jenkins (1987), White, Power and White (1989) did not interpret the results of Wysocki and Jenkins' experiments as meaning that students did not know about suffixes but rather that they ignored them when giving definitions for words. They also criticized the studies by Freyd and Baron (1982) and Wysocki and Jenkins (1987) on the basis of their investigation of the number of words the children in the middle grades can encounter and characteristics and frequencies of affixed words. They found that whereas only 10% of their analyzed words had nonneutral suffixes, two thirds of the posttest items in the studies were words with nonneutral suffixes. White, Power and White (1989) argued that morphological analysis accounts for quite a proportion of children's vocabulary growth, and stressed the value of morphological instructions for children.

Anglin (1993) examined children's development of recognition vocabulary knowledge and its relationship with their morphological analysis ability. He partitioned children's vocabulary knowledge into different morphologically defined types of words: first into root words, inflected words, derived words, literal compounds and idioms, and then into monomorphemic words, bimorphemic words, multimorphemic words, and idioms. All analyses revealed a relatively rapid increase in knowledge of derived words in grade 1, grade 3 and grade 5. Multimorphemic words make up increasing proportions in the children's recognition vocabulary between grade 1 and grade 5 whereas the proportion of monomorphemic words decrease significantly. The bimorphemic words account for the highest proportion of children's vocabulary at all grade levels, however, the proportion of bimorphemic words decreases slightly through these years. The percentage of complex word entries accounted for by morphological analysis is found to have increased significantly from 40% in grade 1 to 51% in grade 5, independent of the relationship between the increase in the number of complex words and other words learned.

The research reviewed above suggests that derivational morphological development is an incremental process taking place over several years for young native English speakers and there is research evidence that even preschool children possess some knowledge of derivational affixes (Bowerman, 1982; Clark & Cohen, 1984; Clark & Hecht, 1982; Clark, 1993). The evidence provided for ESL learners' knowledge of derivational morphology is far from adequate as research addressing this issue is scarce. Three studies were found to have investigated how ESL learners' affix knowledge related to other aspects of vocabulary knowledge.

Schmitt and Meara (1997) measured the change in learners' suffix and word association knowledge on productive and receptive tasks over an academic year. They found that although participants showed an average gain of 330 words, the learners increase in affix knowledge was by 5% on the productive task and by 4% on the receptive task each year. The researchers concluded that the learners show rather poor knowledge of the allowable suffixes for the verbs, especially the derivational suffixes. They called attention to the learners' "rather weak awareness of derivational suffixes and their use" (p.26).

Mochizuki and Aizawa (2000) investigated the relationship between learners' vocabulary size and their affix knowledge and the order of affix acquisition. Their results showed that L2 learners' affix knowledge increased in proportion to vocabulary size, providing support for Schmitt and Meara's research. They also showed that there is a difficulty order of prefixes and suffixes which is relatively stable and can be taken as the acquisition order. The order is group one: *re-, pre-, un-, -ation, -ful, ment*, group two: *non-, ex-, ist, -er, ize, -ly,* group three: *anti-, -ous, -ness, ism, -able*, group four: *semi-, en-, post-, -less, -ily*, group five: *inter-, counter-, in-, -ish, -y*, group 6: *ante-*. When this order is compared with the levels of ease of learning Bauer and Nation (1993) established for the English affixes, it can be seen that of the 17 affixes in the first three groups, 13 (76%) belong to Bauer and Nation' level 3 (the most frequent and regular derivational affixes) and level 4 (frequent, orthographically regular affixes). The last three groups contain 7 affixes (64% of the total in the last three groups) which belong to Bauer and Nation's level 5 (regular but infrequent affixes) and level 6 (frequent but irregular affixes). The order of acquisition reported by Mochizuki and Aizawa (2000) does not differ much from Bauer and Nation's (1993) prediction. The difficulty order might be accounted for not only by the factors mentioned by Bauer and Nation (1993) such as frequency of affixes, frequency of words that contain an affix, and the polysemous and the polyfunctional nature of prefixes and suffixes but also by the factors related to the special circumstances such as loan words in Japanese and instruction.

Schmitt and Zimmerman (2002) examined L2 learners' productive ability in dealing with the four major derivative classes, noun, verb, adjective and adverb and the relationship between productive derivational word knowledge and global knowledge of a word. The results indicated that the students usually know two or three forms of the derivative classes. They showed increasing knowledge of noun and verb derivatives at

each level of word knowledge but adjective and adverb forms appear to be more difficult. The researchers take the results to imply that the knowledge of one word in a family does not necessarily imply productive knowledge of other forms in that family and they challenge the facilitative effect of word family knowledge in the productive mode. They call for more direct instruction on the derivative forms.

These studies, though small in number, suggest that L2 learners have big gaps in both their receptive and productive derivational knowledge despite the fact that they increase their morphological awareness and knowledge as they increase their vocabulary size and other aspects of vocabulary knowledge. It might be anticipated that L2 learners' derivational knowledge, compared with L1 learners', would increase even more gradually over a longer period of time due to the smaller amount of exposure they have to the target language. More attention may need to be given in teaching to raise learners' awareness in this respect and enhance the facilitative effects of word parts.

2.2 The etymological study of words and its application in language learning

In the second part of this literature review, attention will be turned to the etymological study of English words and the role of etymological information in language learning. The existing dictionaries and teaching materials which contain etymological information or information about word part relationships will be reviewed. This review not only points to the necessity to quantify and systematize the etymological information and word part relationships but also helps to clarify the non-diachronic nature of the present study. Following this, two educators' arguments for the value of etymological knowledge in language learning will be presented and some teaching programs trying to make use of the knowledge of Latin roots will be described and discussed.

2.2.1 Etymological information about English roots

The diachronic study of language is historical linguistics which is concerned with change in language or languages over time (Campbell, 2004), and etymologies of individual words are the product of diachronic linguistics. In its restricted sense, etymology is the study of word origin. In its broad sense, according to Drysdale

(Landau, 2001), the etymological study of words sheds light on a range of aspects of a word: its source language or language family; its first form and / or immediate source; its date or period of entry into the language under study; changes in its form and meaning; intermediate stages; its ultimate known source; semantic development; its ultimate underlying or hypothetical form; its cognates in related languages derived from the underlying form; and other words derived from the same base. Ilson (1983) views the broad sense of etymology as consisting of four types of information: 1) the immediate and ultimate word origins and cognate words in other languages; 2) morphological analyses of word structures; 3) morphological analyses of word formation processes such as back formation, blends, analogic formations, reduplication, etc.; and 4) analyses of " cognitive procedures" of word formation and development such as metaphor and historical allusion (p.78).

Part of or all of the information listed by Drysdale and Ilson about a word's etymology can be obtained in different types of historical dictionaries (e.g. *Oxford English Dictionary* (OED), *Shorter Oxford English Dictionary* (SOED), specialist etymological dictionaries (e.g. *A Comprehensive Etymological Dictionary of the English Language* (CEDEL) (Klein, 1966), *Chambers Dictionary of Etymology* (CDE) (Barnhart, 2003)), and monolingual English dictionaries for native English speakers (e.g. *The New Oxford Dictionary of English* (NODE), *American Heritage Dictionary of the English Language* (AHDEL)). One major problem with making any use of the above sources of word roots by EFL learners is their incomprehensibility and hence inaccessibility. The following is an excerpt from the OED:

> **cause** [a. F. *cause* (= Pr., Sp., It. *causa*), ad. L. *causa*, *caussa*. The latter came down in living use as It., Sp., Pr. *cosa*, ONF. *cose*, F. *chose* matter, thing (a sense which *causa* has in the Salic Law, in Gregory of Tours, and the Capitularies). At a later period the med.L. *causa*, of philosophy and the law-courts, was taken into the living languages, in the form *causa*, *cause*; in Fr. from the 13th c.]

To interpret the etymologies in any of the dictionaries, language learners should be equipped with knowledge related to both the history of the English language and conventions for treating etymologies in dictionaries. To be more specific, the dictionary users must know what parts are included in the entry and what they signify, namely, immediate origin, ultimate source, cognates, etc. They also need to be able to make sense of the explanatory language used such as Old Saxon, Old High German, Old

Norse, Latin, etc. What makes the task even more formidable is the form of abbreviations, OHG, OS, L, etc. and the writing systems of source languages.

A dictionary that distinguishes itself from other dictionaries is the *New Oxford Dictionary of English* where etymologies are written in plain English without abbreviations. What restrains language learners from benefiting from it is the fact that since it is designed for native English language users, it does not cater for the needs of foreign language learners and there is an absence of a cross-referencing system to reveal the relations between words. Also there is a lack of immediately noticeable clear connections between the meanings of word roots and the present-day meaning of words. The two example entries from NODE below illustrate this point.

> Admit – ORIGIN late Middle English: from Latin *admittere*, from *ad-* 'to' + *mittere* 'send'.
> Suspect – ORIGIN Middle English (originally as an adjective): from Latin *suspectus* 'mistrusted'. Past participle of *suspicere*, from *sub-* 'from below' + specere *'to look'*.

In spite of the plain language used in the glosses of the etymologies in these examples, readers still need to exert themselves to reason out the connection between the ancient forms and meanings and the current ones. Moreover, the etymological explanation does not show the user the other etymologically related words and the useful relationships between the words.

Etymological information on word roots is dealt with from a diachronic linguistics perspective in books intended for use mainly in college-level courses dealing with English word structure (e.g. *English Vocabulary Elements* (Denning, Kessler & Leben, 2007), *English Words, History and Structure* (Stockwell & Mindova, 2001)). As diachronic linguistics studies how and why language or languages change, these books usually begin with an introduction of the family history and the history of English language. After the analysis of the structure of the English words, they explain regular sound changes such as Grimm's Law and the Great Vowel Shift, describe the process of borrowing linguistic material from another language, and account for the semantic change of words. They normally contain long lists of affixes and roots with glosses with the purpose of "expanding vocabulary skills by teaching the basics of the learned, specialized and scientific English vocabulary" (p. III, Denning, Kessler & Leben, 2007).

Other types of books providing etymological knowledge of word roots are available and they may be sub-categorized into three groups. One group is more like story books.

They are quite popular with native English readers "simply because they select just those words and expressions that will provide material for entertaining accounts and are often highly speculative" (Landau, 2001, p. 131). Another group resembles a dictionary which lists a great number of word affixes and roots with brief explanation of their meaning and a few examples (e.g. *A Stem Dictionary of the English Language* (Kennedy, 1971), *Suffixes and Other Word-Final Elements of English* (Crutchfield, 1999)). The third group approximates a text book or exercise book where a group of roots are presented in each learning unit with exercises aimed to consolidate the form and meaning of the word parts (e.g. *Grow your vocabulary: by learning the roots of English words* (Schleifer, 1995)*; Words under Construction* (Cherry, 1989); *English words from Latin & Greek elements* (Ayers, 1986)*; Expanding your vocabulary, a skill-based approach* (McWhorter & Sember, 2009)).

The obstacle to learners' access to the information about word roots in the dictionary-like books is that they are very comprehensive, including large numbers of roots, of which quite a proportion are roots of technical terms specific to a subject. The other difficulty preventing language learners from benefiting from the dictionaries involves the use of very low frequency example words to illustrate a root in these dictionaries. In some dictionaries, only two or three words are provided to illustrate each root.

Textbooks including knowledge of word roots represent the long-standing practice of word unit analysis in vocabulary teaching. Fully aware of the problem that there is considerable difference between the etymological meaning of a word and its present-day meaning, these books adopt two approaches to word root analysis. One approach is to leave out the words whose current meaning has changed considerably from their root meaning; the other approach is to attempt to solve the problem by introducing learners to the history of the English language, especially the general patterns of semantic change. The first approach is usually taken by word-building textbooks aiming to enlarge students' vocabulary. In spite of this intention, the benefits students can get from them are limited by the small number of roots included in a few lessons. *Expanding your vocabulary, a skill-based approach* (McWhorter and Sember, 2009) is representative of such textbooks. In the chapter of "using word parts to expand your vocabulary", ten roots (*cap-, -cede, cred-, dict-, mis-/mit-, port-, sen-, spec-/spect-, sym-/syn-, voc-/vok-*) are presented with their meanings, example words with the roots and their definitions and example sentences to show the use of the words. A few

example words are selected to illustrate the root meaning. For example, " *dict-* (tell, say): A dictionary tells what words mean. *Contradict* (verb): To say the opposite. *Dictate* (verb): To express orally to another person, to command. *Dictatorial* (adjective): Exercising excessive power or authority. *Diction* (noun): Wording, use of words in speech and writing" (p 88). This short list of words shows the learners the meaning and form connections between the words to some extent but not clearly enough. How is "Exercising excessive power or authority" related to "tell, say"? Why is VERDICT not included which is "what a judge says about a case in court"?

The second approach is generally adopted by the books which aim to arouse students' interest in words, to give insights into the change of English words, or to instruct students in etymologies of words, rather than merely expand the learners' vocabulary. A typical example of this type of textbook is *Words under Construction* (Cherry, 1989). Each chapter of this book gives a lesson on the history of English and some linguistic knowledge of words such as back formations, apheresis and aphesis, combinations of bases, word analysis that includes the analyzing of etymological definition, change from abstract to concrete and vice versa, words from Greek history and philosophy, etc. Information of word roots is provided in two ways:

1) MOLE- mass + *-cule* molecule
MUS- mouse + *-cle* muscle (but muscular)
PART- part + *(i)cle* particle (but particular)
com- + PLET- to fill + -ion completion
pre- + VENT- to come + ion prevention
pro- + DUCT- to lead + ion production (p. 103)

2) CRE-, CRESC-, CRET- to grow crescent, excrescence, concrete
I-, IT- transient, ambient, initial, transition
JUG-, JUCT-, a yoke; jugular, juncture, join,
JOIN-, JOINT- to join rejoinder, conjointly
LEG-, (LIG-), to choose, legible, legend,
LECT- to pick out, eligible, elect
MON- to warn, admonish, monument,
to advise monitor, premonition
SOLV-, SOLUT- to free, solve, absolve,
to loosen solution, absolute (p.100)

From the two excerpts, it can be seen that even the instruction on semantic change will be of little help for learners who try to connect the root meaning with the current meanings of some example words (e.g. *pre-* + VENT- to come + ion prevention; SOLV-, SOLUT-to free, solve, absolve, to loosen, solution, absolute). The two or three words with a particular root can only give learners a vague idea of the relationship between words and their roots. This type of book might be more beneficial for native speakers or very advanced foreign language learners to deepen their knowledge of the development of the language and experience its power, but not for the majority of learners of English as a second language.

The above review makes two points clear. One is that a diachronic linguistics approach is not the research approach for the present study. It will not be carried out from the diachronic linguistic perspective analyzing the developmental stages of words' form and meaning in the course of their history because its aim is to sort out sets of formally and semantically closely related words in order to come up with a useful set of hints to aid vocabulary memorization. The information concerning the relationships between words, as are shown in the form and meaning constants shared by them, can help learners make the form-meaning connection more readily when they learn the words. The change in sound or semantic development or the origin of the changes which has taken place in the history of a word is not our concern. Thus not all etymologically connected words will be considered as pedagogically meaningful because many word roots have shifted away from their original meaning or form and therefore have become too opaque to be of help for L2 vocabulary learning. The analyses of the form and meaning of words is not necessarily true to their etymological history. The etymological information about word roots is used in the present research as a helpful source for the identification of formal constants and the recognition of the thread of meaning among words based on the current meanings of words.

The other point is that the etymological information available in dictionaries and other resources for native language users cannot be easily accessed or efficiently used by learners of English as a foreign language. Etymological information about words and word relationships has not found its way into learners' dictionaries although learners' dictionaries have undergone great innovations since the publication of the first of its type (*the Idiomatic and Syntactic English Dictionary* in Japan in 1942 thanks to the endeavors of the three pioneering teachers of EFL - Harold Palmer and A.S Hornby and Michael West). Even the earlier editions of the *Advanced Learner's Dictionary of*

Current English incorporated information about grammatical patterning and sufficient invented example sentences were provided to illustrate grammatical patterning and to indicate typical collocations. Set phrases were included and well presented. The *Longman Dictionary of Contemporary English* as the rival of the OALD introduced several important improvements on the OALD. The most significant one was to restrict the defining vocabulary to the most frequently used 2000 words of English. It also introduced a more accessible coding system for grammatical information, for example, T stood for transitive, "I" for intransitive, the number "1" for noun or pronoun, "6" for that-clause. In the late 1980s, *Collins Cobuild English Dictionary* based on a computer corpus of texts came into being. Its major innovations included giving whole sentences as definitions to give a sense of typical contexts, using corpus-based real English as examples and providing a separate listing of antonyms and synonyms and eventually frequencies of the use of words. The *Cambridge International Dictionary of English*, which entered the market later, featured a guide word for each sense and examples for every grammatical pattern and typical collocations.

The recent editions of all these well-known learners' dictionaries have done even more to meet language learners' decoding and encoding needs. Definitions are made more understandable for learner-users, and there is not only comprehensive grammatical information but also information about lexical patterning like collocations and idioms. In addition to this, information has been added on the cultural and pragmatic aspects of vocabulary to deepen and widen learners' understanding of English vocabulary. The new forms of learners' dictionaries, CD-ROMs used on a computer and hand-held electronic dictionaries have enabled more functions to be realized such as cross referencing, searching, and more features to be added - sound, an examples bank, a phrase bank, pictures, exercises etc. Learners' dictionaries have come a long way since their first appearance. However, as Nation and Webb (2011) commented, these innovations or improvements, "although very useful, are still not enough. Learners' dictionaries are not only for learners, they also need to be for learning. That is, we need dictionaries which help the learning of the language" (p. 62). They suggest including in learners' dictionaries information showing "useful relationships between etymologically related words to help vocabulary learning so that learners' dictionaries will truly become learning dictionaries" (p. 62).

The textbooks attempting to employ word root information to facilitate vocabulary learning are not based on systematic information on roots but rather on selected roots

and example words for convenience. The meaning connections between words are not made clear enough to facilitate learning. There is no guidance for learners and teachers on the ease of learnability of the words through analyzing their roots, nor on the frequency of the words or the number of the words that can connected by a root. Even if these textbooks do not intend to make the analysis of word roots a mnemonic technique, their purpose of enhancing vocabulary learning still requires more systematic information and clearer explanation about the word form and meaning connections. The scattered bits of information are not adequate to serve the facilitative purpose of the textbooks.

2.2.2 Arguments for the value of etymological information in L2 vocabulary learning

Some linguists argue for the value of etymological knowledge for ESL learning.

Ilson (1983), after reviewing the differences between monolingual dictionaries for native speakers and non-native speakers argues for the inclusion of etymology in learners' dictionaries. He suggested that etymology should be interpreted in its broader sense to see its significance for EFL learners. Instead of viewing etymology as the search for word origins and word cognates, it should be interpreted as information about the process through which a word form and the meaning connected with the form has resulted in what they are now. In this view, etymology consists of four types of information: 1. the immediate and ultimate word origins and cognate words in other languages. 2. morphological analyses of word structures. 3. morphological analyses of word formation processes such as back formation, blends, analogic formations, reduplication, etc. 4. analyses of " cognitive procedures" of word formation and development such as metaphor and historical allusion (p.78). Ilson argues that it is important for the language learners whose native language is closely related to English to have knowledge of cognates in the two languages. The second and third types of information may help to clear up confusing points about spelling and word meaning. The last type of information, the information of what he calls "why" etymology, is particularly useful for foreign language learners for it provides a revealing insight into the English words and paves a new way for them to reach the word meaning. Based on this broad conception of etymology, Ilson summarizes the four benefits that

etymological information may bring to learners as being able to help disambiguate, to relate words with the same root which are otherwise dispersed in a dictionary, to illuminate meaning by making words easier to remember, and to motivate learners by encouraging an intrinsic interest in language. The present research, which provides the link between the meaning of word parts and the dictionary meaning of a new word, is a step towards the actualization of the benefits.

While Ilson is concerned with the place of etymology in lexicography, Kelly (1991) argues for the usefulness of the meta-linguistic knowledge of classical word roots in students' vocabulary development. He proposes the analysis and systematic learning of word roots of Latin and Greek origin as part of a pedagogical intervention for the vocabulary development of advanced students. In his view, glosses should be provided for the students which contain the form and meaning of the roots of words in their reading. He claims that if students are more aware of the constituent roots of words and their meanings, they will be in a better position to comprehend or produce these words.

Kelly supports his proposal by categorizing 3 types of words which lend themselves to being studied with the proposed method. First, there are words not only formed with constituents transparent in meaning but also with productive roots. The Graeco-Latin forms of these words need to be learned as this knowledge may lighten the learning burden by reducing complex word forms to analyzable parts and obscure meanings to easily comprehensible senses. The second type of words is those that may not be so suited for the root analysis as the first type. The constituent structures of these words are not so easily identifiable and their meanings are not uniformly related to the meanings of their constituent roots. An example is the word *immense* (im "not" +mens "measure"). However the benefit from analyzing the root *mens* will extend to words with the constituent root of *mens* like *commensurate, commensuration.* In the third type of words, the present meaning of a word may have shifted away from that of its source word, or one constituent root is not known. However the root analysis will still be of help for students in later recognition and retention if they can recognize all or some of the constituent roots of words.

Kelly's proposal is valuable in three respects. First he points out that the method should be synchronic rather than diachronic. This means that the forms and meanings of contemporary words, not those of the source words, are used in presenting roots and their meaning. In this way, no etymological or historical knowledge of English words is required on the part of language learners. Second, he maintains that the criterion for the

presentation of the forms of the roots and explanations should be whether the explanations are able to best illuminate the current meaning of the words but not whether they are "pedantically true to the historical facts" (p. 71). Third, he recognizes the varying degrees of suitability of different types of words for the application of the method of morphological and etymological analysis.

Two questions may be raised concerning Kelly's proposal. The first question is whether the analysis of word roots as a learning technique can only benefit advanced learners as Kelly asserts. It is a premature conclusion to draw before quantitative information is obtained about the words containing the roots at different frequency levels. If the most frequent 1000 or 2000 words contain productive and transparent word roots, there is no reason why learners at these levels of study should not benefit from this method. The other question that is left unanswered in Kelly's proposal concerns his observation that different types of words do not lend themselves equally to being studied by the proposed method. In view of this phenomenon, it is necessary to know how many and what words belong to the most suited category. In addition to that, it is necessary to find out how many and what words, in spite of their being identifiable and transparent in both form and meaning in relation to their roots, have so low a frequency that they are not useful for language learners. There will not be a good return for the learning time and effort if learners are asked to learn the word roots which can only produce a small number of low frequency words with an opaque meaning relationship to their roots.

2.2.3 Research on the relationship between Latin study and vocabulary size in L1 learning

In the 1930s through the 1950s, several correlational studies were done to test whether Latin study has positive effects on vocabulary size. No clear evidence was found that knowledge of Latin aided in the expansion of the English vocabulary.

Otterman (1955) investigated the value of teaching prefixes and word-roots in vocabulary development. The experimental group which consisted of 293 seventh grade students was taught one prefix or word-root a day for ten minutes with 250 familiar words as examples. After matching the experimental and control groups on the basis of sex, chronological age, mental age and average reading score and vocabulary and

spelling tests, she found that only the high mental age group showed a statistically significant gain in the interpretation of new words among all the groups. The experimental group was significantly superior to the control group only in spelling and the delayed recall of prefix and word-root meanings. The experimental group did not show a significant superiority in visual or auditory perception, nor did they show any significant improvement in general vocabulary, reading comprehension or speed of reading.

Barnes (1942) investigated the validity of the assumption that the knowledge of word roots is valuable in that it can produce a guide to the meaning of the derived words. He tested 75 university students by asking them to write definitions for 30 words on the basis of the etymologies provided for them on the examination paper. They had met many of the words in their history and biology courses where they were continually shown the origins of scientific terms. In addition to that, the majority of the subjects had at least two years' experience of learning Latin. In their Verbal Expression class at university, they were taught word derivation related to Latin and Greek roots. Although they had spent a large amount of time on word study, they could not do well in the test. The average score was 6 out of 30 with the lowest score at 2. The students were reported as giving absurd definitions. An example is that some students defined the word *interdict* as "an interruption of another's speaking". The researcher came to the conclusion that a knowledge of root meanings alone is not of great value in determining the current meanings of English words" (p. 611).

Carroll (1940) first devised a measure of morphology knowledge and then correlated the three variables of knowledge of Latin, vocabulary size and knowledge of morphology. He reported significant contributions of Latin and vocabulary size to the prediction of morpheme knowledge. However he concluded that morpheme knowledge but not Latin made significant contributions to the prediction of vocabulary size.

Thompson (1958) evaluated a program of vocabulary development devised by James I. Brown who tabulated the most important prefixes and root elements and compiled a list of twenty prefixes and fourteen root elements which could unlock the meanings of over 14,000 words. These important prefixes and roots were then combined into fourteen master words. Students were asked to memorize the Latin and English forms and meanings of the prefixes and roots. They were also trained to see relationships between etymological and dictionary meanings so that they would have an effective tool for deriving meanings of unfamiliar words. Thompson then examined the

efficacy of the 'Master Word' program. He found that the students were able to retain the meanings of key prefixes and root elements more easily, able to identify the various forms in actual words quite accurately and able to use this ability to increase their vocabularies very significantly. In spite of this, the percentages he presented indicate that the students performed better in retaining the meanings of the prefixes and roots and in recognizing the various forms of prefixes and roots in actual words than in increasing vocabulary by using the knowledge about the affixes and roots.

Shepherd (1974) separated knowledge of the word parts which form derivatives containing an English word base and knowledge of the word parts of which Latin-root base derivatives are composed. He then partialed out the intelligence variable and studied the correlations between the two types of word-part knowledge and the two types of knowledge of derivatives. The results indicate that knowledge of Latin roots and the affixes which combine with them is not strongly related to knowledge of derivatives which are composed of these elements, and that knowledge of English word bases and the affixes which combine with them is strongly related to knowledge of derivatives which are composed of these elements. The different effects caused by the two types of knowledge can be explained by the fact that the meanings of the Latin roots are too remote and elusive in the modern English words to be of much help for vocabulary learning. The words composed of semantically opaque bound stems, though morphologically complex, are represented by the ordinary native users of English as morphologically simple, not able to be decomposed in form and meaning (Marslen-Wilson, Waksler & Older, 1994).

The slight benefit Latin study brings to the English word learning as demonstrated in the above research was also revealed in Orleans (1922) and Barnes (1942). Orleans had expert judges estimate the usefulness of the meanings of Latin forms for determining the meaning of English derivatives, and Barnes (1942) had judges evaluate students' ability to use the etymologies of English derivatives for the purpose of writing the definitions of the derivatives. Both of the investigators concluded that the relation between the meanings of Latin forms and the present-day meanings of English words was so remote that spending much time teaching students the meanings of ancient forms was seriously questionable.

In fact, this conclusion exposes three weaknesses in the old teaching programmes that tried to make use of word roots. First, when the purpose of teaching students the knowledge of roots is to enhance their English vocabulary learning, the teaching should

not go beyond the form of modern English. Requiring students to memorize the ancient forms and meanings of roots is imposing an extra burden on them. Memorizing the contemporary meaning of a root as clearly reflected in a familiar word is much easier but still helpful for accessing an unknown word which contains the same root form and meaning.

Second, in view of the fact that many modern words have shifted away in various degrees from the original meanings of their roots, quantitative knowledge should be obtained first about how many English words can be connected to their root meanings before efforts are made to utilize the knowledge of roots. What is implied in the results of Shepherd's study is that when the form and meaning of words are transparent enough, knowledge of word parts will have a significantly positive effect on the knowledge of words. This leads to the next thing that needs to be done in this research area, that is, on the basis of the quantitative information about the connection between words and their roots, transparency of root form and meaning should be rated so as to provide a guide for teachers in their choice of what roots to teach for the most beneficial return.

The third weakness in teaching programs like the 'Master Word' approach is the missing link between the meaning of word roots and the dictionary meaning of the words which contain the roots. To make the knowledge of roots more effectively benefit English vocabulary learning, definitions of words, where possible, should be rephrased to integrate the meaning of their roots as a thread of meaning through the words that are composed of the roots. In doing this, learners can be helped to establish connections more easily between form and meaning, and between familiar words and new words.

No research has been found that explores the effects of instruction on word parts upon second language vocabulary learning. All the previous studies on the effects of employing etymological information about word roots in English word learning have focused on using it to derive meaning of the unfamiliar words rather than to aid retention of word form and meaning. However, the fact is that many words have drifted away from the original meanings of their roots due to social and pragmatic factors and also human psychological and cognitive factors (Campbell, 2004). As Nation (1994) suggested, it is likely that the greatest value from learning word parts lies in using them to enhance retention of the given meanings of words as the meanings of both affixes and roots vary from word to word. For this reason the present study will focus on the use of the information about word roots as mnemonic devices to enhance vocabulary learning. For example, the root of the high frequency word *describe* is likely to pave the way to

the learning of the low frequency word *inscribe* because *describe* provides not only a familiar form but also a familiar meaning thread. When we give the hint for *inscribe* in such as a way that it reminds learners of the familiar word *describe,* less effort will be needed to acquire the new word.

2.3 Vocabulary learning theory and factors affecting foreign vocabulary learnability

The last part of this chapter will turn to the theories and empirical research into foreign word learning and retention which is the primary concern of the present study. This part will first describe the levels of processing theory (Craik & Lockhart, 1972) to account for the effectiveness of vocabulary retention operations. It then reviews research findings concerning the factors affecting the ease of foreign vocabulary learning and retention. The purpose of this review is two-fold. First it forms part of the rationale for the vocabulary learning technique we proposed as a vocabulary learning mnemonic. Second, it justifies our use of a meaning transparency scale, a spoken similarity measurement and a written similarity measurement in filtering the data in order to come up with a list of accessible words and our use of meaning transparency, spoken similarity and written similarity as the three factors to evaluate the degree of learnability of words.

2.3.1 The levels of processing theory

In expounding their levels of processing theory, Craik and Lockhart (1972) state that what is remembered is not what is stored in the short-term or long-term structures in the brain. Memory should be viewed as a byproduct of perceptual processing which is composed of a series of operations of the cognitive system. Processing is a continuum beginning at the sensory analyses and moving towards deep semantic-associative analyses. The persistence of memory is determined by the depth with which the stimuli were processed. When people are induced to process words at the shallow level of their phonological or orthographic form, a high level of retention of the words will not be achieved. In contrast, if people are engaged in deeper semantic processing of the words involving their meanings in a context, their images, their collocations, stories associated

with them and other associations, the retention of the words will be much more long-lasting. The researchers therefore argue that orthographic or phonological encoding is at a shallow level of processing whereas semantic encoding is at a deeper processing level.

Craik and Tulving (1975) later suggest that what is critical to retention is not simply the presence or absence of semantic encoding, but rather the elaborateness with which stimuli words are encoded. This modification of their theory is related to Morris, Bransford and Franks' (1977) argument that the best means of encoding material depends on the retrieval conditions that are expected. If the aim is to teach students phonetics, then it would be most appropriate to draw their attention to the phonological features. Other evidence that supports this modification comes from the experimental result that when subjects are required to choose a word that fits a more elaborate sentence rather than a simple sentence, they have a better recall for this word afterwards. The reason for the difference in recall is that the elaborate sentence induces the analyzing of more features and associative dimensions of the word than a simple one. However, as Baddeley (1990) explains, this evidence also illustrates that semantic encoding helps the long-term memory more than phonological processing. Obviously, apart from the basic sounds of a word, the only other phonological features that can represent a word are the possible types and tones of voice. But a word, if semantically represented, may include many dimensions including its contextual meanings, the feelings it conveys, the history and experiences associated with it, the images it generates, etc. This interpretation reinforces the idea that "encoding many distinctive features will help recognition" and that "deeper semantic and elaborative encoding will tend to lead to the encoding of more features" (Baddeley, 1990, p. 169).

Although the theory of depth of processing has been challenged ever since its formulation, the view that remains unquestioned by both applied linguists and psychologists is that the quality of processing activities, the kind of operations carried out by the learner, determines the level of lexical retention, and it is not the time spent on learning an item and the difficulty of the learning task that determine the retention of what is learned.

The word learning technique proposed in this study stimulates the elaborate processing of words by exploring both their form and the meaning of words to establish relationships among words mainly through their root parts. The interaction between recognizing the shape of word parts and their meanings and relating the shape and

meaning to other words requires a certain amount of active engagement with the formal and semantic attributes of the words.

2.3.2 Factors affecting foreign vocabulary learnability

Some English words are easier to learn than others. Why is this so? Many factors might affect the ease of learning an English word.

Learning an English word, according to Nation, (2001, p. 23) involves knowing its form, meaning and use at the most general level which encompasses nine aspects of knowledge of a word:

1. being able to recognize it when it is heard and being able to pronounce it
2. being able to recognize it in reading and being able to write it
3. recognizing the morphological components that make it up and knowing what morphological components are needed to express its meaning,
4. knowing what meaning the word signals and knowing what form is used to express its meaning
5. knowing the concept of the word and knowing the referents of the concept and knowing what other words are associated with it
6. knowing what other words are related to it and being able to use other words to express a similar meaning
7. knowing its grammatical functions and being able to use it grammatically correctly in a sentence
8. knowing the words that collocate with it and being able to use the right words to collocate with it
9. knowing the constraints on its use and being able to use it appropriately on different occasions.

This description of what is involved in learning and knowing a word suggests that even partially acquiring a word by learning its pronunciation and spelling and linking up its form with its meaning implicates several factors that may affect the ease of its learning: pronounceability (Is the word's phonological pattern familiar to the learner?), orthography (Is the written form familiar?), and meaning (Is its semantic content familiar? Is there a clear labeling of that meaning in one's native language or can its meaning be found in a similar English word form?). The established findings concerning the psycholinguistic factors that may determine ease or difficulty in foreign

vocabulary learning will be first reviewed. On the basis of the literature on the determinants of learnability of words, three measures will be developed in order to measure the learnability of low frequency words related to known high frequency words, namely, a scale for measuring meaning transparency of a new word in relation to a known word, a method for measuring spoken form similarity between a new word and a known word and a method for measuring written form similarity between a new word and a known word. These measures will be presented and their rationale explained.

2.3.2.1 Pronounceability

Research on vocabulary difficulty indicates that an important factor affecting learning is the pronunceability of a word. Familiarity with the phonemes, the combinations of phonemes and suprasegmentals like stress and tone in the second language is helpful in speaking, writing and remembering L2 words. Phonological difficulty is to a large extent caused by the disparity between the learner's L1 system and L2 system. Rodgers's study (1969) of English-speaking learners of Russian clearly demonstrates that those Russian words like *haze* whose phonemes and phonotactic patterns are not new to the English-speaking learners are easier for them to pronounce and therefore are more likely to be retained while words like *mgla* is found to be more difficult for the learners to pronounce and therefore more difficult to remember.

Research in cognitive psychology suggests that an individual's ability to repeat novel phonological patterns in order to hold them in short-term memory is an important factor determining long-term vocabulary acquisition. Gathercole and Baddeley (1989), in their experiment with L1 learners, found the size of individuals' short-term phonological memory to be a good predictor of their success in language learning. Service (1992) studied Finnish children learning English as a second language and showed that their capacity to repeat back and to copy English nonwords predicted their subsequent success in target language learning better than their ability to match syntactic-semantic pairs in their own language. Ellis and Beaton (1995) experimented with English-speaking learners who had no previous knowledge of German. In their attempt to memorize German words with various techniques, the ease of pronunciation of foreign language words was found to be significantly correlated with their learnability. Their interpretation of the result is that the easier it is to represent the sound sequence of a new word in phonological short-term memory, the easier it is to learn

because this representation promotes longer-term consolidation for the word's articulation and meaning association.

However, learners need not be limited by the capacity of their short-term phonological memory. The capacity of short-term memory is not solely defined in terms of the time taken by a speaker to articulate the sounds of a word (articulatory loop or phonological loop), but long-term lexical phonological memory makes a contribution as well. Support for this point can be found from a variety of sources. Hulme, Maughan and Brown (1991) demonstrated that when the rates at which words and non-words are articulated are held the same, words are better recalled than nonwords, indicating the benefits from the long-term storage of the words. Gathercole, Willis, Baddeley and Emslie (1994) and Gathercole (1995) showed that nonwords with a phonological structure similar to that of real English words were more accurately repeated immediately after presentation than less "wordlike" nonwords, presumably because the more wordlike nonwords were better supported by long-term phonological knowledge than the less wordlike ones because of their resemblance to real English words. In addition to the research done involving short-term memory span, the involvement of long-term lexical-phonological knowledge has also been shown in the research into L1 and L2 vocabulary learning. Gathercole, Willis, Emslie and Baddeley's (1992) research suggests that for L1 learners the size of phonological short-term memory plays a less important role in vocabulary learning as learners get older: the time span for articulating nonwords at age 4 predicts vocabulary size at age 5, but after the age of 5, the time span for articulating nonwords does not predict vocabulary size of the next year. Beyond age 5, a learner's vocabulary size predicts his/her performance in nonword repetition. This result points to the fact that long-term meaning based phonological knowledge of vocabulary can overcome the limitation of short-term memory and support word learning.

This result is consistent with the research findings about second language vocabulary learning. In Papagno, Valentine and Baddley's (1991) experiments, when they tried to interfere with the operation of the phonological loop when subjects were learning foreign words which bear a resemblance with some first language word, the disrupting effects on their learning were not serious. Nor were serious effects observed when subjects were told to learn to associate words in their native language. But when learners' short-term phonological memory was interfered with in the course of their trying to learn foreign words which had no form similarity to the native language, the

disrupting effects were serious. In Cheung's (1996) study involving 12 year-old lower proficiency second language learners from Hong Kong, the capacity of their phonological short-term memory (the time span for repeating nonwords) was a significant factor in learning, but for higher-proficiency learners it was not. Learners with higher proficiency may have been drawing more on long-term knowledge of the second language vocabulary to support their learning than the low-vocabulary learners were. Cheung (1996, p.871) regards this as evidence of "the increased involvement of long-term knowledge in word learning which might have overshadowed the contribution of phonological memory for the high-vocabulary subgroup".

Against this research background, Nation (2001) suggests that the difficulties created by the limited short span of phonological memory and the great disparity between one's native language and foreign language can be overcome by developing meaning-based vocabulary learning techniques such as the word part technique as is proposed in the present research. In this technique, connections are made between the form of unknown foreign words and the form of already known foreign words, assuming that the known words depend on long-term lexical-phonological knowledge and can support memory of the new words. These connections will be useful as learners progress in their language proficiency. Although pronounceability of a word depends on the similarity between the L1 and L2 phonological systems for beginners, pronunceability of a word can eventually depend more on the analogy between the known L2 words and the new L2 words to support their short-term memory as their L2 proficiency improves.

The above review of the literature shows that familiarity with the sound system of the L2 determines the pronunceability of a word and in turn leads to easy learning of the word. While the familiarity depends on the similarity between the L1 system and the L2 system especially for novice learners, the familiarity also depends on long-term L2 lexical-phonological knowledge which can involve analogy between known L2 words and new L2 words. Thus, in the current research, connections will be made between the pronunciation of new foreign words and that of already known foreign words and the ease of pronouncing a word will be measured by comparing the phonological similarity between a known L2 word and a new L2 word.

2.3.2.2 Orthography

The argument concerning the orthographic factor responsible for the ease or difficulty of L2 vocabulary learning parallels that of the phonological factor in that similarity of one's native writing system to the L2 writing system makes transfer to an L2 easier. An L2 learner of English from a German or French language background may find English written forms easier to learn than a learner from a Chinese or Japanese background because the former's language and English derive from common origins and abound with language borrowings. In this way, the German learner may retain *hund (dog)* more easily than the French word *chien* due to its phonological and etymological similarity with the English word *hound*. In addition to the interlexical factors, familiarity with the rules governing the positioning of letters (e.g., *ll* are not placed at the beginning of an English word) and the correspondence between spelling and sound (e.g., ou - /aʊ/) also influences vocabulary learning (Ellis & Beaton, 1993; Laufer, 1997). Just as has been argued for the facilitating effects of the known English words on learning the spoken form of English words above, the same holds for acquiring the written form of English words. For those whose native language writing system has considerable differences from the English language, and for those who have already acquired some English words, the words whose written forms are familiar to them can serve as a bridge to take advantage of in learning new words. Based on this consideration, the similarity between the written form of a new English word and a known English word will be measured. The degree of similarity will be seen as a factor determining the ease of learning the orthographic aspect of a word.

2.3.2.3 Connecting form to meaning

The acquisition of L2 word meaning involves the mapping of two lexical and conceptual systems onto each other. As human experience is classified differently by different language systems, very often a word in the L2 cannot be directly mapped onto a concept existing in the L1 and the L2 learner has to restructure existing L1 concepts or develop a new concept that corresponds to a lexical item in L2. When roughly the same form in the first language relates to roughly the same meaning as a word in the foreign language, the form-meaning link is easier to make. Thus cognates shared by the foreign language and the first language are much easier to learn than other words (Nation, 2001).

The keyword method (Atkinson, 1975) tries to make the form-meaning connection easier by putting a first language link between the second language word form and its meaning. Comparably, the technique proposed in the present research tries to make the form-meaning connection easier by presenting a known high frequency word which shows a clear connection between the form of a new word and its meaning. Cohen (1987) reviewing studies on the keyword method, made the point that visually based learning techniques are more effective with concrete words than abstract words as concrete words are more imageable. He further points out that learners with higher language proficiency may find the keyword technique less effective than verbal mnemonics because they have stored more L2-vocabulary-based form-meaning associations which can be made use of without turning to an image for help. Nation (2001) justified this technique by citing an example from the *Dictionary of New Zealand Sign Language* (Kennedy, 1997). The sign for the words *trophy, award, cup, or prize*, is "both fists are held out at waist-level, some way apart, palms facing each other/up, blades down, and are moved up to chest level". For this sign, a hint is given that shows the connections between the sign and the meaning of the sign, namely, "raising a trophy cup by its handles" (p.49).

Deconinck, Boers and Eyckmans (2010) used sound-symbolism as part of their theoretical basis when they explored the possibility of "turning students' appreciation of the form-meaning motivation of words into a way to enhance processing depth in the course of learning new vocabulary" (p.8). Sound-symbolism refers to the theoretical assumption that the correspondences between sound and meaning are not arbitrary but motivated. For example, Bloomfield (1933) discussed the phenomenon of consonant clusters occurring in some words conveying the same meaning (phonesthemes). The sounds of /sl-/ in such verbs as *slide, slip, slime* are potentially connected with the meaning of smooth movement on a surface and thus sound-symbolic. In Deconinck et al's experiments they asked the experimental group to consider that the form and the meaning of a stimulating word might not be an arbitrary link. Then the mnemonic effectiveness of this treatment was assessed in the immediate and delayed post-tests in comparison with the control group who were asked to indicate their familiarity level with the target words and with the subexperimental group who were asked to rate the usefulness of the target words. Results showed that both word form and word meaning retention were fostered by simply asking learners to evaluate the form-meaning relatedness.

The mnemonic technique of using a high frequency known word as a link to the form and meaning of the new lower frequency word can be partially grounded on sound-symbolism although the form-meaning relationship between the new word and the known word is not sound-symbolic in nature. Just as Deconinck et al (2010) stated in their study, the nature of the appreciation of the sound-meaning link in the words in their experiment was not due to sound symbolism in a strict sense, but rather it could be induced by coincidental similarity with known words in the L1 or an additional familiar language or even idiosyncratic associations. It is logical to argue then that the appreciation of the sound-meaning link of a L2 word can be motivated by a familiar word in L2 and its effectiveness can be anticipated.

In fact, support for this argument can be found in Laufer's (1988) comprehensive study of "synforms" (similarity of word forms) which induce confusion on the part of L2 learners. She asked 321 adult learners of English as an L2 to finish two multiple-choice tests by choosing appropriate words from among groups of English synforms to fill in the blanks in sentences. The tasks demanded that forms be able to be associated with meanings rather than just knowledge of form. The analysis of results indicated that the most difficult synform types were suffix synforms (e.g., *comprehensible, comprehensive; considerable, considerate*), consonantal synforms (e.g., *conceal, cancel; price, prize*), prefix synforms (e.g., *superficial, artificial*), and vocalic synforms (e.g., *cute, acute; date, data*).

On the surface, her findings seem to contradict the proposal that a form-meaning L2 link word should be put between the form of a new second language word and its meaning to make the form-meaning connection easy in vocabulary learning. However, the results can also be interpreted to mean that if synforms with different meanings are easily confused, then words which are not only similar in form but also share meaning content are easy to acquire because the form-meaning connections are much easier to establish. Perhaps what is important to do is to help learners avoid the confusion by providing some helpful hints. Take the easily confused synforms *price / prize* for example. Students may be encouraged to learn *prize* through *price* which is a high frequency word with the help of the hints that while *price* is value for goods, *prize* is a value you win. Admittedly, some words sharing form similarity are not so transparent in terms of meaning, and some others do not lend themselves to be learned with this method. Thus, a scale needs to be developed for measuring the meaning transparency of a L2 word compared with the known linking L2 word.

The literature shows that familiarity with phonological patterns, the orthographic system and semantic content of words determines the ease of learning foreign words. No convincing evidence has been found concerning which of these factors is more responsible for the ease or difficulty than others in learning English vocabulary.

The roles of form and meaning in the acquisition and processing of L2 vocabulary has been a subject of debate by psycholinguists. The L2 mental lexicon differs from the L1 mental lexicon in that the former operates on phonological connections rather than on semantic connections. This view is supported by the research findings of Carter (1987), Channell (1988), Gass and Selinker (1994) and others and by the research cited above which looked at factors involved in L2 vocabulary learning difficulty. This view of the L2 mental lexicon however was challenged by Singleton (1999) based on the results of the Trinity College Dublin Modern Languages Research Project, which was a longitudinal study conducted with Spanish and Italian university students who studied French or German, and involving the use of various testing instruments such as the C-test, word association tests, questionnaires, and introspective questions for data elicitation (See Singleton, 1999 for details). The C-tests showed that while the advanced learners' lexical processing was more semantically and pragmatically driven than the beginners', a larger proportion (never below 61%) of correct and appropriate responses given by the beginners provided evidence that contextual meanings of words were taken into consideration and that the correct replies were also predominantly semantically and pragmatically driven. The word association test showed that some responses that were hard to categorize as paradigmatic associations or syntagmatic associations or clang associations (association based on phonological resemblance only) could be interpreted as being semantically associated with the stimuli. The larger number of clang responses found in L2 came from 4 out of 16 subjects, which could be explained by the different effects of the limited L2 vocabulary knowledge on different individuals. Singleton (1999, p. 236) maintained that "the organization of the mental lexicon of advanced L2 learners is like that of the L1 mental lexicon, predominantly meaning-based. Differences between the L1 and L2 data sets can readily be accounted for in terms of different levels of lexical knowledge in the two languages and also, to an extent, in terms of interaction between the nature of L2 lexical knowledge and individual learner characteristics". The results from Singleton's project can thus be interpreted to mean that both form and meaning factors influence the acquisition and processing of L2

vocabulary to various degrees determined by the variables of learning contexts and learners' language proficiencies and other individual learner differences.

2.4 Summary

This chapter has covered the literature in a wide range of research areas. The examining of the research findings on affixes and roots, the use of etymological information and other information about word parts in L1 and L2 language learning, and the linguistic research of morphological representation in the human mind, and especially the survey of the existing materials which contain information about word roots lead to the following conclusions:

1. Systemized information on word form and meaning relationships based on etymological knowledge about word roots can help lighten the learning burden of vocabulary.

2. This information is not present in learners' dictionaries.

3. No standard guide is available for language teachers and learners of English on helpful word roots and on the words that can be accessed by using the information on the roots (Nation &Webb, 2011).

These conclusions mean that in order to make the etymological information on word roots and the information on word form and meaning relationships available and applicable to teachers and learners, further research needs to be conducted to find out:

1. the frequency level of the words containing useful word parts. This is to make sure that parts in high-frequency words are used to help the learning of low-frequency words.

2. the degree of formal similarity between the related words. This will show which words are formally easy to learn by employing knowledge of word roots.

3. the shared meaning between the related words which is related to the shared form (the root). This enables the meaning of low-frequency words to be accessed through the high-frequency words.

4. the degree of meaning transparency of lower-frequency words in relation to the high frequency known words to indicate which words are semantically easier to learn.

Chapter 3 Instruments

To prepare for the analysis of the form and meaning relationships between the new lower frequency words and the known high frequency words so that a list of words with high form and meaning transparency compared with the known words can be sorted out, three instruments were developed to measure spoken form similarity, written form similarity and meaning similarity that the new words share with the known words. This chapter provides the rationale and the description of the three measures.

3.1 Measuring spoken similarity between new words and known words

Methods for measuring similarity between sounds of words are explored and widely applied in speech technology where a phonetic comparison method is used to identify spoken words, to assess second language proficiency (Bernstein, Barbier, Rosenfeld & De Jong, 2004), to diagnose articulatory problems (Connolly, 1997), to quantify children's acquisition of pronunciation (Somers, 1999), to identify languages and verify the identity of a speaker (Muthusamy & Spitz, 1997; Furui, 1997), to avoid developing trademarks that are phonetically confusing with other trademarks in commercial branding (Kondrak & Dorr 2004; Lambert, Chang & Lin 2001), and to help in spelling correction and cross-language information retrieval (Toutanova & Moore, 2002). Phonetic comparison measures are also used to identify cognates in historical linguistics, to prove the historical connections of languages, to map the relations of languages and dialects and to trace the separation of languages and their subgroupings (Covington, 1997; McMahon & McMahon, 2005). These applications require phonetic comparison algorithms enabling computer implementation, and reliability and significance testing. The diversity of the applications determines the differences in the methods adopted to compare the sounds of words. The phonetic comparison algorithms have been developed on the basis of the differences between the acoustic properties of the speech stream; the differences between articulatory features; the distance between individual sounds as perceived by language users; the judged distance between sounds in a communicative context; or the historical distance between sounds, in time or in number of events (Kessler, 2005). The following is a review of the issues involved in the development of the phonetic comparison algorithms which will lead to the choice of

the measure for comparing spoken similarity between words for the purpose of the present research.

3.1.1 Binary comparison vs. multi-valued comparison

As Kessler (2005) stated, "Most techniques for measuring phonetic distances take the distance between phonological segments as point of departure" (p 248). One way that is frequently used is the calculation of Levenshtein distance (LD) or edit distance. LD is a numerical value of the cost of the minimum number of operations of insertions, deletions or substitutions that would be needed to convert one phonetic string into another (Kruskal, 1999). In the simplest algorithms, a cost of zero is assigned to identical phones and a cost of one to non-identical phones. This binary comparison was adopted by Nerbonne & Heeringa (1997)) when they sought to measure phonetic distance between Dutch dialects. McMahon and McMahon (2005) criticized this approach on the grounds that in spite of the beauty of the computational simplicity of this method, Nerboone and Heeringa's algorithm produces results that are not only inconsistent with historical-linguistic developments but also run counter to the intuition of the speakers of the dialects. For example, they give the same cost to the substitution of /a/ by /t/ as the substitution of /a/ by / ʊ/. However, it is not true that a linguistic change from /a/ to /t/ is "as likely or natural as a substitution of / ʊ/ for /a/. Sound changes far more commonly involve differences in phonetic quality than complete insertions or deletions of segments, or changes of linear order like metathesis" (p.213). Their second criticism of Nerboone and Heeringa's method is that since the edit distances are computed by matching and comparing the phonetic strings segment by segment, this linear comparison of phonological segments is not adequate for comparisons between different languages or for comparisons across spans of time. This is because changes in language may have caused the order of the segments to change. They use two word pairs as examples to illustrate their point, *bridle/bird* and *friste/first*. The change from *bridle* and *friste* to *bird* and *first* involves the operation of metathesis (transposition). Nerboone and Heeringa's "straightforward, linear segment-matching algorithms" (p.213) will end up matching the wrong segments etymologically.

Quite a number of studies (Grimes and Agard, 1959; Kessler, 1995; Kondrak, 2003; Heggarty, 2005) compute the multivalued articulatory features of a phonetic segment as

a way of capturing the change in phonetic quality. According to Kessler (2005), this use of feature bundles is the most common way to measure phonetic similarity. For example, Kondrak (2003) used a system where the Place feature takes on 11 values and the Manner feature 7 values. The values of features range from 1.0 to 0.1, and all values are based on the experimental measurements of actual distances between vocal organs. The distance between two sounds on a feature was the degree of the difference between the numeric values and the distance between two sounds as a whole was the total differences. He also gave different saliency values to different phonetic features. The greatest weight was given to the feature of manner while smallest weight went to the feature of length.

Kessler (1995) tested different approaches for computing distances between Irish dialects. Kessler found that the feature-based multivalued method performed worse than a simpler binary measure, which employed a binary identity function between phones. Heeriga (2004) found a similar result when he compared four phonetic comparison algorithms for mapping the relations of 15 Norwegian dialects. He reported the same striking result of the perception test which used speakers of the dialects to give judgments about the relations of the dialects. They interpreted the result to mean that for dialect speakers, all distances, whether it be between /iː/ and /ɪ/ or between /iː/ and /ʌ/, are the same when they are functionally or sociolinguistically the same.

In the above mentioned studies, articulatory features are used rather than acoustic features for the practical reason of being easy to obtain and for the theoretical reason of being objective.

3.1.2 A model for predicting the judged spoken form similarity

A model to compare the "similarity of sound" of two words in the area of psycholinguistics was developed by Vitz and Winkler (1973). It is a phoneme-based measure to predict the perceived "similarity of sound" of English words. Their method is to align two words in order to compute the distance between them. When the two words are aligned, one is placed above the other to show the identical phonemes or the different ones between them. The alignment rule is to minimize the difference or the distance between two strings. The comparison is binary: the distance between two

identical phonemes is defined as zero and the distance between two non-identical phonemes as one. For example, *sit* and *its* are compared like this:

/sɪt*/

/*ɪts/

Out of the 4 positions, two phonemes match /ɪ/ and /t/. The phonemic distance between the two words is 2/4.

Vitz and Winkler (1973) also conducted five experiments to test the correlation between the phonemic distance predicted by the model and native language users' judgment of the spoken form similarity of the word pairs. The first four experiments each used 16 New York University students as subjects who were asked to rate the similarity between each of the 25 words they heard and a standard word on a 5-point scale. The 25 words and the standard word were presented as word pairs in the recording. In each of the four experiments, the comparison words differed from the standard word by different numbers of phonemes which were located in different positions of a word. The first experiment used the shortest comparison words, each comparison word having one syllable and three phonemes and two or three clusters (e.g. *wage, rule, keys*). In each of the following experiments, the number of syllables, phonemes and clusters that were in common with the standard word was increased gradually in the comparison words. When the word pairs were tested for their spoken form similarity, they were counterbalanced in the order of presentation and were tested first in the standard-comparison order and then retested in the comparison-standard order. The results showed that the phoneme-based model predicted well the human judgment of spoken form similarity between words. The correlations were -.92, -.81, -.92, -.94 respectively in the four experiments. However, evidence was found in the experiments that there was the effect of the varying degrees of similarity between phonemes. For example, /sat/ was judged closer to /set/ than to /sit/ because /ɑː/ is closer to /e/ than to /iː/. In experiment 5, they asked the subjects to rate 15 word pairs. The correlation between the subjects' ratings and the prediction of the phoneme model for these 15 pairs was relatively low, -.77. It was also found that some of the word pairs were assumed highly similar because their vowels were the same (e.g. *see-pea, hoe-sew)*; some others were assumed not highly similar because their vowels were

different (e.g. *inc- arc*, *air- fir*). This was an indication of the failure of the model to assign more weight to vowels than to consonants.

Thus, in spite of the high correlations between the human ratings and their phonemic similarity model, a weakness of the model Vitz and Winkler recognized is its failure to measure the similarity of phonemes. They first attempted to overcome this weakness by assigning a distance cost of 0.5 for two similar phonemes which were defined as the phonemes differing by only one articulatory feature according to Chomsky and Halle (1968). For example, /ɪ/ and /iː/ differ from each other by only one feature, tenseness. Therefore, they were treated as similar phonemes and the difference between them is 0.5. However, this remedy was proved to have either failed to improve or lowered the correlation between the predicted values of sound similarity of word pairs and the human rated similarity scores. They attributed the lower correlation to the equal weight they gave to the different features of the phonemes. Their postulation seems to be consistent with the views of the researchers in the field of computational phonetics who aim to work out the optimal algorithms to compare the closeness of dialects and languages, to identify cognates or to reconstruct languages. For example Kessler (1995) considers the equal weighting of features one of the reasons for the poor performance of his feature-based algorithms for analyzing Irish dialects. However, from the reports provided by the subjects of their judging process, Vitz and Winker (1973) came to the conclusion that "relatively little of the variance in the rating of complete words is due to factors existing at a lower or more molecular level than the phonemes" (p.386) and that stress, phonemes or syllables and serial position effects that are at a higher level of the phonological structure than the articulatory features are responsible for the variance.

Next Vitz and Winker revised their phoneme model and proposed a phonemic cluster model after considering the subjects' reports of their judging processes. Vitz and Winker's model takes the phonemic cluster as the structural unit of analysis. A phonemic cluster is defined as a "phonemic representation of a consonant or vowel cluster" (p. 386). In the word "*plant*", /pl/ and /nt/ are consonant clusters, and /a/ is the vowel cluster. "The distance between two phonemic clusters is the proportion of phonemes which do not match after alignment" (p.386). The principle for aligning the phonemic cluster model is to minimize the phonemic cluster distance between the words being compared.

The following two examples illustrate how the predicted distances between word pairs are calculated:

/*pl . ɑː . nt /

/ spl . ɪ . *t/ = （1/3 + 1 + 1/2）/3 = 0.61

When the model was tested using the comparison words of experiments 2 and 5 which involved coding phonemes into phonemic clusters, significant improvement was achieved in correlations between the predicted scores and the ratings. The correlation for experiment 2 increased from -81 to -.90; the correlation for experiment 5 improved from -.77 to -.86.

When Derwing (1976) studied the relationship between morpheme recognition and the perceived semantic and form similarity in word pars, he tested Vitz and Winkler's phoneme model and phonemic cluster model by asking the subjects to rate the spoken form similarity of 115 word pairs that "best represented the full range of semantic and phonetic similarity involved" (p. 46). The results of his study showed that both the models were highly predictive of the human performance on the spoken form similarity test (r = 0.88, r = 0.89). The nearly equal correlation results for the two measures are not consistent with Vitz and Winkler's findings when they tested the predictability of the two measures. The discrepancy in their testing results could be attributed to the difference in their data. Vitz and Winkler's data were comprised of pairs of words which varied in the number of syllables and the number and position of phonemic clusters for comparison purposes. For example, *grand/plant, split/plant, blond/plant*. Derwing's data were words with etymological and morphological relations. A word pair *fable/ fabulous* in his data did not lend itself to the use of the phonemic cluster method. According to this method, /bl/ in FABLE should be compared with either /b/ or /l/ in *fabulous*. No matter with which phoneme /bl/ is compared, the similarity result between the part –BUL- and the part –BL- is 0.5. This type of data was not dealt with by Vitz and Winkler in their phonemic cluster model. Derwing's data also contains a few word pairs like *epsy/egyptian* which may be syllabificated in different ways according to different syllabification principles. This could be another factor which has affected his predictability score for the phonemic cluster method.

3.1.3 The method for this study

One of the goals of this study is to provide sets of formally and semantically similar words for teachers to use in second language teaching. This requires that the phonemic similarity between pairs of words must be consistent with teachers' and learners' intuition and perception because psychological adequacy is the prerequisite for any teaching intervention to have a good effect.

The two requirements determine the inapplicability of the ideas of phonetic comparison used in speech technology and historical linguistics. In those areas the acoustic or articulatory features of phonetic segments are used as the fundamental units of calculation and comparison of phonetic similarity. This idea seems to be lacking in psychological reality. As Vitz and Winkler (1973) reported, the subjects in their study mentioned using four possible structural units in rating spoken form similarity between word pairs: words, syllables, clusters, and phonemes. The subjects gave very little evidence in their report for the significance of distinctive phonetic features for their judgment about the degree of similarity or difference between pronunciations of words. This indicates that language users are largely unaware of the phonetic feature processing which passes very rapidly in the course of perceiving the phonetic similarity or difference of spoken words. The reliability of this finding is confirmed by Heeriga's (2004) comparison of four phone-based and feature-based algorithms, where the phone-based algorithms came out as superior to the feature-based ones in the perception test. That is why Kessler (2005) drew the conclusion that binary comparison is more appropriate for applications involving human judgment.

Most of the existing algorithms compute over feature bundles which often contain a large number of features. A feature can take as many as 11 values in Kondrak's (2003) scheme. These features are sometimes weighted to reflect the different degrees of salience. The accuracy achieved by these algorithms is not what is needed by this research. What is needed is an ordinal scale that is able to tell the teachers and learners whether a new word is relatively easy to acquire in terms of its pronunciation rather than a complicated and intangible algorithm that is expected to identify cognates, to describe relations of languages and dialects, or to diagnose articulatory problems.

For similar reasons, McMahon and McMahon's (2005) criticism of the simple binary comparison is not relevant to the present study. In the study of historical linguistics, phonetic comparison aims to resemble the truth of the historical

development of a language. Although the source of the sets of the words in this study is an etymological dictionary, mapping the sound changes in a detailed manner is not its goal. It is possible that the degree of difference between /ɑː/ and /ɒ/ is not as big as that between /ɑː/ and /t/. However whether the distance between the former should be counted as greater than the latter, and what should be the difference between the two pairs needs to be tested empirically. As Vitz and Winkler found out, in spite of the fact that /iː/ and /ɪ/ only differ by one feature, the subjects rate them farther apart from each other than /iː/ and /ʌ/. It is very likely that this judgment is related to the phonetic context a feature is in. As is pointed out by Kessler (2005), this is a problem with all the algorithms of phonetic comparison, namely, they give "a linear, additive model of feature effects, where it is assumed that the contribution of each feature is independent of the contribution of any other feature" (p. 251). It is likely that features interact with each other so that one feature appears more significant in a certain phonetic context than another.

The problem the binary comparison has with the language phenomenon of metathesis as McMahon and McMahon have pointed out can also be ignored. The diachronic relations between phonetic forms are unknown to the language users. When they hear *respect* and *sceptic*, they can judge whether the two words sound alike but few people, if any, can notice the swap of the sounds /k/ and /p/ in the second word compared with the first word. More important is the difference of the goal of the present study from that of the historical reconstruction of languages, or that of cognate identification. The reflection of the diachronic truth of the two words is not the goal of the present study, rather a listener's perception of the similarity of sound is its concern because it determines the ease or difficulty involved in their memorizing and learning the sound of a new word.

Our data consists of words with morphological and etymological relations which contain a large number of word pairs like INDICATE/PREDICT, CHANNEL/CANAL, FLOWER/FOLIO. Vitz and Winkler's phonemic cluster model is not suitable for this type of data. For example, the phonemic cluster model requires that / kt / in PREDICT should be compared with either / k / or / t / in INDICATE. This comparison means that the similarity between the part –CT- and the part –CATE- is 0.5 no matter whether the cluster / kt / is compared with / k / or with / t /. The problem in this case then is that one

identical phoneme / k / or / t / is left out without being considered in the comparison. The human judgment could be that the similarity between / kt / and /keɪt/ is greater than between / pl / in *plant* and /p/ in *park* in Vitz and Winkler's data, because no other phoneme in *park* except /p/ is identical with the two phonemes in the phonemic cluster /pl/. As was mentioned above, this problem was not dealt with by Vitz and Winkler when they designed and tested their phonemic cluster model because in Vitz and Winkler's data, the words were deliberately varied to have different numbers of phonemic clusters (e.g. *grams* does not have identical phonemic clusters with *pl.a.nt* whereas *pl.o.ts* shares one identical one / pl / and / t /, half phonemic cluster with *plant*). For this reason, Vitz and Winkler's phonemic cluster model for comparing the spoken forms of word pairs was considered not to be the appropriate choice for the current study.

To summarize, Vitz and Winker's phonemic model is more appropriate than the algorithms for this study in that it is based on empirical data and was retested and confirmed by Derwing (1976). Because it has more psychological adequacy, it is more suited for research on language teaching and learning. The high degree of objectivity and accuracy possessed by those computer programs for phonetic comparison is not needed by the present study. The second reason is that it is appropriate for the data of this study which contain etymologically related word pairs.

3.1.4 Modifications to the phonemic model

Vitz and Winker's model is chosen as the basis for comparing the phonological similarity between word pairs in this study. However, two modifications are made to it to transform it into a scale that is needed by this study. The first modification is related to the nature of the present study, namely, learning new words through known words by taking advantage of the form and meaning similarity between them. Thus one principle should be added, that is, if the pronunciation of a new word is part of the known word, it enjoys the highest degree of phonological transparency because it is easiest to learn. The pairs *middle/mid* and *explain/plain* are covered by this rule. The second modification is that after the alignment of phonemes, identical phonemes are counted rather than the different ones so that the data shows phonological similarity rather than distance

between two words. This modification is for the convenience of accessing the learnability of words at a later stage.

The method for measuring the phonological transparency of new words applies the following rules which are implemented in the order given here:

1. write out the phonemes the pronunciation of a word contains according to the *Oxford Advanced Learner's Dictionary of Current English* (1995). The first pronunciation of a word, namely, the British one, is used.
2. align them in the way that minimizes the phonemic distance
3. code the number of identical phonemes by assigning 1 score to each identical phoneme
4. normalize the length by dividing the total scores by the length of the alignment.

The following are some examples to illustrate the procedures. The word on top is the known word.

- example /ɪ g z ɑː m p l ***/

  exemplify /ɪ g z e m p l ɪ f aɪ / similarity score = 6/10 = 0.6

In this pair, there are 10 alignment positions. The shared phonemes are 6. The phonological similarity between the two words is therefore 6 out of 10. The same goes for the next two pairs of words.

- mind / m aɪ n d /

  mania / m eɪ n ɪə/ similarity score = 2/4 = 0.5

- inform /ɪ n fɔː m /

  reform / r ɪ*fɔ ː m / similarity score = 4/6= 0.67

3.2 Measuring written similarity between known words and new words

Information about the orthographic similarity of letter strings comes from research into the nature of visual word recognition, or orthographic input coding. This is because the manner in which visual words are identified determines the degree of the similarity between different letter strings which in turn affects a word-coding theory's explanatory

power in terms of the facilitative or inhibitory effects of different letter positions on the coding system.

Research in this area has employed the masked priming paradigm to investigate the way letter strings are coded. The most commonly adopted research procedure in the masked priming paradigm is the three-field technique. A standard three-field procedure involves first presenting a forward mask usually in the form of a row of # symbols, and then presenting a lower-case prime usually for 50ms followed immediately by an upper-case target. All the three stimuli, the mask, the prime word and the target word appear in the same location on the screen of a computer. Since this research procedure does not give subjects enough time to identify primes, any priming effects can be regarded as the results of automatic processes rather than strategic processes such as the synonym effects. Subjects are requested to reply whether a target is a word or non-word. Formally related non-word primes generally produce facilitatory effects (the subjects can make quick responses) for the targets because the formally similar non-word primes help the subjects to identify the target words. However, when formally related word primes are used, inhibitory priming effects are typically observed, that is, longer time is taken for subjects to tell whether the target is a word or non-word. This supports the lexical inhibition hypothesis that orthographically similar words strongly activate lexical competitors of the target. Both the facilitatory effects of non-word primes for targets and inhibitory effects caused by the primes are interpreted as evidence of orthographic similarity between the prime and the target.

The illusory word technique has recently been used by a few researchers who observe how the readers' attention is distracted by two words at different locations. In their attempt to recognize the two words, they may combine letters of the two words and perceive an illusory word. For example, when the two words "hike" and "have" are presented very briefly and followed by a mask, they may report that one of the words they have seen is "hive" because they have moved one letter of one word to the same position in the other word. The illusory effect is evidence of orthographic similarity between words.

The following is a summary of the findings concerning the orthographic similarity between two letter strings that are revealed by the research on letter position coding. This summary provides some of the evidence that is needed for the development of a scale to measure orthographic similarity between word pairs.

3.2.1 The substitution of a single letter

A wealth of research has shown either inhibitory effects or facilitatory effects as a result of the similarity between stimuli letter strings and target letter strings that differ from each other with respect to the substitution of a single letter relative to formally unrelated letter strings; for example, *WOLD – word, AXLE- able* are more similar to each other than *thug – able* (e.g. Forster, Davis, Schoknecht & Carter, 1987, Ferrand & Grainger, 1992, Forster & Veres, 1998, Perea & Rosa, 2000, de Moor & Brysbaert, 2000, Perea & Lupker, 2004, Davis & Lupker, 2006).

3.2.2 The substitution of a single letter vs. having one or two neighbor letters removed

Studies exist showing how different is a pair formally differing from each other with respect to the substitution of a single letter in relation to a letter-string pair in other form relations.

Davis and Bowers' (2006) using both the illusory word experimental task and masked priming paradigm confirmed their previous finding (2004) that a pair of letter strings differing from each other with respect to the substitution of a single letter are more similar to each other than a pair of letter strings which differ from each other in having one neighbor letter removed (e.g. *stop – soap*) which are more similar than two letter strings differing with respect to two neighbor letters substituted (e.g. *stop – snap*).

3.2.3 Addition or deletion of one letter

Letter strings that overlap except for the addition or deletion of one letter are more similar to each other relative to formally unrelated letter strings (Davis and Taft, 2005; de Moor & Brysbaert, 2000; Schoonbaert & Grainger, 2004). Experiments show that pairs of letter strings that differ from each other with respect to the deletion of one letter like *mircle – miracle, scome – come* are more similar than formally unrelated pairs like *miracle – bentho, scome – scoad.* However, the target word containing a repeated letter, for example, *balance* with the letter "a" repeated, tends to be more similar to its prime *balnce* than a word without a letter repetition, *miracle* to *mircle* according to Schoonbaert and Grainger (2004).

3.2.4 The transposition of adjacent and non-adjacent letters

The similarity effects of two letter strings that differ from each other with respect to the transposition of two adjacent letters were observed relative to the formally unrelated primes (Schoonbaert & Grainger, 2004; Taft & van Graan, 1998). Also, two letter strings differing from each other in the transposition of two adjacent letters, for example, *salt – slat, word – wrod* are more similar to each other than a pair of letter strings differing from each other with respect to the substitution of a single letter, *sant-saft* (Chambers, 1979; Forster, Davis, Schoknecht & Carter, 1987; Andrews, 1996). Two letter strings differing from each other in the transposition of two adjacent letters are more similar than two letter strings differing from each other with respect to the substitution of two neighbor letters, namely, *uhser-usher* where two adjacent letters "sh" were transposed into "hs" share more orthographic similarity with each other than *ufner-usher* where "sh" were substituted with "fn", according to Perea and Lupker (2003).

It seems that the similarity effects of pairs of letter strings differing from each other with the transposition of two adjacent letters are largely determined by word length, but the number of letters in a word as a function of the similarity effects of such letter strings remains unknown. Schoonbaert and Grainger (2004) reported evidence that the orthographical similarity shown in the transposition of one adjacent letter might depend on word length. 7-letter strings with two adjacent letters transposed might show larger orthographical similarity to their base words (e.g. *service - service*) than 5-letter strings (e.g. *point – ponit*). This is consistent with Humphreys, Evett and Quinlan (1990) who found that the similarity effect of transposition of two adjacent letters would disappear in 4-letter words showing no difference in similarity effect from letter strings where two neighbor letters are substituted. Guerrera and Forster (2008) even observed the similarity effects of transposition pairs of letter strings involving three transpositions in 8-letter words.

Non-adjacent transposition letter strings also demonstrate similarity effects (Perea & Lupker, 2004). Both the non-adjacent consonant transposition letter strings (*cadama*) and the non-adjacent vowel transposition letter strings *(anamil*) are perceptually more similar to their base (*camada, animal*) than a non-word with two letter substitutions (e.g. *caviro*) to its base (e.g. *casino*). Also, in comparison with letter strings with the

substitution of a single word, non-adjacent transposition letter strings appeared to be more similar to the original words.

3.2.5 The position of the substituted and transposed letters

The evidence supporting the similarity effects of letter strings with one letter substituted or with two letters transposed is contradictory and inclusive in respect of the position of the letters being substituted or transposed. Some researchers believe that pairs of letter strings (e.g. *clerk – clrdk*) that differ by an interior letter are likely to be more perceptually similar than those (e.g. *disturb – idsturb*) that differ by an external letter (Johnson, Perea & Rayner, 2007, Perea & Lupker, 2003, Rayner, White, Johnson & Liversedge, 2006). With respect to the substitution of a single letter, Perea (1998) concludes that only orthographically related pairs where the stimulus differs from the prime by the third letter (*women – woven*) or the fourth letter (*frost – front*) shows similarity effects compared with an unrelated word condition.

In contrast with these findings, Grainger, Grainger, Farioli, van Assche and van Heuven (2006) reported a failure to find any interaction between serial position effects and orthographic similarity. Any length of a subset of the target letter strings is perceived to be similar to the target as long as the relative position of letters was respected across the subset and the target. For example, *arict – apricot* are more similar to each other than *acirt – apricot,* but not more similar than *aric – apricot.* The judgment of similarity is not affected by the presence or absence of "length-dependent, absolute position information" – to insert filler letters or characters to provide absolute position information does not affect the similarity between a pair of letter strings. Thus, *apric2t -apricot* are not more similar to each other than *arict-apricot*. The judgment of similarity is not even affected by inserting hyphens in wrong positions; for example, *a-ric-t – apricot* and ar-*i-ct – apricot* are not different from *arict – apricot.* The relative position of the overlapping letters in two letter strings has little influence on the perception of whether or not they are more similar to each other, particularly in conditions where there was no evidence for phonological effect, for example, *apric – apricot, ricot – apricot, arict –apricot*). The results of Grainger et al's research add to the previous evidence provided by Humphreys, Evett & Quinlan, 1990, Peressotti & Grainger, 1999, Chambers, 1979)

3.2.6 Summary

To summarize the findings of the research reviewed above, the following conclusions can be made: two types of letter strings, namely, 1) those that differ from their base words with respect to the substitution of two neighbor letters and 2) unrelated word forms, are less similar to their base words than the following four types of letter strings to their base words, namely, 1) letter strings that differ from their base words in the transposition of two adjacent letters, 2) letter strings that differ from their base words in the substitution of a single letter, 3) letter strings the differ from their base words in having one neighbor letter removed, and 4) letter strings that differ from their base words in transposition of non-adjacent letters.

To be more specific, the research has shown that letter strings that differ from their base words in the transposition of two adjacent letters are more similar to their base words than letter strings that differ from their base words with respect to the substitution of a single letter, which are more similar to their base words than letter strings that differ from their base words in having one neighbor letter removed, which in turn are more similar to their base words than letter strings that differ from base words in the substitution of two neighbor letters. Also it is known that non-adjacent transposition letter strings are more similar to their base words than a letter string with a single letter substituted, which in turn are more similar than letter strings with two neighbor letters substituted.

The evidence concerning the degree of similarity between different types of letter strings comes from research into the process of recognizing visual words with the aim to establish models of letter position coding. However the purpose of the present research is to develop a measure that can compare the orthographic similarity between a known word and a new word which are semantically and formally related to each other, so that teachers and learners will be well-informed about the ease or difficulty of learning the form of a new word. The divergent purposes give rise to a number of problems that render it difficult to develop an orthographic similarity measuring scale completely based on the evidence presented above.

The first problem is that some gaps still exist concerning what types of letter strings have a higher degree of similarity than others. For instance, no research has been found to address the issue of whether adjacent letter transposition letter strings are more similar to their base words than non-adjacent letter strings. Also it is unknown whether

deletions and additions affect the degree of similarity in the same way as substitution of one single letter. The information which is important for the purpose this study but which is absent from the research findings is whether substituting a single letter plus removing a letter will result in more or less similarity between words than substituting a single letter plus adding a letter or other forms of combination of these orthographical changes (e.g. *market – merchant* vs. *market - commerce*).

The second problem concerns the non-word nature of the letter strings that are used as stimuli or targets in the experiments. In the majority of the experiments, a large proportion of the letter strings that are utilized as stimuli to demonstrate the facilitatory or inhibitory effects in word identification are not real words. This weakens the reliability of the evidence yielded from these experiments as the basis for measuring the orthographic similarity between real words.

The third problem may be that the lengths of the words that are used in the experiments are controlled and therefore most of the words being compared are short and of the same length. However, the data of the present study includes words of various lengths with shared meanings and letters.

The last concern with using the above evidence as the basis for developing a scale for this study is that some findings have not been replicated by other researchers. For example, up to now no research is available that confirms Davis and Bowers' (2006) finding that letter strings differing from their base words in the substitution of a single letter are more similar to their base words than letter strings differing from their base in the removal of a neighbor letter.

For the reasons presented above, the experimental evidence yielded from the research area of word recognition cannot be used solely as the basis for developing the orthographic scale for the purpose of comparing the orthographic similarity between a new word and a known word in order to know the ease or difficulty involved in learning the new words. However, in designing a measure for this research some evidence which has been provided by quite a number of experimental studies is useful. This includes the similarity effects of letter strings that differ from their base words in the transposition of two adjacent letters, letter strings that differ from their base words in the substitution of a single letter, and letter strings the differ from their base words in having one neighbor letter removed, letter strings that differ from their base words in transposition of non-adjacent letters. The information yielded from the reviewed research that is not taken into account includes the evidence concerning the length of words, the number of

transpositions and the number of intervening letters between the transposed letters, the relative positions of identical letters in a word. This evidence is ignored mainly due to the large information gap or reported contradictory results.

The consideration of the relevant information resulting from the reviewed psychological research is reflected in the most important principle of maximizing the similarity of two letter strings when the order of letters is respected in the designing of an orthographical similarity measurement for the current research. When the similarity of two letter strings is maximized through alignment, letter strings that differ from their base words in the transposition of two adjacent letters, letter strings that differ from their base words in the substitution of a single letter, letter strings the differ from their base words in having one neighbor letter removed, and letter strings that differ from their base words in transposition of non-adjacent letters will get a larger similarity score than letter strings that differ from their base words in the substitution of two neighbor letters or orthographically unrelated words. For instance, when SILVER and SLIVER are aligned in the way to maximize the number of similar letters, the alignment is:

SIL*VER
S*LIVER

The similarity between the two is 5 out of 7 alignment positions and thus the similarity score for this pair is 0.71, which is larger than aligning them in: SILVER which will
SLIVER
result in a 4 out of 6 similarity (0.67).

The principle for maximizing the similarity between two words in alignment is also reflected in word pairs like RESPECT/RESPECTIVE. When RESPECT is compared with PERSPECTIVE, there are two ways to align the two words. One way is

RESPECT
PER*SPECTIVE.

The similarity between the two words is 6 out of 12. The other way is RE*SPECT.
PERSPECTIVE
The similarity between the two words is then 6 out of 11. The latter alignment is adopted for two reasons. First, as is shown in the above review of the literature in psychology, there is ample evidence of the similarity effect of adjacent transposition letter strings. Second, the evidence is not adequate supporting the orthographical similarity effect caused by different letter positions. It probably does not matter much

whether to align together the shared letter “e” or to align “r” together. Therefore, the latter alignment which maximizes the similarity effect of adjacent transposition letter strings “re”/ “er” is preferred.

If the lower frequency new word is part of the high frequency known word, the new word enjoys the highest similarity score. This principle is established because although learners are learning the lower frequency word, its written form, being part of a word they already know, is not new for them. The example is PLAIN to be learned through EXPLAIN.

The measurement of orthographic similarity follows these steps which are presented in the order of their application to the comparison of word pairs.

1. Align them in the way that maximizes the similarity between two letter strings
2. Code the number of identical letters by assigning a 1 score to each identical letter
3. Normalize the length by dividing the total scores by the length of the alignment.

Consider the following examples:

- **mar**ke******t**
  merchan**t** = 4/8 = 0.5
- **pra**c******tice
  pragma**tic*** = 6/10 = 0.6
- **pri**c**e**
  priz**e** = 4/5 = 0.8

3.3 Measuring meaning transparency between new words and known words

Although the notion of semantic similarity has been explored in philosophy, psychology and artificial intelligence, it is more extensively studied in natural language processing, because determining the degree of semantic similarity between two words is a fundamental need for all applications in natural language processing. For example, the measure of semantic relatedness may be applied to word sense disambiguation – locating the appropriate sense of a polysemous word in a text. It may also be used for

information extraction and retrieval, automatic indexing, and determining the structure of texts.

In the field of natural language processing, some researchers distinguish the notion of semantic similarity from that of semantic relatedness. While semantic relatedness is a more general term, semantic similarity, representing a type of semantic relatedness, is a more restricted concept (Resnik, 1999). A pair of words which are semantically dissimilar can be semantically related to each other. Resnik (1995) gives *car-gasoline* as an example of a semantically more related pair and *car-bicycle* as a formally more similar pair of words. In the present study including the following review of the literature on natural language processing, these two terms are not differentiated. They are used interchangeably with the term "semantic transparency" which expresses the idea that the meaning of one lower frequency word can be learned more easily through that of a high frequency known word because the two words have a certain overlap in meaning.

In the next section, a review will be provided of methods proposed to formalize and quantify the semantic similarity between words first in the area of natural language processing and second in psychology. The review will be brief and summarizing instead of being comprehensive due to the peripheral nature of most of the literature to the present study. It will devote more space to the semantic aspect of the previous research which is more relevant to the present study and downplay the computational aspects because of their restricted use in computer science and their highly technical complexity.

3.3.1 The review of relevant research on semantic similarity

The approaches taken to compute semantic similarity use a lexical resource – a dictionary, a thesaurus, WordNet (Felbaum, 1998) or other semantic networks as a knowledge base. All these approaches construe the lexical resource as a network or directed graph and measure semantic similarity based on the properties of paths in this graph (Budanitsky & Hirst, 2005).

In Morris and Hirst's (1991) thesaurus-based approach, they used Roget's International Thesaurus, 4th Edition (1977) as the major knowledge base for computing semantic similarity. The thesaurus is hierarchically structured. It is composed of 1042 sequentially numbered basic categories with each category being grouped into a number

of broad classes. Then the classes are divided into several levels of finer clustering: roman-numbered subclasses and capital-letter-numbered sub-subclasses. These in turn are divided into categories. There is therefore a hierarchical structure above the level of category and below it. The thesaurus also has an index which directs the reader to the words related to a given word.

Class 1 . . .
Class 4: Matter
I
.
.
.
III Organic Matter
A ...
B Vitality
407 Life
1. NOUNS life, living, vitality, being alive, having life, animation, animate existence; liveliaess, animal spirits, vivacity, spriteliness; long llfe, longevity; viability; lifetime 110.5; immortality 112.3; birth 167; existence 1; bio-, organ-; -biosis.
2 . . . .
.
408 Death...

Figure 3.1 The structure of Roget's Thesaurus adapted from Morris and Hirst (1991)

Morris and Hirst's (1991) method of assessing semantic distance, and perhaps all the methods using Roget-structured thesauri as the basis to obtain semantic distance, according to Budanitsdy and Hirst (2005), rely on the category structure, the index and the pointers within categories that cross-reference other categories. This is partially the reason why semantic distance cannot be expressed with a numerical value. Morris and Hirst (1991) identified five types of semantic relations between words which were categorized into "semantically close" or "semantically not close". When the base forms of a word pair meet any one of the following criteria, they are said to be semantically close: 1) They have a category in common in their index entries. 2) One word has a category in its index entry that contains a pointer to a category of the other word. 3) A word is either a label in the other word's index entry or is in a category of the other word.

4) Two words are in the same group, and hence are semantically related. 5) The two words have categories in their index entries that both point to a common category.

Kozima and Furugori (1993) used a dictionary-based approach. They constructed a semantic network out of the *Longman Dictionary of Contemporary English* which used 2851 words as the defining vocabulary. The researchers first created a node for every headword in the dictionary. Thus the defining vocabulary had 2851 nodes corresponding to its size. Then the nodes were connected to each other to form 295914 links. This part became the densest part in the network because the remaining nodes, representing words other than the defining vocabulary, have links only to the limited defining-vocabulary but not to each other. In the network, the similarity function α between words of the defining vocabulary was computed by means of spreading activation on this network (Spreading activation was defined as activating a node of the network for a certain period of time causing activity to spread over the network through the links). The similarity of words outside of the densest part of the network is measured by treating each word as a list of the words in its definition. The similarity function of *linguistics* and *stylistics* is, for example, α ({the, study, of, language, in, general, and, of, particular, languages, and, their, structure, and, grammar, and, history}, {the, study, of, style, in, written, or, spoken, language}).

WordNet (Felbaum, 1998) was developed as a program that allows users to browse an on-line dictionary on the basis of semantic similarities. It has become a lexical source for research into the measurements of semantic similarities in natural language processing. WordNet consists of four separate semantic nets, noun, verb, adjective and adverb. With synonymy as the basic semantic relation in WordNet, words of the four parts of speech are separately organized into networks of sets of synonyms (synsets). A synset can be used to express a lexical concept and thus represent a concept in WordNet. Since the first fully developed network in WordNet was the noun network, many pieces of research on the measurement of semantic similarity are based on it.

The most important semantic relation in organizing nouns into a network is the relation of subordination between lexicalized concepts (hyponymy). The nouns in WordNet are divided into several hierarchies which correspond to different semantic fields. At the top of the hierarchies are eleven unique beginners (e.g. event, entity (organism, object, body and food), psychological feature (cognition, feeling and motivation), etc) which are abstract concepts encompassing all the vocabulary inheriting features from the unique beginners. Thus a unique beginner corresponds roughly to a

primitive semantic component in a compositional theory of lexical semantics. The maximum number of nodes in a noun hierarchy is 16 and seldom goes more than 10 or 12 levels deep. The noun nodes are connected by nine relations in addition to the synonymy relation that is implicit in the network. The nine relations are 1) hyponymy (is-a); 2) hypernymy (has instance); meronymy (part-of) which includes 3) component-of, 4) member-of and 5) substance-of; and holonymy which includes 6) has part, 7) contains substance, 8) has member; 9) antonymy (complement of).

To compute semantic similarity in a taxonomy like WordNet, the word net may be treated as a tree graph and the semantic similarity between two lexical concepts is viewed as the distance or path length between the nodes corresponding to the two lexical concepts being compared. The path length which is determined by the levels of nodes between two concepts determines their degree of semantic similarity; the shorter the path, the more similar the words are. A problem with this approach is that it takes for granted that "links in the taxonomy represent uniform distances" (Resnik, 1999, p 96). However, a widely recognized fact is that a single taxonomic link covers varying semantic distances. Researchers such as Sussna (1997, as cited in Budanitsdy & Hirst, 2005), Wu and Palmer (1994) and Leacock and Chodorow (1998) have attempted to counter this problem by using different versions of a scaled metric which gives weights to semantic links.

The information-based approaches to the computation of semantic distance, as another attempt to solve the problems inherent in the semantic network based methods, incorporate information from a corpus rather than relying on the distance between the nodes corresponding to the items being compared. Resnik (1999) presented a measure based on the notion of shared information content – an idea that "one key to the similarity of two concepts is the extent to which they (two words) share information, indicated in an *is-a* taxonomy (a hyponymy taxonomy) by a highly specific concept that subsumes them both" (p.96). As is shown in the diagram below, the features shared by *nickels* and *dimes* are implicitly captured by categorizing *nickel* and *dime* as subordinates of *coin* in WordNet. In comparison, the most specific superclass that *nickel* and *credit card* share is *medium of exchange*. In figure 3.2, *is-a* relationships are shown with solid lines while the dotted lines indicate that some intervening nodes in the original NetWork taxonomy are not included here.

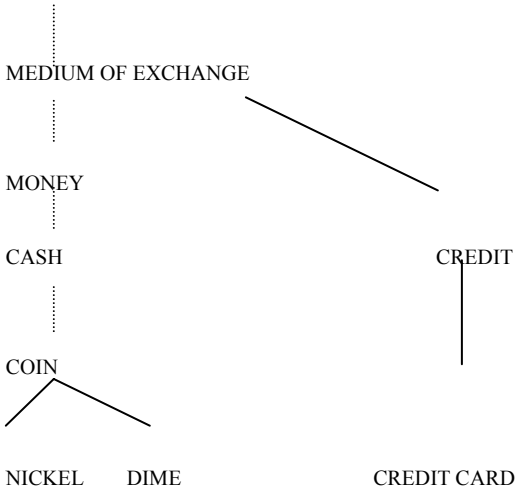


Figure 3.2 Fragment of the WordNet taxonomy adapted from Resnik (1999)

In Resnik's method, the probabilities are associated with concepts in the taxonomy and each occurrence of any noun in the Brown Corpus of American English was counted as an occurrence of each taxonomic class containing it. Thus the numerical evidence comes from the corpus statistics not the counting of the links. This avoids the problem of counting network edges in the determination of the degree of semantic similarity.

An important study of semantic similarity was conducted by Landauer and Dumais (1997) in the area of psychology. They proposed Latent Semantic Analysis (LSA) as a computational theory that aims to provide an explanation for humans' acquisition of large quantities of knowledge with the availability of relatively much more limited exposure to knowledge. The practical application of this theory is extracting the contextual meaning of words and determining their semantic similarity by applying a mathematical technique to a large text corpus. The basic assumption of this theory is that the degree of similarity of words and sets of words to each other is largely determined by the extent to which they tend to appear in similar contexts. Thus if statistical information about the co-occurrence of words can be extracted from a large enough body of text, it will reveal the degree of meaning similarity of these words. To realize it as a computational method, the text is first represented in a matrix with columns standing for a piece of text and rows standing for individual word types. Each cell then contains the information about the frequency of the word types that are used in a particular passage. Next the data in the matrix is transformed to weigh each cell frequency and finally

singular value decomposition (SVD), a statistical technique similar to factor analysis, is performed to decompose matrix entries into independent principal components. This produces an optimal vector of 300 dimensions to represent each word. Similarities are calculated as the cosine of the angle between each pair of vectors.

This fine-grained measure of meaning similarity was used by Rastle, Davis, Marslen-Wilson and Tyler (2000) to prepare material for priming tasks to probe into the representation of morphemes when they needed semantically similar but morphologically unrelated word pairs in their experiments. It was also adopted by Howard and Kahana (2002) to estimate the semantic relations among list items when they studied the effects of temporal and semantic proximity on output order in free recall of random word lists.

Although no mention has been seen of Landauer and Dumais's study by researchers in the field natural language processing, it is apparent that their notion of semantic similarity is consistent with that of distributional similarity adopted by the research in natural language processing (Dagan 2000; Mohammead and Hirst, 2005, etc.). As Budanitsky and Hirst (2005) point out, the difference between semantic similarity and distributional similarity lies in the fact while the former indicates the relationship of concepts (word meanings), the latter is a corpus-dependent co-occurrence of words.

3.3.2 Semantic similarity in the present study

A measure of semantic similarity in the present study is needed to judge to what extent the meaning of a low frequency word which is unknown to learners is shared by a high frequency word which is already learned. The degree of the overlap in meaning between the known word and the new word determines whether the meaning of the new word can be inferred easily from the knowledge of the form and meaning of the known word and in turn determines the accessibility of a new word. The meaning overlap is reflected in and expressed by a meaning constant shared by a pair of words. This meaning constant needs to be first singled out to link up the new word and the known word. Then the measure of semantic similarity between a pair of words is to measure the degree of the involvement of the known word's meaning in the meaning constant, or in other words, its involvement in the meaning of the new word. This aim has several implications in relation to the above literature. First, this notion of semantic similarity need not be distinguished from that of semantic relatedness or distributional similarity. The meaning constant might be an attribute or a feature of a word, or it might indicate

the context the two words tend to appear in as long as it can serve the purpose of connecting the new word through the known word. Second, it is not unreasonable to state that the underlying idea of this study is compatible with that of the semantic resource based approaches to the measure of semantic similarity in natural language processing. Those approaches judge two words similar if they share one or more attributes or features as represented in the hierarchies in a word network. Likewise, the meaning constant in this research can be seen as an attribute or feature shared by a known word and a new word. Third, with guiding and facilitating teaching and learning as its purpose rather than mimicking human judgement of semantic similarity, a scale for grading the meaning similarity between a known word and a new word will satisfy the purpose, rather than a complicated algorithm. The algorithms produced by the above reviewed research show a high degree of precision for the purposes of word sense disambiguation and information retrieval, but that precision required by natural language processing is not necessary for the present study.

3.3.3 The scale for measuring semantic transparency

For this study, it is necessary to develop a scale to measure the meaning transparency of low frequency words compared with the high frequency words. This is an ordinal scale which ranks the meaning transparency of words from the highest to the lowest. Numerical values 1-5 are assigned to the words to indicate their ranking in terms of meaning transparency.

The element considered crucial in determining whether a new word is transparent in meaning in relation to a known word is the role the known word plays in explaining the new word. The more directly and noticeably the known word is involved in the explanation of the new word, the higher meaning transparency the new word enjoys. The assumption underlying the ranking system is that the degree of ease in making use of the known word in learning the meaning of a new word is an indicator of the degree of meaning transparency and accessibility of a new word, and vice versa.

As was stated above, the meaning constant shared by both the known word and the new word serves as the link between their meanings. When the meaning constant is the known word itself, it means that the known word is most directly made use of to access the meaning of the new word. For example, *visit* can be directly used to explain the low frequency word *visa* "a note put on your passport that gives you permission to **visit** a

foreign country". When the meaning constant is not the known word itself, but rather a word which is part of the meaning of the known word, it means that not the known word but only part of it gets involved in connecting the new word. An example is the use of "see" (in *visit* means "go to see") to explain *supervise* "to see that the right thing is done". Since the known word *visit* is more salient in the explanation for *visa* than for *supervise* and since *visit* can be made use of directly and easily, the connection to *visa* is therefore more transparent than to *supervise*.

According to this criterion, the semantic transparency of the new words in relation to the known words is graded into 5 levels. When the meaning of the new word is the meaning of the known word and can be explained by the new word itself, the new word enjoys the highest semantic transparency level. The examples are *direction* in relation to *direct*, *youth* to *young*, and *kitty* to *cat*. Next to this grade is the one where the known word itself is the meaning constant and the new word can be explained by the known word plus other content words (see *visit/visa* above for an example). The third grade of semantic transparency applies when the known word itself cannot serve as the meaning constant of a pair and therefore the new word cannot be explained by the known word, but it can be explained by a word which approximates the meaning of the known word. A word is said to approximate the meaning of a known word when it is the only content word or one of the only two content words in the explanation of the known word. In the example of *visit/supervise* above, since the word "see" which represents the meaning constant of the pair is one of the two content words used to indicate the meaning of the known word *visit*, "go to see", it is viewed as an approximate meaning of the known word. The fourth level of semantic transparency means that the known word itself cannot serve as the meaning constant and cannot be used to explain the new word. The word which represents the meaning constant cannot be said to approximate the meaning of the known word either because it is only part of a long explanation for the known word. For example, *reverse* may mean "**turn** sth the other way around" where the meaning constant "turn" is one of several content words required to explain the known word *reverse*, when "turn" is used to indicate the meanings of the new words like *adverse* "**turning** against sb", *vertebra* "any part of the backbone which can **turn** into different directions" and *perverse* "thoroughly **turned** to wrong way", the known word itself becomes much less visible in the meaning of the new words. The least transparent grade (level 5) in terms of meaning is when the new word cannot be explained by the known word itself, or a word approximating its meaning, or a word which is part of the

meaning of the known word. Examples are *revolve, envelop, involve* by *develop; contempt, contemplate* by *temporary; inhabit, habitat* by *habit*, etc.

When the degrees of the involvement of the known word in explaining the new words are equal, another factor is taken into consideration in the design of the scale: the length of the explanation of the new words. If the explanations of the new words are long, they will impose a greater burden on learners in that it takes more effort to process and memorize them. Also in a longer explanation, the meaning constant of a pair of words, will become less salient to the learners. When more content words explaining the meaning are there distracting attention, it makes it more difficult for learners to connect the known word and the new word.

Thus according to this criterion, the second, third and fourth grades discussed above are further divided into three levels with the higher transparent levels having less content words for learners to remember when learning the new words. The word pair *account/recount* where *recount* means "to give detailed **account** of sth" is assigned a higher transparency level than *damage/epidemic* where epidemic is explained as "a widespread disease that **damages** many people's health" although both pairs involve the known word itself.

In the cases where figurative language use is observed in the attempt to connect the new word with the known word, their meaning transparency is rated as lower than the literal use of the linking words. Figuratively using the linking words refers to the situation where in the attempt to give hints to access the new word with the known word, the sentence patterns "to be like sth " or "as if" are used. Consider the examples, in the word pair *wall/valley*, *valley* can mean "a long area of lower land lying between two hills as if between two walls". In *sit/supersede*, *supersede* means "(of the new thing) to prevail over an old one as if to sit over it". Words requiring this type of explanation are rated as lower in terms of meaning transparency than the words that can be connected to the known words without the figurative use of language. However, the figurative language phenomenon is not considered so primary a factor as the involvement of the known word in the meaning of the new word to determine the meaning transparency of the new word. This is because using figurative language to indicate word meaning is not regarded as a sure indicator of meaning opacity for a new word and hence not as an indicator of the major difficulty involved in accessing a new word. For one thing, figurative expressions have various degrees of semantic transparency among themselves. In addition, people who come from different language and cultural backgrounds may

find their native language facilitates or hampers their understanding of the figurative expressions in English in various degrees. Table 3.3.1 describes the scale for measuring meaning transparency of a new word in relation to a known word. It also contains examples.

Table 3.1 The scale for measuring meaning transparency

1. The meaning of the known word is the meaning of the new word. The new word may be a different part of speech, or can be explained by the known word itself or the known word plus non-content words. e.g. long/length; young/youth.
2. The new word can be explained by the known word itself.
2a. A **frequently used meaning** of the known word is used in the hint. The hint contains 3 or less than 3 content words in addition to the known word. e.g. sense/sensual: of the pleasures of **senses** sense/sensitive: **sensing** changes or influences quickly 2b. **A frequently used meaning** of the known word is used in the hint. The hint contains more than 3 content words. e.g. sense/sentence: a grammatical unit used to express a **sense** defend/defendant: a person accused in a legal case who needs to **defend** himself against an accusation. 2c. **A frequently used meaning** of the known words is used in the hint. Its meaning is shown in the figurative use of language. e.g. wall/valley: a valley is a long area of lower land lying between two hills like between two **walls**. wall/interval: An interval is a period of time between two events like the space between two **walls**.
3. The new word can be hinted at by an explanatory word which approximates the definition of the known word, but not the known word itself.（A word is said to approximate the definition of the known word if it is the only content word or one of the only two content words in the definition of the known word.）
3a. T**he frequently used meaning** of the explanatory word is used in the hint for the new word. The hint contains 3 or less than 3 content words in addition to explanatory word. e.g. local: of this **place** locate: To locate sth is to find its exact **place**. apparent: sth that is apparent can be clearly **seen**. transparent: sth that is transparent can be **seen** through. 3b. T**he frequently used meaning** of the explanatory word is used in the hint for the new word. The hint contains more than 3 content words in addition to the explanatory word. e.g. local: of this **place**

allocate: to allocate things is to set them in different **places** for different people to use.

3c. T**he frequently used meaning** of the explanatory word is used in the hint for the new word. Its meaning is shown in the figurative use of language.

e.g.
depress: to **press** one down (make one low in spirits)
impress: to **press** sth deep into (has a strong influence on) your mind

spirit: the **breath** of life
inspire: to fill sb with a feeling as if to **breathe** it into them

4. The new word can be explained by a word which represents the meaning constant and which is part of the definition of the known word.

4a.The hint for the known word contains 3 or less than 3 content words in addition to the explanatory word. The hint for the new word contains 3 or less than 3 content words in addition to the explanatory word.

e.g. agent: one who **doe**s business for another company
agenda: things on the agenda are the things a government must **do**

compute: to decide by mathematical **thinking**
repute: sth **thought** to be good

4b. Either the hint for the known word or the hint for the new word contains 3 or less than 3 content words in addition to the explanatory word.

e.g. surprise: sth which **takes** your attention unexpectedly
apprentice: sb **taken** in as a learner learning a trade from a killed employer

detail: small items that sth is **cut** into
tailor: the person whose job is **cutting** material to make cloths

4c. Both the hint for the known word and the hint for the new word contain more than 3 content words. Or the meaning of the explanatory word is shown in the figurative use of language

e.g. combine: join or mix **two** or more things together to form a whole
binocular: glasses with **two** lenses making distant objects seem nearer

depend: **hang** from sb (remain connected with) them in order to get care or support
pending: leaving sth unfinished as if it is **hung** up.

5. The new word cannot be explained within one sentence to show the connection between its meaning and the meaning of the known word.
e.g. tend/tender
tend/taunt
offer/ferret
extra/exterior

Chapter 4 Methodology

The research centers around the idea that the knowledge of the first 2000 words language learners already possess may give them easier access to words of other frequency levels by means of analyzing the form and meaning similarity between the high frequency known words and the low frequency new words. It addresses the issue at two stages: to quantify the information concerning the number of accessible words, and to analyze the pedagogical usefulness of the accessible words. It specifically seeks answers to the following questions:

1. How many word families of lower frequency levels can the first 2000 word families connect to through analyzing the form and meaning similarity between the root parts of first 2000 words and the lower frequency words?
2. What are the frequency levels of the accessible words?
3. What are the form transparency levels of the accessible words in relation to the first 2000 words?
4. What are the meaning transparency levels of the accessible words in relation to the first 2000 words?
5. What are the overall levels of accessibility of the accessible words?

Using the meaning transparency scale, the spoken similarity measure and the written similarity measure described in the previous chapter, a study of the first ten thousand words of English was carried out. The study involved identifying the meaning and formal constants in word groups and connecting the meaning of the lower frequency words with the meaning of the known high frequency words by providing hints which contain the meaning constants. The hints and the form constants were then subjected to the rating of their meaning and formal transparency by using the aforementioned scale and the measures so that the word pairs that are closely related in meaning and resemble each other in form could be extracted. Finally the ease of learning the chosen words was assessed. This chapter describes the procedures applied to fulfill these research goals.

Throughout the thesis, the word “access” or “accessibility” is used with reference to the potential facilitation of word retention afforded by the constants. The word “access” or “accessibility” is not intended to mean that those constants will enable learners to autonomously figure out the meanings of words, for example during reading.

4.1 The source of the data

The thousand word lists based on the BNC (Nation, 2000) were used in this study.

A Comprehensive Etymological Dictionary of the English Language (1966) (CEDEL) was used as the first source to show the possible formal and meaning connections among words. This dictionary was selected mainly because it offers more thorough and substantial cross-references of cognates than other etymological dictionaries. This dictionary, as the editor stated, has a cross-referencing system that "extends the association of cognates within a group of words and suggests some of the more remote connections of Proto-Germanic and Indo-European" (p.xxi). This feature makes available the data that are needed for the purpose of identifying the form and meaning constants a group of words share. For example, when the high frequency word *describe* is looked up, the dictionary provides information about the meaning of the word root "to write down" as well as a list of cognates: *inscribe, inscription, scribe, manuscript, scripture, conscript, script, scribble, transcribe, prescribe, subscribe, prescription, postscript, proscribe, proscription, nondescript, circumscribe, circumscription, ascribe, ascription, interscription, interscription, rescript, conscribe, adscript, etc.* This list not only clearly shows the formal constants of this group of words, *scribe* and *script*, but also makes it possible to determine the meaning thread running through a set of words by providing a good source of related words. The etymological meaning, however, may not be able to be used to connect the present day meaning of words all the time, but it may be of help in recognizing the meaning constants. Other historical or etymological dictionaries like the OED and the American Heritage Dictionary of the English Language, lacking a thorough cross-reference system, do not supply a list of cognates. For the word *describe,* the OED gives only a description of the history of sense development:

[ad. L. *dēscrīb-ĕre* to copy off, transcribe, write down, write off, sketch off in writing or painting, mark off, etc., f. de- I. 2 + *scrībĕre* to write. Preceded in ME. use by *descrive* (through OF.), of which *describe* may be considered as an assimilation to the orig. L. form. The spelling *dis-* arose from confusion with words having the prefix *des-*, *dis-*: see des-.]

Unless all the individual words are looked up separately, it is not possible to know the connection among these words. Thus, those dictionaries are not suitable to be used as the major source of data for the present study.

However, a thorough cross-referencing system has its disadvantages. As stated above, the goal of the study is to identify word pairs whose forms and meaning are both closely related so that both the meaning connection and the form connection between the words are obvious to teachers and learners. In the CEDEL a word is usually traced back to its ultimate origin and even words that are derived from the Indo-European base are presented in a group as related to each other. The long list of the cognates it presents contain quite a number of words that are not useful and meaningful for this research because these words are either too remotely connected in meaning or share too little form similarity. The second problem is that in some cases, the reader is referred from one word to another which in turn refers to still another one. This line of connections among words in the course of meaning development will go a long way without a break. Here is a typical example:

> Because, adv. – ME. *bi cause*, fr.*bi*, 'by', and *cause* 'cause'. See **by** and **cause**.
>
> Cause, n. – F., fr. L. *causea*,'cause, reason, purpose', which is of uncertain origin. It stands perh. for **cause-tā* and orig. meant 'a striking', hence is rel. to *cūdere*, 'to strike, beat, knock', fr. I.-E. base *qāu-, 'to strike, beat'. See **hew** and cp. Words there referred to. Cp. Also **accusative, accuse, causerie, coze, excuse, kickshaw, recusant**. For sense development cp. L. dēcīdere, 'to cut off; to decide' (see decide)
>
> Hew, tr. And intr. v. – ME. hewen, fr. OE. Heawan,'to cut, strike, hew', … fr. I. E. base …'to strike, beat'. Cp. **Hag, haggle, hoe**. Cp. Also **causal, caudex, cause, codex, concuss, coward, incus.**
>
> Decide - …
>
> By - …

This characteristic of the data source not only means that a proportion of the data does not meet the requirement of the present research but also will cause difficulties when grouping the data for data analysis.

In view of the problems, two steps were taken to obtain the needed data for the present study: a rough gathering of data and the filtering of the data by applying the criteria of frequency, meaning and form.

4.2 The rough gathering of data

This procedure is carried out to achieve two purposes: to break the long chains of references and to initially shorten the long lists of cognates. This step should enable the words presented in the dictionary to be entered into the computer as practically

manageable groups for further processing. To accomplish this purpose, all the words in the two thousand word list are first looked up individually and all the cognates provided under each of these words are collected and placed under the high frequency word if they meet the requirement that their roots share more than one letter and/or more than one phoneme with the roots of the known high frequency word. This criterion is established for two reasons: First, the great majority of the English roots have one syllable which consists of either an onset, nucleus and coda, or a nucleus plus an onset or a coda. The criterion of having more than one letter or phoneme in common is the bottom line to make any root recognizable and at the same time is safe enough not to exclude any useful data. Second, all of the words provided within a group as related in the dictionary share the same etymology and therefore nearly all of them have at least one letter or one phoneme in common with each other in their root parts. The criterion of having at least two shared letters or phonemes in roots serves well the purpose of breaking the chain of references and dividing the etymologically connected words into practically operationalizable groups. Take the example of *because* again. After this criterion is used, words like *hew, hag, haggle, hoe, kickshaw, codex, coze, coward, decide, by* are excluded. Thus the set of words headed by the known word *because* now includes *accusative, accuse, causerie, excuse, recusant*, *cause, causal, concuss, incus*. This principle for data gathering is effective in reducing the large number of words presented in the dictionary, because the needed cognates presented for a word can be easily identified and selected most of the time. This makes the data gathering procedure more efficient and purposeful. This advantage can be seen in the following examples:

1） *be – bhava, bhumi-devi, bhut, big, bound, bower, build, busk, neighbour, fiat, future, phyle, phsic, phusio-, -phyte dubious, esteddfod, prabhu, prove, superb, symphytum, tribe, tribune, tribute*

2） *eat - edible, fret, obese, dent,* ***etch****, nestitherapy, esurient, esculent, edestin, comestible, comedo*

However, it cannot be denied that the criterion of having two identical letters and/or phonemes in the root has its drawback as it may let in quite a number of words that obviously have little in common with the known words in terms of form and meaning. This can be seen in the example of the *speak* group. According to the criterion, the words that should be selected are: *speak - speech, spokesman, sparse, sprinkle, disperse, spray, spark, asparagus, sprig, sprag, sparsile, sparger, intersperse, asperse,*

asperges, Sperrgula. Obviously, only *speech* and *spokesman* are related to *speech* in meaning. But it seems that this disadvantage needs to be tolerated at this stage because otherwise there is the risk of dismissing the words *gleam, glitter, glisten, glaze*, *glare, glow, glass* etc as being not related and losing these data.

An exception to the principle for data gathering was made, that is, when a word shares only one letter or phoneme in its root with the known word but it shares more than one letter or phoneme in its prefix or suffix with that of the known word, this word was included in the data as well. *Agent* whose root part is *ag* shares only one letter *g* with *intransigent* and *exigent* where the root is *ig*, but they share the same suffix *–ent* which gives the words more form similarity. A similar case is found in the words *assess, assiduous, assize.* The decision that these types of words are included in the data is in line with the aim of producing sets of formally and semantically similar words which lend themselves to easier learning, even though the similarity is strictly speaking not morphologically connected.

Homonyms as identified by the dictionary were included in the data and marked. Their cognates listed in the dictionary were gathered as well. For example, *pound* meaning "a unit of weight" and *pound* meaning "enclosure" are followed respectively by words with the same root, *ponder, pendant, preponderate, pood, etc* and *impound, poind, pond, etc.* All these words were included in the data.

The dictionary does not specify the principles it follows in dealing with the derivational forms of words. A close examination shows that it seems to regard the derivational forms of a word as a separate word if the adding of an affix causes a change to the word form, but as derivational forms of a word if the adding of affixes does not cause any change. Thus in listing the words which have *-pet-* as their root, for example, COMPETE, COMPETITION and COMPETITOR are presented as separate words together with other words like APPETENCE, PERPETUAL, COMPETENT in the entry of PETITION since in adding the suffixes *–tition* or *–itor*, the letter *e* is deleted. Therefore the treatment of some other words like CONFESS is different. Its deviational forms CONFESSION, CONFESSOR, CONFESSED*,* etc are not viewed as individual single words, but the deviational forms of *confess* are no longer listed in the entry for words with the root *–fess-*. This principle is not consistent with the one behind the designing of the BNC lists. Although using the word family as a unit of counting words is the idea behind making the BNC word lists, the criteria applied to the lists are the ones described in Bauer and Nation's (1993) scheme and the word families are set at

Level 6 according to the scheme. This level includes the inflections and the high-frequency, regular productive and transparent derived affixes. As the frequency levels of the lists increase, the criteria for inclusion in the word family are relaxed slightly. Thus using CEDEL as the source of data means that while some words which belong to the same word family in the BNC lists are included in the data, other words which are seen as different word families may be missed out. At the stage of roughly gathering data, this problem is ignored and is left to be dealt with in data checking.

Proper nouns are included in the data as the first fourteen BNC lists contain names of countries, the people and languages of the countries and the names of some well-known cities. Although the other types of proper nouns such as people's names, the names of cities and the names of mountain ranges are included separately in the separate proper nouns list which is beyond the focus of this research, all the proper nouns listed in the dictionary were first selected in the procedure of the rough gathering of data. This is because identifying the different types of proper nouns individually is even more time consuming than including them all at first and then leaving the work of selecting to the computer programme at the next stage of data processing.

Compound words which are included in the dictionary were excluded. Compound words were defined as words composed of two or more potentially free forms, both phonologically and orthographically. This means that words like BREAKFAST and GRANDAD are not compound words whereas words like CARTE BLANCHE, BILLET-DEUX, and SAFEGUARD are compounds and therefore were excluded from the data. For words like FOREHEAD and OUTRAGE, it seemed that their status of being compound words could not be determined using this definition alone, because the parts FORE and OUT could be both prefixes and phonologically and orthographically free forms. To solve this problem, Marchand's (1960) lists of prefixes and suffixes were consulted to help make the decision. For instance, according to Marchand, fore- meaning "situated in front" is a prefix as in Old English FOREHEAD, FORELOCK, FORETOOTH, FORESHIP. Thus, FOREHEAD is considered as a complex word rather than a compound. *Out-* is regarded by Marchand as a locative particle as the first element in compounds formed together with verbs, nouns, adjectives or participles. OUTRAGE was therefore dropped off as a compound word. There are words like FOREMOST which are not even dealt with by Marchand. In this case, FOREMOST was deleted from the data for this research as well.

Affixes which are etymologically connected with certain words are excluded, but combining forms are included in the data. Marchand's (1960) lists of affixes were used as the criterion to decide which forms are affixes not combining forms. For example, *-less, -ish, in-, -ent*, etc are affixes and were deleted from the data while *-cide, syn-, -graph, -grade, -gen*, etc are combining forms and therefore remained in the data.

A word may be etymologically associated with several groups of words and therefore appear more than once in the data. These words were not checked and picked out in the process of data gathering considering the great work load involved. When the data were analyzed using Excel to see how many words of each frequency level had been gathered, the same words connected more than once were counted only once as one word.

4.3 Filtering the data

After the step of gathering the data roughly from the dictionary, the data was carefully analyzed in order to obtain the sets of words which are closely related in meaning and obviously similar in form. Three criteria were applied to the data filtering procedure: frequency (whether the new word was in the most frequent 10,000 word families), form similarity and meaning connection.

4.3.1 Filtering the data by applying the frequency criterion

Frequency was applied first as a criterion by using the Range programme. In addition to the other functions it can perform, such as comparing different texts, finding out the coverage of a text by certain word lists, and discovering the shared and unique vocabulary of pieces of writing, etc, the Range programme can rate words according to their frequency levels. It was used in this research to compare the data roughly gathered from the etymological dictionary against the first ten thousand word families in the BNC to see what words in the data are in the lists and therefore should continue to remain in the data for further analyses, and what words in the data are not in the lists and should be deleted.

The highest frequency level of the words was set at the tenth thousand. Words that are not within the range of the first 10 thousand words were excluded. The frequency level was set a bit higher than is required for the unsimplified unassisted reading of English texts mainly out of two considerations. First, some words may demonstrate high

form and meaning transparency when compared with the known words and thus lend themselves to very easy learning. If a low frequency word can be learned with little effort, it is a worthwhile and rewarding learning experience. Second, these extra words may be needed by advanced learners who study English for various purposes and may give learners in general an advantage in language use.

The frequency criterion was applied first simply because it is a simple and efficient operation. As a result of using the Range program to find the frequency levels of the words, roughly 60% of the words were removed from the data as they were shown to be beyond the first ten thousand words of English. After this step, about 4,000 words remained in the data (see the Results Chapter for details). This procedure made the application of the meaning and form criteria feasible.

4.3.2 Filtering the data by applying the meaning criterion

Next the meaning criterion was applied by measuring the semantic closeness of the new words to the known words on the meaning transparency scale. The meaning criterion was used to filter through the data before the procedure of applying the form criterion due to the difficulties involved in determining the point at which the data should be cut off on the scales of measuring form similarity. The difficulty is caused by the fact that form similarity is measured by two dimensions, phonological similarity and orthographic similarity. There are very few words which can be rated as equally high or low on the two dimensions of the form transparency scale. There are some words such as SIGN/SIGNIFY/SIGNIFICANCE, JUDGE/JUDICIOUS, MOTHER/MATERNITY which have almost the lowest phonological similarity but much higher orthographic similarity. If only the phonological similarity scale is applied, this type of data will be lost for the research. The orthographic similarity scale could be used instead of the phonological scale to filter the data. However, since all the words are etymologically related, all the words share a certain degree of orthographic similarity, especially after the step of the rough gathering of the data. There are words such as TEST/TEXT, SUIT/PURSUIT, STRIKE/STREAK, etc. which apparently do not have a meaning connection although they enjoy relatively high form similarity. Thus if the cut-point is set high on the orthographic scale, this type of data can be excluded. However this meanwhile runs the risk of excluding some useful data. If the cut-off point is set low, the application of the form criterion becomes meaningless because only a small number

of words will be excluded and a large number of words will still be left to be filtered by the meaning criterion.

The sets of words were examined and the meaning constants were identified. The hints for the higher frequency words were given in the way that shows the meaning constants demonstrated by all the words in a group. Then the hints were rated on the scale for measuring meaning transparency. Words that were rated as level 5 on the scale were considered as inaccessible and therefore discarded from the data. The following is a detailed description of this procedure.

4.3.2.1 Identifying meaning constants

In the attempt to show the semantic connection between the new words and the known word, the meaning constants shared by both the known words and the new words need to be identified first. Several dictionaries were consulted in extracting a common meaning element from a set of words. They were the *Oxford English Dictionary*, *A Comprehensive Etymological Dictionary of the English Language*, *the Oxford Advanced Learner's Dictionary of Current English*, and *the Longman Dictionary of Contemporary English*.

The meaning constants may be the etymological meanings of the root of the sets of words. For instance, when the set of words EXIST, ASSIST, RESIST, PERSIST and INSIST are checked in the OED, the etymological meaning "stand" is shown to be their meaning constant and it can be used to define the new words and the known words.

Example

Etymological meaning:

Exist - f. *ex-* out + *sistĕre* reduplicated form of *stă-* to stand

Assist - f. *ad-*, *as-* to + *sistĕre* to take one's stand

Resist - *re-* RE- + *sistĕre*, redupl. form of *stāre* to stand

Persist - classical Latin *per-* PER- *prefix* + *sistere* to cause to stand

Insist - *in-* (IN-[2]) + *sistĕre* to stand

Consist - f. *con-* altogether + *sistĕre* to cause to stand, place, stand, stand firm, stand still, stop, etc

Hints with the meaning constant “stand”:

*ex***ist**	to **stand** *out* showing it exists
as**sist**	to **stand** next to sb in order to help
*re***sist**	to **stand** pushing *back* against sb or sth
in**sist**	to **stand** firm in what you want to do
*con***sist**	to **stand** *together* to make up the whole
*per***sist**	to **stand** firmly *through* time

However, the meaning constants identified from the dictionary sources are not necessarily the etymological meaning of a set of words. Since this research aims to show the form and meaning similarity between the known words and new words in order to make learning easier, whether the meaning constants which serve to link up the meaning of the known words and the new words are etymologically true is not the primary concern. For quite a proportion of the words, although they are etymologically related to each other, the etymological meaning of their roots is no longer present in their current meaning or can no longer be used to show that they are currently semantically related by that etymological meaning. In the example of the SOLVE, DISSOLVE, RESOLVE group, the etymological meaning of -*solv*- “loosen” can no longer be seen. In this case, “solution” is used as the meaning constant to link the group of words.

Another phenomenon is that despite the fact that a group of words still demonstrates the etymological meaning of their roots, it is not good enough to be used to express the meanings of the words. For example, AWARE, AWARD, WARD, WARN, REWARD, BEWARE, WARDEN, WARE may share the meaning constant of “watch, observe” as is shown in the etymological dictionaries. The problem with this meaning constant is that it is difficult to use it to link these words. Therefore after examining the present definitions of these words in various dictionaries, the word “aware” was used as the meaning constant to connect them all. Thus the following definitions were produced:

solve	to find a **solution**
dis**solve**	mix a solid with a liquid to form a **solution**
re**solve**	to settle or find a **solution** to a problem

a**war**e	
a**war**d	the prize you give sb to show you are **aware** of a good act
warn	to make sb **aware** of danger
ward	to try to be **aware** of danger or illness and protect sb against it
re**war**d	sth you give sb to show you are **aware** of a good act
be**war**e	be **aware** of the danger and guard against it
warden	the person who has to be **aware** of danger in order to protect sb or sth
wary	**aware** of possible danger
ware	**aware**

4.3.2.2 Indicating the hints

4.3.2.2.1 Basic principle

The basic principle followed when indicating the link for a new word is that it should be able to help learners connect the new word with the known word easily. Following this principle, a caution is exercised, that is, the hint that indicates the semantic link between the known word and the new word should not be a full dictionary definition which shows as many semantic elements a word contains as possible and tries to present a precise description of an object or concept in a limited space. The hint for the purpose of this research is intended to help learners remember the form and meaning of a new word through linking it to a high frequency word they have learned. In other words, it should be a hint that serves as a bridge leading learners to the dictionary definition of the new word. To fulfill this purpose, the hint for the new word is made short and memorable. Effort is also made to include as consistently as possible the meaning constant which may be a word representing the meaning of the root or may be the known word itself. Wherever possible, the meaning of a prefix or suffix in the new word is included in the hint.

In the attempt to indicate the meaning of the unknown word by using the meaning constant, some hints may sound a bit awkward. While unnatural explanatory language is avoided wherever possible, we do not think this feature of the hints will invalidate the current study. After all, the hints do not serve as the main language input for learners.

The facilitative effect of the hints in vocabulary learning and retention should outweigh the disadvantages brought about by the language quality of the hints.

In the following example, PRIZE is at the second 1000 word level, and the known word PRICE is in the first 1000 word level.

Example 1

Price - the amount of money you have to pay for something / Prize - something that is given to someone who is successful in a competition, race, game of chance etc (*Longman Dictionary of Contemporary English*)

Price – sum of money for which sth is (to be) sold or bought; that which must be done, given or experienced or keep sth / Prize - sth (to be) awarded to one who succeeds in a competition, lottery, etc. (*Oxford Advanced Learners Dictionary*)

Price: value / Prize – a valuable thing you win (hint)

The example of PRIZE shows that the meaning constant that connects the known word PRICE and the new word PRIZE is "value". "Value" is used as the hint for PRICE because it will make sense to learners who know the word PRICE and because it is short and easy to remember. The hint for the new word PRIZE, "a valuable thing you win", contains the meaning constant, "value" and a second word to remind learners of the idea that a PRIZE is a reward for someone who is successful in a competition, race, lottery or game.

In example 2, the explanation for the known word GLASS is "Glass has a shining quality" which contains the meaning constant "shining". This is used to link a set of words: GLIMMER, GLITTER, GLEE, GLARE and GLEAM. The meaning given next to each word is not a definition, but merely a hint that brings out one of the qualities of GLASS.

Example 2

glass	glass has a **shining** quality
glimmer	**shine** faintly with a wavering light

glee	great joy **shining** on the face
glitter	to **shine** brightly with flashes of light
gleam	to **shine** brightly with reflected light
glare	**shine** in a dazzling way
glow	to **shine** softly
glisten	to **shine** with sparking light

Example 3

*con***tract**	an agreement that **draws** people *together*
*ex***tract**	to **draw** sth *out*
*dis***tract**	to **draw** attention *away*
*ab*s**tract**	to **draw** *from* what is real or concrete

Example 3 illustrates another principle in giving the new words hints, namely, not only the meaning constant is consistently included in the hints, but the prefixes are also explained clearly (in italics) where possible in order to help learners obtain a form-meaning connection for the whole word.

The hints for unknown verbs are to-infinitives (e.g. punctuate - to put points like commas or stops into a piece of writing). The hints for unknown nouns are noun phrases or gerund phrases (e.g. traction - power to draw sth along; contraction - drawing together a muscle strongly). The hints for unknown adjectives are adjective phrases, participle phrases or preposition phrases (e.g. turbulent - disorderly, troubled and violent; punctual - coming or doing sth at a precise point in time, tripartite - of three parts).

In the following description of the methodology, the term “linking words” will be used to refer to the high frequency known words through which the lower frequency unknown words are accessed while the term “explanatory words” will be used to refer to the words used to express the meaning constants which are included in the hints to demonstrate the meaning relations between the known words and the new words. As is shown in the following section, the explanatory words are sometimes the linking words, but sometimes they are words expressing part of the meaning of the linking words.

The sections below all deal with the methods of indicating the hints for the unknown words. Although these semantic links seem complex, they are all aimed at making the known word - unknown word connection as transparent as possible so that the learning is as easy as it could possibly be. The complexity of the rules lies in the analyzing of the data not in its use.

4.3.2.2.2 Two types of explanatory words

The identified meaning constants are words used to explain the known words and the new words in order to link them up. These explanatory words are of two types: the known word itself and a word which represents the meaning or part of the meaning of the known word. Some words can only be accessed by the known word itself while others can only be accessed by a explanatory word other than the known word (see the example of POINT below). When the explanatory word is not the known word itself, it may be a word that approximates the meaning of the known word or one that accounts for only part of its meaning, especially the meaning of its root (See the previous Chapter). The group of words headed by POINT, PUNCTUATE and PUNCTUAL is explained with "point" itself while the others are explained by "sharp" which approximates the meaning of POINT because the hint for POINT contains only the explanatory word "sharp" and a second content word "tip".

Example 1

poi**n**t	
pu**n**ctuate	to put **points** like comma or stops into a piece of writing
pu**n**ctual	coming or doing sth at a precise **point** in time
poi**n**t	*a **sharp** tip of sth*
poig**n**ant	painfully **sharp** to mental or emotional feelings
pu**n**	humorous **sharp** remark
pu**n**cture	the small hole made by sth **sharp**
pu**n**ch	a **sharp** tool for making holes

In cases where the meaning of the new words can be hinted by both the known word itself and another explanatory word, a flexible approach was adopted as to the choice of the explanatory word. Two different solutions were adopted for the problem. The first solution can be illustrated by OBJECTIVE (the underlined hints in example 2

below). It might have been separated out and connected directly with OBJECT which is a second thousand word by saying "objective means object". However, in that case, its relation with the other words that have the form constant –ject- and with the meaning constant "throw" would be lost. Moreover, the relationship between OBJECTIVE and OBJECT seems the one between the suffix –ive with OBJECT, which cannot bring out the relationship between the roots of the two words. In dealing with OBJECTIVE then, we related it with all the other words containing –ject- by using both explanatory words "object" and "throw". The meaning transparency level for this type of words was rated according to the more transparent explanation. The formal similarity score for OBJECTIVE was calculated in comparison with OBJECT not REJECT. The justification for this treatment is that OBJECT as a familiar word for the learner can serve as a link to reach the new word OBJECTIVE. In addition, the meaning and form of the new word are further elaborated by providing the information about its meaning and form connection with some other words headed by the second familiar word REJECT. The double connection offered should be able to make the learning of the new word easier.

Example 2

re**ject**	to **throw** away as inadequate
in**ject**	to **throw** (force) a liquid into the body with a syringe
jet	a narrow stream of liquid or gas **thrown**(forced) quickly out of a small hole
e**ja**culate	to **throw** (speak) out a remark suddenly
inter**ject**	**throw** remarks between statements by another person
de**ject**ed	to be **thrown** down in feelings
pro**ject**or	a device for showing pictures by **throwing** light onto a screen
ob**ject**ive	an **object** / what you **throw y**ourself against **thrown** against (based on) solid facts
sub**ject**ive	**thrown** under the control of your feelings

The second solution is for sets of words like the CONTRACT groups. No connection was given to show the relationship between CONTRACT/

CONTRACTUAL/SUBCONTRACT and CONTRACT/ATTRACT/DISTRACT/ EXTRACT/ABSTRACT/ SUBTRACT, etc. by using the explanatory word “draw” in the hints for the former group. This is because both sets of words are headed by CONTRACT and therefore their semantic relationship is self-evident. In separating out the former group, the form and meaning closeness among the words can be more clearly shown for each of the two groups.

Example 3

contract	
contractual	agreed in a **contract**
sub**contract**	(a company) to sign a **contract** with other companies to let them do some of its work

con**tract**	an agreement that **draws** two groups together
at**tract**	to **draw** attention
ex**tract**	to **draw** sth out
dis**tract**	to **draw** attention away
abs**tract**	**drawn** from what is real or concrete
sub**tract**	to **draw away one quantity**
de**tract**	to **draw away value from**
re**tract**	to **draw** back
con**tract**ion	**drawing** together muscles strongly
pro**tract**ed	continuing for a long time as if **drawn** a long way
traction	power to **draw** sth along
tractor	a strong vehicle for **drawing** farm machinery
in**tract**able	unable to be **drawn** to a different opinion

4.3.2.2.3 The choice of linking words

The high frequency known words which are used to access the meaning of the lower-frequency unknown words are linking words. They may be a first thousand word or a second thousand word as they are assumed to be known to the learners and serve as the starting points to connect other unknown words. The principle of choosing a linking

word from the first two thousand word lists is that we try to make it demonstrate the meaning and form link as clearly as possible. When a first thousand word can meet this criterion, it is given priority over a second thousand word because using a first thousand word gives a chance to learn new words to the learners whose vocabulary size has not progressed to the second thousand words. If a second thousand word however can better show the form and meaning connection between the known words and the unknown words, the second thousand word is the choice. In choosing between COMMITTEE (a group of people who are **sent** together to conduct some business) and PERMIT (an official document that **sends** a person through the border), COMMITTEE, the first thousand word was preferred over PERMIT which is a second thousand word, because when "sent" was used as the meaning constant, both the linking words COMMITTEE and PERMIT require five other content words in addition to "sent" to explain their meanings and therefore both give equal prominence to the meaning constant. However, when the choice was made between the first thousand word CONTRACT (an agreement that draws two groups together) and the second thousand word ATTRACT (to draw attention to sth), ATTRACT was used as the linking word to access other lower frequency words such as EXTRACT, DISTRACT, ABSTRACT, SUBTRACT, etc. This is because the meaning constant "draw" is more prominent in "to draw attention to sth" in comparison with the longer explanation for CONTRACT. Another example is the choice made between the first thousand word BEAT and the second one BATTLE. Since the remaining words of the group are COMBAT, BATTALION and BATTLEMENT which all share the form constant *-bat(tl)-*, BATTLE was a more appropriate word to access them than BEAT which is a variation of *-bat-* although it enjoys higher frequency than BATTLE.

4.3.2.2.4 Accessing several senses of new words

It is quite possible that more than one meaning of a word can be connected through a known word if a polysemic point of view of lexical semantics is taken. However, we did not systematically exhaust all the possible meanings of a new word that can be accessed through a known word. A simple argument for this treatment of data is that a systematic comprehensive way is impossible and not feasible in view of the fact that no dictionaries divide the semantic content of a word into the same number of the same senses. Ruhl (1989) believes that word senses and definitions in dictionaries are produced on the basis of the intuitions of their lexicographers. In fact, linguistics, which

arose centuries after lexicography, has been influenced by lexicography which has never been a strictly scientific field. Ruhl's belief can be supported if the definitions for the word GRADUATE (verb) are compared from three important learner's dictionaries, the *Oxford Advanced Learner's Dictionary*, the *Longman Dictionary of Contemporary English* and the *Collins Cobuild Advanced Dictionary of American English*. In OALD, four definitions can be found for this word: Mark with degrees for measuring; Arrange according to grade; Take an academic degree; Give a degree or diploma to. In LDOCE, four definitions for two senses covered by OALD are provided: to obtain a degree, especially a first degree, from a college or university; to complete your education at high school; to start doing something that is bigger, better, or more important; to give a degree or diploma to someone who has completed a course. In CCADAE, two definitions are offered: When a student graduates, they complete their studies successfully and leave their school or university; if you graduate from one thing to another, you go from a less important job or position to a more important one.

By citing Ruhl, however, we are not stating that we took a strong monosemic stance treating words as having only one meaning when we tried to show the meaning connection between known words and new words. There is no doubt about the existence of multiple senses of words although we do believe that many senses presented in dictionaries are contextual variations of one meaning of the words rather than discrete meanings of words. Thus, when coming across words with more than one "meaning" as presented in the dictionaries that were consulted where these senses could obviously be accessed through the linking word, we followed the practice that the more frequently used accessible meaning should be given. The second hint for the word should be less specific and more able to summarize the semantic content of the word revealing the core meaning (see the following examples). Alternatively, we combined two "meanings" into one as in the case of INTRODUCTION/CONDUCT. Instead of presenting two hints for CONDUCT (to lead musicians or singers; to lead people around a place), one hint was used, namely, "to lead a group of people".

grade	**degree**
graduate	(a person who) take(s) a university **degree** to measure sth with **degrees**

circle	
	a group of people giving a performance in a **circle**
circus	an area in shape of a **circle**

4.3.2.2.5 Form and meaning frequencies of explanatory words

The words used to show the meaning constant of a set of words, namely, the explanatory words, should be words within the first two thousand words of English. Since this research looks at how many word families can be accessed by the first two thousand words through examining the form and meaning similarity between them and the low frequency words, the explanatory words should also be kept within this frequency range.

For the same reason, the meanings used as the basis to link up the unknown words should be frequently used meanings of the explanatory words. The meaning frequencies of known words were checked using Monopro on the Wellington Spoken Corpus and the Wellington Written Corpus to ensure that the meaning of the explanatory word used to define a new word was a common meaning of the word. One hundred sentences with the target word were first randomly selected from the two corpora. The meaning or sense of a word was regarded frequent enough to connect the unknown words if there are ten sentences or more using the meaning of the sense within the one hundred selected sentences. Two learners' dictionaries, the *Oxford Advanced Learner's Dictionary* and the *Longman Dictionary of Contemporary English* were consulted in determining the division of the meanings of explanatory words in the selected sentences. Consider the following examples:

Example 1

term	the **end** of a period
ex**term**inate	to **end** the existence of sth
term	
terminology	**terms** used in a subject of study or profession

Example 2

bid **order**

for**bid**

In example 1, two meanings of the word TERM are used to connect the new words. One is “the end of a period”; the other TERM meaning “words”. Both meanings are frequently used meanings of TERM. Another example is the word PROJECT in the group of words headed by the known word REJECT above. PROJECT was not used as a linking word or explanatory word to access PROJECTOR with the hint “a projector is a device to project light onto a screen” because the verb PROJECT is not a frequently used meaning.

When BID with the meaning of “order” in example 2 was checked using Monopro, only 38 sentences were selected from the two corpora. Of the 38 selected sentences none of them use the meaning “order”. It was then decided that this meaning should not be used to assess new words.

4.3.2.2.6 Meaning frequencies of new words

The meaning frequencies of the definitions of the new words were controlled as well. When a meaning could not be found in the *Oxford Advanced Learner’s Dictionary*, it was not given as a meaning that can be accessed by the known word. When a meaning is marked as old-fashioned or archaic, it was not included in the data. In the examples below, BUTT meaning “a big round container for storing alcohol”, and GOSSIP meaning “god mother or god father” were excluded from the data.

bo**tt**le a **container**

but**t** a big round **container** for storing alcohol

god

gossip **god** mother or **god** father

4.3.2.2.7 Frequencies of the words used in a hint

Words used to describe both the known and the new words should be limited to as high a frequency as possible. Particular attention is given to ensure that words that are used in a hint are more frequently used words than the new word being described. An

example to illustrate this principle for indicating the hints is the word pair PRICE hinted as “value” and PRIZE. When giving hints to connect the meaning of the two words, PRIZE meaning “something of value awarded to you” was avoided in favor of “a valuable thing you win” because “award” is a word at a lower frequency level (a third thousand word) than PRIZE itself (a second thousand word). A learner who tries to learn PRIZE is very likely to have little or no knowledge of the third thousand words. Using a lower frequency word to explain a higher frequency word will increase the learning burden which goes against the primary intention of this study.

4.3.2.2.8 Homonyms

The dictionary treats homonyms as separate headwords. As stated above, homonyms were collected at the stage of roughly gathering data. Since the Range programme cannot distinguish two or more completely different meanings of the same written form, the homonyms still remained in the data after the criterion of frequency was applied to filter the data. At the stage of indicating hints to connect the new words with the known words, the meaning of a homonymic known word was first checked so as to be sure that it is frequently used enough to get into the first two thousand words before it can be used as the meaning constant to access the new words. This was done to be consistent with the principle stated above that the meaning frequencies of linking words should be controlled. Consider the examples of *can* (ability, container) and *must* (be obliged to, new wine or mold). While *can* as container is qualified to serve as the meaning constant and the linking word to access *canister*, *must* meaning “new wine or mold” cannot be used to access *mustard*, *mushroom*.

Likewise, the new words connected through the homonymic known words, when given hints to indicate their meanings, were also checked in the *Oxford Advanced Learner’s Dictionary* to see whether the meanings are frequent enough to be included in the learner’s dictionary. This principle was described above as the means to control the meaning frequencies of the new words.

4.3.2.2.9 Derivational forms of linking words

The derivational forms of an explanatory word should belong to the same word family as the explanatory word which is kept within the first two thousand words. Thus ECCENTRIC in the following example is considered accessible through the

explanatory word “centre” although its derivational form “central” is used in the hint for ECCENTRIC. This is because “central” and “centre” belong to the same word family which is a first thousand word family.

centre	
ec**centr**ic	one whose behavior is outside **central** or normal behavior

4.3.2.2.10 Light verbs

Light verbs are words which function as grammatical items but do not carry much meaning themselves. They are avoided as linking words if possible. Thus instead of saying AGENT is “one who does business for a company”, “one who **acts** for a company” is used as its definition in order to avoid the light verb “do”. However, there are a few occasions when light verbs are difficult to avoid as in the ACT/TRANSACT example. Then a light verb has to be used to access a new word.

agent	one who **acts** for company
agenda	a list of things that must be **acted** on

act	to **do**
trans**act**	to **do** business with sb.

4.3.2.3 Rating hints and excluding inaccessible words

After meaning constants are identified and definitions given to connect a set of words, the definitions were rated according to the meaning accessibility scale (See the previous chapter). Some of the words that had been included through the procedure of the rough gathering of data turned out to be difficult to access by the known word. These words were deleted from the data.

In the following example, PLAIN, PLANE, PLATE, PLAICE, PLATEAU, PLOT, FLOUNDER are shown to share the meaning constant “flat” which is the known word “FLAT” itself. The other words PLAN, PLACE, PLANT, CLAN, PLATINUM, PIANO

and FLATTER are filtered out. After the procedure of applying the meaning criterion, the data that remain are further reduced.

flat		
plain	**flat** country	2a
plane	**flat** or level surface	2a
plate	a **flat** dish	2a
plaice	a **flat** seafish	2a
floun**d**er	a small **flat** fish	2a
plateau	raised **flat** area	2a
plo**t**	a small piece of **flat** area	2a
plant	NA	
clan	NA	
platinum	NA	
piano	NA	
flatter	NA	

4.3.2.4 Inter-rater check for the ratings of the hints

To assess the reliability of the ratings of the meaning transparency levels of the unknown words in relation to the known words, an inter-rater check was undertaken. 32 sample items were randomly selected by their serial number from all the hints given to the accessible words. The inter-rater was an EFL teacher who had taught English as foreign language to Chinese students for more than ten years. The inter-rater was informed about the purpose of the research and then was instructed how to use the scale for measuring meaning transparency to rate a hint as level 1, 2, 3 or 4. The inter-rater carried out the rating independently afterwards. It was found that inter-rater consistency was 93% (30 out of the 32 sample hints were rated as having the same levels of meaning transparency as given by the researcher).

4.3.3 Filtering the data by applying the form criterion

After the procedure of giving hints to words, the semantically accessible words were filtered through by applying the spoken and the written form criteria. First the calculations were done for each semantically accessed word to show their phonemic similarity and orthographic similarity in relation to the known word using the measures described in the previous chapter.

The words whose phonological or orthographical similarity scores are larger than 0.5 are considered to be phonologically or orthographically easy to access. The similarity score of more than 0.5 roughly means that more than half of the letters or phonemes are identical in the alignment of a known word and a new word. The words whose phonemic or orthographic similarity scores are equal to or smaller than 0.5 but larger than or equal to 0.25 are considered accessible but not easy to access.

Table 4.1
The scheme for assessing words' phonological and orthographical accessibility

	easily accessed	able to be accessed	not accessible
phonological (spoken form) similarity scores	⩾0.5	⩾0.25 & <0.5	<0.25
orthographical (written form) similarity scores	⩾0.5	⩾0.25 & <0.5	<0.25

A word was considered too far away from its linking word to be phonologically or orthographically accessed if it has a similarity score of less than 0.25. The threshold score of 0.25 roughly means that if the alignment of a known word and a new word contains 8 phonemic or letter positions, only less than 2 letters or phonemes are shared by the known word. (e.g. FAMOUS/EUPHEMISM). The threshold is set very low in view of the fact all the data are etymologically related and share at least one phoneme and one letter in their roots. The low threshold is based on the consideration that some semantically closely related words may lend themselves to easy learning although they are only moderately related to the known words in terms of word form. However, different decisions were made for words that are below this threshold. If a word is the only accessed word through a certain known word and whose phonological or orthographical similarity score is less than 0.25, it was deleted from the data (see example 1 below). When a word, though with as low a phonological or orthographical similarity score as less than 0.25, is one of a set of words that can be accessed through the known linking word, it was not discarded from the data, but was marked

(EUPHEMISM in example 2 below). The decisions are based on the following considerations. First, for word groups like JUDGEMENT/ PREJUDICE, JUDICIAL, ADJUDICATE, JURISDICTION, JURY, JUROR where quite a number of words are semantically transparently related and share the same root *–jud-* , the effort of overcoming the formal difficulty will be worthwhile, especially for learners with higher language proficiencies who have established more meaning associations between words and have better morphological awareness. Second, a special form is kept for the purpose of comparison and contrast with the other words in a set of words, which might increase the chance of it being learned. The word EUPHEMISM in example 2 below is a word of such a type. Third, when a word is far away from the known linking word in both written form and spoken form and it is the only word that can be accessed through the known word, the effort would not be worthwhile, as in example 1.

Example 1

rain	
ir**ri**gate	supply water to crops to help them grow when there is not enough rain

Example 2

famous	much **spoken** about
fame	noun of **famous**
fate	the course of one's life that has been **spoken** by God
in**fa**nt	a small person who can not **speak**
eu**phem**ism	the **speaking** of polite words, not the direct ones
pre**fa**ce	words **spoken** as an introduction to a book

An exception to this rule is ADD/ADDENDUM where ADDENDUM is the only accessible word through ADD and their form similarity is low (0.14 – spoken form similarity, 0.38 – written form similarity). However this pair was not excluded because the whole known word is within the new word and the new word enjoys very high meaning accessibility (2a).

4.4 Formatting the data

4.4.1 Regrouping words

Words were grouped in the way that best shows the form and meaning constants shared by words. Before the procedure of formatting the data was performed, these words, for example, were grouped together because they were etymologically derived from the same source:

part	
apart	
pro**port**ion	
de**part**ure	the action of going **apart**
particle	a particle is a very small **part** of a thing
de**part**	to go **apart**
partition	division into **parts**
dispro**port**ion	a state of being out of **proportion**
apartment	a set of rooms set **apart** for living in a building
partner	a person who has a **part** in an undertaking
partake	to have a **part** of sth
im**part**	to give other people a **part** of information or knowledge
participate	to take **part** in
tri**part**ite	of three **parts**
com**part**ment	separate **parts** of a space for keeping things in or sleeping
portion	a **part** of sth
ap**port**ion	to give as the **part** one gets

Because some words can be best linked by *part* and some others by *apart* and still others by *proportion*, and because in this group, some words are more similar in form with each other (e.g., four words share -*port*-), these words were regrouped into three smaller groups where words with the same meaning constant and the same form constant were put in the same group:

Group 1

part	
partner	a person who has a **part** in an activity
participate	to take **part** in
particle	a very small **part** of a thing
com**part**ment	separate **parts** of space for keeping things in or sleeping
partition	division into **parts**
im**part**	to give other people a **part** of some information or knowledge
partake	to have a **part** of sth
tri**part**ite	of three **parts**

Group 2

a**part**	
a**part**ment	a set of rooms set **apart** for living
de**part**	to go **apart**
de**part**ure	the action of going **apart**

Group 3

pro**port**ion	**part**
portion	a **part** to be given
ap**port**ion	to give as the **part** one gets
dispro**port**ion	a state of being out of pro**port**ion

As can be seen from the data, the precondition for regrouping is that there is a high frequency word serving as the starting point (part, apart, proportion) for learning each regrouped set of words. Otherwise, these words cannot be regrouped. For instance, in the case of the second group, words with the form -*sequ*- cannot form a group of words themselves because no high frequency word with -*sequ*- is available to link up the other words with -*sequ*-. The other reason for keeping the words with -*sequ*- within the group led by SECOND is that the -*sequ*- words not only clearly share the same meaning constant with the -*sec*- words, but also share the same phonological form -se/k/-.

second

con**sequ**ence

sequence

sub**sequ**ent

con**sec**utive

sequel

pro**sec**ute

con**sequ**ential

4.4.2 Presenting form constants of a group of words

Our aim is to make the form constants of a group of words as clear and as obvious as possible for teachers and learners to perceive and use in their vocabulary teaching and learning. This requires that a flexible approach be adopted rather than sticking rigidly to the patterns of word roots. To fulfill the primary requirement, the following guidelines were applied:

1) The shared form between words should be presented rather than the etymological word roots for some groups of words in order to maximize the form consistency between words. In the example below, the form pattern given is *-repa(i)r-* although *re-* is actually a prefix.

-repa(i)r- "repair" as in **repai**r

reparation

Other examples include: *-provid-* as in PROVIDE, PROVISO, IMPROVISE, PROVIDENT. This method should be used particularly when the prefix or the suffix no longer carries into words any semantic or syntactic meaning that can be observed and taken advantage of in vocabulary learning.

However, the method should not be used when instead of promoting learning, maximizing the form similarity might become a burden for memory. Consider the example of the SECOND group again. Instead of providing *-sec-, -seque(n)-* as the form

pattern, -*sec*- and -*sequ*- should be presented for the whole group to avoid the trouble of remembering more form variations. Moreover, the forms -*ence*-, and -*ent*- used with the words in the SECOND group are suffixes indicating the part of speech of words.

2) Basically, when two or more than two words in a group of words share the same series of letters, the series of letters should be treated as a form pattern and presented to remind the learners or teachers of the words being learned. This number is chosen based on the reasoning that if within the range of ten thousand words, there are two or more than two words sharing this pattern, there is a good chance that there are more words in the same form pattern beyond this range. Then the form constant is worth learning anyway. Thus two form patterns should be presented for the JUDGEMENT group.

-jud-, -jur- "judgment" as in judgment

pre**jud**ice
judicial
ad**jud**icate
judicious
jury
jurisdiction
juror

High frequency words that can illustrate all the form patterns should be shown where possible as in the case of DESCRIBE/ DESCRIPTION although they can actually be seen as one word set:

-scrib-, -script- "written" as in de**scrib**e and de**script**ion

scribble

sub**scrib**e
pre**scrib**e
tran**scrib**e
in**scrib**e
pre**script**ion

---

script

con**script**ion

manu**script**

scripture

post**script**

Consider another example:

-clam-, -claim- "say" as in

claim

clamor

re**claim**

ac**claim**/ac**clam**ation

pro**claim**/pro**clam**ation

ex**claim**/ex**clam**ation

In this example, the low frequency words belonging to the same word families like ACCLAMATION, PROCLAMATION/EXCLAMATION are deliberately listed together with ACCLAIM, PROCLAIM and EXCLAIM to show learners the two form patterns presented.

3) In spite of the principle established above that when two or more than two words show the same string of letters or sounds, it is presented as a form pattern, an effort is also made to control the number of presented form patterns within the limit of two in most cases because memorizing additional form patterns is likely to be extra labor for language learners. Only in rare cases were three form patterns provided, usually when the known word can connect a relatively large number of lower frequency words which clearly demonstrate several different form patterns. For the set of words headed by RESPECT, *-spec(t)-,-spic-,-scope-* are given as form constants; for words headed by NAME, *-nam-, -nom-, -nym-*.

In the set of words, OCCUPY, CAPTURE, COP, ANTICIPATION, CAPTIVE, despite the fact that the form *-cap-* is shared by the two words CAPTURE and CAPTIVE, it is not given as the form pattern simply because there are three other formal variations in a small group of 5 words. This group of words is considered not to

be consistent enough for a constant pattern to be used. In cases like this, *-c-p-* is presented to indicate that while the consonants are stable the vowels are not.

4) The symbol "-" is used in presenting form constants to indicate the other letters that may appear in a word (see *-vis-* below as an example). Brackets are used to show the letter inside them can be omitted (e.g. *-fa(-)l-* in the group of words headed by FAIL below).

fail
false
default
fallacious

5) When a word is formally unique in a group of words but shares the same meaning constant and etymology with the other words in the group, its form is seen as a variant:

-vis- "see" as in **vis**it
ad**vic**e -vic- is a variant of –vis-
ad**vis**e
re**vis**e
super**vis**e
visible
visual
en**vis**age
en**vy** -vy- is a variant of –vis-,

If the word showing a form which is different from the others is a high frequency known word, the form pattern is presented in the following way:

-clar- is a variant of -clear- as in **clear**
clarify
de**clar**e
clarinet
claret

Here -*clar*- is first given as the form pattern for the group of the words for the reason that the majority of the words are in the form of -*clar*- instead of -*clear*-. -*clar*- is described as a variant of -*clear*- so that the whole group can be linked up to the known word CLEAR.

6) Due to form change in the history of the language, the written form has sometimes become different from the other related words, but their pronunciation remains the same as the others. Thus both sound and written similarity in form were presented, or the spoken form was used in presenting form patterns so that form constants can be seen:

-se/k/: -sec-, -sequ- as in **sec**ond

con**sequ**ence

sequence

sub**sequ**ent

con**sec**utive

sequel

pro**sec**ute

con**sequ**ential

-/k/-n "know" as in **ca**n

kee**n**

ac**q**uai**n**t

cu**n**ning

can**n**y

4.5 Data checking

The “find” function in Microsoft Word was used to do the second round of data collection by picking up any words that might have been missed in the first round of data collection. This is an attempt to include all the words that can be accessed through the known words. The reason why the second round of data collection was done after

data analysis is that the elicitation of data would be more clearly guided and more efficient after the meaning and formal constants were identified.

The form constants in the word lists were used to find all the words from the 2nd thousand words to the 10th thousand words which share the form constants in the BNC word lists. For example, the group of words that were proved to be accessible through the known word *similar* and *same* include a*ssimilate/simulate/resemble/ simultaneous/assemble* after the meaning and form transparency scales were applied. Then the formal constants *sim*, *sem, sam* were entered into the "find" interface to elicit words containing the same formal constants. This procedure produces *casement, semester, disseminate, disenfranchisement, semen, semantic, semicolon, inseminate, reimbursement, chastisement, housemaid, reassemble, semaphore, semipro, amusement, basement, semi, semigloss, semiconductor, seminar, endorsement, semitrailer, horseman, pessimism, simmer, pessimistic, pessimist, simplistic, sample, sampler, sesame, samaritan* in addition to the words that were already included in the word group. After words that do not carry the meaning thread "being similar or same" were dropped off, two words were added to the word group: *simplistic* and *reassemble.*

For high frequency words like *see* which were found to be unable to access any words after the procedure of data gathering and data filtering, the whole word *see* was entered into the "find" function to pick up the derivational forms of *see* which belong to different word families.

4.6 Determining the accessibility of words

Up to this stage of the analysis of the data, the following information has been obtained: the frequency of the words, the form constants of a set of words, the hints that indicate the meaning connection between the known words and the low frequency words, the meaning transparency levels of the connected words, and the similarity between the known words and the low frequency words in terms of both spoken and written forms. The final piece of added information is an indication or index of to what extent each of the low frequency words is easy to learn through the known high frequency words, namely, the degree of accessibility of each of the lower frequency words. This information is considered important and necessary because it is a more direct and convenient reference for learners and teachers to use. Without it, its users will

be faced with the difficulty of looking at all the separately presented pieces of information produced so far to intuitively weigh up a word's overall accessibility.

There are several ways to work out the index of accessibility. The first possible way is to add up the figures for meaning frequency levels, phonological similarity and orthographic similarity after first converting the interval data for the latter two into ordinal data as in the former. In other words, there are three figures for, for example, the word SIGNIFY accessed through SIGN. The three figures are: 2a for meaning transparency level, 0.29 for phonological transparency and 0.57 for orthographic similarity. On the meaning transparency scale there are ten levels in the scale of the ease of accessibility, 1, 2a, 2b, 2c, 3a, 3b, 3c, 4a, 4b, 4c. So 9 is assigned to SIGNIFY as 2a is at level 2. The phonological similarity and written similarity scores ranging from 0 to 10 can be regrouped into ten levels: 10: 0.9<phonemic similarity scores or orthographic similarity scores≤10, 9: 0.8<scores≤0. 9, 8: 0.7<scores≤0.8, 7: 0.6<scores≤ 0.7, 6: 0.5<scores≤0.6, 5: 0.4<scores≤0.5, 4: 0.3<scores≤0.4, 3: 0.2<scores≤0.3, 2: 0.1<scores≤0. 2, 1: 0≤scores≤0.1. Thus the phonological similarity between SIGN and SIGNIFY 0.29 is converted into 3 while its orthographic similarity 0.57 is converted into 7. The sum of the three converted numbers (9 + 3 + 7 = 19) is used to indicate the overall accessibility level of the low frequency word SIGNIFY.

The apparent advantage of computing the accessibility index of a word by summing up the converted values of its meaning transparency level and formal similarity as compared with a known word is that an individual word can be assigned a distinct value. However its drawbacks are easily seen as well. First, converting the interval phonological similarity figures into ordinal data will conceal the differences to a certain degree. Second, the same overall score can be arrived at in many different ways. For example, the sum of the meaning transparency level and the phonological and orthographic similarities for ADVERSE versus REVERSE is the same as the sum for SIGNIFY versus SIGN. However, the fact is that while it is much more difficult to access the meaning of ADVERSE through REVERSE compared with accessing the meaning of SIGNIFY through SIGN, the spoken form of SIGNIFY is not so easy to access through SIGN as that of ADVERSE through REVERSE. Thus when the same result is taken to indicate the same degree of ease of a word's accessibility, some important information will be missed out. Ignoring the influences of the different factors upon the ease of learning a new word by giving them equal importance cannot be

justified on the basis of the psychological evidence reviewed above. It is very likely that the different factors affecting the difficulty of learning a foreign word vary in their importance in different learning conditions and environments with different learners. The third disadvantage of indicating the ease of accessibility of a word in this way is that the indices may be too big a number to be used conveniently. The sums can range from 3 to 30 with up to 28 intervals, which still cannot provide a clear and straightforward indication to their users.

An alternative way of producing the indices of the ease of accessibility is setting the thresholds for the easily accessed words, and the words that can be accessed but with difficulty. This means that words which enjoy high meaning transparency, and high form similarity levels, both phonological and orthographical, are first sifted and then words whose meaning and spoken and written forms are all difficult to access through a known high frequency word are picked out as well.

By high meaning transparency level, it is meant that a word is rated at level 1, levels 2a and 2b, or level 3a. They are higher than 3b on the scale for measuring meaning transparency. The words rated between 3b and 4c are considered able to be accessed through the meaning of the known words but with difficulty. The dividing line drawn in between 3a and 3b means that when the meaning of a new word is the meaning of the known word, or when the meaning of the new word can be explained directly by the known word or by the approximate meaning of the known word, the known word is more directly and noticeably involved in defining the new word and thus enables the new word to be accessed more easily.

Words at level 3b are excluded from the easily accessible words because of the greater number of words required in their hints to show the connection between the approximate meaning of the known word and the new word. Hints for meaning at level 2b are long as well, but they directly contain the known word, which is considered a lesser step taken than getting the approximate meaning of the known word first and then using it to connect with the new word. Words at 3c are not included in the easily accessed words due to the complication involved with the figurative use of the explanatory word. Although words at level 2c involve figurative uses of the explanatory words as well, unlike the words at 3c where the figurative use of the words is the explanatory words which approximate the meaning of the known words, the explanatory words at level 2c are the known words themselves. Thus again one more

step needs to be taken to get to words at 3c than those at 2c. For this reason, words rated at 2c rather than 3c are considered easily accessible.

When the new word is connected to the known word in such a way that only a small part of the meaning of the known word can be seen in the new word as with words of level 4, the new word is deemed to be not easily accessed. Table 4.2 is a summary of the scheme used to assess the semantic accessibility level of a word.

Table 4.2
The scheme for assessing semantic accessibility

	easily accessed	able to be accessed	not accessible
meaning transparency levels	1, 2a, 2b, 2c, 3a	3b, 3c, 4a, 4b, 4c	5

Word form accessibility is judged by spoken form and written form similarity scores. As is shown in Table 4.3, when the spoken or written similarity score is equal to or higher than 0.5 for a word, it is regarded as easily accessible in terms of spoken form or written form. When both forms of a word enjoy a similarity score equal to or higher than 0.5, the word is said to be formally easily accessible. Words whose both spoken and written form scores are lower than 0.5 are regarded as formally difficult to access. Words which have either the spoken or the written form scores equal to or above 0.5 are given the label "formally able to be accessed". Three levels of accessibility are set for the form of a word instead of two as for the meaning accessibility of a word because there are two form scores for each word.

Table 4.3
The scheme for assessing form accessibility

	easy to access	able to be accessed		accessed with difficulty
phonological (spoken form) similarity scores	0.5 ↑	0.5 ↑	0.5 ↓	0.5 ↓
orthographical (written form) similarity scores	0.5 ↑	0.5 ↓	0.5 ↑	0.5 ↓

Three levels were used to indicate the ease of a word's accessibility: easily accessed (EA), able to be accessed (AA), and accessed with difficulty (AD). The EA words refer to those whose meaning transparency is rated as 3a or higher than 3a and whose spoken and written similarity to the known word is equal to or more than 0.5. The AD words include those whose meaning transparency level is rated below 3a and at the same time whose spoken and written forms are both lower than 0.5. The middle group of words, the AA words, includes those which have either a low meaning transparency level, or a low phonological similarity score below 0.5, or a low orthographic score below 0.5. The

distinguishing of this group of words from the other two types can be justified on the basis of the literature concerning the factors affecting the ease or difficulty of learning a foreign word. As was reviewed, research has shown that a familiar phonological pattern, a familiar orthographic pattern, familiar meaning content of a word, and an easy form-meaning connection are all determinants for the ease of learning a foreign word. No literature has been found that demonstrates which of these factors has greater determining power than others. Table 4.4 summarizes the form and meaning criteria for assessing a word's accessibility level.

Table 4.4
The scheme for assessing words' overall accessibility levels

	meaning transparency level	phonological similarity score	orthographical similarity score
easily accessed	3a ↑	0.5 ↑	0.5 ↑
able to be accessed	3a ↑	0.5 ↓	0.5 ↓
		0.5 ↓	0.5 ↑
		0.5 ↑	0.5 ↓
	3a ↓	0.5 ↑	0.5 ↑
		0.5 ↑	0.5 ↓
		0.5 ↓	0.5 ↑
accessed with difficulty	3a ↓	0.5 ↓	0.5 ↓

Chapter 5 Results

The present study aims to come up with a list of semantically related and formally similar English words to facilitate vocabulary learning. The first two thousand known words are used as the point of departure to connect with the lower frequency words in the first ten thousand word families. The meaning connections between the new words and the known words are shown in the short hints while the form relations between them are measured by the spoken form and written form similarity scores. The data was gathered and processed following the procedures described in Chapter 3. The source of the data was *A Comprehensive Etymological Dictionary of the English Language* (Klein, 1966). The first procedure performed in the study is roughly gathering the data from the etymological dictionary. This was followed by the application of the frequency criterion, then the meaning criterion and the form criterion. After the roughly gathered data was filtered using the three criteria, the remaining data was checked to make sure that no useful data is missed. The data was finally rated in terms of the extent of their accessibility. This chapter describes how the roughly gathered data, that is, the words which are etymologically related to the first 2000 words according to the etymological dictionary are reduced in number as the frequency, the meaning and the form criteria were used. It also reports the results of data checking and the rating of the accessibility of the filtered data.

5.1 Results of rough data gathering

The procedure of roughly gathering data resulted in 9240 words including 1024 first 1000 words and 983 second 1000 words, and 7233 words from frequency levels other than the first 2000 words. This was the result when counting was made following the dictionary's system of dealing with derivational words. That is, in this counting, each word form which is cited by the dictionary as related to the first 2000 words was regarded as a different word. Homonyms, however, were not counted as different words. Thus, EXCLAIM and EXCLAMATION were counted as two words because both of them are given separate citations in the dictionary and are described as etymologically related to CLAIM although they belong to one word family in the BNC lists. On the other hand, the word BALL for example was counted as one word in spite of its homonymic status. According to the etymological dictionary, BALL has three

etymological senses: “round”, “dancing”, and “vessel” and it is listed three times in the dictionary as three head words (three entries). The three senses are related to the following three groups of words respectively. The three BALLs were counted only once in spite of the unrelated meanings they have while the words related to them in meaning were counted as different words because they have different forms.

ball	**ball**	**ball**
bold	symbol	bowl
buck	ballet	boll
bulk	ballistic	rocambole
bull	parable	
balloon	ballerina	
belly	metabolism	
bale	amphibole	
ballot	amphibology	
bullock	anabolism	
baleen	ballade	
balinger	balladry	
billow	ballista	
	bayadere	
	ballad	
	bolide	
	bolometer	
	boule	
	catabolism	
	diabolic	
	discobolus	
	ecbolic	
	elaphebolion	
	embolism	
	emboly	
	hyperbola	
	hyperbole	
	parabola	
	tribolium	
	tribulus	

5.2 Results from using the word frequency criterion

After the roughly gathered words were counted as described above, the criterion of word frequency was applied. In this procedure, the 9240 words were run through the Range programme to find their frequency levels. Words within the ten most frequent 1000 word families remained in the data and those beyond the tenth 1000 were discarded. As we applied the frequency criterion, words within the range of the first ten thousand word families were now checked according to the first ten BNC lists to make sure that the words belonging to the same word family were counted as one word family. As the Range programme cannot distinguish homonyms, homonyms were still counted in the same word family.

After the 1024 first 1000 words and 983 second 1000 words resulting from the rough gathering of data were grouped into word families, they became 926 first 1000 word families and 924 second 1000 word families. The number reduces because the derivational forms of words which were treated as different words are counted in one word family by the Range programme. For example, RETRACT and RETRACTION are presented as two different words related to CONTRACT in the dictionary, but are regarded as one word family in the BNC word lists. The following is a description of how the two numbers were further reduced when the frequency criterion was used.

926 of the first 1000 word families and 924 of the second 1000 word families are etymologically connected to words from an unlimited range of frequency levels. In other words, these numbers include the first and the second 1000 words which are related to 1) words from the third 1000 to the tenth 1000 word families; 2) words at frequency levels beyond the first ten thousand English words (e.g. BRANCH, a second thousand word, according to the etymological dictionary, is related to two words BRANK, EMBRANCMENT, which are not within the first ten thousand words); and 3) words within the first two thousand words (e.g. The three first 1000 words. LEAD, LOAD and LEARN, are related to each other in addition to five other words which have frequency levels beyond the tenth 1000 words: LORE, DELIRIUM, LODE and LEITMOTIV/LADE). The words like BRANCH and LEAD, LOAD and LEARN were included in the numbers of 926 and 924 respectively before the frequency criterion was used.

After the frequency criterion was applied, words in the first 1000 and the second 1000 words which are etymologically related only to words beyond the first ten

thousand words like BRANCH, and the first 1000 and the second 1000 words like LEAD, LOAD and LEARN which are etymologically related only to words within their own frequency level but not to words at other frequency levels within the first ten thousand words were removed from the data. Then it was found that 846 first 1000 word families and 856 second 1000 word families were etymologically related to words at a frequency level other than their own within the first ten thousand words.

To be more specific, five kinds of first and second 1000 words were eligible to be included in the numbers of 846 and 856. First, the word is a homonym, and one of its meanings is etymologically related to a word at a frequency level other than its own within the first ten 1000 word families. For example, while PINK (plant) has no etymological relations with any word family within the ten 1000 words, its homonym PINK (a nasalized variation of PICK) has. The word PINK was then regarded as a word with semantic relations with words at a frequency level other than its own within the first ten 1000 words. Second, the word is etymologically related to an affix or combining form which is part of a word that is at a frequency level other than its own within the first ten 1000 word families. One example is a word like SYSTEM, a first 1000 word, which is etymologically connected to "syn-" as in words SYNDROME, SYNDICATE, SYNTHESIS, SYNCHRONIZE, SYNTHETIC, IDIOSYNCRACY. All these connected words are within the range of the second to tenth 1000 word families. However, in the case of BRUSH, a second 1000 word, which is related to "bryo-", since no word within the third to tenth 1000 frequency levels can be found having this form, BRUSH is seen as having no relations and is therefore not counted. Third, the word, part of which is related to a word at a frequency level other than its own within the first 1000 word families such as CUPBOARD and SATURDAY. In CUPBOARD, "board" has relations with other words but "cup" has not; in SATURDAY, "day" has relations with other words but "Saturn" has not. The last type of word is those which do not belong to the first four types but which are etymologically related to words at a frequency level other than their own within the first ten 1000 words. This type of word constitutes the majority. The examples are words like ABSOLUTE, a first 1000 word which is related to SOLVE, a second 1000 word; SOLUTION, a second 1000 word, DISSOLVE, a fourth 1000 word, RESOLVE, a fourth 1000 word, and RESOLUTE, a tenth 1000 word. These five kinds of words constitute the 846 first 1000 word families and 856 first 1000 word families that are seen as related to words at a frequency level other than their own within first ten word families.

There are 134 first and the second 1000 words (including 63 first 1000 words and 71 second 1000 words) which, according to *A Comprehensive Etymological Dictionary of the English Language*, have no etymological relations with any other words. They include words like ANT, BED, AT, BOTHER, SUDDEN, SHOW, SISTER. There are 16 words that cannot be found in the dictionary: OP, STATES, SECONDS, AUNT, BOOKING, CARP, DRAW, ETC, FIRMS, NAUGHTY, SPAIN, WHALES, WHEREAS, LONDON, MRS, OKAY.

We now consider the change in the number of the 7233 lower frequency words (dictionary entries not word families) which were shown to be etymologically related to the first 2000 words at the stage of roughly gathering data after we applied the frequency criterion.

Table 5.1 below shows the result of the procedure of applying the word frequency criterion to the 7233 words. They were now reduced to 2578 word families which are related to the first two thousand English words and which are within the range of the third to the tenth thousand word families. Thus, from the third 1000 to the tenth 1000 level, there were (8000-2578) 5422 word families (68%) that were not etymologically related to the first two thousand word families. The example below illustrates the process of applying the frequency criterion. The numbers in front of the words indicate their frequency levels. {!} indicates that the word is not within the first ten 1000 word families and should therefore be deleted. CLASS and CLAIM with no numbers in front of them belong to the first 1000 word family band. They are shown to be etymologically related to 6 words which are from the third to the ninth 1000 frequency levels. These 6 words are part of the 2578 word families. The system of rating the frequency levels of the words by using numbers in curly brackets, {9}, is the output using the Mark text function of the Range programme.

class
claim
{9}clamor
{7}reclaim
{7}acclaim
{6}proclaim
{6}exclamation/exclaim
{3}calendar

{!}declaim

{!}nomenclature

{!}paraclete

{!}nomenclator

{!}declamation

{!}clamant

{!}chamade

{!}calends

Table 5.1 shows the number of word families at the third to the tenth 1000 frequency levels resulting from applying the frequency criterion. After this data filtering procedure, when the number of the accessible "words" is mentioned or discussed, the unit of analysis used is word families rather than word types or lemmas.

456 out of the third thousand English words, that is, nearly half of the third 1000 words are etymologically connected with the first and the second thousand English words. A regular drop in the number of words that are etymologically related to the first 2000 words can be observed from the third to the tenth 1000 frequency levels except at the tenth 1000 level. The drop is generally gradual, not more than fifty words, with only a relatively big drop (63 words) being shown at the fifth 1000 frequency level. This result indicates that the first 2000 words have more etymological relations with higher frequency words than lower frequency words.

Table 5.1
Number of the third to the tenth 1000 word families related to the first two thousand words

frequency level	3rd1000	4th1000	5th1000	6th1000	7th1000	8th1000	9th1000	10th1000	total
number of words	456	414	351	334	307	261	216	239	2578

5.3 Results of applying the meaning transparency criterion

The 2578 words were next analyzed through the procedure of applying the meaning transparency criterion. During this procedure, the known words (the first 2000) were used as linking words to show the connection between the meaning of the low frequency new words (the third to the tenth 1000 words) and the meaning of the known words. A short hint (a phrase) was given if necessary to indicate the connection between the new word and the known word. A word was considered to be able to be accessed in

meaning by the first two thousand known words if it could be explained in a hint by the known words themselves or by an explanatory word which is part of the meaning of the known word. A word that could not be explained in a hint by the known word or with part of the meaning of the known word was deleted from the data as a semantically inaccessible word. The following is an example to illustrate how the procedure was applied to the group of words headed by the first 1000 word CLIMB.

climb	
cliff	steep mountain that is difficult to **climb**
climb	to get up by **clinging** to sth
clay	sticky earth that **clings** to swh
cleave	to **cling** fast to sth
clover	NA (not accessible)
calamity	NA
clam	NA

In this example, CLIFF can be explained by the known word CLIMB itself and CLAY and CLEAVE by "cling" which is part of the meaning of the known word CLIMB. CLOVER, CALAMITY and CLAM cannot be explained by either. Thus, applying the meaning criterion to this group of words resulted in three words being removed.

So the 2578 third to tenth 1000 word families which resulted from the procedure of applying the frequency criterion were analysed using the meaning transparency criterion. The results (Table 5.2) show that a total of 1500 word families can be accessed in meaning by the first two thousand words. Of this number, half come from the third to fifth 1000 word families. The third and the fourth 1000 frequency levels provide the greatest number of words that can be accessed through the high frequency known words (259 word families from the third 1000 word list and 263 from the fourth). The percentage figures in row four are calculated by dividing the row-two figures by the row-three figures. Again a general declining tendency in the number of accessible words emerges across the eight frequency levels although there is a slight increase at the fourth and the tenth 1000 frequency levels.

About 58% of the 2578 word families (1500 words) can be connected in meaning through the first two thousand known words. When the separate numbers at each 1000 word frequency level are compared before and after the application of the meaning

transparency criterion, roughly the same proportion exists. For example, 259 out of 456 word families (57%) at the third 1000 frequency level can be connected in meaning by the first two 1000 words; 170 out of 307 word families (55%) at the seventh 1000 frequency level can be accessed in meaning; and 126 out of 239 (53%) at the tenth 1000 can be accessed. The semantically accessible percentages for different meaning frequency levels do not vary considerably across the frequency levels.

Table 5.2
Numbers of accessed words at the third to the tenth 1000 frequency levels after applying the meaning transparency criterion and their percentages

frequency level	3rd1000	4th1000	5th1000	6th1000	7th1000	8th1000	9th1000	10th1000	total
number of semantically accessed words	259	263	212	192	170	156	122	126	1500
numbers of etymologically related words	456	414	351	334	307	261	216	239	2578
percentages of the semantically accessible words	57%	64%	60%	57%	55%	60%	57%	53%	58%

The number of the first 2000 words that can access the words at lower frequency levels also decreases after the application of the meaning transparency criterion because some of them cannot be used as linking words to connect the meaning of any of the lower frequency new words and thus were removed from the data. For example, in the following group of words, AREA, a first 1000 word, is etymologically related to four other words which are within the third to the tenth 1000 frequency levels. However, none of the four words can be accessed in meaning by giving a hint that shows the semantic connection between them and AREA. The word AREA therefore was removed from the data.

area
azalea
arson
ash
ardent

In another group of words, although three first 1000 words OFFER, REFER, and CONFER are etymologically related to eight other lower frequency words, only OFFER can be used to access the meaning of other words in this group. REFER and CONFER were deleted after applying the meaning transparency criterion.

offer	to say you would **bring** (give) sth to sb
refer	
confer	
transfer	to **bring** sb from one place to another (make him move)
prefer	to **bring** sth before sth else to show your favour
suffer	to **bring** sb into a painful experience
fertile	(of land) that is able to **bring** forth good crops
infer	to **bring** out a conclusion
defer	to **bring** sth to a later time (to postpone sth until a later time) to do it
circumference	NA
ferret	NA

After the meaning transparency criterion was applied, 476 first 1000 words were found to be able to access words ranging from the second to the tenth 1000 frequency levels.

The second 1000 words is a special group of words. While they are assumed to be high frequency known words which serve as linking words to access the meaning of the lower frequency words, they are at a lower frequency level than the first 1000 words. For the learners who have not acquired knowledge of the second 1000 words, or have only acquired part of it, the knowledge of the first 1000 words may help them to access the meaning of the second 1000 words. For this reason, where possible, words in the second 1000 words were also shown to be connected with the first 1000 words in meaning. Thus while some second 1000 words were used to access the meaning of lower frequency words, some others were shown to be connected in meaning with the first 1000 words. This inevitably resulted in a small number of the second 1000 words which function both as words accessed by first 1000 words and as linking words to access words at the third to the tenth 1000 levels. The word GENERATE is an example. It was first accessed by the first 1000 word GENERAL through the meaning constant "kind" both of them share: GENERAL means "all of a kind" and GENERATE means "to cause a kind of thing to begin". Then GENERATE was used to connect the meaning of series of other words with the meaning constant "produce" as demonstrated below. The meaning constant that connects GENERATE with GENERAL is different from the one that connects GENERATE to GENUINE, GENE, GENETIC, GENESIS and other words in the group. However, we do not view this as a problem simply because the aim of the study is not to show the etymological meaning of words, but rather to aid retention of words.

generate	**produce**
genuine	true to what is first **produced**
gene	part of a cell that **produces** similar features in children
genesis	how sth is first **produced**
genetic	of the part of a cell that **produces** similar features in children
genius	the ability to **produce** new ideas
indigenous	**produced** naturally in a land
ingenuity	cleverness in **producing** new ideas and things

engender	to **produce** a situation
congenital	**produced** within a person
genital	of the **productive** organs
ingenious	able to **produce** clever new ideas

After the procedure of applying the meaning transparency criterion, it was found that 205 second 1000 words were able to be accessed by the first 1000 words and that 285 second 1000 words were able to access words within the third to the tenth 1000 frequency bands. 11 second 1000 words (PLANE, DETERMINE, METER, VALID, DRAG, TOUR, DISTINCT, PRACTICAL, STORE, GENERATE, DAMAGE) functioned both as accessed words and as words to access lower frequency words, that is, the 11 words are included both in the numbers of 205 and 285. Thus, there were (205 + 285 -11) 491 second 1000 words shown to be related in meaning with other words at a frequency level other than their own within the first ten 1000 word families after they were analyzed using the meaning transparency criterion.

Table 5.3 tries to capture the reduction of the number of the roughly gathered first two thousand words from the etymological dictionary as a result of applying the frequency criterion and the meaning transparency criterion.

Table 5.3
The decreasing numbers of the first and the second 1000 word families that are semantically connected with words at a frequency level other than its own

		first 1000 words	second 1000 words
roughly gathering the data	dictionary entries related to words at any frequency levels	1024	983
	word families related to words at any frequency levels	926	924
applying the frequency criterion	word families related to words at a frequency level other than their own within the first ten thousand word families.	846	856
applying the meaning transparency criterion	word families used to access words at the second to the tenth 1000 words	476	285

This table also shows that whereas 476 out of 846 of the first 1000 words are able to access the meanings of the lower frequency words, 285 out of 856 of the second 1000 words are able to be used to access the meanings of the lower frequency words. This is partly caused by the practice (described in Chapter 4) that the first 1000 words should

be given priority if both the first and the second 1000 words can provide clear and easy connections for the lower frequency words.

RUNG, SAW and DROVE are three semantically accessible words categorized into the first 1000 word families by the Range programme because they are in the form of the past or past participle of the first 1000 words RING, SEE and DRIVE respectively.

Thus, when the 205 second 1000 words whose meanings can be connected by the first 1000 words are added up with the 3 first 1000 words and the 1500 third to tenth 1000 words which can be accessed by the first two thousand words, 1708 (1500+3 +205) words can be semantically accessed by the 761 (476 plus 285) known words.

When the 1708 semantically accessible words were analyzed on the basis of their meaning transparency in relation with the known linking words, the hints given to the 1708 words were rated on the scale for measuring meaning transparency developed in Chapter 3. For example, in connecting ADVOCATE with the first 1000 word VOICE, the hint "to voice one's opinions publicly to support sth" was given. As the hint contains three content words in addition to the linking word VOICE, it was rated as 2a according to the scale for measuring the meaning transparency. In connecting SUBSUME with the first 1000 word ASSUME, ASSUME could not be used directly in the hint for SUBSUME to show the meaning connection between the two words, so the part of the meaning of ASSUME "take" was used because ASSUME means "to **take** it as true before there is proof". The hint for SUBSUME involving the meaning "take" is thus "to take sth into a larger thing (to include it)", which figuratively uses "take into" to mean "include". According to the scale for measuring the meaning transparency, the hint for SUBSUME was rated as 4c (The greater the number, the less transparent the connection).

The reason that 1728 hints were given to and rated for the 1708 word families is that 2 homonyms and 18 words which consist of two parts with one part being accessed by one known word and the other part by a different known word were given hints twice and rated twice. The homonyms are CONTINENT and PLAIN.

The 18 words that are made up of two parts are SUPERVISE, TELESCOPE, SUPERIMPOSE, EQUIVOCAL, MICROSCOPE, SUPERSONIC, UNIFORM, PRIVILEGE, UNICORN, CENTIMETER, EXTRAORDINARY, EQUIVALENT, VERDICT, TELEGRAPH, MILLIMETER, SUPERFICIAL, SUPERCEDE, SUPERFLUOUS. TELEGRAPH is such a word. It is composed of two parts, -*tele*- and

-graph-, of which the former can be connected by the high frequency word TELEPHONE and the latter by another high frequency word PARAGRAPH. When the semantically accessed words were counted in terms of frequency levels, words like TELEGRAPH were counted once in spite of their repeated appearance in the data. However, when the hints given to the word were rated on the scale for measuring meaning transparency, two values were obtained as is shown below:

telephone	means of sending message **far**	
telegraph	a machine for sending a written message **far**	4a
para**graph**	a **written** passage	
tele**graph**	a machine for sending **written** messages	3a

The first hint for TELEGRAPH is rated as 4a because there are 3 content words in addition to the meaning constant "far" in the hint for the linking word TELEPHONE whereas the second hint for TELEGRAPH is rated as 3a because the hint for TELEGRAPH contains only two content words, the meaning constant "written" and the other word. As the meaning constant is easier to access for the word pair TELEGRAPH/TELEPHONE than that for TELEGRAPH/PARAGRAPH, the meaning transparency levels for the two hints for TELEGRAPH, or for the two parts of TELEGRAPH are different.

In the following report, the results of rating the hints (1728) for the 1708 unknown words are shown in table 5.4, table 5.5 and table 5.6. The results will be reported first separately for words at the third 1000 to the tenth 1000 frequency level, then words at the second 1000 frequency level and then the first 1000 frequency levels. Finally all numbers of the semantically accessible word forms within the first ten 1000 frequency levels will be summarized. Because there were 19 repeatedly rated words within the third to the tenth 1000 frequency bands, the number of hints in table 5.4 is 1519, 19 more than the 1500 semantically accessible word families at the third to the tenth 1000 frequency levels. In table 5.6, the number of hints is 206, one more than the 205 semantically accessible word families (PLAIN, a second 1000 word, was rated twice).

The results in table 5.4 show that (57+705) 762 hints can be rated at the first two semantically most transparent levels, accounting for more than half of the total number of hints, whereas only 290 hints were rated at level 4, the semantically most opaque end

of the scale, accounting for only 16% of the total. When the ratings of the hints were further grouped into narrowly defined levels of meaning transparency, it can be seen that the greatest number was at level 2a, being able to be connected with the meaning of the high frequency known word itself with no more than three content words in addition to the known word itself. This is followed by words at level 2b and 3a, 2b being the hints which contain the known word itself but require more content words to explain the new words; and 3a being the hints which require an explanatory word approximating the meaning of the known high frequency word. The clear tendency of the meaning transparency levels shown in table 5.4 is that a greater number of hints for the new words are more transparent than opaque in relation to the meaning of the known words. Words that require figurative language use of the explanatory word to link up their meanings with the meanings of the known words (words rated at 2c, 3c or level 4c) form the smallest number, suggesting that the meaning of the great majority of the accessible words can be connected through the literal meaning of the high frequency known words. The number of words whose meaning roughly equals the meaning of the known word is also small, making up only 4% of the total accessible words.

Table 5.4
Number of hints for the 1500 semantically accessible words at the third to the tenth 1000 frequency levels rated at different meaning transparency levels

meaning transparency levels (broad)	1	2			3			4			total
number of accessed words	57	705			467			290			1519
meaning transparency levels (narrow)	1	2a	2b	2c	3a	3b	3c	4a	4b	4c	total
number of words	57	406	250	49	291	133	43	92	126	72	1519

Table 5.5
Numbers and percentages of the hints for the third, sixth and tenth 1000 words at different meaning transparency levels

transparency levels	1	2	3	4	total
numbers of ratings for the third 1000 words	18	119	80	42	259
percentages of ratings in the total	7%	46%	31%	16%	
numbers of ratings for the sixth 1000 words	5	89	69	30	193
percentages of ratings in the total	2%	46%	36%	16%	
numbers of ratings for the tenth 1000 words	1	62	39	25	127
percentages of ratings in the total	1%	49%	31%	20%	

Next we examined whether the meaning transparency levels of words are related to the individual frequency levels of the words. We used the meaning transparency levels of the words at frequency level 3, level 6 and level 10 as examples to explore the relationship (Table 5.5) because the three frequency levels are representative of the higher and medium and the lower frequency words that are to be connected with the first two thousand known words. Table 5.5 shows that 46% of the semantically accessible third 1000 and sixth 1000 words are rated at the meaning transparency level 2, a rather high transparency level, and that 49% of the tenth 1000 words are at this level. The numbers of words rated at the meaning transparency level 4 are 16%, 16% and 20% for the third, sixth and tenth 1000 words. There does not seem to a relationship between the frequency level and the level of the meaning transparency for the connected words.

The 205 second 1000 words whose meaning can be accessed by the first 1000 words were also rated (table 5.6). Again it is shown that the second 1000 words that are rated at level 2 form the largest percentage (59%) of all the accessible words. The second 1000 words rated at level 4 in terms of meaning transparency are the smallest number. One difference observed when the distribution of the meaning transparency levels of the second 1000 words is compared with that of the third to the tenth 1000 words is that the number of words rated at level one for the second 1000 words constitutes a larger percentage than for the third to the tenth 1000 words. Another difference is that the hints rated at 4 for the second 1000 words do not make up as big a percentage as those for the third to the tenth 1000 words (9% for the former and 19% for the latter).

Table 5.6
Number of hints for the 205 semantically accessible words at frequency level 2 rated at different meaning transparency levels

meaning transparency levels (broad)	1	2			3			4			total
number of words	17	121			49			19			206
meaning transparency levels	1	2a	2b	2c	3a	3b	3c	4a	4b	4c	total
number of words	17	88	30	3	27	13	9	6	7	6	206

The three first 1000 words RUNG, SAW and DROVE were rated at 2b, 2a, and 2a respectively.

Thus the total number of hints for words that can be accessed through the first two 1000 known words is 1728 (1519+206 +3) after using the meaning criterion. (Table

5.7 is a summary of the results regarding the rating of the hints for all the accessible words within the first ten 1000 word families.

Table 5.7
Number of hints rated at different meaning transparency levels for semantically accessible words at the first ten 1000 frequency levels

meaning transparency levels	1	2a	2b	2c	3a	3b	3c	4a	4b	4c	total
number of words from the third to the tenth 1000 frequency levels	57	406	250	49	291	133	43	92	126	72	1519
number of words at the second 1000 frequency level	17	88	30	3	27	13	9	6	7	6	206
number of words at the first 1000 frequency level	0	1	2	0	0	0	0	0	0	0	3
total	74	495	282	52	318	146	52	98	133	78	1728

5.4 Results of applying the form transparency criterion

After applying meaning transparency criterion, the form criterion was applied to further filter the remaining data. The 1708 word families resulting from the procedure of measuring their semantic accessibility were measured in terms of spoken form and written form similarity in relation to the known high frequency words. According to the form criterion, if the form similarity score of a lower frequency word, either spoken or written, is less than 0.25, it is regarded as formally inaccessible. If the spoken or written similarity scores for a word are equal to or higher than 0.5, the word is formally easily accessible in spoken form or written form (See Chapter 4 for details). Applying this criterion caused 11 word pairs of these words to be deleted from the data although a greater number of words (233) have either a spoken similarity score or a written similarity score below the cut-off point. The reason for deleting the 11 words and maintaining the other 222 (233-11) words is: first, either their spoken form or written form is inaccessible; second, the unknown word is the only word that can be connected in meaning. Memorizing the semantic link in order to learn one word whose form is not easy to learn is therefore considered not worthwhile. The deleted word pairs are BISCUIT/CONCOCT, ELSE/PARALLEL, SHED/SHEATH, KILL/QUALM, LET/LENIENT, SEVEN/SEPTEMBLER, WORK/WROUGHT, ALTHOUGH/ALBEIT, STORE/RESTAURANT, RAIN/IRRIGATE, WOULD/VOLUNTARY. The remaining formally inaccessible words include words

like SURVEY in the group VIEW/PREVIEW/REVIEW/INTERVIEW/SURVEY, or all the words in the group PREJUDICE/JUDICIAL/ADJUDICATE/JUDICIOUS /JUDICIARY/JURY/JURISDICTION/JUROR except the first 1000 word JUDGE. Such words were not removed from the data because words like SURVEY can be compared with the other words in a group and its chance of being learned might increase. Words like the group headed by JUDGE are very closely related in meaning to the known word and this increases the possibility of learning them (See Chapter 4). After the 11 formally inaccessible words were deleted from the 1708 words, 1697 words remained as is shown in table 5.8.

Table 5.8
The number of words that remained after the use of the form criterion

frequency level	1st 1000	2nd 1000	the third to the tenth 1000	total
number of semantically accessed words after applying the meaning criterion	3	205	1500	1708
after applying the form criterion	3	203	1491	1697

The 1697 remaining words gave rise to 1717 spoken or written similarity scores in relation to the known words. This is also the number of hints that remained after the applying of the form criterion (See table 5.13). The number of spoken or written similarity scores is 20 more than the number of accessible word families because 20 words, as described above, appear twice in the data. In the following report of the results, the term “word forms” is used to refer to the 1717 items with the spoken or written similarity scores in order to distinguish them from the number of the accessible words or word families.

Table 5.9 shows the number of word forms whose spoken form similarity scores and written form similarity scores are less than 0.25, are equal to or bigger than 0.5, or are in between after the procedure of applying the form criterion. 0.25 is the cut-off point of the form similarity scores for inaccessible word forms while 0.5 is the cut-off point of the form similarity scores for formally easily accessible word forms. Thus this table shows that about half of the accessible word forms (50% of the spoken similarity scores and 57% of the written similarity scores) can be easily related to the known words and that only a small percentage (13% for spoken forms and 4% for written forms) of semantically accessible word forms are not formally accessible. The percentage of inaccessible spoken forms is larger than that of the written forms by 7%

whereas the percentage of easily accessed spoken forms is smaller than that of the easily accessed written forms by 9%.

Table 5.9
Number of form similarity scores for words at the first ten 1000 frequency levels whose forms are easily accessible or inaccessible but remain in the data

score range	≥0.5	< 0.5, ≥0.25	<0.25	total
spoken form similarity score	832	660	225	1717
written form similarity score	956	698	63	1717

In table 5.10 and table 5.11, we present the number of form similarity scores after they were grouped into ten categories. The distribution of the spoken similarity scores in table 5.10 shows that the spoken forms with similarity scores between 0.5 and 0.6 are 374, making up the largest proportion of the total (22%). The second biggest number of spoken forms (283) has similarity scores between 0.6 and 0.7. This is followed by those with similarity scores of 0.2≤s<0.3 and then by 0.2≤s<0.3. Both the highest and the lowest similarity scores involve very small numbers of words. However, the second lowest score group (0.1≤s<0.2, 124) covers a much greater number of spoken forms than the second highest score group (0.8≤s<0.9, 47). The following are examples of spoken similarity scores from the four score groups encompassing larger numbers of spoken forms:

body/bodice 0.8, million/millionaire 0.86;

cause/causal 0.75/, proportion/disproportion 0.7;

step/stamp 0.6, sure/assure 0.67;

stick/stigma 0.5, cover/discover 0.57;

force/reinforce 0.43, compensate/recompense 0.45;

sense/resent 0.33, secure/curious 0.38;

season/disseminate 0.22, system/syndrome 0.25;

pure/purgatory 0.14, agreeable/gracious 0.17;

Table 5.10
Number of spoken similarity scores in each of the 10 score categories

spoken form similarity scores	0.9≤s ≤1.0	0.8≤s<0.9	0.7≤s<0.8	0.6≤s<0.7	0.5≤s<0.6	0.4≤s<0.5	0.3≤s<0.4	0.2≤s<0.3	0.1≤s<0.2	0≤s<0.1	total
number of scores	20	47	109	283	374	231	246	276	124	7	1717

Table 5.11
Number of written similarity scores in each of the 10 score categories

written form similarity scores	0.9≤s ≤1.0	0.8≤s<0.9	0.7≤s<0.8	0.6≤s<0.7	0.5≤s<0.6	0.4≤s<0.5	0.3≤s<0.4	0.2≤s<0.3	0.1≤s<0.2	0≤s<0.1	total
number of words	14	51	165	304	423	288	294	160	18	0	1717

The regrouping of the written similarity scores into ten categories shows that the written form similarities tend to distribute across the scores from 0.7 to 0.3, a slightly narrower spread than those of the spoken forms. Table 5.11 shows, as in table 5.10, the biggest number (423) of similarity scores are within the range of 0.5 to 0.6. This is followed by 304 (0.6⩽scores <0.7), then by 294 (0.3⩽scores <0.4) and 288 (0.4⩽ s<0.5). This result suggests that more written forms have slightly more or less than half of letters that are identical to the letters of the known words in an alignment which maximizes the identical letters. The following are the examples with written similarity scores within the four ranges which cover the largest number of words:

range/ranger 0.83, receive/receiver 0.88
account/accountant 0.70, arrange/rearrange 0.78;
mix/remix 0.6, arrive/derive 0.67;
rent/render 0.5, rubbish/rubble 0.57;
ball/bulge 0.4, certain/certificate 0.45;
complain/plague 0.33, remain/manor 0.38;
message/dismiss 0.22, commit/transmit 0.27;
middle/intermediary 0.17, supply/replenish 0.14.

Table 5.12 gives the lowest and highest similarity scores for both spoken and written forms and the number of word forms with these scores. It can be seen that both the spoken forms and written forms use the highest similarity score 1.0. However, only the spoken form of one word INN has identical pronunciation to the linking word IN. All the other word forms, spoken or written obtain the highest score because their spoken forms or written forms are part of the known words. For example, PUB is included in PUBLIC. The numbers of items with the lowest spoken similarity scores are not as large as those of the written similarity scores. Also while the spoken forms have the similarity score 0, the written forms do not. This may be because sounds are more subject to change than writing, or may be an effect of the method of scoring.

Table 5.12
The first 3 highest and lowest spoken and written similarity scores, the number of word forms with the scores and their examples.

	the 3 highest spoken similarity scores				the 3 lowest spoken similarity scores		
scores	1	0.88	0.86		0.09	0.08	0
number of scores	23	6	7		1	1	5
examples	in/inn, public/pub	important/ importance	conscious/ conscience		major/ magnificent	nerve/ neurological	eat/etch
	the 3 highest written similarity scores				the 3 lowest written similarity scores		
scores	1	0.89	0.88		0.17	0.15	0.14
number of scores	14	1	3		10	1	2
examples	public/pub	telephone/ telephony	multiple/ multiply		name/ denomination	mix/ miscellaneous	supply/ replenish visit/envy

5.5 Results of data checking

The "find" function of Microsoft Word was used to check the first ten thousand word lists as a procedure to ensure that no useful data were missed out. The procedure was performed by feeding into the computer the form constants of a group of words, or the combining forms etymologically related to the first two thousand words, or the root parts of the first two thousand words which had not accessed any lower frequency words. This procedure resulted in 459 word families being added to the accessible word lists. This number mainly includes three kinds of words: first, words that are formally and semantically closely related but not etymologically related such as HEDGE. While this word is not etymologically related to EDGE according to the dictionary, its current meaning can be connected with HDGE (a row of bushes at the edge of a field). A search for "edge" resulted in not only EDGE but also HEDGE; second, words that are classified into different families according to the affixation systems adopted in the development of BNC word lists but that are not treated as separate words by the etymological dictionary. The examples of this kind of words are CRITIC/CRITICISM/CRITICIZE, PRODUCTION/REPRODUCTIVE/ COUNTERPRODUCTIVE, CONSEQUENCE/CONSEQUENTIAL; third, lower frequency words which are not shown to be etymologically related with the first two 1000 words when these known words are looked up, but which are shown to have etymological relations with the first two words when the lower frequency words are

checked. For example, MEDITERRANEAN, a fifth 1000 word, was found to be related to MIDDLE only when this word is checked in the dictionary but not when the high frequency word MIDDLE is checked to see with what words it is semantically related.

Table 5.13 shows that 459 accessible words are added to the data after the final procedure of data checking (The form similarity scores of some word forms are below the cut-off point of 0.25 for formally accessible words, but are kept in the data for reasons stated above). Table 5.13 also shows the distribution of the added accessible words across the third to ten frequency levels. It can be seen that the added words are relatively evenly distributed with only a slightly bigger number of words added to the tenth 1000 frequency band.

Table 5.13
Number of added accessible words to the first ten 1000 word families

frequency level	1st 1000	2nd 1000	3rd1000	4th1000	5th1000	6th1000	7th1000	8th1000	9th1000	10th1000	total
number of accessible word families before data checking	3	203	258	263	210	190	169	155	121	125	1697
added numbers	0	1	43	58	62	49	55	60	65	66	459
total	3	204	301	321	272	239	224	215	186	191	2156

Thus after the data-checking procedure, there were 459 word families added to the 1697 accessible word families, the number of words remaining in the data after the use of the form criteria. The total number of accessible word families now rose to 2156.

Table 5.14 shows the distribution of the added accessible words across the broadly and narrowly defined meaning transparency levels. The number of hints added is more than the number of words added in table 5.13 because 6 added words, TELEPHONY, MICROPROCESSOR, CENTIGRADE, SUPERMARKET, SUPERSTRUCTURE, QUADRUPLE containing two parts, were each given two hints and rated twice. A similar pattern can be observed about the distribution of the added hints in comparison with that of the semantically accessible words before the procedure of data checking was used. More hints for the added accessible words were rated as more semantically transparent in relation to the meaning of the known words. What is noticeable is the 189 hints for the added accessible words which were rated at level 2a in terms of meaning transparency. They account for 40% of all the added hints, a much larger proportion than the 29% made up by the original 495 level 2a hints in the total of 1728 before the data checking. The increased ratings at level 2 are partly caused by the inclusion of the derivative forms of the known words whose meanings are closely related to those of the known words. The next biggest numbers of hints are rated at 2b and 3a. The hints rated at the c levels involving the figurative use of the explanatory word are the smallest numbers.

Table 5.14
Number of hints for added accessible words and for the total number of accessible words within the first ten 1000 frequency levels rated at different meaning transparency levels

meaning transparency levels	1	2a	2b	2c	3a	3b	3c	4a	4b	4c	total
number of hints before data checking	73	494	277	51	318	146	52	96	132	78	1717
added numbers of hints	17	189	93	1	67	32	7	31	23	5	465
total	90	683	370	52	386	178	59	127	155	83	2182

As was stated above, after the application of the form criterion, 11 words were deleted and the number of hints dropped to 1717 from 1728. With another 465 hints added now, the total number of hints after data checking is 2182. The meaning transparency level 2a has the largest number of word forms (683), accounting for 31% of the total, which is followed by 2b, then 3a, 4b and 3b. The hints with the figurative use of the explanatory words at levels 2, 3 and 4 are smallest in number.

Again the relationship between the meaning transparency levels of words and their frequency levels of use was examined by taking the ratings of the meaning transparency of the words at frequency level 3, level 6 and level 10 as examples. Again it was shown that there is no relation between a word's frequency level of use and its meaning transparency level, which was the result we obtained when applying the meaning criterion. The only noticeable difference between table 5.5 and table 5.15 is that because more derivative forms were added to the number of words at the tenth 1000 words at the data checking stage, the percentage of the words rated at meaning transparency level 2 for this frequency level is larger than the other frequency levels.

Table 5.15
Numbers and percentages of the hints for the third, sixth and tenth 1000 words at different meaning transparency levels

transparency levels	1	2	3	4	total
numbers of ratings for the third 1000 words	20	147	87	54	308
percentages of ratings in the total	6%	48%	28%	18%	
numbers of ratings for the sixth 1000 words	7	122	77	37	243
percentages of ratings in the total	3%	52%	33%	16%	
numbers of ratings for the tenth 1000 words	3	105	53	33	194
percentages of ratings in the total	2%	54%	27%	17%	

The next two tables (table 5.16 and table 5.17) present the form similarity scores of the added accessible words. The total number of spoken or written form similarity scores is 2182, the same as the number of the hints because for every word that was given a hint, a spoken and a written similarity score was given as well. The largest number of the added word forms has the spoken similarity scores ranging between 0.5 and 0.6, the same as the distribution of the scores before data checking. However, because the form constants were used to select the data, more added word forms have a spoken similarity score between 0.7 and 0.8 and between 0.4 and 0.5 than the ones gathered from the etymological dictionary. In spite of this, the number of added word forms with a spoken similarity score between 0.2 and 0.3 is still high, ranking the fourth.

Table 5.16
The spoken similarity scores for the added words and for the total number of spoken similarity scores when grouped into 10 score categories

spoken form similarity scores	0.9≤s ≤1.0	0.8≤s<0.9	0.7≤s<0.8	0.6≤s<0.7	0.5≤s<0.6	0.4≤s<0.5	0.3≤s<0.4	0.2≤s<0.3	0.1≤s<0.2	0≤s<0.1	total
number of similarity scores across the 10 categories before data checking	20	47	109	283	374	231	246	276	124	7	1717
added number of scores	3	17	66	88	106	62	50	54	19	0	465
	23	64	175	371	480	293	296	330	143	7	2182

Table 5.17
The written similarity scores for the added accessible words and for the total number of accessible words when grouped into 10 score categories

written form similarity scores	0.9≤s ≤1.0	0.8≤s<0.9	0.7≤s<0.8	0.6≤s<0.7	0.5≤s<0.6	0.4≤s<0.5	0.3≤s<0.4	0.2≤s<0.3	0.1≤s<0.2	0≤s<0.1	total
number of similarity scores across the 10 categories before data checking	14	51	165	304	423	288	294	160	18	0	1717
added number of scores	1	25	80	97	105	78	44	29	6	0	465
total	15	76	245	401	528	366	338	189	24	0	2182

It can be seen from table 5.17 that the added words have roughly the same proportion of written similarity scores spread over the ten score categories as the words resulting from the previous procedures. The use of the form constants to select data did not affect the distribution pattern of the written form similarity scores as it did the distribution pattern of the spoken form similarity scores.

Table 5.18
Number of form similarity scores for word forms at the first ten 1000 frequency levels that are rated as easily accessible or inaccessible but remain in the data after data checking

range of scores	≥0.5	< 0.5, ≥ 0.25	<0.25	total
spoken form similarity score	1112	806	264	2182
written form similarity score	1265	833	84	2182

As can be seen in table 5.18, 1112 spoken forms are easily accessed through the spoken form of the known words, accounting for 51%. The inaccessible spoken forms are only 264 out of 2182, making up 12% of the total. The percentage of the easily

accessed written forms is 58%, 7% higher than that of the spoken forms. The percentage of the inaccessible written forms is only 4%, 8% lower than that of the spoken forms. This is a very similar pattern to the result of the applying the form criterion.

Up till now, we have been presenting the meaning transparency levels and spoken and written form similarity scores of the accessible words separately mainly with word form as the unit for counting the rated hints and form similarity scores. The next section will provide the number of easily accessible word families, the word families that can be accessed or the number of word families that can only be accessed with difficulty by taking into consideration both the meaning transparency and the two kinds of form similarity at the same time.

5.6 The easily accessed words

The accessibility of words is judged in terms of their meaning transparency and form similarity (including spoken form and written form) in relation with the known words. The line for being a semantically easily accessible word is drawn at 3a on the scale for measuring the meaning transparency. This means that if words whose hints for showing meaning connection between the known words and the unknown words are rated at 1, 2a, 2b, 2c and 3a, they are seen as being easily accessible in meaning. The words whose meaning transparency in relation to the known words is rated as 3b, 3c, 4a, 4b and 4c are not easily accessed through the known words in terms of meaning.

Words' form accessibility is judged by their spoken form and written form similarity scores. Formally easily accessible words are those whose both spoken and written forms enjoy a similarity score equal to or higher than 0.5. Words whose both spoken and written form similarity scores are lower than 0.5 are regarded as formally difficult to access. The label "formally able to be accessed" is given to the words which have either the spoken or the written form scores equal to or above 0.5 (See table 4.3).

In judging the accessibility of a word family, both the meaning accessibility and the form accessibility were taken into consideration. Three levels of accessibility, easily accessible, able to be accessed and difficult to access, were set up for the accessible words (See table 4.4). The easily accessed words are defined as words with meaning transparency levels of 1, 2a, 2b, 2c or 3a and at the same time with spoken and written form similarity scores equal to or larger than 0.5. Words which are difficult to access

are those that are semantically not easy to access and formally difficult to access. The words labelled as "able to access" have at least an easily accessible meaning or easily accessible spoken form or written form. The following tables provide examples of the words with different levels of accessibility and they give the numbers of words at different accessibility levels on the basis of their meaning transparency first and then on their form similarity and finally on the basis of both .

Table 5.19
Numbers of word families categorized as semantically easy to access and semantically not easy to access

levels of semantic accessibility	semantically easy to access	semantically not easy to access	total
number of word families	1579	577	2156

Table 5.20
Numbers of word families categorized as formally easily accessed, formally able to be accessed and formally difficult to access

levels of form accessibility	formally easily accessed	formally able to be accessed	formally difficult to access	total
number of word families	961	429	766	2156

Table 5.21
Number of the easily accessed words, the words able to be accessed and the words accessed with difficulty and their examples

	number	examples
easily accessed words	739	count/counter; count/discount; count/recount; provide/proviso; provide/improvise; force/fort; force/enforce; force/forte
able to be accessed	1158	view/preview; video/evident; experience/experiment; figure/configure; decide/suicide; introduce/induce
accessed with difficulty	259	committee/transmit; committee/submit; committee/mission; introduction/abduct; introduction/viaduct; market/merchant; market/merchandise; force/reinforce
total	2156	

By the standard set for the easily accessible words, 739 word families can be easily accessed through the known words. 259 words are regarded as difficult to access because their meaning transparency levels are at 3b, 3c, 4a, 4b, and 4c, and their spoken and written form similarity scores are both below the cut-off point of 0.5. 1158 words are labelled as "able to be accessed" as these words have either high meaning transparency or a high spoken or written form similarity score. Take VIDEO/EVIDENT in the example column of table 5.21 for example. The meaning transparency level of EVIDENT in relation to VIDEO is 3b, its spoken form similarity score in relation to

VIDEO is 0.43 and its written form similarity score is 0.57. With the spoken similarity score being below the cut-point, it belongs to the "able to be accessed" category.

When the numbers of words in tables 5.19, 5.20 and 5.21 were calculated, the 26 words (6 were added after the data checking to the original 20 words) that were given hints and form similarity scores twice were counted once by using the higher of the two ratings to decide their grades of accessibility. In spite of this criterion, only two words PRIVILEGE and UNIFORM have two sets of contradictory ratings. In the pair PRIVATE/PRIVILEGE, for example, it has meaning transparency rated at 2b (a special right available to a particular person), and a spoken form similarity score of 0.5 and a written form similarity score of 0.56. However, in the pair LEGAL/PRIVILEGE, its meaning transparency level is 3b, the spoken form similarity score is 0.13 and the written form similarity score 0.30. This word is categorized as "easily accessible" because its meaning can be easily learned through the known word PRIVATE and because more than half of the word form *privi-e* is accessible through PRIVATE. All the other words have two sets of consistent ratings. When the numbers in table 5.20 were calculated, it was found that SUPERSTRUCTURE is the only word with both sets of its form similarity scores being above 0.5. All the rest of the 24 words with two sets of ratings have consistent scores for the "formally able to be accessed" level. When the numbers for table 5.19 were calculated, EQUIVALENT and EQUIVOCAL were found to be semantically easy to access while the other of the 26 words have meanings which are not easy to access through the new words. The 26 repeated words were counted once.

A total of 2156 word families can be accessed through the known words, either the first 1000 or the second 1000 words with various degrees of ease of learning. 1949 (2156 - 204 second 1000 accessible words - 3 first 1000 accessible words) third to tenth 1000 word families can be accessed through the first two thousand words, accounting for about 25% of the 8000 third to tenth 1000 word families.

Table 5.21 shows that 739 (34%) out of the 2156 accessible words are easy to learn with the aid of the known words. The majority of words (54%) can be accessed both semantically and formally through the known words although not very easily. The words which pose great difficulty for learning constitute a small proportion (12%).

When tables 15.19, 15.20, and 15.21 are examined together, it can be seen that 1579 out of 2156 (73%) of the accessible words are easy to learn in terms of meaning and that about 961 out of 2156 (45%) of them are easy to learn in terms of form. This

suggests that more accessible words have easily accessible meaning but not easily accessible form. This results in 739 or 34% of the accessible words being easy to learn.

The easily learned words are quite evenly spread over the second, fifth, sixth and seventh 1000 frequency levels, about 80 words being at each of these frequency levels. Only at the third and the fourth 1000 frequency levels are there more than one hundred easily accessible words. The ninth and the tenth 1000 frequency levels have the smallest numbers of easily accessible words. The percentages of the easily accessible words at the individual frequency levels are quite even, mostly between 30% and 40%. Since analysis of the relationship between the meaning transparency ratings of words and their frequency levels (the third to the tenth 1000) of use above did not show the existence of any relationship between the two factors, the low percentage (23%) for the easily accessible words at the tenth 1000 frequency level is likely to be caused by their low form similarity with the known words. On the other hand, the relatively big percentage (41%) of the easily accessible words at the second 1000 frequency level is related to the high percentage of their high meaning transparency in relation to the first 1000 words (60% of level 2 rating as shown in table 5.6).

In the appendix attatched to the thesis, a variety of examples of the accessed words is presented to show the process of data analysis and the results of the research.

Table 5.22
Number of the easily accessed word families at the first ten 1000 frequency levels

frequency levels	1st1000	2nd 1000	3rd1000	4th1000	5th1000	6th1000	7th1000	8th1000	9th1000	10th1000	total
numbers of easily accessible words	2	85	113	114	93	85	79	65	59	44	739
accessible words	3	204	301	321	272	239	224	215	186	191	2156
percentage of easily accessible words	67%	41%	38%	36%	34%	36%	35%	30%	32%	23%	34%

5.7 The most productive form constants

Table 5.23 contains the twenty most productive form constants. They are productive in the sense that they can combine with other word parts to create a relatively large number of new word forms. These new word forms are easier to access by learners if they are taught the knowledge of these productive form constants. Each one is able to connect at least ten lower frequency words through one known word and one meaning constant. The constants like -posit-, -pos- are counted as one because they share the same meaning constant "put" and have been connected by one known word POSITION and because they might have been subsumed under –pos-. Thus when the number of words accessed by –vers-, -vert- was counted, the words INVERSE which uses the meaning constant "reverse" to be connected and ADVERSE, CONTROVERSY, INVERT which use the meaning constant "opposite" were not included in the number. The words "visit" and "see" were treated as one meaning constant and "sense" and "feel" were treated as one meaning constant, because "see" is the approximate explanatory word for "visit" and "feel" for "sense" (see the definition of approximate explanatory word in the meaning transparency scale).

Table 5.23
Most productive form constants

serial number	form constants	meaning of the constants	number of accessed words
1	-posit-, -pos-	put	21
2	-spec(t)-,-spic-,-scope-,	look	21
3	-vers-, -vert-	turn	19
4	-ceive-, -cept-	take	16
5	-super-	above	15
6	-vent-, -ven-	come	15
7	-sens-, -sent-	sense (feel)	15
8	-sta-, -stan-, -stat-	stand	14
9	-nam-, -nom-, -nym-	name	14

10	-mit-, -mis-	send	13
11	-mid-, -med(i)-	middle	13
12	-pris-, -pre-	take	13
13	-vis-	visit (see)	12
14	-tract-	draw	12
15	-gen-	produce	11
16	-form-	form	11
17	-graph-	write	11
18	-sign-	sign	10
19	-cess-	go	10
20	-ord(i)-	say	10
21	-dict-, -dicate	say	10
total	21	21	286

The average level for meaning transparency was calculated for the 21 form constants by first converting the meaning transparency levels 1, 2a, 2b, 2c, 3a, 3b, 3c, 4a, 4b, and 4c into 10, 9, 8, 7, 6, 5, 4, 3,2, and 1 respectively and then dividing the added values of the meaning transparency levels for the 21 form constants by the number of the ratings. The result indicates that the meaning transparency level of these 21 most productive form constants averages 5.7 which means that the average meaning transparency level is between 3a and 3b. When the meaning transparency levels of the individual form constants were examined, it was found that the words with the forms *–nym-, -nom-, -nym- and –sta-, -stan-, -stat-* have the highest meaning transparency level, all rated at 2a or 2b and that the words with the forms –mis-, -mit- and -pris-, -pre- have the lowest meaning transparency level, all rated at 4b or 4c.

5.8 The use of etymological meanings to connect lower frequency words

Counting all of the data reveals that of the words which have been classified as being accessible through the first two thousand words of English, only 8 accessible lower frequency words are not etymologically connected with the known words: ARRANGE/ARRAY; EDGE/HEDGE; BAND/BANDIT; BASE/BASTION, MIDDLE/MEDDLE, DESTROY/CATASTROPHE, RUB/SCRUB, SECRET/ DISCREET. In contrast with this small number, about half of the accessible words are

etymologically related with the known words but are not connected by using the etymological meaning of their roots. For example, CERTAIN/CERTIFY/ASCERTAIN/ CERTIFICATE is a group of words etymologically related with each other. When giving hints for them, “certain” is used as the meaning constant to connect the unknown words and known word CERTAIN rather than the etymological meaning “to determine”. Other examples include using the meaning constant “aware” to connect AWARD/WARDER/REWARD/WARD/WARY/WARE, etc instead of the etymological meaning “to watch” and using the meaning constant “structure” in the hints for the etymologically related words OBSTRUCT/DESTROY/CONSTRUCT/ INSTRUCT/DESTRUCTION/CONSTRUE, etc, but not the etymological meaning “to build”. About half of the hints for the known words and the unknown words use the etymological meaning of the roots of the words to show the meaning connections. For example, “to go”, the etymological meaning of –cess- was employed as the explanatory word to give hints for words ACCESS/EXCESS/CONCESSION/RECESSION/ ANCESTOR/PREDECESSOR/PROCESSION.

Chapter 6 Discussion

The results of filtering the data by applying the frequency, meaning and form criteria showed that 2156 word families within the first ten 1000 word families could be made easier to remember by revealing their connection to the first two 1000 known words. In the 2156 accessible word families, there are 1949 within the third to tenth frequency bands. Of the accessible words, more third (301) and fourth 1000 words (321) can be accessed by the high frequency known words than the words at the lower frequency levels. In spite of this, the decrease in the accessible number of words at the other frequency levels is not dramatic.

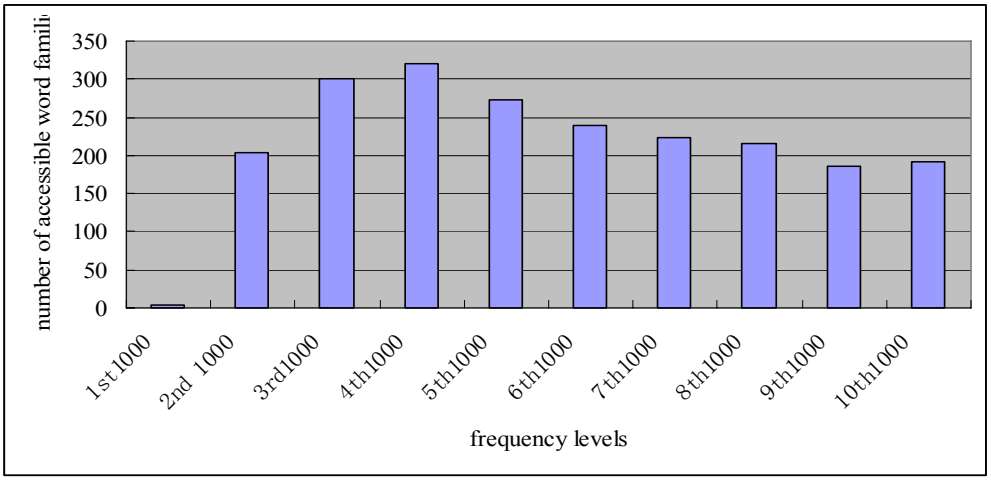


Figure 6.1 Distribution of the 2156 accessible word families over the first ten 1000 frequency bands

More hints for the accessible words were rated at the semantically more transparent levels than at the opaque levels. While 1105 hints for the accessible words were found to be at the high level of meaning transparency (level 2), 365 hints were rated at the low meaning transparency level (level 4). Examined on the narrowly defined meaning transparency levels, hints rated at level 2a include the greatest number of words, followed by level 2b and level 3a. No relationship was found between the frequency levels of words and their meaning transparency levels. The total number of semantically easily accessed words is 1579 out of 2156 word families (the cut-off point was set before level 3b).

Of the 2156 accessible word families, 961 were found to be formally easy to access, that is, both their spoken form and written form similarity scores are above 0.5, whereas 766 word families are formally difficult to access as both their spoken form and written

form similarity scores are below 0.5. When the spoken and written form similarity scores are examined separately, 1112 spoken form similarity scores and 1265 written form similarity scores are higher than 0.5.

The 2156 accessible word familes were finally divided into three categories by taking into consideration both the meaning and form factors. This resulted in 739 easily accessed word families with both high meaning transparency and high form similarity in relation to the known words. The majority, 1158 word families, are categorized as "able to be accessed" as they have at least an easily accessible meaning or easily accessible spoken form or easily accessible written form. 259 word families are difficult to access because neither their meaning nor their form, spoken or written, is easy to learn.

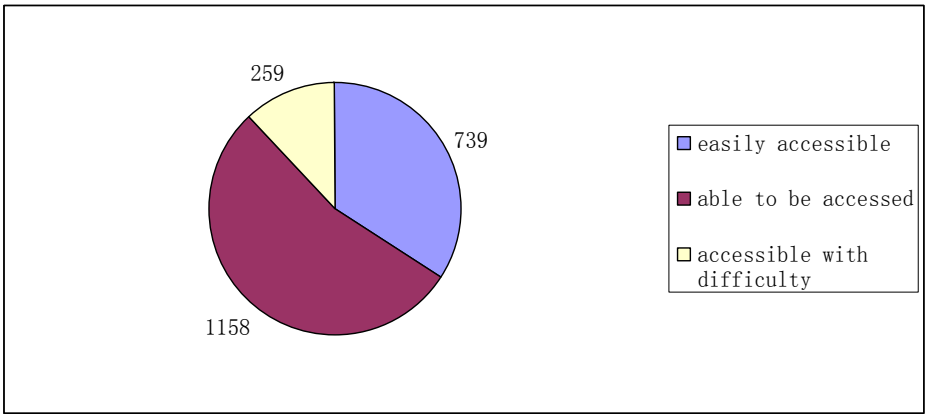


Figure 6.2 Number of word families at the three levels of accessibility

These results indicate that about one quarter (1949) of the 8000 third to tenth 1000 word families can be learned with different degrees of ease through analyzing the root parts of words and exploring the relations between the known words and the lower frequency words. 34% of these accessible words can be learned with a high degree of ease. Thus the results of the study show that the proposed word part technique is potentially facilitative for ESL vocabulary learning in that it can help to lighten one quarter of the learning load. The results indicate that the roots and the interrelations between them are not part of a regular system but need to be used on a case-by-case basis.

Since the relationships between word parts or roots described in the study exist only for some words of the language, and they are not systematic knowledge underlying English language vocabulary, the information about words parts and word relationships provided by the study is therefore expected to be used for learning individual words

rather than the entire vocabulary of the language. The technique should not be regarded as the primary tool for English vocabulary learning, but rather it is a supplement to other teaching and learning strategies to help vocabulary learning.

Direct comparison of the results of this study with those of previous research into the English word roots is difficult due to the disparities in both research aims and methodologies. First, the previous research on the frequencies of the English word roots counted the number of roots and their frequencies of use in a corpus in addition to tracking their origins. The results of the research, however, could provide some guide to pedagogy. The present research uses the term "root" only vaguely when identifying form and meaning constants of a set of words so that the form and meaning of the low frequency words can be connected to that of high frequency known words. The primary aim of the present study is therefore to aid the learning and retention of the unfamiliar English words. Second, the previous educational research into the effects of learning the classical roots on vocabulary learning focuses on using the etymological meanings of the roots to help learners derive the current meanings of words with the roots as a way to enhance vocabulary size. The present research is education-oriented just like the previous research, but it has the different purpose of using the form and meaning similarity between words as a mnemonic to help vocabulary learning. Although no similar study has been done which allows direct comparison with this study, some general conclusions can be drawn about the results of our study. In the following sections, two aspects of the study will be discussed. First, there is discussion of the historical and linguistic factors affecting the number of words that can be accessed through the first two thousand words. Secondly, there is discussion of the limitations of the present research and suggestions for further research.

6.1 The number of the accessible words

Although the present study did not aim to analyze English words from a linguistic and etymological perspective, some inferences can be drawn about the reasons why not a very large percentage of lower frequency words were found to be accessible through the first 2000 words. First, words of Germanic (Anglo-Saxon) origin form the core of the first thousand words of English which we used to access the lower frequency words. According to Roberts (1956), words of Anglo-Saxon origin make up 83% of the first

1000 English words and this drops to 34% in the second 1000 words. Thereafter Anglo-Saxon shows a general decrease until it levels out in the eighth 1000 words at about 30%. Meanwhile the French and Latin elements show a general increase. While less than 20% of the first 1000 words are from French and Latin, about 60% of the second thousand words are found from French and Latin. This percentage never drops and even slightly goes up after the second 1000 through to the tenth 1000 English words. The French and Latin elements are the major input into the English language for the terms of government, law, higher culture and science. In contrast, the high frequency native words, words of Germanic origin, are short concrete words used for everyday communication purposes. The etymological composition of the first ten 1000 words in English determines to some extent that not a very large percentage of the lower frequency words can be accessed by the first 2000 words, especially not by the first 1000 words. The finding that more first 1000 words (476) than second 1000 words (286) are able to access words at other lower frequency levels is partly caused by the principle of giving priority to the first 1000 words when both the second 1000 and the first 1000 words can access lower frequency words.

Second, roots of Italic (French and Latin) origin are more productive in English than roots of Germanic origin (Bird, 1987). Whereas one word of Italic origin can generate 11.6 other words, a word of a Germanic origin can only generate 5.6. One possible reason, according to Bird is the inflecting nature of Italic English as opposed to the isolating nature of Germanic English. Another reason is that Italic English is "less eroded as a result of age and the strong stress accent" compared with Germanic English (p.16). The third reason is that since Italic English has been brought into the English language, directly from Latin and indirectly from French, entering through two channels has given rise to a large number of root doublets like NOUN/NOMINAL, FAITH/FIDELITY. Because the first 2000 words which we used to access the lower frequency words are composed of the highest proportion of Germanic language elements, the roots of the first 2000 words are not very productive and therefore cannot produce a large number of words at lower frequency levels.

Third, the results of the present study may be accounted for by the inference that the roots of the first and the second 1000 words, especially the roots of the second 1000 words of Italic origin may not have strong overlap with those of the lower frequency words. One of Bird's findings is that the number of roots in the first 7476 word types is initially high and becomes rapidly smaller. Thus, there are 139 roots in 356 words of

Italic origin in the first 1000 words in comparison with 57.5 roots in 507.8 words in the second 1000 words. The number of roots diminishes to 10 in 520.3 words of Italic origin in the seventh 1000 words. There is no mention of the extent to which the roots at different frequency levels overlap with each other in Bird's study. However, the overlap must not be considerable because otherwise the same roots may not have generated a much larger number of words at the lower frequency levels of words. Or it might also be possible that there is some degree of overlap between the roots at different frequency levels, but they have generated many more low frequency words than high frequency words.

Table 6.1 Distribution of word roots of the most frequent 7476 words of English according to their origins (from Bird, 1987)

	Germanic	Italic	Hellenic	others
frequency levels	roots / words	roots /words	roots : words	roots : words
1st 1000	234./563.5	139. /356	26./37.5	7./10.5
2nd 1000	88./383.3	57.5/507.8	20./32.3	6./10.5
7th 1000	19./330.3	10./520.3	14./65.3	5./10.5

The results of our study show that more words are etymologically related in the third and the fourth 1000 word families to the first 2000 known words than words at other frequency levels and that after the meaning criterion was applied, the number of semantically accessible words in the third and fourth 1000 frequency bands is still larger than that of words in the fifth to the tenth 1000 word bands. This is probably because the percentage of words of Germanic origin in the third and the fourth 1000 word families is relatively large compared with words of other frequency levels and these words share the same roots with the first 2000 words. It may also be due to the relatively larger overlap between the roots of the third and the fourth 1000 words and those of the first 2000 words as they are all relatively high frequency words compared with the other words in the first ten 1000 word families and thus share more etymological relations. It is not surprising that the smallest number of words etymologically related to the first two 1000 words is in the tenth 1000 words. For one thing, within the tenth frequency band, more words are of different origins from the first two 1000 words; and also, even if some words from the tenth 1000 words come from the same origin as the first two 1000, it is likely that a large number of them do not share the same roots as the words in the first two 1000 words.

The fourth factor is a semantic one. The current meanings of many of the English words have been removed to various extents from the etymological meanings of the roots which constitute the words. The semantic change of words is a subject of historical linguistics which has traditionally classified the change in meaning into several types. Two common types of semantic change are the widening in meaning or the increase in the range of meanings of a word to be used in more contexts, and the narrowing in meaning so that it is appropriate in fewer contexts. Metaphor is an even more common motivator for the semantic change of words. When one thought, object, event or experience is associated with another which is viewed as similar, the meaning of a word is extended to another semantic domain. For example, in CURRENCY, the meaning of "run" is extended metaphorically to express "pass" (CURRENCY is money that passes from person to person). EJACULATE is extended metaphorically to express to "throwing" out a remark. Other kinds of the semantic change include metonymy (a change in meaning from one thing to another with association other than similarity to it), synecdoche (using a part to refer to the whole), degeneration (adding a negative evaluation), elevation (adding a positive evaluation), avoidance of taboo and obscenity (Campbell, 1999). The primary cause of semantic change has been attributed to linguistic and psychological factors as well as historical, social, political, technological, and cultural factors and all other factors related to human life. For example, human thought is believed to be characteristic of the associative patterns which generate new meanings for a word.

On many occasions, words have undergone a shift in meaning to such great extents from their etymological meanings that words with the same root no longer display meaning relatedness with each other. This can be illustrated by our finding that 59%, that is, 1500 out of 2578 etymologically related words which are within the third to tenth 1000 word families can be connected in meaning with the first 2000 words by giving them a hint indicating the connection. Of the 1500 semantically accessible words, about half are linked up in meaning with an explanatory word which is not the etymological meaning of the word root. The word CERTAIN, for example, cannot readily access CERTIFY using the etymological meaning of the root *-cert-* "decide, determine", but they can be connected with the meaning "certain": "to declare that one is certain of sth". Other words like DOCTOR/DOCUMENT/DOGMA/DOCILE show little meaning relatedness with each other anymore.

Another semantic reason for the inability of some lower frequency words to be accessed by the high frequency words is the "safe assumption that the more frequently used a word is, the more likely it is to undergo shifts in meaning from the historical, etymologically based sense" (Kelly, 1991, p.72). Examples of such words are easy to find. DOCTOR is no longer someone who teaches. LITERATURE does not mean acquaintance with letters (*-liter-* means letters) or books. Kelly justified the value of the roots in vocabulary learning by citing the formal and technical words composed of the highly productive Latin and Greek roots such as HOMOPHONOUS, HOMOGRAPHS, HOMOMORPHIC, HOMOCENTRIC, HOMOGENEOUS which are transparent in form and meaning relationship if one is aware of their constituent parts and their meaning. None of the four words, however, can be found within the first ten 1000 word families and it is a safe estimation that the great majority of the formal and technical words are not in the frequency range used in this study. This can be seen as another factor affecting the results of the present study.

Another reason why some words cannot be accessed is the lack of phonological similarity between the lower frequency words and the known words although they are etymologically related. In spite of the fact that PEDAL, PEDESTRIAN etc. with the root *-ped-* meaning "foot" are semantically closely related to the first 1000 word FOOT, they cannot be accessed through the word FOOT because of the phonological changes they have undergone according to Grimm's law. Since /p/ and /d/ in PEDAL or PEDESTRIAN have changed to /f/ and /t/ in FOOT, there is neither spoken similarity nor written similarity between them.

The factors mentioned and discussed so far are not isolated but rather overlap with each other. It is the combination and interaction of them that has led to the result that only 2156 words were accessed through the two thousand most frequently used words.

6.2 The relationship between words' form, meaning and frequency of use

As was mentioned in the literature review, in theoretical morphology, the bound stems with opaque meanings such as *-mit-* in TRANSMIT or COMMIT cause trouble when defining the notion of morpheme. In psycholinguistics, there has been debate about the mental representation and access of such word parts as their meanings are not conscious knowledge of most native users of the English language. This study does not

take an interest in the theoretical arguments, but it does show that quite a proportion of such words cannot be usefully explained with the etymological meaning of the roots, and cannot even be explained by giving another more current meaning of the roots. On the other hand, the results of the present study also provide evidence indicating that quite a number of the words with bound stems are relatively easy to access in terms of meaning in relation to the high frequency words. For example, while SECOND means "following the first", CONSECUTIVE means "following continuously" because the root -*sec*- means "to follow". The exact number of such roots was not counted as it is not what the study aimed to do. However the results can at least show that quite a number of words with bound roots lend themselves to relatively easy learning by employing the meaning of the roots.

The results show that 739 out of 2156 accessible words are easy to learn with the help of the form and meaning information about the known words, accounting for 35% of the total accessible words. When the number of the semantically easily accessed words and the number of the formally easily accessed words were examined separately, it was found that more words are easily accessed in meaning than in form and that the number of the easily accessed spoken forms is smaller than that of the easily accessed written forms. Although this is likely to have been partly caused by the criteria adopted in the research methods, this result can still suggest that part of the semantically easily accessed words do not show form similarity to the high frequency words that is great enough to make them easy to learn. Typical examples of this kind of words include JUDGE/JURY/JURISDICTION/JUDICIAL, NEGATIVE/NEGLECT/NEGOTIATE and SIGN/SIGNIFY/SIGNATURE/DESIGNATE. Previous studies on the pedagogical value of instruction in Latin roots (Carroll, 1940; Barnes, 1942; Otterman, 1955; Shepherd, 1974) were all concerned with the remote connection between the etymological meaning of roots and the present meaning of words and for this reason they called into question the advisability of teaching the roots. Barnes (1942), for instance, after analyzing the results of the test which required students to identify word meanings by using etymological information following instruction on word roots and word meanings, concluded that "the information concerning the root meanings frequently confused the students. When a student was meeting a word for the first time the leap of logic necessary to get from the root to the current meaning was often hazardous" (p. 611). While the elusive meaning connections between words are an important factor that makes the analysis of word roots as a learning technique unable to

be applied to some words, it should be noted that the form divergence between words is another important factor that cannot be neglected when researching the word part technique. The results of the research show that the word form, especially spoken forms of the root parts of words show variations from each other due to the shift of stress and the process of affixation in addition to historical factors. Another interesting observation in the study is that more frequently used words are more subject to form change. The examples are not difficult find. VOICE, the high frequency word, is different in form from the root form of the rest of the etymologically related lower frequency words: ADVOCATE, VOCAL, VOCABULARY, EQUIVOCAL, EVOCATION; CLEAR is a variation of -*clar*- as in the lower frequency words CLARITY, DECLARE, CLARINET, CLARET. Putting this observation together with Kelly's (1991) assumption that more frequently used words tend to show greater semantic change leads to an equally safe assumption that more frequently used words experience and demonstrate more change to the etymologically based form and meaning.

In spite of this, the rating of the second to the tenth 1000 accessible words on the meaning transparency scale does not indicate any relationship between the level of meaning transparency of words and their frequency levels of use.

Becker, Dixon and Anderson-Inman (1980) produced 800 high frequency morphographs which contain the root forms which appear in 10 or more words in their 25,782 word corpus and therefore were recommended by the authors as the focus in vocabulary instruction. The most productive form constants sorted out by this study are all included in Becker et al's (1980) list. Because the accessible words are limited to the first ten 1000 words in this study, the order of the productive form constants according to the number of words they can access is not totally the same as that of frequently occurring roots in Dixon et al's study. In their study, for example, -*sta*- is the most frequent root while -*pos*- is more frequent than -*sta*- in our research. In addition to the factor of frequency of use, we took into consideration the meaning accessibility and the form accessibility of these root forms. The analysis of the meaning and form factors shows that the words with these root forms are not difficult to access through the high frequency words.

6.3 Limitations and further research

When assessing the degree of learnability of the accessible words, the threshold criteria were use to select words for three different levels of learnability. The threshold scores for the easily accessible spoken and written forms of words were set at 0.5 and the threshold level for the meaning transparency of words was set as 3a. Words whose two form scores and the meaning transparency levels meet the threshold were categorized into the highest degree of accessibility or ease of learning whereas when neither the two form scores of the words nor their meaning transparency levels reached the threshold, they were regarded as words difficult to access or words with a low level of accessibility. The rest of the words are those that can meet at least one of the threshold criteria and were regarded as having a medium degree of accessibility. This accessing system is not necessarily consistent with the ease of learning the students experience in reality. Research needs to be done to come up with an accessing system where the score for each accessible word is a measure of the degree of the ease of learning a word. This probably involves further exploring the relationship between the two factors, form similarity and meaning similarity to find out the role of each factor in learning new English words.

Information about students' reactions to the learning technique needs to be gathered for the purpose of evaluating the technique and improving teaching and learning. This should include the processes of students' using the technique to learn, their feelings about the ease or difficulty of applying the technique and the helpfulness of the technique to their study, and the causes of their feelings and the learning effects. Students' reactions to the hints that are provided to help them access the meanings of new words need investigation in particular. So far it is not clear how students of different language and cultural backgrounds and different proficiency levels respond to the hints and to what extent they find they are helpful for learning.

The third aspect that needs further research is the additional knowledge that is required on the part of teachers to adopt the technique in their teaching. The question is whether teachers with no etymologically and morphologically related knowledge can effectively use the technique to help their students. For many teachers, where the English language is their second language, this question is perhaps even more acute because they do not have as much intuition to draw on as the native speakers. It is also not known whether the information provided in a reference book for teachers

concerning the form and meaning constants, the meaning connections and the explanations about the word relationships and variations in form are sufficient for teachers to use. If it is not, then what further information or knowledge or training is needed by the teachers should be found out.

The study is concerned with the question of how many words can be accessed through the first 2000 most frequent words. All the hints for the higher frequency words were formulated and rated on the basis of the first two thousand words. It is likely that when a third 1000 word, for example, SUSPEND (to hang from) is learned through a first 1000 word DEPEND, it is easier to access the meaning of the fifth 1000 word APPENDIX through it rather than through DEPEND. Similarly, MICROSCOPE, STETHOSCOPE, TELESCOPE are easy to learn from the first 1000 word RESPECT, but after the fourth 1000 word MICROSCOPE is learned this way, the other two lower frequency words will become easy to access through MICROSCOPE rather through RESPECT. The information about the change of accessibility in relation to the sequence of learning is not provided in the study. Further studies may be worthwhile doing to show how learning a lower frequency word through the first two thousand words can better facilitate the learning of other lower frequency words.

One particular interesting and much needed line of research is to compare the efficacy of the keyword method and the word-part technique. As is shown in the above discussion, the two vocabulary mnemonics share several commonalities. While the keyword method is a much researched subject, the word-part technique is rather understudied. Investigating the effects of the word-part technique in relation to the effects of the keyword method and perhaps other vocabulary learning strategies on new words retention can give insights into the advantages and disadvantages of various learning strategies, in particular, the word part technique proposed in the current study. The second part of the thesis will focus on the effectiveness of the word-part technique in comparison with the keyword method and the unstructured learning in learners' recall of the target foreign words.

Part two

Chapter 7 Introduction

The first part of the thesis proposed the word part vocabulary learning technique, which is a mnemonic device based primarily on the interrelationships between the roots of English words. What underpins this learning technique is the idea that the form and meaning similarity between the known words and the to-be-learned words can facilitate the memory of the new words. The word part technique consists of two stages of learning. The first stage requires the learner to identify the form similarity between the new L2 word and the linking word (the known L2 word) in order to establish a form-based association. The second stage requires the learner to recognize the meaning similarity shared by the new L2 word and the known L2 word in order to use the meaning constant to connect the new word. The proposed method can be described as a chain of two links connecting the new L2 word with the known linking L2 word.

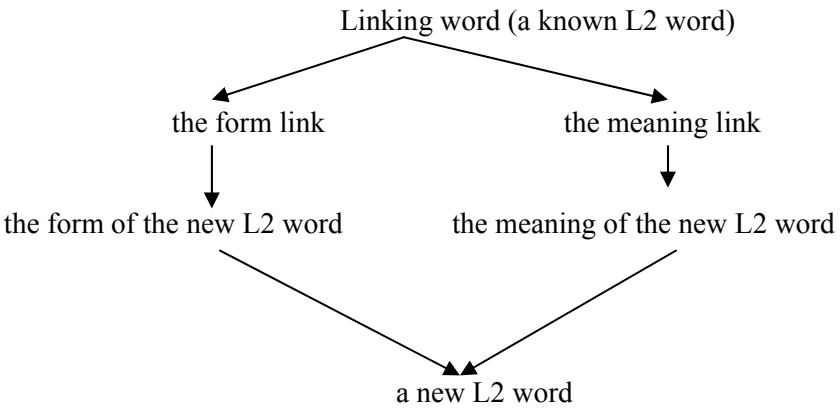


Figure 7.1 The analysis of the word part technique

One vocabulary learning technique that has been repeatedly mentioned in the first part of the thesis is the keyword technique. This vocabulary learning technique was developed by Atkinson (1975) and received special attention in the research on vocabulary learning in the following decades. Numerous studies have demonstrated that the keyword method can facilitate memory of new words because it involves elaborate processing of words at both the sensory and semantic levels (Pressley, Levin, & Delaney, 1982; Pressley, Levin, Kuiper, Bryant, & Michener, 1982; Barcroft 2002, Shapiro & Waters, 2005). The keyword technique divides vocabulary learning into two stages. The first stage requires the learner to associate the spoken form of the new L2 word with an acoustically similar L1 word which is called the keyword. After the sound

connection is formed, the second stage requires the learner to make a mental image to link the meaning of the keyword and the meaning of the L2 word. The keyword method can be illustrated as a chain of two links connecting a L2 new word to the keyword:

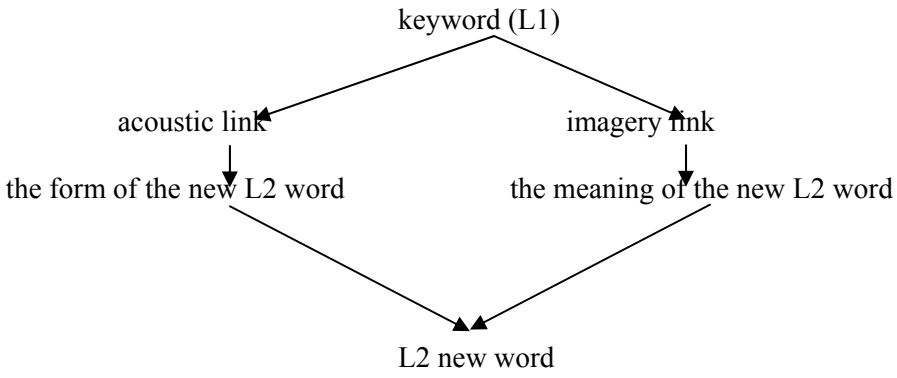


Figure 7.2 The parts of the keyword technique

Parallels can be drawn between the keyword technique and the word part technique. First, both are composed of two critical stages where two links, the form link and the meaning link are formed to connect the known word with the new word. Second, both have a known word as a linking word because it can help the learner make a close form and meaning relationship between the known word and the new word and because the learner's knowledge of the linking word can be made use of. The major differences are: (1) the keyword usually has no etymological relationship with the new word whereas the part of the linking word in the word part method often does, (2) the keyword technique involves a mental image whereas the word part technique involves relating the form and meaning of the root part of a new word to that of a known word, and (3) the keyword is usually an L1 word whereas the linking word in the word part technique is a known high frequency L2 word.

In spite of the similar features shared by the word part technique and the keyword technique, as the review of the literature will show in the next chapter, no research has been undertaken to compare the effectiveness of the two learning strategies in vocabulary learning in the several decades where there has been experimentation with the keyword technique. The second part of the thesis is an attempt to bridge the gap by investigating the facilitative effects of the two learning methods in the learning and retention of to-be-learned foreign words.

In this second part of the thesis, literature on the research into the effectiveness of the keyword technique in comparison with some other vocabulary learning techniques will first be reviewed. The literature review will also includes issues involved in the design of the experiments and the implementing of the experimental procedures. Following this is the description of the research methods for the experiment aiming to compare the efficacy of the keyword technique and the word part technique in helping learners to learn and retain foreign words. The results of the experimental study will next be presented and discussed.

Chapter 8 Literature review

The keyword technique as a mnemonic for vocabulary learning has probably received more attention than any other vocabulary learning technique in the area of vocabulary acquisition research. A great amount of research has been carried out seeking evidence for its effectiveness in comparison with other vocabulary learning strategies, with learners of different ages and individual characteristics and in different learning contexts. It has been demonstrated to be superior over other vocabulary learning strategies including learning a word in context (Pressley, Levin & Miller, 1982; Moore & Surber, 1992; Brown & Perry, 1991; Rodriguez and Sadoski, 2000), rote learning (Avila & Sadoski, 1996; van Hell & Mahn, 1997; Rodriguez and Sadoski, 2000; Sagarra & Alba, 2006), using pictures (Levin, McCormick, Miller, Berry & Pressley, 1982), imaging the meaning of the word (Pressley, Levin, Kuiper, Bryant, & Mitchener, 1982) and semantic mapping (Sagarra & Alba, 2006). The keyword technique has been proven to facilitate vocabulary retention for both children (Pressley, 1977; Pressley & Levin, 1978; Pressley, Levin, & Miller, 1982; Ulanoff & Pucci, 1993) and adults (Pressley & Ahmad, 1986; Desrochers, Wieland & Cote, 1991; Beaton, Gruneberg & Ellis, 1995) and even for the elderly (Gruneberg & Pascoe, 1996). Its facilitative effects have been found for learners with various individual differences (Delaney, 1978; Mullis, 1977; Rohwer, Raines, Eoff & Wagner, 1977; Pressley, Levin, Nakamura, Hope, Bispo & Toye, 1980). It has been shown to be effective in L1 vocabulary learning (Levin, McCormick, Miller, Berry & Pressley, 1982; Pressley, Levin & Miller, 1982) as well as in L2 vocabulary learning (Atkinson & Raugh, 1975; Ellis & Beaton, 1993, 1995; Gruneberg & Pascoe, 1996). The keyword technique has been demonstrated to result in better L2 vocabulary learning in many languages such as Chinese (Wang & Thomas, 1992), English (Elhelou, 1994; Rodriguez & Sadoski, 2000), German (Desrochers, Wieland & Cote, 1991; Beaton, Bruneberg, Hyde, Shufflebottom & Sykes, 2005), Hebrew, Navajo, and Russian (Delaney & Raney, as cited in Cohen, 1987), Italian (Beaton, Gruneberg, & Ellis, 1995), Spanish (Raugh & Atkinson, 1975, Levin, Pressley, McCormick, Miller & Shriberg, 1979; Sagarra & Alba, 2006), Tagalog (Wang, Thomas, & Ouellette, 1992), and Latin (Shapiro & Waters, 2005). The keyword technique has been studied in both laboratory and classroom conditions (Raugh & Atkinson, 1975;

Fuentes, 1976; Pressley, McCormick, Miller & Shriberg, 1979; Brown and Perry, 1991).

In contrast to the large body of research that points to the better effects of the keyword technique on vocabulary learning than other learning methods, a number of studies have produced evidence that shows the limitations of the technique and therefore challenges its superior effects (Hall, Wilson & Patterson, 1981; Johnson, Adams & Bruning, 1985; de Groot, Dannenburg & van Hell, 1994; Beaton, Gruneberg & Ellis, 1995; Wang & Thomas, 1995, 1999; van Hell & Mahn, 1997; Campos, Gonzalez & Amor 2003; de Groot & van Hell, 2005). In spite of the fact that "keyword method effects are pervasive and of impressive magnitude" (Pressley, Levin & Delaney, 1982, p.71), Hulstijn (1997) argues for a balanced view on the mnemonic. He maintains that it should be an addition to rather than a substitute for other learning strategies.

8.1 Research into the efficacy of the keyword technique in comparison with other vocabulary learning techniques

The effectiveness of the keyword technique in vocabulary learning has most frequently been compared with learning new words by using the context, rote learning and unstructured learning (using one's own strategy). More recent research has looked at the combined effects of the keyword technique and one other vocabulary technique. The comparisons of these vocabulary learning techniques have been made both in laboratory settings and in natural classroom settings.

8.1.1 Laboratory studies

Numerous experiments have been conducted in laboratories to find out the facilitative effects of the keyword technique on vocabulary learning. The studies reviewed below are a few examples of this body of research. Some other studies concerning the effectiveness of the keyword technique carried out in laboratories will be reviewed in sections 8.2, 8.3 and 8.4 so that their different focuses can been shown more clearly and discussed more conveniently. The review will give more attention to research into the learning of foreign words using the keyword technique by adult learners.

At the early stage of the research into the keyword technique, Atkinson and Raugh (1975) investigated its efficacy in relation to the self-strategy learning condition. Their subjects were American students who were native speakers of English and had not learned any Russian before. The researchers used the between-subjects design instead of the within-subjects design for the reason that in the latter design, the subjects often used the keyword technique as well in the control condition. The second reason for their choosing the between-subjects design was that if some subjects had studied one Romance language, they would be able to learn some words in the control condition by recognizing the new words as cognates. The research studied the efficacy of the keyword technique in learning the Russian language not only because it was a non-Romance language that is not so closely related to the subjects' foreign language learning experience but also because it contains some frequently used phonemes which the English language does not have. The target words were controlled for their imageability. The keywords were selected by a four-person committee. Before the experiments, the subjects in the keyword group were given instruction in using the technique, a practice session during which they tried to learn ten Russian words by applying the instructed learning method, and a test trial. The control group was told to try hard to remember the Russian words and their provided English translations. Following this, the word learning and testing procedures were completed by the subjects over the next three days and there was a comprehensive test involving all the target words on the fourth day. During the learning procedure, each target word was first spoken and it was presented to the subjects for ten seconds (together with the keyword in the keyword condition). All the tests, including the trial test, the tests on the first three days and the comprehensive test were a Russian-to-English translation task. There was an unexpected delayed test after 30 or 60 days.

The results of the study demonstrated that the keyword technique was highly effective compared with the self-strategy learning on all measures; the mean score of the keyword group in the three-day recall tests was 72% while the mean score of the control group was 46%.

Moore and Surber (1992) contrasted the effectiveness of two vocabulary learning treatments, the keyword technique and learning words in a semantic context, with the outcome of self-strategy learning. In the keyword condition, both L1 translation and the keyword were provided for the target word and the subjects were trained to generate their own images that related the keyword with the target word. In the semantic learning

condition, the subjects were provided with the L1 translation for the target word and three sentences contextualizing the new L2 word. They were instructed how to attend to contextual clues. The control group was only asked to try hard to remember the target word and its L1 translation. The subjects in their study were American first-year, second-year and third-year university students who were learning German as their second language. 10 to 15 subjects were randomly assigned to each learning condition at each level. They were asked to learn 12 nouns and 12 verbs with concrete and imageable meanings. The presentation of the learning material was paced at 25 seconds for each item in order to control time on task. The immediate and delayed post-tests took two forms. One was the English test where the subjects wrote the English translations for the German target words. The other form was a German test where the subjects were asked to fill in the missing word in a sentence. The subjects were informed of the immediate post-test while the delayed test was unexpected.

The major finding of the study was that overall neither the keyword technique nor the contextual learning was more effective than the control for the English test. However, for the first-year and the second-year students, treatments aided learning more than the self-strategy learning in the production of German words in both the immediate and delayed post-tests. The researchers interpreted their results as indicating that the keyword technique or the semantic method is not as effective with more advanced learners as with the beginners because advanced learners may "have developed their own strategies to the point where an additional intervention does not help and might possibly interfere" (p. 292).

In their study, no mention was made about whether pre-tests were taken by the subjects to show whether the target words were new to them or to what extent they knew about the words before they received different treatments. The numbers of subjects in the treatments groups were small. Data analysis for the third-year students could not be done due to the inconsistent pattern of the ordering of groups.

Van Hell and Mahn (1997) conducted two experiments to look at the effectiveness of the keyword technique in comparison with rote learning with 36 experienced foreign language learners and 40 inexperienced language learners. They manipulated the variables of concreteness of the target words, the semantic relationship between the keywords and the to-be-learned words, and test time in addition to the learning experience of the subjects. They also found, as Moore and Surber (1992) did, that the keyword technique was not more beneficial than rote learning with the experienced

learners. Not only were fewer words recalled by the experienced learners using the keyword technique in the immediate and the delayed post-tests than those engaged in rote learning, but also more time was needed by them to recall the translations of the foreign target words. Moreover, the effect of the concreteness of the to-be-learned words was not observed: the concrete words were not better recalled than the abstract words by both the experienced and the inexperienced learners. However, the results showed that when the keywords were semantically related to the target words, learning was effectively aided, particularly for the experienced learners to learn the concrete words.

8.1.2 Implementing the keyword technique in a classroom context

Research was conducted to investigate the effectiveness of the keyword technique relative to other learning methods when it is implemented in a classroom context. Mixed results were found. Pressley, Levin and Delaney (1982) discussed the methodological inadequacies of some studies (e.g. Fuentes, 1976; Willerman & Melvin, 1979), criticizing these studies for the problem of group-by-treatment confounding caused by using intact classes of students as subjects for different treatments. As Cohen (1987) pointed out, the obvious problems with the studies carried out in the natural classroom environment are the interfering elements such as student attention, motivation and subjects' established vocabulary learning patterns.

One of the earliest attempts in this respect was the study of Fuentes (1976) who looked at the possibility of implementing the keyword technique procedures in a classroom context. The second-year high-school students who were learning Spanish were asked to learn 5 new Spanish words a day at their own pace using the keyword technique and their own strategy in their regular classes over a period of six weeks. 10 minutes were given to the subjects to learn the 5 words. The post-test and delayed post-test did not show better performance for the keyword groups relative to the control groups. Fuentes therefore reached the conclusion that the keyword technique cannot be successfully applied to a classroom condition.

Levin, Pressley, McCormick, Miller and Shriberg (1979) expressed doubt about Fuentes' conclusion by pointing out several problems with the design of Fuentes' (1976) study. First, the second-year high-school students may have developed some efficient vocabulary learning strategies of their own. Second, the long learning time available to

the subjects provided opportunity for them to adopt more sophisticated strategies. Third, the target words included various parts of speech, but the keyword technique typically yields better results with concrete nouns and active verbs. Fourth, the long time allowed for learning caused a ceiling effect in their initial learning either in the keyword condition or in the control condition. Finding Fuentes' (1976) conclusion difficult to accept, Levin, Pressley, McCormick, Miller and Shriberg (1979) conducted six experiments to assess the effectiveness of the keyword technique in an actual classroom context. In the first two experiments, second- and first-year high school students taking Spanish courses were instructed in classroom groups to use the imagery-based keyword technique or to use their personal learning strategies (control) to learn the meanings of a list of 50 Spanish concrete nouns. A test followed immediately within the same classroom session to ask the subjects to write down the English translations for the Spanish words. Just as in Fuentes' study, no effect of the keyword technique on the foreign word learning was observed in the first two experiments. In experiment 3, all subjects were tested individually. Also a third variable was added, that is, whether the subjects were allowed to allocate time to each of the target words freely or the learning procedure was paced by the experimenter. Facilitation of the keyword technique was obtained in experiment 3. The superiority of the keyword technique was observed both when the students were paced through the study list and when the students had the freedom to allocate their study time. Experiment 4 was the same as experiment 3 except that the individual administration procedures of experiment 3 were replaced with group administration as in the classroom. The keyword technique was shown to be unsuccessful in classroom application in experiment 4 as in the first two experiments. Experiments 5 and 6 used grade five elementary students as subjects. While experiment 5 administered the keyword technique in small groups, experiment 6 administered it in an intact class. The results of both the experiments demonstrated great facilitative effects of the keyword technique and therefore supported the researchers' speculation about the differences in the subjects. The contrasting results of experiments 1, 2, and 4 with those of experiments 5 and 6 led the researchers to the conclusion that the classroom applications of the keyword technique would bring more benefits to younger learners than to older learners. The different results of experiment 3 from those of the other experiments show the interference of such factors of concentration and motivation.

Sagarra and Alba (2006) compared the effectiveness of three methods of learning vocabulary: rote learning, semantic mapping and the keyword technique. In the rote memorization condition, the subjects were asked to memorize the first language (L1) translation of a new L2 word. To ensure the students' use of the designated learning method, they were told to write and read the word pairs continuously, but not try to find other ways of memorizing them. In the semantic mapping learning condition, subjects were asked to draw a diagram showing the L1 semantic associations of the target word. The verbal version of the keyword technique was adopted which involved relating the new L2 word with an acoustically or orthographically similar L1 keyword and then connecting the L1 keyword with the L1 translation of the L2 word in a sentence. The keywords were generated by the subjects themselves. The subjects of Sagarra and Alba's study were 778 university students who had just begun their Spanish as a second language learning. Both immediate and 3-week delayed post-tests required the subjects to match the target words with pictures. The results of the tests revealed that the keyword technique which requires deeper processing using form and meaning associations was superior in retention. Rote memorization of L1–L2 word pairs was more effective than using semantic mapping. The implication of the results is that using the keyword technique and direct L1 keyword-translation links in vocabulary learning at early stages is more effective than exploring the semantic associations of the new words.

The researchers were careful to enhance the validity and reliability of the experiment. The researcher controlled the length, frequency, concreteness and imageability of the learning material. The pretest was administered to make sure the targets words were new to the subjects. The three different treatments and the target words for each treatment were counterbalanced. The problem with the design of this experiment is the mismatch between the pre-test format and the post-test format. Using a posttest which is different from the pre-test does not allow one to measure the vocabulary knowledge gained through learning.

Recent research into the efficacy of the keyword technique shows interest not only in real classroom situations but also in the effects of the keyword in combination with other learning techniques (Brown and Perry, 1991; Rodriguez and Sadoski, 2000). For instance, the effectiveness of rote learning, the context method, the keyword technique and the combination of context and keyword techniques was investigated by Rodriguez and Sadoski (2000) in real classroom settings. The subjects in their study were 160

students of 8 intact ninth-grade EFL classes in Venezuela. Four 15-page booklets were prepared, one for each treatment condition. For the rote rehearsal condition, the Spanish translation of the English target word was provided. For the keyword condition, a keyword for each target English word was given in addition to the Spanish translation and the English target word. The imagery link was orally presented to the subjects. The booklet for the context method did not provide an explicit Spanish translation of the word, but presented three example sentences of the target words. The booklet for the combined keyword and context treatment condition contained the example sentences and the keywords. After a training session, the subjects studied the target words from the booklets. A cued-recall test which required the subjects to translate the 15 English words into Spanish was given to the subjects both immediately and after a one-week delay. Several steps were taken to increase the reliability of the study. First, two 15-item multiple choice tests were designed to assess the subjects' vocabulary knowledge both in English and in Spanish before the subjects received the treatments. Second, two meetings for the instructors were held to familiarize them with the instructions and procedures. Third, the rate of presenting the new words to the subjects by the instructors was controlled, set at two minutes for each word. Fourth, the researchers exercised statistical control over the effects of both Spanish and English vocabulary knowledge and attribute-by-treatment interactions in data analysis.

The results of this study indicate that the subjects studying under the combined keyword/context condition far outperformed those using the other methods both in the immediate recall test and delayed test regardless of the language proficiency levels. No effect was found for the keyword technique relative to the context and the rote learning conditions. However it was shown that the keyword technique was more effective for students with less than average English vocabulary knowledge while the rote learning method was more effective for students with above average English vocabulary knowledge.

A great amount of research in both laboratory and classroom settings points to the beneficial effects of the keyword method compared to other vocabulary learning strategies and even more beneficial effects of the combined learning techniques. The evidence coming out of the laboratory experiments is more consistent than that of the classroom research concerning the efficacy of the keyword method. Several studies have come to the conclusion that the keyword method is not as effective with

high-proficiency language learners as with beginners (Rodriguez and Sadoski , 2000; Moore and Surber, 1992; Levin, Pressley, McCormick, Miller and Shriberg, 1979).

8.2 Different versions of the keyword technique

Since the introduction of the keyword technique by Atkinson (1975), there has been research exploring the different degrees of effectiveness caused by the different ways of implementing the keyword technique. This is actually an attempt to optimize the learning method.

8.2.1 Imagery keyword technique and sentence keyword technique

When looking at the effectiveness of the imagery version of the keyword technique versus the verbal version, Atkinson concluded on the basis of this pioneering research in 1975 that the imagery version was slightly superior to the sentence version. This conclusion has been confirmed by some of the subsequent studies.

Delaney (1978) investigated the effects of the verbal and visual versions of the keyword technique, and the interaction between the keyword effects and individual differences. A group of university students were first tested on their verbal fluency and visualization ability. Then forty-eight subjects were selected for participation in the experiment on the basis of their performance on psychometric tests. Three different treatments were compared. The first was the control condition where subjects were instructed to learn the English translation of Malay words as in a standard word-pair learning experiment. The second was the verbal keyword condition where subjects were asked to think of verbal relationships between the foreign language word and the given English translation by constructing a phrase or sentence to connect the two words. The third was the visual keyword condition in which subjects were asked to generate a mental image of the referents of the keyword interacting with the English translation to help them remember the association between the two words. The verbal keyword technique produced greater facilitative effects for students with high verbal fluency ability than the visual keyword technique whereas the visual keyword technique produced better results for students with low verbal fluency ability. The low verbal fluency group that received instruction on the visual keyword technique performed

better than any of the other groups involved in the ability-treatment interaction although the difference between the groups did not reach significance.

In Pressley, Levin and Miller (1982), imagery and sentence versions of the keyword technique of vocabulary learning were contrasted with three contextual learning methods and the control condition. In the Imagery Keyword condition, the subjects were presented with the target word with an underlined keyword. Then they were told to learn the meaning of the target word by forming a certain image which related the target word and the keyword. In the Sentence Keyword technique, the students were told to work out meaningful sentences which related the keyword and the target word. The three contextual learning methods were the Sentence Provided (the subjects were asked to learn from provided sentences which contained the target words), the Sentence Generate (the subjects were expected to learn the target word by generating a sentence which contained the target word), and the Sentence Judgment (the subjects learned a target word by judging whether the usage of the target word was correct in a provided sentence). In the control condition, the subjects were instructed to try hard to remember the meaning of the target words. In all the learning conditions both the target words and definitions were presented to the subjects on cards with the presentation of each card paced at 10 seconds.

The subjects of their experiments were American university Psychology students. They learned 32 very low frequency English words. After the words were studied under different learning conditions, a self-paced vocabulary test was taken by the subjects. Three marking criteria, a strict, an intermediate and a lenient scoring system were used to assess the subjects' answers. The results of their study show that subjects' retention of definitions in the imagery keyword condition was substantially superior to the other four learning conditions. The sentence keyword version was not as effective as the imagery keyword technique. However, when the lenient scoring system was applied, the benefits of the sentence keyword version became significant. The advantage of the imagery keyword technique in vocabulary learning over the sentence keyword technique could be seen although the difference in effectiveness of the two was not significant. The benefits of the three contextual learning methods were statistically negligible when compared with the control condition.

As Cohen comments in his 1987 review, the success of the visual version of the keyword technique depends in part on the words used as target words in the experiments. For some abstract words which are more difficult to associate with a

picture, the advantages of the imagery keyword technique will not be shown. This is the reason why in Pressley, Levin and Miller's (1982) study of fifth-grade school children learning Spanish words, the sentence keyword technique and the imagery keyword technique were equally effective in learning concrete words. In contrast, the verbal keyword technique was more successful for abstract noun learning. The success of the visual version of the keyword is also related to the individual factors such as verbal and visual ability as shown in Delaney (1978).

8.2.2 Self-generated keyword or experimenter-provided keyword

A group of studies examined the facilitative impact of experimenter-provided versus learner-generated keywords and/or definition links. More consistent findings have been reported with children's performance in vocabulary learning than with adults' when various versions of the keyword stage and the imagery-link stage are manipulated. Young children typically obtain more benefit from keywords and imagery interactions provided by the experimenter than older children due to the different cognitive development stages they are experiencing. Pressley and Levin (1978) asked second- and sixth-grade subjects to learn Spanish nouns using the keyword technique. Three variations of the imagery-link stage were used. One was an experimenter-provided interaction condition where the subjects were shown drawings of the keywords and the English translation referents interacting. The second variation was a word control condition where the subjects were provided with only the printed keywords and their translations without pictures, and they had to create not only their own images for these words but also the interactions between the images. The third variation was the subject-generated interaction condition in which the subjects were shown the separated drawings for the keywords and for the translation referents, but the subjects needed to generate their own linking images. The results of their study showed that second-grade keyword users under the interactive picture condition learned more vocabulary items than those who were given separated pictures to generate their own imagery links. Second graders in the word control condition remembered fewer items than both picture-provided groups. In contrast, the performance of the sixth graders in the three imagery-link variations did not show significant differences. The results point to the conclusion that it is necessary to provide young children with interactive pictures in order for the keyword technique to be effective with them because they have not yet

developed imagery generation ability and imagery mnemonics ability. Older children benefited equally from any of the variations at the imagery-link stage. This finding is supported by later studies such as Levin, Shriberg, Miller, McCormick, & Levin (1980); Shriberg, Levin, McCormick and Pressley (1982); and McGivern and Levin (1983).

Mixed results have been produced from research into adults' learning of foreign vocabulary by employing variations of the keyword technique. Hall, Wilson, and Patterson (1981) confirm Raugh and Atkinson's (1975) assertion that keywords provided by the experimenter are more effective than those generated by participants. In their first experiment, they examined the effectiveness of the two keyword conditions, namely, keyword generated and keyword provided in relation to a control condition in which the subjects were asked to learn 30 Spanish words by using strategies of their own choice. The means for the recall of the English equivalents for the target Spanish words were 24.41 for the keyword provided condition and 17.94 for the keyword generated condition in the immediate paired-associate test, a significant difference in effectiveness between the two learning conditions. A further examination of the self-reports of the keyword generated group revealed that keywords were not generated for 20% of the target words due to the difficulty involved in generating an appropriate keyword. The deficiency of the keyword generated group was caused by keyword generating, not by finding functional links between the keyword and the target words. What is noteworthy is that in the one-week delayed recall test, it was observed that the subjects in the keyword generated group forgot fewer items relative to the keyword provided and the control group, suggesting a better effect on long-term retention with the keyword generated method than the keyword provided method. This line of reasoning was taken up by Wang, Thomas, and Ouellette (1992) and Wang and Thomas (1995) when they discussed the research findings that long-term forgetting was greater for subjects instructed to use the keyword technique than for learners engaged in rote rehearsal. They hypothesize that letting subjects generate their own keywords may be superior because the self-generated keywords "are less prone to the interference from pre-experimental associations" (Wang, Thomas & Ouellette, 1992, p.527) coming from the experimenters' modes of coding.

Contrary to Hall et al's (1981) and Raugh and Atkinson's (1975) findings, Pressley, Levin, Nakamura, Hope, Bispo, and Toye (1980) reported that in the learning of 30 concrete Latin words, there was no significant difference between the college-age subjects' recall of the English translation of the Latin words with the provided keywords

and the subjects who had to generate their own keywords. However, it was found that providing keywords led to more spelling errors of the Latin words when the spelling of the syllables of the provided keyword was not identical to that of the corresponding Latin word.

Advantages and disadvantages of having the keyword and/or the image supplied by the experimenter have been discussed by some researchers. One possible advantage is that the learners are spared the trouble of devoting much time and energy to devising the keywords (Cohen, 1987; Pressley, Levin & Delaney, 1982). The disadvantage is that learners may "find it difficult to identify keywords as effective as those identified by the experimenter" (Campos, Amor & Gonzalez, 2004). For older children and adults, the learning results are at least equally good when they are asked to generate their own keywords and interactive images as when they are supplied with the keywords and linking images (Cohen, 1987). However, the advantage of generating one's own keywords and images will be reduced by the increase in difficulty and complexity of the generating task. The learners might find themselves unable to deal with the task of coming up with their own interactive images for the target words which do not lend themselves to readily generated images (Pressely, Levin & Delaney, 1982).

8.3 Qualities of the keywords

The research into the effect of the keyword qualities is also part of the effort to optimalize the keyword technique. Raugh and Atkinson (1975) conducted four experiments in which they varied the control procedures to evaluate the efficacy of the keyword technique in learning Spanish words with respect to the quality of the keywords. In experiment 1, the subjects in the experimental group were taught the keywords first and then were asked to form an imagery link between the keyword and the English translation of the Spanish words. In experiment 2, the subjects in the experimental group were not taught the keywords first, but went straight to the vocabulary learning by applying the imagery keyword technique. In both of the experiments, the subjects in the control condition were told to learn the target word by rehearsal. In experiment 3, the experimental group used the keyword technique while the control group was permitted to use any vocabulary learning strategy except the keyword technique. In experiment 4, a free choice condition was added to experiment 3.

This condition allowed the students to use any method to learn the words and keywords were provided when asked for. Several conclusions were drawn from the results of the experiments about how to optimize the keyword technique: 1. Provided keywords work better than self-generated ones especially when the learners are not familiar with the phonological system of the target language. 2. It is more effective when the learners generate the imagery link for themselves than when they are asked to use a provided one. 3. A good keyword is the one that bears enough similarity in sound with the target word so that the target word will not be confused with the other target words. Using a keyword that approximates all the sounds of the target word very often means that several L1 words have to be included to form the keyword. This will make it difficult to generate a simple and striking image to link up the meaning foreign word with the keyword.

They propose the following criteria for choosing a keyword. First, the keyword sounds as much possible like the foreign word, but it does not necessarily sound like the entire word. This means that the keyword can resemble any part of a foreign word in sound. It also means that the keyword can contain more or less phonemes than the foreign word.

Second, the keyword should help to easily form a memorable image that links up the keyword and the meaning of the target foreign word. According to this criterion, concrete nouns or abstract nouns with easily located symbolic imagery are better to satisfy this criterion as they conjure up images in people's minds. In addition, a keyword must also be easily imaged in relationship with the meaning of the foreign target word. Thus, this criterion is aimed at making the imagery link simple.

Third, the keyword should be different from the other keywords devised for the other target words in an experiment. This means that a keyword should not be repeated in the learning on the same day, but can be used for different words on different days.

When Ellis and Beaton (1993) evaluated the keyword technique, repetition and the own strategy conditions by asking the English as L1 university students who had never learned German to memorize German words, they demonstrated that when the keyword was a noun, the keyword technique was superior to the own strategy condition. When the keyword was a verb, however, the subjects in the keyword group performed consistently more poorly than all the other three learning groups. They also showed that more nouns (68%) were learned than verbs (53%). They explained these results both as an effect of part of speech and as an effect of imageability. For one thing nouns "have

an existence independent of what happens to them or what they "do" while verbs are "inherently less "meaningful" in the sense that verbs require agents for their execution" (p.550-551). Since nouns were rated by the subjects as more imageable than the verbs, it could be the imageability effect which made nouns more meaningful. They argued that imageability and meaningfulness are "different ways of looking at the same thing".

In a more recent study by Beaton, Gruneberg, Hyde, Shufflebottom and Sykes (2005), they reexamined the effectiveness of the keyword technique by employing high quality keyword images – the keyword and foreign target word overlap as much as possible in pronunciation and spelling; the keyword images involve active interaction between the L1 translation and the keyword. They asked independent judges to rate keyword images in terms of their memorability. It turned out that both noun keywords and verb keywords were able to generate high quality keyword images as well as low quality keyword images. The results of their study show that when the quality of the keyword image is adequate, the keyword technique leads to better receptive and productive recall than a poor keyword images condition or rote learning. Thus the conclusion of their 1993 study that noun keywords are more beneficial than verb keywords was extended to mean that the nature of the keyword image is critical in determining the efficacy of the keyword technique.

8.4 The role of imageability of the to-be-learned words

Another concern of the researchers who investigate the efficacy of the keyword technique is the effect of the imageability of the target words. Shapiro and Waters (2005) investigated the degree of cognitive engagement and visual encoding as possible sources of the effectiveness of the keyword technique. The teaching material included 15 high-imagery value Latin words and 15 low-imagery value Latin words which did not contain similar parts to English words or words of other Romance languages. The learning material was prepared by asking 48 pre-test participants to rate the imagery value of each target word on a 7-point scale. In the experiment, the subjects were asked to memorize the 30 target words with two versions of the keyword techniques, the Self-Generated condition that required greater cognitive effort because the subjects had to generate their own keywords and interactions, and the Given condition which required less cognitive involvement because both the keywords and the interactions

were provided for the subjects. No significant main effect of processing strategy or interactions between imagery value and processing were found in either the immediate or the delayed post-tests. However, a strong effect of imagery value level was found in both post-tests. The keyword technique worked better with high-imagery words. The subjects successfully recalled 79% of the high-imagery words in the one-week delayed test. The results indicate that the effectiveness of the keyword technique is based on a visual image.

Their conclusion that "the use of visual imagery is a fundamental underpinning of how the keyword technique works" (p. 140) has been confirmed by the results of Desrochers, Gelinas, and Wieland (1989) and Campos, Amor and Gonzalez (2004). For example, in Campos et al's (2004) study, they observed that the keyword technique appeared to be effective for words with high image vividness but not for words with low image vividness. In Experiment 1, a sample of 363 high-school students was randomly divided into four groups. The subjects were required to learn L1 equivalents of a list of 16 Latin words (8 with high image vividness, 8 with low image vividness), using the rote method or the different versions of the keyword technique. Experiment 2 required the subjects to learn 16 high-vividness and 16 low-vividness Latin words. In the immediate post-test and the one-week delayed post-test, recall for the high-vividness words was significantly better in the keyword groups than the rote method group in both experiments. Learning method had no significant effect for low-vividness words.

Contradictory evidence, however, has also been produced showing that the ease of learning concrete words is not magnified by the keyword technique and that concrete words are learned equally more easily than abstract words by using other vocabulary learning strategies. As mentioned above, van Hell and Mahn's (1997) study does not demonstrate any advantages of using the keyword technique to learn the concrete words over rote rehearsal. Their finding is consistent with Delaney (1978) when he examined the roles played in retaining foreign words by such variables as the imageability level of the target words, individual differences, and the versions of the keyword technique. He used American university students as the subjects and 12 high-imagery and 12 low-imagery Malay words as the target words. He concludes that the subjects did not benefit more for concrete words from the keyword technique than from the standard word-pair learning method.

8.5 The effect of pacing the learning

As Cohen (1987) pointed out, the general problem found in the research comparing different vocabulary learning techniques is that learners tend to deviate from the learning techniques they are supposed to use (Ott, Blake & Butler, 1976; Bellezza, 1981; Hall, Wilson, and Patterson, 1981; Ellis & Beaton, 1993). For example, Bellezza (1981) reports that whereas 66% of the subjects used the technique they were instructed to use in one study, only 25 used the one they were required to in another. However, 39% of the subjects in the control group used the strategy which was supposed to be used by the experimental group. Ellis and Beaton (1993) also pointed out the interesting phenomenon that learners were actually using several learning strategies at once. They found that some learners in the repetition condition had both repeated the words and formed imagery associations to help them remember the words. The combination of two learning strategies was the reason for the subjects in the repetition group to be able to remember words more accurately.

As is shown in the studies reviewed above, the problem of subjects deviating from the expected learning technique is usually dealt with by pacing the learning process in an experiment in order to reduce the subjects' chance of allocating different amounts of time to different words and using the techniques they are not supposed to use. The results of pacing the study procedure, however, are mixed. Levin, Pressely, McCormick, Miller and Shriberg (1979) observe the superior effects of the keyword technique over the control condition in both paced and unpaced presentation of the target words. On the other hand, Hall, Wilson, and Patterson (1981), after systematically manipulating the pacing variable when they assessed the effectiveness of the keyword technique in relation to the self-strategy learning condition, concluded that "the keyword technique might be a powerful enough study strategy to prove superior when self-generated strategies are restricted by rigidly paced presentation" (p. 356). They speculated that when the items for learning are presented in an unpaced way, the subjects will have all of the learning material simultaneously under their own control and will be able to apportion different amounts of time to each word under study and restudy each word with different frequencies. More importantly, the unpaced presentation can increase the possibility of smart students finding more sophisticated and more effective learning strategies for themselves rather than being restricted to repeating the learning material. Cohen (1987) believes that some subjects will deviate from the experimental

instructions regardless of how they are instructed to learn. This is determined by their individual learning styles. Therefore some learners will resort to a mnemonic even if they are required to do rote-learning while others will still use a verbal mediator even if they are instructed to use visual imagery. "More able and/or older learners may have developed more sophisticated and effective cognitive strategies which would in turn be of benefit in learning vocabulary through the use of mnemonics" (p 49).

8.6 Testing the knowledge gained about words using the keyword technique

Knowing an English word involves knowing several aspects of knowledge about the word including its form, meaning and use, and both receptive and productive knowledge. As can be seen from the above review, assessing the effectiveness of the keyword technique in the studies comparing it with other learning techniques is mainly based on data obtained from testing the subjects' recall of the definition of a foreign word. Some research has looked at learners' productive knowledge by asking them to produce the target words after they learned them using the keyword technique (Gruneberg & Pascoe, 1996; de Groot, Dannenburg & Van Hell, 1994; Beaton, Gruneberg, Hyde, Shufflebottom & Sykes, 2005). A few studies have assessed the subjects' memory of vocabulary pronunciation (Fuentes, 1976), spelling (Pressley, Levin, Nakamura, Hope, Bispo & Tyes, 1980), comprehension, usage (Pressley, Levin & Miller, 1981) and recognition of the words they learned (Merry, 1980).

Two studies have involved testing subjects' associative recognition of the target words, that is, subjects being asked to pick out the target word from a word list which corresponds in meaning to the provided definitions. In Merry's (1980) study, it was found that children using the keyword learning method performed better in associative recognition of French vocabulary words, relative to both own-strategy and repetition control groups. As Pressley, Levin and Delaney (1982) comment, Merry's study has two problems with its design. First, the vocabulary recognition task was administered after the definition recall task from which some information might be carried over to the recognition test. This makes it difficult to determine how much of the facilitation was due to the learning effects. The second problem is that the recognition test did not contain distractors. Therefore it could be regarded as an inversed procedure of a recall test. The simple test could cause a ceiling effect.

Pressley, Levin, Hall, Miller and Berry (1980) avoided the problems in Merry's (1980) study by testing the subjects only for associative recognition of the target foreign words and by giving each of the target foreign words a distractor word. The distractor items had the same keyword syllables as the target words. Performance of the subjects of the keyword group in the target word recognition test was comparable with those of the control group, showing that the use of the keyword technique did not facilitate, nor did it depress correct backward associative recognition. However, the keyword subjects selected the distractors more frequently than did the control subjects.

Both Merry (1980) and Pressley at el. (1980) used a recognition test to look at the subjects' receptive knowledge of the target words. Recognition/recall is a distinction affecting the difficulty in learning a word. Recognition test items are easier than recall items when the distractors are not very close in form and meaning to the target word because they do not require comprehensive and/or in-depth knowledge about words to give a correct answer (Nation, 2001).

L2 to L1 translation is used by most researchers to test the subjects' receptive knowledge of the form and meaning connection of the target words. As can be seen from the above review, a large number of the studies use only one criterion to judge the correctness of the subjects' answers in the tests. Some studies have adopted two or three criteria, usually more lenient criteria and more strict criteria to mark subjects' L1 translations for the target words so that the strength of knowledge gained can be evaluated. For example, when Pressley, Levin and Miller (1982) compared the imagery version and the verbal version of the keyword technique with the contextual learning conditions, they tested the subjects' recall of the form-meaning connection of the target words by requiring them to write down as much of the definition as they could remember. Three scoring systems with different degrees of tolerance for the accuracy of the definitions of the target words were used in order to see how much partial definition could be recalled for a word for the different treatments. The strict scoring system counted the complete definition as correct. The intermediate scoring system accepted a definition which spells out the essence of the meaning of a target word. The lenient scoring system gave credit to a fragment of the meaning. This test which involves a scale of accuracy is a way of measuring of the strength of the knowledge of the previously learned words.

The problem with a large number of studies exploring the efficacy of the keyword technique is using only one test to evaluate the results of vocabulary learning. Nation

and Webb (2011) give two reasons for using multiple tests to test the same words. One reason is that using more than one test makes it possible to measure the different kinds of knowledge gained about the words. The other reason is that this practice is able to measure the strength of knowledge gained about the words. Even if the different types of tests focus on the same aspects of vocabulary knowledge and correlate with each other to a reasonable degree, there is still a substantial amount of difference in the outcomes of these tests. They can reveal different dimensions and different degrees of knowledge gained about the target words (Nation, 2001). Nist and Olejnik (1995) designed four tests to measure the subjects' vocabulary knowledge: writing an illustrative sentence, completing sentences by filling in blanks, multiple-choice items for identifying basic definitions and more detailed meanings of words. The correlations between the tests were all less than 0.7, showing that it is likely that different aspects of vocabulary knowledge of the same words were being tested. The lack of high correlation between the four types of tests indicates that using multiple tests for the same words is able to provide a more comprehensive and precise picture of the learning outcomes.

8.7 Implications of the literature for the present research

The above review of the literature on the study of the keyword technique brings to attention some issues that should be taken into consideration in the research design of the experiments. First, research can use different versions of the keyword technique such as the imagery keyword technique or the verbal keyword technique, the experimenter-provided keyword or the self-generating keyword. Second, researchers argue about the use of the between-subjects design or within-subjects design in order to avoid certain confounding effects. Third, the quality of the keyword and of the interactive image created about the keyword and the target word may affect the learning effects. Fourth, multiple tests should be used to test subjects' knowledge of the target words in different depths and aspects. Fifth, variables such as study time, learning procedures, and learning environment need to be controlled to ensure the validity and reliability of an experiment.

Also the review of the literature on the investigation of the effectiveness of the keyword technique in vocabulary learning relative to other learning techniques reveals a

gap in research. No study has been carried out to compare the efficacy of the keyword technique with that of the word part technique although a large amount of research has compared the keyword technique with learning from context, semantic learning, rote learning and learning with one's own strategy. As was already mentioned, the word part technique and the keyword technique have several parallels. Not only do the procedures of using the two methods have common features, but they are also based on the same theoretical assumption that more elaborated processing results in better retention of the words being learned. An investigation into the efficacy of the word part vocabulary learning method in comparison with the keyword technique will add to the knowledge of the advantages and disadvantages of using different vocabulary techniques in foreign vocabulary teaching and learning. The current research attempts to investigate the effectiveness of the word part technique relative to the keyword and the self-strategy learning conditions, taking into consideration the high- and low-imageability words and different test formats. It aims to seek answers to the following questions:

1. What are the relative effects of the three learning conditions?
2. Do the different test formats yield different retention scores in the three learning conditions?
3. What is the effect of the imageability level of a target word on vocabulary learning in the three conditions?

Chapter 9 Research design

The research is designed to assess the effectiveness of the word part technique in English word learning retention in relation to the keyword technique and self-strategy learning. The effects of the imagery levels of the target words as well as the test formats will also be investigated in the learning of English vocabulary in the three conditions.

9.1 Subjects

The subjects are 121 year-one university students in China. Although they come from 3 departments of one university, they have similar learning experience and proficiency levels. They learned English as their foreign language for six years as a compulsory course at middle school. They passed the university entrance examination three months previous to the data gathering and were admitted into the university. At middle school, they had been taught to read simple English texts, listen to short everyday conversations and stories and write simple short passages according to the national curriculum for EFL teaching. The national curriculum requires that students should know about 3,000 lemmas by the time they graduate from middle school. However, it is reasonable to estimate that their vocabulary knowledge has not reached that goal. This estimation is based on two facts. First, because they are majors of natural sciences, their English scores at the national university entrance examinations are generally not as good as those who are allowed to major in English. Second, because the university is not a key university but a third level university, their English proficiency levels are even lower than the non-English majors at key universities.

These subjects are all native speakers of Chinese. They have had no opportunity to be exposed to another foreign language. There is no instruction on vocabulary learning strategies either in middle school or in university.

9.2 Material

The preparation of the experimental material involved two procedures. Fifty words were initially selected by the experimenter for further examination. These words satisfy the following criteria:

1. They are rated as easily accessed words by the present study so that they are suitable for learning using the word part technique. This criterion makes sure that the selected words are optimal for the word part technique in terms of retention.

2. Pairs of words where the new words and the known words are related to each other in terms of affixes were excluded. For example, "sinful", a 9th thousand word, was not selected as a to-be-learned word because it is related to the high frequency word "sin" by affixation by adding the suffix –ful rather than through the root of the word.

3. Their frequency levels are mainly between the seventh 1000 and tenth 1000 so that they are highly likely to be unknown by the subjects. The selected words were not found in their text books. Some higher frequency words were included like "hedge", "transact" because these words are not close to the life of the subjects and they are not likely to be known by them.

4. Part of speech was controlled as there is evidence that a wide of variety of grammatical classes may reduce the effectiveness of the keyword technique. Only nouns and verbs were selected. Words of different parts of speech may have different levels of concreteness and imageability, and therefore different levels of learnability with the keyword technique.

5. Roughly half of the words were considered by the experimenter to be easy to visualize and the other half difficult to visualize.

6. The lengths of the words were controlled. All the target words have one to three syllables.

The second procedure of preparing the learning and testing materials was asking 13 native speakers to rate the words on a seven-point scale for degree of imageability, ranging from 0 (very difficult to visualize) to 7 (very easy to visualize). Before ranking the experimental words, they were told that nouns like "car" or "table" and verbs like "kick" or "grab" have high imageability while nouns like "soul" or "comparison" and verbs like "emancipate" or "rate" had low imageability. 10 words with the highest ratings and 10 with the lowest ratings were selected for use in the experimental study. The mean for the 10 high-imageability words chosen for the study was 5.68, with a

range of 5.08-6.62. The mean for the 10 low-imageability words was 1.95, with a range of 1.45-2.46. The difference between imagery sets is statistically significant ($t(14.4) = 16.55$, $p < .0005$).

The terms "imageability", "concreteness" or "abstractness" were all used in the literature review and will be used in the discussion. High imageabilty tends to coincide with concreteness because "words easy to imagine are usually words that refer to concrete entities and words hard to imagine usually refer to abstract entities" (de Groot, 2006, p. 473). The correlation *r* between word imageablility and word concreteness was 0.83 in Paivio, Yuille, and Madigan's (1968) study and the correliation *r* was 0.96 in de Groot's (1989).

The keywords for the 20 target words and the imagery interactions between the referents of the keywords and the target words were devised by the experimenter. The keywords have at least one syllable identical to the target words. They are all colloquial Chinese words. All the keyword images were made as interactive as possible between the keywords and the target words. The images were also made to be novel, humorous and bizarre where possible.

Both the keywords and the images were checked by asking three native Chinese PhD students in applied linguistics who understand the keyword technique well to judge and revise them.

The imagery version of the keyword method was adopted in the current experiment instead of the sentence keyword version. This is because evidence from previous studies (Atkinson, 1975; Delaney, 1978; Pressley, Levin and Miller, 1982) has shown that the imagery version is superior to the sentence one although individual differences may get involved in the issue. Ample experimental evidence has demonstrated that "the use of visual imagery is a fundamental underpinning of how the keyword technique works" (Shapiro & Waters, 2005; p. 140; Desrochers, Gelinas, & Wieland, 1989; Campos, Amor & Gonzalez, 2004). Since the current study intended to compare the optimal effectiveness of both the keyword method and the word part technique, the more advantageous imagery version of the keyword method was adopted.

Experimenter-provided keywords and images were used in the experiment for the reason that the low-imagery words were difficult for the students to write an interactive image for within a limited time. Being unable to generate the keyword image means that they may deviate from the expected learning technique by resorting to their own strategy.

Thus the material to be used in the experimental study was made optimal in terms of retention for both the word part technique and the keyword technique except that half of the target words are high-imageability words while the other half are low-imageability words.

The dictionary version of the information about word part and word relationships for a target word was presented to the subjects for the word part learning condition (See 9.5 for example). For the keyword learning condition, the target words, the keywords and the imagery interactions between the keyword and the target word were given for the keyword learning condition (see 9.5 for example).

Chinese was used for the definitions of the target words, the keywords and the interactive image in the keyword technique learning condition. For the subjects in the word part learning condition, Chinese was provided for the hints and the definitions of target words and the known English words.

The learning material was programmed for computer delivery. A booklet was also prepared for each participant. The content of the booklet was different from the online materials. While the online materials contain only the information of the target words (see 9.5 for the detailed description and appendix II) for the subjects of the three different learning conditions to study in the main experiment, the booklet contains the following (see 9.5 for the detailed description):

1) the pre-test for the 20 target words

2) instructions for the three learning methods

3) the information about 4 words for practice and the post-test items for the practice session

4) the post-test items for the 20 target words

To make sure that the knowledge about the target words were really gained during the experimental process, the pre-tests and the post-tests are identical. The following section is a decription of the formats of the pre-test and post-test.

9.3 Pre-test and Post-tests

In addition to the control of word frequency, a pre-test is another procedure to ensure that the target words were not known to the subjects. The post-tests of the experiment in the current research were aimed to find out the different learning effects

of the three different learning conditions and to explore the role of word imageability in word retention and the role of the different test formats. Since the tests were meant to show the subjects' retention of the written word form and its link to a meaning, Waring and Takaki's (2003) test formats and the order of using them was adopted. However, different criteria for designing the distractors and for scoring the responses were applied because the learning effects of the current experiment resulted from different vocabulary learning techniques rather than extensive reading as in Waring and Takaki's study.

The tests for this experiment consist of one form-recognition test, one multiple-choice meaning recognition test and one English-to-Chinese translation test. They are all tests of receptive knowledge. The word form recognition test requires the subjects to choose the words they can recognize after learning them. The form recognition test consists of 20 target words and 20 distractors. The ratio of 1:1 between the target words and the distractors guarantees that the chance for the correct choice and the wrong choice is equal. The distractors were chosen according to the criterion that the distracting words should contain formally identical root parts to the target words. For example, "tar" was used as a distractor for "tor" and "tractate" for "transact". For one target word, one distractor was provided. This is slightly to the disadvantage of word part technique because word form is learned through the similarity in the root part between a known word and an unknown word. Several of the keywords in the keyword method do not bear phonological similarity to the roots of the words. Therefore the keyword method group is less likely to be distracted than the word part technique group. The distractors were tested in the pilot study to be new to the subjects.

The multiple-choice test is a meaning recognition four-choice test with the correct meaning and three distractors. The three distractors are one of the three types of Chinese words: 1. The distractor contains the form and/or pronunciation which resembles that of the keyword. For example, the distractor "逮捕" for the target word "daisy" contains the keyword "逮"（dai）". 2. It shares part of the meaning with the known high frequency word which is used to access the target word. For example, the distractor"云天"for the target word "daisy" contains the meaning "day" which is a first 1000 word through which the subjects learn the low frequency word. 3. The distractor is a phrase whose meaning is related to the target word. For example, the distractor "采花"is related to the meaning "flower". Thus the multiple-choice item for "daisy" is:

daisy　　菊花　　云天　　逮捕　　采花

Caution was exercised to ensure that the four choices are the same part of speech and of the same length or every two choices are of the same part of speech. The choices were written in Chinese mainly for the reason that all the subjects are native speakers of Chinese whose English proficiencies are relatively low. Nation and Webb (2011) list several reasons for the advantages of using the L1 in designing the options in a multiple-choice test. First, the subjects' inadequate ability in understanding the L2 vocabulary and sentence structures used in writing up the options plus their poor reading skills may cause them difficulty in dealing with the task. This will end up testing "knowledge and skills that are not part of the vocabulary knowledge" (p 355, Nation & Webb, 2011). Second, even if L2 meanings were presented instead of L1 synonyms of multiple-choices, the subjects would still link the L2 definitions to their L1 translations because the stage of L2 learning they are in determines that the L1 words and L2 words are not separately stored in their mental lexicon. Third, the L1 options place the subjects in a better position to take advantage of the knowledge they have already established in relation to the L1 options.

The translation test requires the subjects to translate the target words into Chinese. They could write only one translation for the English word if they were sure of its correctness. But they are allowed to give at most three possible Chinese meanings. This design encourages the subjects to demonstrate their partial knowledge about the target words.

The tests were given in the order of the word-form recognition test first, the translation test second, and finally the meaning-recognition multiple-choice test. The word-form recognition test was given first because it requires the subjects to demonstrate the least knowledge of the words. The meaning-recall translation test was administered second so that the knowledge gained from the meaning-recognition multiple-choice test would not be carried over to the more demanding recall test.

9.4 Scoring

In the word-form recognition test, both the correct answers to the target words and the false recognitions were counted and assigned one point for each of these responses. The final scores for the form recognition test were obtained by subtracting the number

of wrong choices from the number of right word form choices (see the rationale for the double penalty in 10.1). In the meaning-recognition test, one point was credited to one correct choice. In scoring the translation test, the translation nearest to the meaning of a target word was selected and considered if more than one was provided by the subjects. The same translations as the ones provided in the study material and their near synonyms were counted as correct and given one point. The Chinese translations spelling out parts of the word meaning were given half a point. The examples are "挂在脖子上的锁，a lock hung around of one's neck" instead of "an ornamental case hung around one's neck"; "沙 sand" for "silt"； "当地的那个地方 that local place" instead of "exact place of sth"

Summary of the scoring system

Word-form recognition test	1 correct answer – gain 1 point
	1 false answer – subtract 1 point
Meaning-recognition multiple-choice test	1 correct choice – gain 1 point
Translation test	1 correct translation – gain 1 point
	1 partial translation – gain 0.5 point

9.5 Procedures

The 121 first year university students were randomly assigned in equal numbers to the three learning conditions (There were 41 subjects in one of the three groups, and there were 40 in each of the other two groups). The subjects were seen in groups of 10 or 11 in a quiet language lab. They were asked to sit the pre-test first. The test paper was then collected to prevent the subjects further referring to the words. After that, the 10 or 11 subjects were given a 20-minute practice session aiming to familiarize them with the learning methods they were expected to use as well as the experimental procedures. For the word part group and the keyword technique group, the subjects were told that they were being taught new strategies of learning English vocabulary. For the control group, the subjects were told that the experimenter would like to discuss with them the vocabulary learning strategies they used. The time allowed for treatment was the same for the three learning groups.

The following instructions were written in Chinese in the booklet given to the subjects of the word part technique group:

As you can see, printed in the middle are the English word (pulley) you are trying to learn along with its Chinese translation (滑轮). On top of it is the other English word (pull) which is known to you along with its Chinese translation (拉). The spoken and written form of the new word is very similar to that of the known word. They both share the sounds /p ʊ l / and the letters *pull-*, which you can see at the left top. The following sentence (用来把东西向上拉的机械 a grooved wheel for ropes used for pulling sth up) is a hint which indicates to you how their meaning is related too. Since you are familiar with "pull", you can use the similarity in form and meaning between "pulley" and "pull" to learn the new word. Read the information about the form and meaning relationship between the new word and the old word and try to remember the new word and its meaning with the help of the known word.

Try to learn the following four words with this technique.

The following instructions were written in the booklet given to the subjects of the keyword group:

As you can see, the English word (pulley) printed at the left is a new word you are trying to learn. Its Chinese translation (滑轮) is printed at the right. In between them is a Chinese word (扑 pu) which sounds like the English word. This word is called the keyword. The sentence (想象一个疯子扑向滑轮被吊了上去。 Imagine a crazy man runs to a pulley and gets hung). This mental image can help you remember the new word and its meaning. Try to learn the following four words using this technique.

The following instructions were written in the booklet for the subjects of the own strategy group:

Here is an English word (pulley) you should learn and its Chinese equivalent (滑轮). How do you usually try to learn the form and meaning of an English word? Try to learn the following four words with your own methods. For example, you could first look at the English word and its Chinese translation and repeat them to yourself silently. Then you close your eyes and try to retrieve them. Use your own methods to learn the following four words.

The subjects were first allowed enough time to read the instructions by themselves. The experimenter then explained steps involved in using the learning techniques with an example. After the instruction, subjects were allowed to study a practice list of four example items (two nouns and two verbs). 20 seconds were given to each of the words as the study time. The control group was first asked questions about the strategies they used in English vocabulary learning. They were also given example words to show how they usually tried to memorize English words. The same training time and practicing time were allowed for the control group.

After they practiced learning the four words, the experimenter asked questions to determine if the subjects understood the keyword procedure. Then the subjects were given a practice test on the four words they had studied and a feedback discussion was held after the practice test to make sure that they were clear about the method and the test items.

Following the practice sessions, the experimental sessions were carried out.

The following instructions were provided in Chinese in the booklet for all the subjects:

You will be presented with a series of 20 slides. You are required to use the practiced method to memorize the English words. You will be allowed 20 seconds to learn each word with a one-second rest in between words. After 20 slides have been shown, your memorization of these words will be tested. You will be given as much time as you need to complete each test. Please follow these instructions as closely as possible. Don't take notes in the course of learning.

The keyword condition program consisted of a three-part procedure with the English word appearing on the left top of the screen, the keyword in brackets in the centre, the Chinese translation for the target word on the far right side of the screen, and the imagery mediation sentence was presented in a field underneath the keyword and the target word. In order to control time on the learning task, each sequence was presented on the screen for 20 seconds with a one-second rest in between each, during which time there was nothing on the screen.

villa　　（微辣）　　乡村别墅

想象你在**乡间别墅**里吃**微辣**的烤羊肉串是多么惬意。

The program for the word part condition presented the English target word with its Chinese translation in the middle of the screen, and the known word which is used to access the target word and its Chinese translation on top of the target word. The form constant was shown at the top left. Following the Chinese translations was the hint for the target word or are the hints for both the target word and/or the known word. In all the words, the overlapping part between the known and the unknown word was highlighted, as were the explanatory words in the hints so that particular attention was drawn to them. For each target word, the program displayed the teaching material for 20 seconds with a one-second rest in between words, during which time there was nothing on the screen.

village 乡村

villa 乡村别墅

Subjects under the own-strategy condition were presented with the target words and their Chinese translations only.

villa 乡村别墅

In all the three formats of presenting the learning materials, the target words were spoken as they were presented. The speech in this experiment was recordings extracted from an online dictionary. The 20 target words were divided into three groups with each group containing words of different lengths and imageability levels. As was described above, the subjects were trained and tested in groups of ten (In the immediate posttest, there were 11 in one group. In the delayed posttests, 4 students were absent). The three groups of words were presented in different orders for each group of the subjects under each learning condition to avoid a serial effect. There was a one-second rest after the last word appeared. Immediately after the short stop, the subjects were administered the immediate post-test. Nine days later the same test was administered to the subjects.

9.6 Pilot study

Pilot studies were conducted with Chinese EFL learners at different language proficiency levels to determine the following:

1. How much time is needed to complete the treatments, the learning session and the tests?
2. Will a group of 10 students make it difficult to guarantee that every subject is able to be adequately trained, follow instructions and adopt a positive attitude to what they are supposed to do?
3. Will the form-recognition test and the meaning-recognition test yield a ceiling effect or floor effect?
4. Are the instructions for the treatments and the tests clear enough?
5. Are the distractors in the form-recognition test unknown to the learners?

The changes and improvements made to the design of the experiment as a result of the pilot studies include: 1. A practice test should be included to make sure that every

subject knows how to apply the learning methods and how to complete the tests. 2. A short period of time should be allowed after the treatments for a discussion about the questions about the treatments. 3. Several distractors were replaced with new ones because they were too easy to identify as the wrong choice in the form recognition test. For example, “distraction” had been used as a distractor for “transact”. It was replaced with “tractate”. 4. Several distractors for the multiple-choice meaning recognition were rephrased because their meanings were not related to those of the target words and thus were very easy to dismiss as wrong choices. A few others were modified to be more suitable as distractors bearing the form or meaning elements of the keywords or the known linking words.

Chapter 10 Results

The results of a descriptive analysis with means and standard deviations for each learning method in the immediate and delayed post-tests are shown in tables 10.1, 10.2 and 10.3 for the three test formats and are shown in tables 10.4, 10.5 and 10.6 for the two imagery levels of the target words.

To assess the effectiveness of the three learning methods in relation to the test format and the imagery level of the target words, a repeated-measures ANOVA was performed on the retention scores in the immediate post-tests and then the delayed post-tests. The between factor is learning condition (keyword method, word part technique, self-strategy), and the within factors are word type (abstract or concrete), and test format (form recognition test, meaning recognition multiple and translation meaning test). Paired comparisons were conducted to determine the source of the interaction between the treatment and the test format. Repeated-measures one-way ANOVAs of the mean retention scores in each learning condition were performed to look at the effectiveness of the learning methods in learning the two types of words, namely, high imageability words and low imageability words.

10.1 The effect of the test format and time of testing

There are three test formats in the experimental study – form recognition, multiple-choice meaning recognition, and translation. These test formats which are all tests of receptive knowledge were used to measure different aspects and strengths of vocabulary knowledge. It was expected that the form recognition test would be easier than the multiple-choice test which would be easier than the translation test.

Table 10.1 Means and (standard deviations) in the immediate and delayed post-tests for the form recognition test in the three learning conditions

treatment	immediate post-test	delayed post-test
word part	14.40 (4.74)	10.58 (4.02)
keyword	14.83 (3.79)	9.68 (3.83)
self strategy	15.76 (3.84)	9.97 (5.23)

Total possible score = 20, n = 38 - 41

Table 10.2 Means and (standard deviations) in the pretest, and the immediate and delayed post-tests for the multiple-choice meaning recognition test in the three learning conditions

treatment	pre-test	immediate post-test	delayed post-test
word part	3.62 (1.69)	13.58 (2.48)	11.76 (3.05)
keyword	3.51 (1.50)	13.05 (2.85)	11.95 (2.58)
self strategy	3.28 (1.72)	14.80 (2.52)	12.87 (3.51)

Total possible score = 20, n = 38 - 41

Table 10.3 Means and (standard deviations) in the pretest, and the immediate and delayed post-tests for the translation meaning test in the three learning conditions

treatment	pre-test	immediate post-test	Delayed post-test
word part	0.03 (0.16)	11.34 (4.37)	5.95 (3.11)
keyword	0.12 (0.40)	7.62 (3.35)	4.64 (2.86)
self strategy	0.03 (0.16)	10.54 (3.30)	5.64 (2.82)

Total possible score = 20, n = 37 - 41

As shown in Tables 10.1, 10.2 and 10.3 and also figures 10.1 and 10.2, this expectation proved to be true for all three treatments at all three times of testing (pre-test, immediate post-test, and delayed post-test) (the form recognition format was not administered as a pre-test) except that in the delayed post-test, the mean scores on the form recognition test format were lower than those on the multiple-choice test for all three treatments. For example, a comparison of the scores for the word part technique shows that in the immediate post-test, the average retention score was 14.40 on the form recognition test, 13.58 on the multiple-choice post-test, and 11.34 on the translation test. For the same treatment, however, at the delayed post-test, the average score was 10.58 on the form recognition test, which is lower than the average score of 11.76 on the multiple-choice meaning recognition, but higher than the average 5.95 on the translation test.

It was also expected that the lowest scores for all three test formats (form recognition, multiple-choice and translation) would occur on the pre-test, the highest scores would occur in the immediate post-test and the somewhat lower scores would occur in the delayed post-test. As shown in Tables 10.1, 10.2 and 10.3, this expectation proved to be true without exception.

The means presented in Table 10.2 and Table 10.3 for the immediate and delayed post-tests were obtained by subtracting the raw scores of the pre-tests from the raw scores of the immediate post-tests or the delayed post-tests. On the multiple-choice test

format of the immediate post-tests, there were altogether 32 (1%) cases out of 2420 (20 test items*121 subjects) where subjects chose the right meaning in the pre-test for a target word, but made the wrong choice for the same word in the immediate post-test. Of the 32 cases, 11 are in the word part learning condition, 16 in the keyword learning condition, and 5 in the self-strategy learning condition. In the delayed post-test, such cases increased to 47 (2%) out of 2300 (115 subjects * 20) with 21 being in the word part group, 13 in the keyword group and 13 in the self-strategy group. When the final scores were calculated for such cases, subtraction was not done for these words from the immediate post-test scores or the delayed post-test scores. The mismatch between the pre-test results and the post-test results did not occur in the translation tests. This indicates that some of the correct choices in the pre-test on the multiple-choice format were the results of guessing. On the translation test format where no possible answers were offered, guessing was much more difficult in the pre-test.

The mean scores for the form recognition test (Table 10.1) were obtained by subtracting the number of the wrong choices from the number of the right word form choices. This means that a double penalty was given for choosing a word form that was not learned. This scoring criterion is appropriate considering the fact that there were a substantial number of subjects who chose to guess and ended up with a high proportion of both the correct and wrong choices. This is especially so in the delayed post-test. In the immediate post-tests, 52 out of 118 (44%) of the eligible test papers included at least one wrong choice. The average number of wrong choices is 1.06. In the delayed post-tests, 96 out of 110 (87%) of the eligible test papers included at least one wrong choice. The average number of wrong choices was 2.56. Admittedly guessing may be made on the basis of the knowledge they had gained through learning. However, if no penalty was imposed on guessing, the scoring system would mean that a score of 16 with no wrong choices out of the total 20 was worse than a score of 18 with 8 wrong choices.

10.2 The effectiveness of the three learning methods with respect to the test formats

The first research question concerns the effectiveness of the word part vocabulary technique in comparison with the keyword technique and self-strategy learning. The following report of the results of the experiments partially addresses this question by

describing the effectiveness of the three learning conditions with respect to the three test formats.

Table 10.1 shows that on the form recognition test of the immediate post-test, the self-strategy group gained the highest mean score (15.76) and the word part learning group gained the lowest mean score (14.40). On the form recognition test of the delayed post-test, however, the word part learning group was the highest (10.58) with the self-strategy group scoring slightly higher (9.97) than the keyword group (9.68).

On the multiple-choice test format of the immediate post-test, Table 10.2 shows that the best performance again occurred in the self-strategy learning condition (14.8), but was followed by the word part learning condition (13.58). In the delayed post-test, a slightly better performance was found in the self-strategy learning condition (12.87) than in the word part learning condition (11.76) and the keyword learning condition (11.95).

As can be seen in Table 10.3, on the translation test format of the immediate post-test, the word part learning group outperformed the other groups with a mean score of 11.34 in comparison to 10.54 of the self-strategy group and 7.62 of the keyword technique. In the delayed post-test, the word part learning group (5.95) also outperformed the other groups (4.64 for the keyword group and 5.64 for the self-strategy group).

The repeated-measures ANOVA analysis with the three learning conditions as between factors and the test format and word type as within factors on the means of the immediate post-test revealed a significant main effect of treatment ($F(2, 115) = 8.13$, $p < .0005$, partial eta-squared = .12, power = .96). The repeated measures also showed that there was a significant main effect of test format ($F(2,230) = 67.83$, $p = .000$, partial eta-squared = .37, power = 1.00) and a significant test format * treatment interaction ($F(4,230) = 4.05$, $p = .003$ partial eta-squared =.07, power = .91). These effects reflect the fact that the subjects in the three learning conditions did not perform in the same way on the three test formats. The repeated-measures ANOVA conducted on the mean scores of the delayed post-tests did not show a significant main effect of treatment ($F(2, 103)= 1.13$, $p = .33$, 95%CI= .02, power = .24) indicating that the differences between the learning groups' performance became very slight. There was still a significant main effect for test format ($F(2, 206) = 114.64$, $p = .000$, partial eta-squared = .53, power = 1.00), but not a significant interaction between test format and treatment ($F(4,206) = .93$, $p = .45$, partial eta-squared = .02, power = .29).

Games-Howell paired comparisons indicate that in both the immediate and delayed post-tests, there was no statistical difference between the three learning conditions in terms of retention on the form recognition test format. On the multiple-choice meaning recognition test format of the immediate post-test, self-strategy learning was statistically superior to both the keyword technique (mean difference = .97, p = .001, 95%CI =1.55, .39) and the word part technique (mean difference = .67, p = .02, 95%CI =1.25, .09). However, in the delayed post-test, no statistical difference was obtained on the multiple-choice test format between any two of the treatments in terms of retention. On the translation test format of the immediate post-test, both the word part learning group (mean difference = 1.94, p = .000, 95%CI = 1.12, 2.76) and the self-strategy learning group (mean difference = 1.57, p < .0005, 95%CI =.74, 2.4) were statistically superior to the keyword learning, but no statistical advantage was found for the word part technique over self-strategy learning. There was only a significant superiority of the word part technique over the keyword method (mean difference = .70, p = .048, 95%CI = .01, 1.40) on the translation test format in the delayed post-test.

10.3 The role of the different test formats

This section provides answers to the second research question that asks about the role of the different test formats in assessing the knowledge gained about the target words in the different learning conditions. Figure 10.1 shows the immediate post-test data discussed above for all the treatments and all the test formats. It can be seen that the greatest differences exist between the mean retention scores for the form recognition test (14.83), the multiple-choice test (13.05) and the translation test (7.62) under the keyword learning condition. The word part technique produced the smallest disparities among the mean retention scores for the three test formats (14.40 for form recognition test, 13.58 for the multiple-choice test and 11.34 for the translation test).

As was reported above, the repeated measures ANOVA showed a significant main effect of test format (F(2,230) = 67.83, p = .000, partial eta-squared = .37, power = 1.00) and a significant test format * treatment interaction (F(4,230) = 4.05, p = .003 partial eta-squared =.07, power = .91). Games-Howell paired comparisons reveal that in the keyword learning condition, there were significant differences between any two of the three test formats (mean difference between form recognition and meaning recognition = .90, p = .03, 95%CI = .08, 1.72; mean difference between form recognition and

translation = 3.66, p = .000, 95%CI = 2.86, 4.45, mean difference between meaning recognition and translation = 2.76, p <.0005, 95%CI = 2.01, 3.50). This result shows that different test formats are capable of revealing different depths of knowledge the subjects have learned about the target words. In the word part and the self-strategy learning conditions, there were significant differences between the form recognition test mean scores and the translation test mean scores (word part technique: mean difference =1.52, p = .000, 95%CI = .72, 2.31; self-strategy: mean difference = 2.51, p = .000, 95%CI = 1.70, 3.33) and between multiple-choice meaning recognition test and the translation test (word part technique: mean difference = 1.12, p = .004, 95%CI = .37, 1.86; self-strategy: mean difference = 2.16, p < .0005, 95%CI = 1.39, 2.92), but not between form recognition and meaning recognition tests (word part: mean difference = .40, p = .34, 95%CI = -.42, 1.22; self-strategy = .36, p = .41, 95%CI = -.48, 1.20). Thus for the word part technique and self-strategy learning, no knowledge difference could be detected by the easier test formats, the form recognition and the meaning recognition test formats.

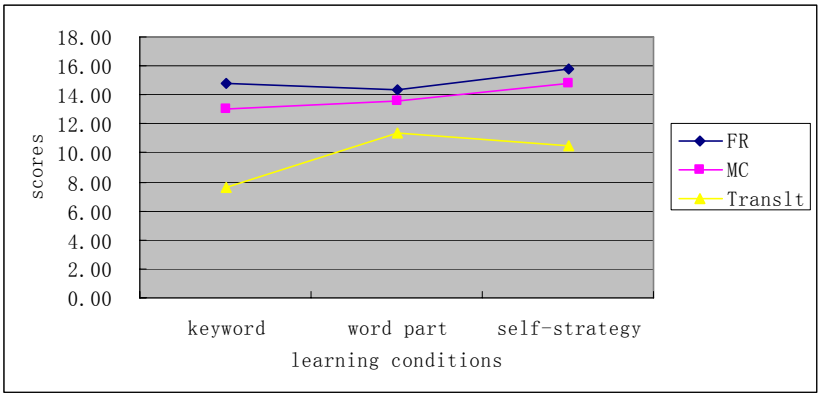


Figure 10.1 Mean scores of the three test formats in the three learning conditions in the immediate post-tests (regardless of the imagery level of words)
MC = multiple-choice meaning recognition test
Translt = translation meaning test
FR = form recognition test

Figure 10.2 shows the delayed post-test data discussed in section 10.1 for all the treatments and all the test formats. The disparities between the mean retention scores for the three test formats under each of the learning conditions were larger in the immediate post-test. For example, the mean retention scores under the keyword learning condition were 9.68 for the form recognition test, 11.95 for the multiple-choice test and 4.64 for the translation test. Games-Howell paired comparisons show that all the three test formats gave significantly different recall scores in the keyword and self-strategy

learning conditions ($p < 0.01$) in the comparisons between any two of the three test forms in the two learning conditions), indicating the effects of task demand and time on the subjects' performance. In the word part learning condition, the form recognition test results were significantly different from those of the translation test (mean difference = 2.34, $p < .0005$, 95%CI = 1.37, 3.11), and the multiple-choice recognition test results were also significantly different from those of the translation test (mean difference = 2.98, $p = .000$, 95%CI = 3.64, 2.32).

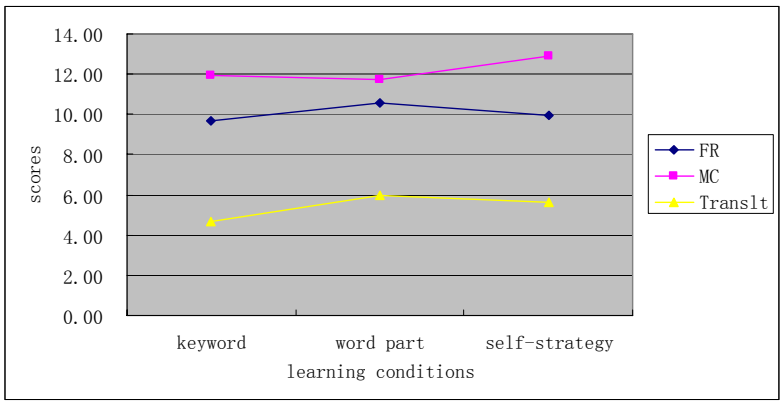


Figure 10.2 Mean scores of the three test forms in the three learning conditions in the delayed post-tests (regardless of the imagery level of words)
MC = multiple-choice meaning recognition test
Translt = translation meaning test
FR = form recognition test

10.4 The word type effect – abstract versus concrete

This section consists of a report of the results of the experimental study which addresses the third research question, namely, what is the effect of the imageability level of the target words in vocabulary learning using the three learning methods.

Tables 10.4, 10.5 and 10.6 present the descriptive data for the two types of words, abstract and concrete words, in the three learning conditions in the pre-test, the immediate and delayed post-tests on the three test formats. All scores are out of 10. As was described above, the mean scores and standard deviations on the different test formats were obtained by taking the raw scores of the pre-tests away from the raw scores of the immediate and delayed post-tests. Examination of the mean scores of the immediate post-tests shows that on all the test formats in all the learning conditions, the subjects scored higher for the concrete words than for the abstract words except that in the form recognition test in the self-strategy learning condition, the mean score for abstract words recall (7.92) was slightly higher than that for the concrete words recall

(7.71). In the delayed post-tests, the same pattern can be observed except that the keyword group scored slightly higher (4.89) for abstract word recall in the form recognition test than for concrete word recall (4.81).

Table 10.4 Means and (standard deviations) of the scores for the two types of words on the form recognition test format in the immediate and delayed post-tests

	immediate post-test		delayed post-test	
	abstract	concrete	abstract	concrete
word part	6.98 (2.87)	7.4 (2.22)	4.83 (2.46)	5.67 (2.24)
keyword	7.3 (2.02)	7.48 (2.24)	4.89 (2.17)	4.81 (2.37)
self-strategy	7.92 (2.87)	7.71 (2.3)	4.74 (2.97)	5.21 (2.62)

Table 10.5 Means and (standard deviations) of the scores for the two types of words on the multiple-choice test format in the pre-tests, and the immediate and delayed post-tests

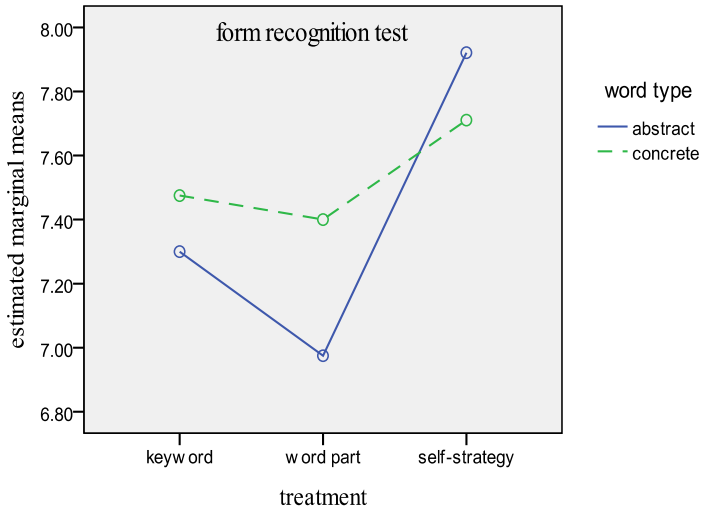
	pre-test		immediate post-test		delayed post-test	
	abstract	concrete	abstract	concrete	abstract	concrete
word part	1.53 (1.2)	2.1 (1.37)	6.75 (1.72)	6.83 (1.57)	5.6 (1.89)	6.18 (2.02)
keyword	1.83 (1.07)	1.68 (1.06)	6.12 (1.85)	6.9 (1.58)	5.76 (2.05)	6.58 (1.65)
self-strategy	1.4 (0.84)	1.85 (1.25)	7.25 (1.45)	7.58 (1.74)	6.03 (1.98)	6.87 (2.02)

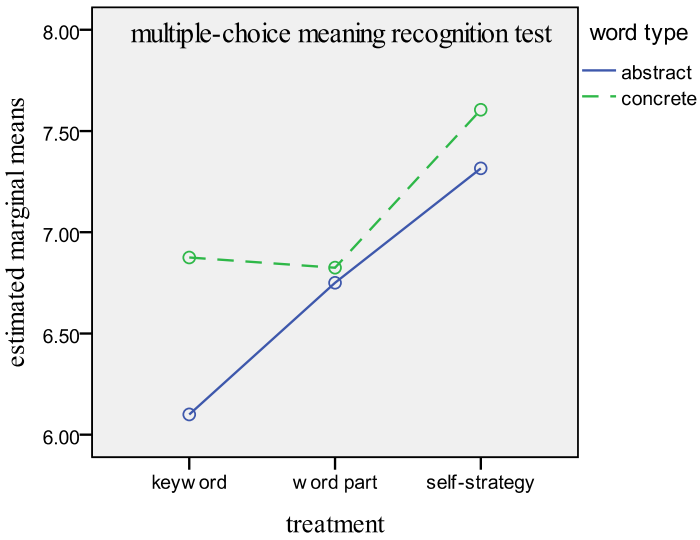
Table 10.6 Means and (standard deviations) of the scores for the two types of words on the translation test format in the pre-tests, and the immediate and delayed post-tests

	pre-test		immediate post-test		delayed post-test	
	abstract	concrete	Abstract	concrete	abstract	concrete
word part	0.03 (0.16)	0	5.01 (2.53)	6.33 (2.19)	2.11 (1.46)	3.88 (2.04)
keyword	0.03 (0.16)	0.07 (0.35)	3.24 (2.19)	4.35 (1.74)	1.66 (1.54)	2.99 (1.73)
self-strategy	0.03 (0.16)	0	4.55 (2.02)	5.95 (1.73)	1.82 (1.34)	3.82 (1.98)

As was stated above, in order to find out the effectiveness of the three learning methods and examine the role of the test format and word type, a repeated-measures ANOVA analysis with treatment as the between factor and word type and test form as within factors was carried out. The analysis of the mean scores of the immediate post-tests shows a significant main effect for treatment ($F(2, 115) = 8.13$, $p < .0005$, partial eta-squared = .12, power = .96) and a significant main effect for word type ($F(1,115) = 26.26$, $p = .000$, partial eta-squared = .19, power = 1.00). However, there is no interaction between word type and treatment ($F(2, 115) = .38$, $p = .69$, partial eta-squared = .01, power = .11). These results reflect the fact that while all the three groups of subjects' performance in word recall vary according to word type, the variations are basically in the same direction, namely, in all the three learning conditions, their recall of

the concrete words was better than their recall of the abstract words. In the delayed post-tests, the same significant main effect was found for word type (F(1, 103) = 66.72, p=.000, partial eta-squared = .39, power = 1.00) though not for treatment (F(2, 103)= 1.13, p = .33, 95%CI= .02, power = .24). Still word type and treatment did not form a significant interaction (F (2,103) = 1.17, p = .32, partial eta-squared = .02, power = .25). The relationship between word type and treatment is illustrated in figure 10.3 and figure 10.4.





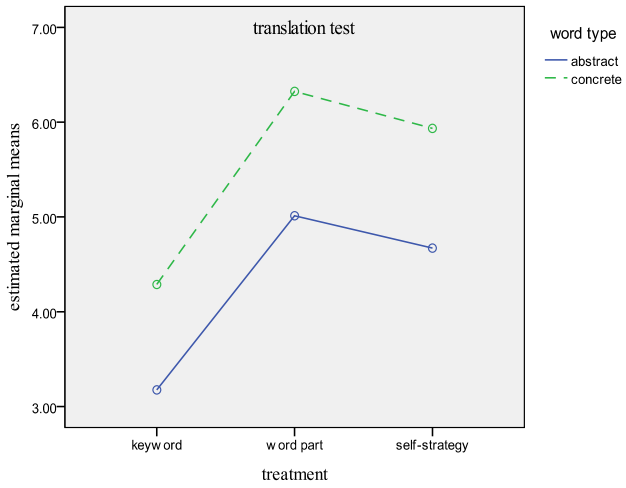
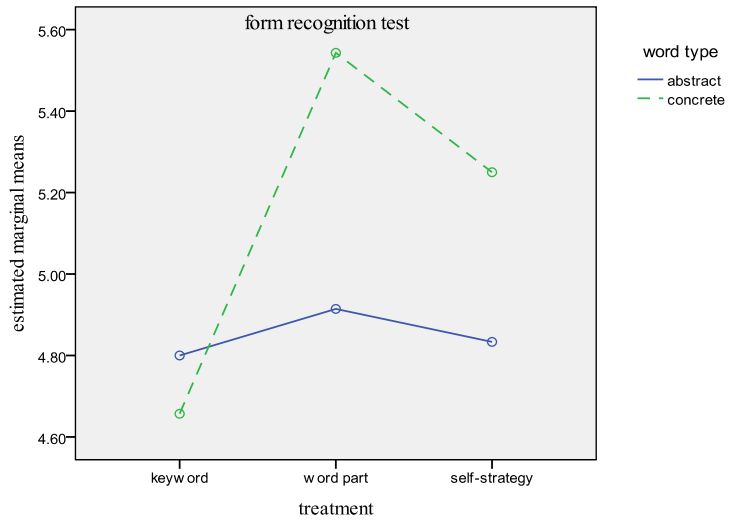


Figure 10.3 Interaction between the two word types and the three learning conditions on the three test formats in the immediate post-test



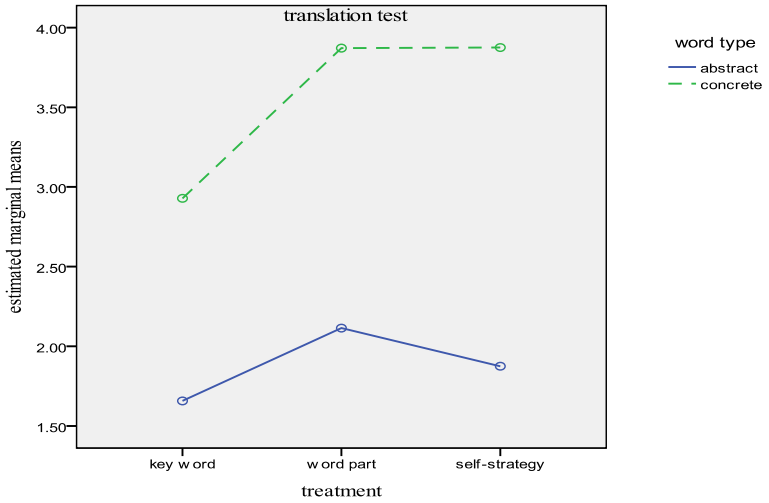


Figure 10.4 Interaction between the two word types and the three learning conditions on the three test formats in the delayed post-test

10.5 Effectiveness of the three learning methods in learning high and low imageability words on each test format

This part reports the experimental results concerning the effectiveness of the vocabulary learning techniques with regard to the two word types, high imageability words and low imageability words. As indicated in figure 10.3, while in the immediate post-test the word part technique yielded the lowest recall scores on the form recognition test for both abstract words (6.98) and concrete words (7.40), it yielded the highest scores on the translation meaning test for both word types (5.01 for abstract words recall and 6.33 for concrete words recall). In contrast, in the immediate post-test, the self-learning strategy produced the best results for both abstract and concrete words recall in the form recognition test (7.92 for the abstract words and 7.71 for the concrete words) and the meaning recognition test (7.25 for the abstract words recall and 7.58 for the concrete words recall). The keyword learning group (7.3 for the abstract words and 7.48 for the concrete words) scored higher than the word part group (6.98 for the abstract words and 7.4 for the concrete words) in form recognition in both abstract and concrete words recall, but lower in meaning recognition in abstract words recall (6.12 for the keyword group and 6.75 for the word part group).

In the delayed post-test, the word part group again scored the highest in both the abstract and concrete words recalls in the translation test (2.11 for the abstract words and 3.88 for the concrete words in Figure 10.4). It scored the lowest in both word types

(5.6 for the abstract words and 6.18 for the concrete words) in the meaning recognition test. The self-strategy group still had the highest recall score for both the abstract (6.03) and the concrete words (6.87) in the meaning recognition test.

Repeated-measures one-way ANOVAs of the immediate post-test mean scores of each learning method showed that there was no significant difference between retention of the high imageability words and the low imageability words in form recognition in any of the learning conditions ($p < .05$ in all cases). The superiority was significant for concrete words on meaning recognition in the keyword learning condition ($F(1,40) = 6.62$, $p = .02$, partial eta-squared = .14, power = .71), but not in the word part condition ($F(1,39) = .05$, $p = .83$, partial eta-squared = .001, power = .06) and self-strategy ($F(1, 39) = 1.11$, $p = .30$, partial eta-squared = .03, power = .18) learning condition. The target words with high imageability were significantly better learned on the translation meaning tests in all the three learning conditions (keyword: $F(1,40) = 11.21$, $p = .002$, partial eta-squared = .22, power = .90; word part: $F(1,39) = 21.27$, $p = .000$, partial eta-squared = .35, power = .99, self-strategy: $F(1,39) = 23.32$, $p = .000$, partial eta-squared = .37, power = 1.00). The relationship between word type and treatment on each test format in the immediate post-test is illustrated in figure 10.3.

The repeated-measures one-way ANOVA on the delayed post-test showed that the high imageability level of words did not produce significantly better word retention than low imageability words on the form tests in any of the learning conditions in the delayed post-tests ($p > 0.2$). The advantage of concrete words learning was significant on the meaning recognition test in both the keyword learning condition ($F(1,37) = 5.2$, $p = .03$, partial eta-squared = .12, power = .60) and self-strategy learning ($F(1,38) = 8.10$, $p = 0.007$, partial eta-squared = .18, power = .79). The target words with high imageability were retained significantly better than the words with low imageability in the translation test in all the learning conditions (word part: $F(1,36) = 40.02$, $p < .0005$, partial eta-squared = .53, power = 1.00; keyword: $F(1,37) = 25.96$, $p < .0005$, partial eta-squared = .41, power = 1.00, self-strategy: $F(1, 36) = 42.29$, $p < .0005$, partial eta-squared = .54, power = 1.00). The relationship between word type and treatment on each test format in the delayed post-test is illustrated in figure 10.4.

Chapter 11 Discussion

The present experimental study aims to investigate the effectiveness of the word part technique in relation to the keyword technique and self-strategy learning. The analyses of the immediate post-tests show that self-strategy learning is statistically superior to the keyword and the word part learning techniques on the multiple-choice recognition tests. While the mean score of the word part technique is higher than that of the self-strategy learning in the translation tests, it is not significantly better than self-strategy learning. The keyword technique is found to be inferior to the other two learning conditions on the translation test format. No significant difference is observed on the form recognition test between any two of the three learning groups. In the delayed post-tests, no significant differences are found among the different learning groups except that the word part technique yielded significantly better translation scores than the keyword technique. These results point to the conclusion that self-strategy learning is at least as effective as the word part technique, and that the word part technique benefits vocabulary retention only slightly more than the keyword technique.

The performance of the subjects in all the three learning conditions varied according to the test formats. The results of the three test forms in the immediate post-tests were significantly different from one another among the keyword learning group. Among the word part and self-strategy learning groups, there was a significant difference between the performance in the translation tests and the performance in the other two test forms. In the delayed post-tests, the differences in the retention scores for all the three test forms reached significance in the self-strategy and keyword learning condition. In the word part learning condition, the mean scores for the form and meaning recognition tests were not significantly different.

In examining the effect of the imageability level of the target words, it was found that there was a main effect of imageability level, but there was no interaction between word type and treatment in either the immediate or delayed post-tests. The descriptive data shows the tendency that concrete words were better learned than abstract words in all the learning conditions and test forms in both the immediate and delayed post-tests. In both the immediate and delayed post-tests, the subjects' performance on the translation test format for the concrete words in all the three learning groups was significantly better than for the abstract words.

In the following sections, the findings of the current study will be discussed from the perspectives of the effectiveness of the learning methods, the effects of the test forms, and the imageability of the target words on the word retention scores. The applications for teaching and learning vocabulary will also be explored. A suggested syllabus for teaching the accessible words is described.

11.1 The effectiveness of the self-strategy learning

One remarkable result of the current study is that the self-strategy learning group was equally effective in vocabulary retention compared with the keyword technique and the word part technique, and it was even better on some test forms. Although this result is at odds with a large body of research that has come to the conclusion that the keyword technique leads to superior vocabulary retention than self-strategy learning, the evidence that the keyword technique is less beneficial for experienced and intellectually mature learners than for inexperienced ones and young children is actually quite well documented in the literature (Levin, Pressley, McCormick, Miller, and Shriberg, 1979; Moore and Surber, 1992; Hogben and Lawson, 1994; van Hell and Mahn, 1997). Our study is parallel to van Hell and Mahn's (1997) in that their subjects were also university students who had at least 6 years' experience in foreign language learning. Although the learning condition involved in their study was termed rote-learning rather than self-strategy learning as in the present study, both of the learning conditions do not involve strategy training. The finding of our study is consistent with van Hell and Mahn's – the subjects performed significantly better in recalling the target words in the non-strategy-training condition than in the imagery keyword learning condition. Levin et al (1979) interpret such findings from two perspectives. One is the difference in the implementation procedures (whether learning is experimenter-paced or unstructured), and the other is the difference in the subjects' cognitive development or the difference in their language experience. Since the three learning groups were all engaged in paced learning in the present study, the second explanation is more relevant and convincing. The subjects of the present study are university students who had learned English for at least six years. It is true that they are not good language learners, and that they had not received training in using vocabulary learning strategies. Perhaps the input of the target language has also been poor in the foreign language learning environment. Nevertheless their experience in learning English as a foreign language is long enough to be able to

provide them with sufficient understanding of the English language and to develop learning strategies which are no less effective than the keyword technique or word part technique. As Moore and Surber (1992) comment, the experienced language learners "have developed their own strategies to the point where an additional intervention does not help and might possibly interfere" (p. 292).

The lack of a strong effect in the keyword and word part learning conditions may be attributed to the short period of training time devoted to the two intervening learning strategies. This explanation is in fact related to the explanation given above. Since the learners have developed their own learning strategies over a long period of foreign language learning, they are able to use these strategies skillfully and effectively when necessary. In contrast, before they applied the keyword and word part learning methods to vocabulary learning, they had been instructed to use them for only ten minutes and had practiced using them with 4 words. The training is perhaps not long enough for the subject learners to feel comfortable with the new learning methods and to be able to use them skillfully.

The reasons for the ineffectiveness of the interventions in vocabulary learning using the keyword and word part learning methods cannot be complete without considering one important characteristic of Chinese EFL learners, namely, their well-practiced ability in doing rote-learning. It is obviously inappropriate to equate the self-strategy learning adopted in the current study to rote-learning because the learners were likely to have used other mnemonics which suited them well. However, if asked what strategy they have used to learn vocabulary, their answer is very likely that they used no particular strategies but rote-learning. Asian students' habit of rote-learning has received a great deal of comment in the area of education and second language learning research (O'Malley & Chamot, 1990; Watkins & Biggs, 1996; Littlewood, 1999; Gu, 2003, Gan 2009). Although the cultural stereotypes of the Asian students' inclination to rote-learning have been challenged and criticized, there is evidence for their superior ability to memorize by rote in second language learning. Tinkham (1989) compared Japanese and American students' attitudes towards rote-learning and their performance in rote-learning by testing their acceptance of the rote-learning strategy and their learning outcomes. The investigation found not only a significantly more positive attitude towards rote-learning on the part of the Japanese students but also significantly better learning outcomes in these students in recognizing and recalling the novel words in another language. The subjects in the present study had done great amounts of

rote-learning in order to pass the National University Entrance Examinations and are doing rote-learning in order to pass the Test for the Non-English Majors Band 4. There is good chance that they are equipped with well developed skills in memorizing words by rote.

11.2 The word part learning technique versus the keyword technique

The results of this study show that there was no significant difference between the word part technique and the keyword technique in the form and meaning recognition tests, but the word part group significantly outperformed the keyword group in the translation test form in the immediate post-test and outperformed them by a narrow difference in the delayed post-test. The explanation for the poor performance of the keyword technique compared to the word part technique may be found in the quality of the keywords which served as the formal and semantic links between L1 words and the foreign words. In spite of the effort to optimalize the quality of the keywords as described in chapter 9, the dissimilarity between the Chinese language and the English language sometimes could frustrate it. One difficulty involved in selecting high quality keywords was finding a two-character Chinese word which closely resembles the sound of the English word. For example, this problem resulted in the selection of *xiu* 修 as the keyword for the target word *silt*. Other examples are the resorting to *dai* 逮 as the keyword for *daisy*; *yasi* 压死 for *siesta; naotou* 挠头 for *denote.* These keywords do not have a satisfactory resemblance with the target words' phonemes and perhaps do not have enough overlap with the target words' phonemes either. The second problem about selecting high quality keywords is related to the first one - there is the difficulty in finding a Chinese phrase which closely resembles a syllable of an English word and at the same time is good enough to generate a mental picture. Using a one-character Chinese word is very often not adequate to create an impressive image to connect the meaning of a target word because the meaning of an English word largely needs to be conveyed by a two-character Chinese word or a Chinese phrase..

As shown in the literature review, it is generally acknowledged that the keyword technique has been proved successful with learners of different language backgrounds and in learning various languages. In spite of the extensive research into the efficacy of the keyword technique, there is no study which focuses on Chinese learners learning English or any other European language using the keyword technique.

The better learning outcome produced by the word part technique in the translation test may be important proof that as learners' language proficiency advances, the better facilitative effects for vocabulary learning come from the knowledge of the target language rather than from their native language. This is because as learners' mental lexicons grow rich with more associations of the forms and meanings of words in the target language, turning to the second language for aid becomes straightforward and therefore effective while making use of the forms and meanings of the native language involves a detour and therefore appears cumbersome.

One interesting outcome concerning the word part and the keyword techniques is that both of them produced retention scores that were significantly lower than the self-strategy method on the multiple-choice meaning recognition test format. Apart from the learner factors discussed above, this may be due to the way we designed the multiple-choice items. Of the four choices for the meaning of each target word, one is related to the meaning of the linking word in the word part technique and one is related to the meaning of the keyword. These two choices could have interfered with the performance of the keyword and word part learning groups and could have given the self-strategy group an advantage as they were not exposed to these meanings before the test.

11.3 The effects of test formats

Three test formats were used in the present study to assess the learners' receptive knowledge gained from different methods of vocabulary learning, the form recognition test, the multiple-choice meaning recognition test and the translation test. The mean scores for the three test formats showed significant differences for each learning condition in the immediate and delayed post-tests. This result indicates that different kinds of test formats can measure and reveal different amounts of receptive knowledge the subjects have gained about the target words. Using any one of the test formats would fail to provide a precise picture of the learning results.

It was found that the three learning methods did not differ from each other on the form recognition test in both the immediate and the delayed post-tests. This finding indicates that for the experienced learners as in the present study, the ability to identify word forms is perhaps more aided by their knowledge about the phonological and orthographical systems of the target language than by the facilitative effects of any

learning strategy. Indeed, in the keyword technique, the learners were not provided with optimal aids in phonetic association between the native word and the foreign word due to the disparity between the two languages. However, this did not affect the subjects' recognition of the forms of the target words. Perhaps this explanation for the lack of a treatment effect on the form recognition test can simply be rephrased into the simple reasoning that the test was so easy for the subjects that their performance was not affected by the facilitative interventions or the unfacilitative interferences.

Some researchers like Ellis and Beaton (1993) and van Hell and Mahn (1997) have reasoned that the superiority in word recall in the rote-learning group over the keyword technique is caused by the reinforced short-term phonological memory of the target words and their translations by the learners who silently rehearsed the sounds of the target words and their first language translations. Judging from the results of this study, their explanation needs reconsideration. As was already discussed above, the self-strategy group was more likely than the other two groups to resort to rote-learning than the other two groups of subjects. Also, the form recognition test is a task that can best reflect the function of short-term phonological memory. However, as can be seen, the keyword group did not recognize the target word forms more poorly than the other groups in the immediate post-test, but they did worse in the translation test. Likewise, the word part group of learners did not perform noticeably differently to the self-strategy group in both the form recognition test and the translation meaning test.

11.4 The effect of the imageability of words

The current study shows that the concrete words had an advantage over the abstract words in acquisition in all the three learning conditions. This result is consistent with findings in psycholinguistic research. Nelson and Schreiber (1992) mentioned four possible reasons for the relative advantage concrete words enjoy in memory. The first one is the imagery hypothesis described earlier in the literature review. This hypothesis is related to Paivio's (1986) dual coding theory that the memory of concrete words, in addition to the verbal storage for them, is strengthened by visualized images that are not easily available for abstract words. The second explanation assumes that contextual information derived from the context of a word can more easily be made use of for concrete words. The third and the fourth explanations are opposed to each other. While one argues that concrete words are easier to remember because they have fewer sets of

concepts associated with them, the other one assumes that their advantage in memory comes from the more sets of associates they possess due to the additional imagery associates they generate. Nelson and Schreiber were reluctant to accept either of these two views.

The view that concrete words can be easier to remember is supported by another finding of the current study, that is, in all the three learning conditions, the retention of the high imageability words was significantly higher than the retention of the low imageability words in the translation test. The same effect, however, was not so apparent in the form and meaning recognition tests. These results suggest that the increase in task demands can amplify the advantages of concrete word learning.

The review of the literature on the efficacy of the keyword technique in Chapter 8 presents evidence for the belief that the keyword technique is more effective for the learning of concrete words than for abstract words. This is because the interactive image between the keyword and the target word is fundamental to the workings of the keyword technique and concrete words conjure up images more easily than abstract words. Our results, however, do not support this view. The present research shows that the keyword group did not demonstrate much better memory of the concrete words than other learning groups, nor did it demonstrate much poorer memory of the abstract words. This result is consistent with Delaney (1978); Pressley, Levin, & Miller (1982), and van Hell and Mahn (1997) whose studies did not find an enhancing effect for concrete words or a hampering effect for abstract words with the keyword technique. It may be a plausible argument that the imageability of words is not so important to the more experienced and advanced students because the knowledge and experience they have acquired about the second language can provide certain mnemonic aids to compensate for the disadvantage of lacking imagery information. Equally possible is the explanation that the imageability factor is not an obstacle for adults who have a large proportion of abstract words in their vocabulary. This can explain the equally good performance on the recall of the abstract words and the concrete words by the inexperienced university students in van Hell and Mahn's (1997) study. Although van Hell and Mahn mentioned this characteristic of adults' mental lexicon, they used it as the starting point for their research interest instead of an explanation for their findings.

11.5 Incorporating the technique into a vocabulary course

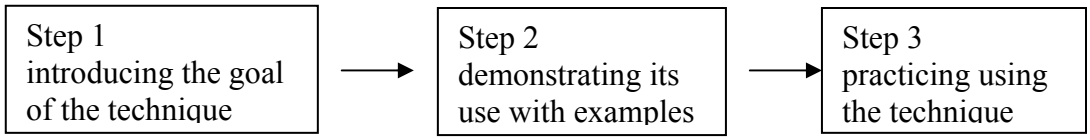
The results of the current experimental study have shown that the participants using the word part technique benefited more from the learning technique in the translation tests than those using the keyword method, although no significant advantages have been found in the form and meaning recognition tests for the word part technique over the keyword method. Considering the effectiveness of the keyword method demonstrated by the large body of research, word part technique is likely to be an equally useful mnemonic worth attention in ESL teaching. The following are some suggestions for incorporating the information about word parts and word relationships provided by part one of the present study into a vocabulary course.

11.5.1 Strategy training

It is appropriate that the word part learning technique is introduced to students during a period of class time set aside for strategy training. Hulstijn (1997) suggested that teachers should begin the introductory session for the keyword method by first making the students become aware of the fact that when they memorize a word, they are memorizing the link between the form and the meaning of the word, so finding a "mediator" can help them access and maintain the link. The same can be done for the word part technique. Tell the students that some English words they are familiar with are helpful mediators for them to learn the new words. They should come to the realization that many lower frequency English words share similar forms and meanings with the words they already know and this fact can make their learning easier.

It is equally helpful at the beginning of the strategy training that the teacher gives students a brief introduction to the history of the English language so that they are better aware of the composition of the language and the formal and semantic characteristics of words of different origins and their relations. This knowledge prepares the students for exploring and employing the form and meaning relationships between words in their learning.

In addition to giving students some insights into English words, the training should also involve the following three steps:



The three-step process is explained in detail as follows:

1. The learners need to understand that the goal of adopting this technique is to use the word part information, especially the word root information and knowledge about the word relationships to help them remember new words.
2. Then the teacher should demonstrate the technique by first taking words from the easily accessible word list as examples to make sure that the meaning and form connection between the new word and the known word is clear enough to the students. It may be more effective if students are asked to contribute examples of words they think are difficult for them to retain and then a few of these words are used as examples to show them how the suggested technique can help them learn.
3. Students are given opportunities to practice using the technique on some new words, first being led by the teacher to go through the procedures involved and then trying to apply them by themselves. Better effect will be achieved if there is practice for every separate step in the strategy and if the practice is carried out in pair work with support from peers.

The technique training is suggested to take about 10 minutes each week twice a week over about 6 weeks until students are fully aware the goal of this technique, the words that lend themselves for using it, and the information that is required for using it until they feel comfortable and confident with the technique.

Learners' mastering of the strategy needs to be monitored and assessed through the course. The learners may be asked to demonstrate how they have dealt with certain words using this learning technique by reporting back the procedures they went through, or they may be asked to speak aloud while applying the technique. Words which are assigned to them to learn, especially lower frequency words, should be tested regularly. The monitoring may be carried out in informal ways, for example, incidentally asking students to explain a word or a few words by applying the word part technique. It may also be a rather formal test with designed items checking the aspects of knowledge as is reflected in the five steps of applying the technique outlined below. In this case, the students are asked to demonstrate they have grasped the forms of the target word roots and their meanings, the forms and the meanings of the target words and their connections with other related words. The following are two possible test items.

1. Write the meanings of the following forms and two example words for each form.

	meaning of the form	words with the form
-ceive-	_____	_____
-sign-	_____	_____
-stan-	_____	_____

2. Write at least two related words for each of the following words.

respect _____

surprise _____

process _____

3. Write the meanings of the underlined words in sentences.

notion

numerous

donate

11.5.2 Direct teaching

Any vocabulary course is likely to set aside some of class time for the direct teaching of higher frequency words because explicit learning is complementary to incidental language development. The word part technique can be employed in direct instruction of the higher frequency words by teachers. The teacher may either analyze the target words by using the procedures in the technique or ask the students to deal with the words by applying the technique during class time. Then explicit exercises are set for the students to do. Exercises with clear focuses are necessary for reinforcing the link between the form constants and the meaning constants and the relationships between the new words and known words, and for consolidating the form-meaning connection of the new words. The exercise types can resemble the ones used in standard vocabulary and grammar teaching such as matching the form constants with their meanings, picking out formally and semantically related words from a group, choosing words that fit the contexts of the sentences, and identifying the meaning connection between sets of words. Here are some example exercise types:

1. Match the roots in column A with their meanings in column B and the words with the roots in column C.

column A	column B	column C
1) –pos-	A) draw	a) subtract
2) –tract-	B) send	b) emit
3) – mit-	C) produce	c) dispose
4) –gen-	D) look	d) perspective

5) –spect- E) put e) genuine

2. Choose related words from the list of words below, put them into four groups, and give the meaning thread for each group.

pose versus compose divert deposit spectacle speculate respective invent convention convert invert

Group 1 _____ ; meaning thread_____

Group 2 _____ ; meaning thread _____

Group 3 _____ ; meaning thread _____

Group 4 _____ ; meaning thread _____

3. Fill in the blank with word that best defines the word in the second half of each sentence. Make sure that your sentences are correct.

1) To attract is to draw one's attention; to distract is to _____ away.

2) To describe is to write what sth is like; to scribble is to _____.

3) Grade means degree; a graduate is someone who holds a _____.

4) To alter is to become other than sth, to alternate is to switch from _____.

4. Complete each of the sentences with an appropriate word from the list below.

gender juror signify duration equation transform uniform

1) Sociologists believe that _____ differences in voting will gradually disappear.

2) What do the words spelt with strange letters _____?

3) Some schools held up to 4 meetings. The average _____ was about one and half hours.

4) Some of the math is quite sophisticated, using differential _____.

5) New settlers _____ the land for profit and made it more like their countries of origin.

6) You remember that time when you were a schoolgirl in _____ going home on the tram.

7) She alone among the _____ had been in favour of a verdict of insanity.

Direct teaching the accessible target words by employing the technique can be carried out in two ways. One way is that a set of formally and semantically related high frequency words are taken out from the teacher's reference book and presented to learners to be studied. For example, IMPOSE/COMPOSE are selected and taught through the known word POSITION because these words are relatively high frequency words and because they contain the highly productive form constant -*pos*-. Although the number of words to be taught at one time depends on the students' language proficiency levels, their characteristics and the time available, we suggest teaching no more than 10 pairs of words each time. The other way of direct teaching is that in the

meaning-focused activities such as reading in the target language or doing communicative tasks, when problems with new words occur, they can be spontaneously taught by applying the knowledge about word parts and word relationships. Although the teacher's concern for vocabulary learning in these activities is not so obvious to the students, the teacher's instruction on the problematic words is explicit.

During the course of teaching, emphasis should not be placed on the etymological nature of the information being used for learning the target words because the form constants, their meanings and the relationships between words are aimed to help memory and therefore are not completely true to etymology. The etymological information concerning the target words should not be elaborated on even if the teacher is equipped with a great deal of that knowledge. Focusing on the etymological knowledge about words in teaching is not the appropriate use of the results of the present research. Also if the learners prefer to come up with their own hints instead of using the hints already provided, they should not be stopped as long as they consider their hints a clearer linkage and a better support for memorization.

No learning strategy is so effective as to be able to guarantee that all words can be retained once they are learned. Rehearsal is necessary for many words, especially for the low frequency words which are unlikely to be encountered repeatedly by the learners. Rehearsal needs to be done at regular intervals and should cover the meanings of words, the spoken and written forms of words as well as other features of the words such as collocations, and grammatical features. It is also useful to give students opportunities to present words that were difficult for them to remember. Then the teacher can give further support by discussing the relationship between the hints and the dictionary definitions, for instance, or by providing more information concerning the words' forms such as the similarity of /f/ in FLAT to /p/ in PLATE or by presenting more examples of the words' use. In addition, the students who have a successful experience with certain words are asked to report how they have managed to learn them.

11.5.3 Deliberate learning

Learning lower frequency words using the technique by the students themselves should be part of the vocabulary course as well. It can be done in the form of an assignment given to the students. This activity can accomplish two purposes. One is to

learn the lower frequency words which could not be dealt with during the limited class time. The other is to develop learners' autonomy in learning vocabulary by applying the learning technique and in language learning in general. Such learning can involve the use of the word cards.

11.5.4 The procedure of learning words using the word part technique

The procedure involves five stages: 1) Relating the form of the new word to that of the known word by identifying the form constants, or the shared root parts. A learner should first recognize that the new word, say, COMPOSE, resembles the known word POSITION in form as both words share the letters -*pos*-. This information may be either pointed out by the teacher or obtained by learners from a learner dictionary. 2) Relating the meaning of the new word and that of the known word by identifying the meaning constants of the pair of words, or the meaning shared by their form constants. The learner then should know that the two words are related in meaning as they share the meaning constant "put": while POSITION means "a place where sth/sb is put", COMPOSE means "to put things or parts together". 3) Connecting the meaning constants and the form constants by remembering the meanings of the word parts. The learner should be aware that the word part –*pos*- means "put" as in the known word POSITION as well as the new word COMPOSE so that access to other lower frequency words like DISPOSE, DEPOSIT, EXPOSE, COMPOST, etc in the future can be helped with this knowledge. Memorizing word parts and their meanings should not cost much effort when the knowledge about the known words is already available to the learner. This step is more to raise the learner's awareness of the form-meaning relationship of a word part by activating the existing knowledge than to learn and memorize something new. 4) Associating and comparing the hints that indicate the meaning relationship between the new words and the known words with the dictionary or contextual meanings for them so that the learner will be reminded the meanings of the new words by thinking of the form and meaning similarity in their future encounters with the new words. 5) Relating the target words to other formally and semantically related words which have been learned in order to reinforce the form-meaning linkage of the both the target word and other known words and reorganizing the mental lexicon by relating the new to the old. This involves retrieving the related word forms and their meanings and

comparing them with the new words in terms of collocations, grammatical functions, associations, etc. The teacher may ask the students to recall the higher frequency words they have learned which are related in form and meaning to the new words under study. Or they may refer the students to the dictionary where they can find lists of related words.

Further explanation is needed here for the fourth step about the hints and word meanings. The teacher should make it clear to the students that the hints are intended to link the words with their meanings. To grasp the meanings of the words they need to associate the hints for them with their uses in contexts. It is equally important to let them know that one hint does not point to one meaning of a word. They should have the awareness that many words in fact do not have as many meanings as the learners' dictionaries present. Many dictionary-based definitions for a word are in fact several senses which are so closely related that they can be conveniently subsumed under one meaning. For this reason, from the first definition which is often the most frequently used meaning or the most central meaning of a word in the learners' dictionaries, or from one of the first definitions for a lexical item, it is very likely that the meaning of the word can be understood. Other dictionary definitions are actually bringing out more details about the word meaning or more clearly emphasizing one aspect of the meaning (Parent, 2008). The hints for the accessible words are not as detailed and comprehensive as dictionary definitions, but they can serve as links to remind learners of either a frequently used sense or a central meaning of a word. In the strategy training or direct teaching, the teacher needs to present some collocations of the words or sentences with the words under study and show the students how the hints can be used to connect the meanings of words. Take the word COMPOSE for example. Its collocations can be "to compose an answer, music, a letter, a poem; to be composed of". When these collocations are related to the hint for this word "to put things or parts together", the meaning of the word becomes clear – to compose means to put musical notes or letters together to form a piece of music or writing; similarly to be composed of sth means to put members or substances or parts together to form a larger body.

Thus, it is necessary that the teacher helps the students develop the dictionary skills that are required to consult a learners' dictionary containing the information on word parts and word relations. At least two dictionary skills are involved in using the word part technique for vocabulary growth. One is knowing where and how the information about word parts and word relations is presented in the dictionary and what

related knowledge can be obtained from the dictionary. The other is knowing the relations between the hints and the dictionary definitions for words and being able to relate the hints to the meanings of a target word from the dictionary. The teacher needs to lead the students through some dictionary items familiarizing them with the format and the related information that can be obtained about the words. Then the teacher needs to read together with the students the hint and the definitions for a word and discuss which dictionary-defined senses of the word can be seen in the hint. It should be noted that some of the dictionary definitions may appear too far away from the hints and thus cannot be connected with the offered hints, and this is especially so for some students than others. If, for instance, the dictionary definition for COMPOSE as in "to compose oneself", "to try to be calm" (to put one's reason together with one's feelings to make oneself calm) is hard to be seen by some students, it may well be best to let this sense pass for the time being rather than force it on them. What the students should be clear about is the way of using the hints to aid the access to the meanings of words, not to grasp all the meanings or senses of a word through a hint.

11.5.5 The order of teaching and learning the accessible words

Of the 2156 words that can be accessed through the first 2000 known words, there are 739 words which are easy to access because they are semantically transparent and formally similar in relation to the known words. These words are the ones to use when the mnemonic method is first introduced to the students. With their meaning and form connections with the known words being easily seen, they can serve well as examples to show the students how to use the learning technique. For lower proficiency students, it is advisable that a longer time should be spent on the easily accessed words so that the students will have more experience in using the mnemonic technique and have a better mastery of it. The sense of success they experience with the easily accessible words may also be helpful for their language learning and future application of the technique.

After the learning technique is introduced to students, it is suggested that the accessible words which enjoy higher frequency of use should receive attention first. High frequency words have been shown by a large body of research to be able to provide high percentage text coverage no matter what the subject matter is. High frequency words provide even greater coverage of all kinds of spoken discourse.

Therefore learning higher frequency words first will have a good return for the time and effort. The results of the present research show that a greater number of the third and the fourth 1000 words (more than one third of the words for both frequency levels) can be accessed through the high frequency known words than words from other frequency levels. These results are encouraging in that one third of the learning burden can be lightened for two thousand very frequent and useful word families with the help of the technique. Learning the second 1000 word families through the first 1000 most frequent words must be given priority if the students have not grasped them.

The lower frequency words do not deserve much attention from the teacher during class time, but they need to be learned by the learners themselves by applying the technique. Assignments should be given to the students to learn 20 to 30 lower frequency words each week after class. The words can be picked up by students themselves or by teachers from the accessible words lists. It may also be a good idea to apply the technique to words that appear in their reading materials. The results of this research show that more than one fourth of the fifth and sixth 1000 words and nearly one fourth of the seventh and eighth 1000 and nearly one fifth of the ninth and tenth 1000 words can be made easier to learn with the help of the technique.

The 21 most productive word parts have been sorted out from the more than two thousand accessible words. They deserve special attention from both the teacher and the learners because learning the 21 word parts will ease the learning of about 200 word families. The great productive power means that learning the 21 forms and their meanings will result in a reward ten times as great as the effort. This is good reason to include words with these word parts from the beginning of the course and deal with the word parts and the higher frequency and the lower frequency words containing the word parts in a principled way.

When the accessible words are taught and learned by employing the word part technique, the relationship between word form accessibility and meaning accessibility and the interaction between the form and meaning accessibility and the learning environment or learners' individual characteristics should be taken into account. For example, as reviewed above, some research has indicated beginner learners' greater reliance on the sound similarity between the target words and words familiar to them because there are not many associations for the words in the second language in their mental lexicon. This suggests that a selection of words with higher form similarity for the lower proficiency students to learn might have better learning effects. It may also be

possible that some learners characteristically cling to form or meaning relatedness between words to a greater extent than others. Then the teacher should respond with appropriate treatment and feedback. The features of the learners' native languages may also make one of the factors affecting the ease of learning such as sound, shape and meaning more important in learning. This also needs to be attended to when selecting and sequencing the words to be learned. The general principle is to begin with the words whose features are easier to learn, and meanwhile to help learners raise their awareness of other aspects of word knowledge and build up more associations among the words in the target language.

The following chart is a summary of a suggested syllabus for incorporating the word part technique into a vocabulary course lasting sixteen weeks.

Table 11.1 A suggested syllabus for teaching vocabulary using the word part technique 11.

<table>
<tr><th>week</th><th>focus</th><th>vocabulary</th><th>activities</th></tr>
<tr><td>1</td><td rowspan="6">technique training</td><td rowspan="3">easily accessed</td><td rowspan="2">teacher demonstration, learner practice with the teacher and with partners, individual learning</td></tr>
<tr><td>2</td></tr>
<tr><td>3</td><td>strategy monitoring & feedback</td></tr>
<tr><td>4</td><td rowspan="3">words able to be accessed and accessed with difficulty</td><td rowspan="2">teacher demonstration, learner practice with the teacher and with partners, individual learning</td></tr>
<tr><td>5</td></tr>
<tr><td>6</td><td>strategy monitoring & feedback</td></tr>
<tr><td>7</td><td rowspan="10">direct teaching & learning</td><td rowspan="10">higher frequency words (the second, third and fourth 1000 words) taught in class & lower frequency words learned by learners themselves; the most productive form constants</td><td rowspan="2">teaching, exercises and assignment</td></tr>
<tr><td>9</td></tr>
<tr><td>10</td><td>rehearsal</td></tr>
<tr><td>11</td><td>test & feedback</td></tr>
<tr><td>12</td><td rowspan="3">teaching, exercises and assignment</td></tr>
<tr><td>13</td></tr>
<tr><td>14</td></tr>
<tr><td>15</td><td>rehearsal</td></tr>
<tr><td>16</td><td>test & feedback</td></tr>
</table>

11.5.6 Two cautions for using the word part technique

There have been well-conducted experiments proving the interference effects of teaching English words in semantic sets (Tinkham, 1993, 1997; Schneider, Healy & Bourne, 1998). The strongest interference occurs when learners are presented a set of

words to learn which are all related to each other. However, the danger of the interference effect caused by applying the word part technique should be very small because in this technique learning is based on learners' knowledge of a known word which is already well established. Learning another word which is formally and semantically related to the known word would not produce a negative effect. Rather bringing them together can strengthen the form and meaning link for the new word.

In spite of this, we do suggest that learners should be presented to learn at one time a pair consisting of the known word and one new word (POSITION/COMPOSE) rather than a group consisting of the known word and several new words (POSITION/COMPOSE/IMPOSE/DISPOSE), especially at the initial stage of learning these words. The guidelines described by Nation (2000) for learning vocabulary in lexical sets are largely applicable to the word part technique. First, two related new words should be introduced several days apart. Second, when teaching the related words, widely differing contexts should be used. Third, after the items have been reasonably mastered, "there is good value in deliberately bringing the items together to see how they differ from each other and where the boundaries between them lie" (p. 9). Thus classroom practice would be different from the consultation of a dictionary adapted along the word-part idea. In that dictionary, several words connected to the same meaning and form constant would be co-presented as described in Chapter one. However, when the word-part technique is used in classroom teaching and learning, several formally and semantically related new words would not be presented and learned together to avoid the interference effects. Learners should be warned of the danger by their teachers when they use the word technique in their own learning.

The second caution that should be exercised is that teachers should not emphasize the etymological meaning of the words and the etymological connection between words. The reason has been mentioned above, that is, the technique is intended to be a mnemonic to facilitate vocabulary learning and retention by showing the form and meaning similarity between the known words and new words. The learners should not see all the connections between words as being etymological.

11.6 Further research

In the current study, no striking advantage was found for learning foreign vocabulary using the word part technique by experienced learners. Nevertheless it was

demonstrated that it is a helpful aid in vocabulary learning. Therefore it is still a useful and engaging learning strategy which deserves attention in ESL research and teaching practice.

As an under-researched area, the efficacy of the word part technique needs to be researched in comparison with other learning strategies including the keyword method and the self-strategy. This line of research is suggested to give more attention to learners of different language proficiencies and native language backgrounds. The length of training time needs to be manipulated as a variable so as to see more clearly whether this is an important factor in explaining the effectiveness of the keyword method and the word part technique versus that of self-strategy learning. The relationship between the learning strategies and the time of word retention was not explored in the present study. Also what is worth investigation is the effectiveness of the word part technique in comparison with other vocabulary learning strategies in acquiring the productive knowledge of foreign words.

11.7 Conclusion

The first part of the current study proposed the word part technique, a vocabulary learning technique involving taking advantage of the form and meaning similarity between high frequency known words and low frequency unknown words. A list of words from the third to the tenth 1000 words was produced which can be accessed by the first 2000 words using the word part technique. In order to test the effectiveness of the proposed method, an experimental study was conducted in the second part of the thesis to compare it with the keyword technique, a much researched vocabulary learning mnemonic technique which bears several resemblances with the word part technique, and the self-learning condition where no special training in vocabulary learning is offered. Several statistical differences were found among the three vocabulary learning techniques. For instance, both the word part technique and the self-strategy learning resulted in a statistically significant superior performance in the translation test in the immediate post-test. Self-strategy learning was superior to the word part and to the keyword technique in the meaning recognition test in the immediate post-test. In the delayed post-test, the word part technique yielded significantly better scores in the translation test to the keyword technique. However, what is worth noting is that the significant differences between the learning conditions are not great. This means that

although they are statistically significant, they are not pedagogically significant. This result shows that like the other techniques used in vocabulary teaching and learning, the word part technique is a valuable supplement to the other vocabulary learning strategies, not a substitute for them.

To sum up, the word part technique may be a worthwhile tool for vocabulary teaching and learning for some learners and in some learning contexts. Apart from its slight superiority over the keyword method as a mnemonic, it has several other benefits in comparison to the other vocabulary learning strategies. First, it reveals the interconnections between the English words to learners so that the foreign language words are no longer discrete combinations of letters. These interconnections are helpful not only for committing new words to memory but also for consolidating known words. The known words and the new words both go through the process of organization or reorganization in the mental lexicon. This processing is beneficial for learning (Baddeley, 1990). Second, the word part technique is able to add pleasure to the target language learning by providing glimpses of history and etymologies of the target words. Although this is not the main purpose of the mnemonic, some necessary background knowledge is interesting and beneficial for learning. Third, analyzing word parts in vocabulary learning can give learners insights into the English language and thus enhance their awareness and understanding of the phonological, orthographical and semantic systems of the English language. This will benefit learners' language study as a whole. Fourth, for learners with relatively low language proficiency, the significance of the word part technique may be found mainly in the aid it offers for memorizing new words. For learners with relatively high language proficiency, its significance is likely to lie more in the insights they can gain into the English words in addition to the mnemonic facilitation.

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Appendix I

Examples of the research results

- EA = easily accessed
- AA = able to be accessed
- AD = accessed with difficulty
- A known word with the mark "*" is a 2nd 1000 word. Otherwise it is a 1st 1000 word.
- A wide variety of example sets of accessible words is provided to show the analyzing process and the possible results of the analysis.

form constants	meaning constants	relationship	1st and 2nd 1000 words	words of lower frequency	frequency level	hints	meaning transparency levels	spoken form similarity scores	written form similarity scores	Accessibility level
-mit-, -mis-	send	as in	com**mit**tee			a group of people who are **sent** to be together to conduct some particular business				
				per**mit**	2	an official document that **sends** a person through the border	4c	0.67	0.33	AA
				trans**mit**	3	to **send** out electric signals	4b	0.33	0.27	AD

				sub**mit**	4	to **send** your plan or writing to sb whom you are under, for consideration.	4c	0.43	0.33	AD
				e**mit**	6	to **send** out gas, heat or light	4b	0.5	0.33	AA
				re**mit**	6	to **send** a payment	4b	0.5	0.33	AA
				o**mit**	7	to **send** sth out (to exclude sth) of a list or article	4c	0.5	0.44	AA
				mission	3	an important task people are **sent** to do	4b	0.33	0.2	AD
				pre**mis**e	3	a statement **sent** before an argument (the basis of the argument)	4b	0.29	0.33	AD
				dis**mis**s	4	to **send** sb away from his job	4a	0.29	0.22	AD
				missile	5	a weapon **sent** to hit a target over a long distance	4b	0.29	0.3	AD
				sub**mis**sion	5	**sending** your plan or writing to sb you are under for consideration	4b	0.29	0.2	AD
				de**mis**e	7	**sending** sth away (the end of sth)	4c	0.17	0.38	AD
				o**mis**sion	8	**sending** sth out of (excluding from)an article	4c	0.33	0.3	AD
-mes- is a variant of –mis-				**mes**sage	2	the information **sent** to another person	4b	0.13	0.22	AD
-view-	see	as in	**view**			to **see**				
				pre**view**	5	**seeing** sth before it becomes generally available.	3b	0.5	0.57	AA

				re**view**	4	the action of **seeing** sth again with the aim to assess	3b	0.6	0.67	AA
				inter**view**	2	a **seeing** of (meeting with) people for examination	3c	0.43	0.44	AD
-vey is a variant of -view-	see (view)			su**rvey**	2	to take a general **view** of sth	2a	0.2	0.29	AA
-vis-	see	as in	visit			go to **see**				
				ad**vis**e	2	to tell how you **see** a matter as guidance for sb	3b	0.33	0.5	AA
				re**vis**e	2	**see** again and make changes	3a	0.33	0.5	AA
				super**vis**e	3	**see** that the right thing is done	3a	0.25	0.33	AA
				visible	3	able to be **seen**	3a	0.67	0.57	AA
				visual	3	relating to or used in **seeing**	3a	0.4	0.5	AA
				en**vis**age	4	**see** in the mind's eye	3a	0.29	0.38	AA
				audio**vis**ual	9	involving **seeing** pictures and hearing sounds	3b	0.22	0.27	AD
				visor	10	the movable part of a helmet helping people **see** properly	3b	0.4	0.6	AA
				visa	4	a note put on your passport that gives you permission to **visit** (go to **see**) a foreign country	2b	0.6	0.6	AA
-vic- is a variant of –vis-				ad**vic**e	2	how you **see** a matter which may be a guidance for sb.	3b	0.13	0.29	AD

-vy is a variant of -vis-	see			en**vy**	4	**see** others' fortune with ill feelings	3a	0.14	0.14	AA
-cis-, -cid-	cut	as in	de**cid**e/de**cis**ion			a judgment about where to **cut** off (what to do or not to do)				
				pre**cis**e	2	with vague parts of information **cut** away	4c	0.5	0.57	AA
				ex**cis**e	6	to remove by **cutting** sth out	4c	0.38	0.43	AD
				circum**cis**e	7	to **cut** around the end of the sex organs	4c	0.38	0.3	AD
				con**cis**e	7	with unnecessary words **cut** away	4c	0.5	0.43	AA
				in**cis**e	9	to **cut** into sth	4c	0.5	0.43	AA
				s**cis**sors	4	a tool to **cut** things	4c	0.43	0.38	AD
				sui**cid**e	3	**cutting** off one's own life (killing oneself)	4c	0.67	0.57	AA
				pesti**cid**e	7	poison to **cut** down on the numbers of bad insects	4c	0.5	0.56	AA
-fort-, -force-	strength	as in	**forc**e			**strength**				
				ef**fort**	2	physical or mental **strength**	3a	0.25	0.43	AA
				com**fort**	2	to **strengthen** sb by saying kind words	3a	0.17	0.38	AA
				fort	5	a **strong** building for defence	3a	0.67	0.6	EA
				en**forc**e	5	to **force** people to obey a law	3a	0.6	0.71	EA

				rein**forc**e	5	to make something **stronger** by giving it support	3b	0.43	0.44	AA
				fortify	6	to make sth **strong**	3a	0.33	0.43	AA
				forte	7	the **strong** point of a person	3a	0.67	0.6	EA
				fortress	9	a **strong** building for defence	3a	0.33	0.38	AA
				fortitude	10	moral **strength**	3a	0.25	0.33	AA
-ran(g)-	range	as in	**rang**e							
				rank	3	a position in a **range** of positions	2a	0.5	0.6	EA
				ranger	5	sb who **ranges** widely in a park and looks after it	2a	0.8	0.83	EA
-run{g)- is a variant of -ran(g)-				**rung**	1	the crosspieces in a ladder that **range** from the lowest to the highest	2b	0.25	0.6	AA
-se/k/: -sec-, -sequ-	follow	as in	**sec**ond			**following** the first				
				con**sequ**ence	4	what **follows** as an effect	3a	0.11	0.27	AA
				sequence	4	the **following** of one thing after another	3b	0.57	0.38	AA
				sub**sequ**ent	4	**following i**n time	3a	0.4	0.3	AA
				con**sec**utive	7	**following** continuously	3a	0.27	0.27	AA
				sequel	8	sth that **follows** an event	3a	0.33	0.33	AA
				pro**sec**ute	4	to **follow** sth up	3a	0.29	0.22	AA
				con**sequ**ential	9	of what **follows** as an effect	3a	0.18	0.23	AA
-b-r-	bear	as in	**b**ea**r**							
				bai**r**n	7	a young person **born** a few years ago	2b	0.5	0.5	EA

				bar**r**ow	5	a cart used to **bear** fruit and vegetables to be sold in streets	2b	0.5	0.43	AA
				be**r**th	7	a place that can **bear** a sleeping person in a train or ship	2b	0.33	0.29	AA
				bu**r**den	3	sth that is hard to **bear**	2a	0.33	0.29	AA
-gno-	know	as in	i**gno**re *			to refuse to **know** more by giving attention	2b	0.25	0.33	AA
				dia**gno**se	5	to examine a patient in order to **know** their disease	2b	0.29	0.29	AA
				dia**gno**sis	6	the examination of a patient in order to **know** their disease	2b	0.22	0.33	AA
				dia**gno**stic	7	concerning the examination of a patient in order to **know** their disease	2b	0.2	0.2	AA
				pro**gno**sis	9	the development of a disease doctors **know** before hand	2b	0.22	0.33	AA
				pro**gno**stic	10	concerning the development of a disease which doctors **know** beforehand	2b	0.2	0.2	AA
-car-	carry	as in	carry							
				career	2	one's job one **carries** through life	2a	0.5	0.57	EA
				caravan	4	a vehicle **carrying** beds and other equipment for people to live in	2b	0.43	0.43	AA
				cargo	7	goods **carried**	2a	0.25	0.6	AA

				mis**car**ry	7	to give birth to a baby before it is **carried** in the mother's body for a long enough time	2b	0.57	0.57	EA
-char- is a variant of –car-				**char**iot	8	a vehicle **carrying** soldiers in a fight in ancient times	2b	0.4	0.43	AA
-ceive-, -cept-	take, receive (take in)	as in	ac**cept**/re**ceive**			to **take** what is offered				
				con**cept**	2	an idea you **receive (take** in)	2a	0.57	0.57	EA
				inter**cept**	5	to **take** sth when it is on its way from one place to another.	3b	0.5	0.36	AA
				de**ceive**	5	to **take** sb in with tricks	3a	0.6	0.71	EA
				de**cept**ive	10	likely to **take** sb in with the trick	3a	0.5	0.44	AA
				per**cept**ion	3	**receiving** information	2a	0.43	0.4	AA
				sus**cept**ible	5	capable of **receiving** influences	2a	0.44	0.36	AA
				per**ceive**	4	to **receive** information with the senses and form ideas about a thing	2b	0.6	0.63	AA
				re**cept**ion	3	noun of **receive**	1	0.43	0.44	AA
				re**ceive**r	4	part of a telephone that **receives** sounds	2a	0.83	0.88	EA
				re**cept**ive	5	able to receive new ideas or suggestions	2a	0.5	0.44	AA
				miscon**cept**ion	8	a **received** wrong idea or understanding	2a	0.27	0.31	AA

				per**cept**ive	8	quick to **receive** information and to understand	2a	0.5	0.4	AA
				re**cept**or	10	a nerve ending which **receives** stimuli from outside	2b	0.57	0.5	EA
				miscon**ceive**	10	to **receive** a wrong idea or understanding of sth	2a	0.33	0.45	AA
-ceipt- is a variant of -ceive-, -cept-				re**ceipt**	3	a piece of paper showing you have **received** goods	2b	0.83	0.71	EA
-m-n-	mind	as in	**mind**							
				mental	2	adjective of **mind**	1	0.4	0.33	AA
				re**min**d	2	to put sb in **mind** of something	2a	0.67	0.67	EA
				re**min**iscence	5	past experiences called back into the **mind**	2a	0.22	0.25	AA
				monument	6	a building serving to keep notable people or events alive in people's **minds**	2b	0.22	0.25	AA
				de**men**tia	8	a serious illness of the **mind**	2a	0.29	0.25	AA
				mania	8	the madness of the **mind**	2a	0.5	0.4	AA
-memo(r)-	remember	as in	**memor**y							
				com**memor**ate	5	to do sth in **memory** of sb	2a	0.56	0.45	AA
				memo	5	record to help **memory**	2a	0.5	0.67	EA
				memorable	6	worth being committed to **memory**	2a	0.63	0.56	EA
				memoir	8	a book based on one's **memory** of one's life	2a	0.5	0.71	EA

				memorandum	8	record to help **memory**	2a	0.5	0.5	EA
-mid-, -med(i)-	middle	as in	**mid**dle							
				*im***med**iate	2	*without* anything coming in the **middle**	2a	0.5	0.33	AA
				medium	3	of **middle** size, level or amount	2a	0.6	0.33	AA
				media	4	radio, newspapers or television as the means of communication as if working in the **middle** of the sources of information and the public	2b	0.75	0.33	AA
				medieval	5	connected with the **Middle** Ages	2c	0.43	0.33	AA
				inter**medi**ate	5	coming to the **middle** level	2a	0.3	0.25	AA
				mediterranean	5	the sea that is in the **middle** of several lands	2a	0.18	0.23	AA
				mediocre	7	being in the **middle** position ranging from good to bad	2a	0.43	0.38	AA
				mediate	8	to work in the **middle** of people to settle arguments	2b	0.5	0.43	AA
				meri**di**an	9	the **middle** of the day	2b	0.44	0.36	AA
				meddle	9	to interfere in the **middle** of a situation	2a	0.75	0.83	AA
				median	10	situated in the **middle**	2b	0.6	0.33	AA
				inter**medi**ary	10	sb who acts in the **middle** of two other groups or people as means of communication	1	0.3	0.17	AA

				a**mid**	9	in the **middle** of	2b	0.75	0.75	EA
-jud-, -jur-	judgement	as in	**jud**ge/judgement							
				pre**jud**ice	4	unreasonable **judgements** about people	2a	0.1	0.31	AA
				judicial	6	relating to **judgements** made in a court of law	2b	0.14	0.33	AA
				ad**jud**icate	7	to make a formal judgement on a matter	2a	0.13	0.3	AA
				judicious	7	showing good **judgement** and sense	2a	0.14	0.33	AA
				judiciary	9	the system of making legal **judgements** in courts	2b	0.13	0.33	AA
				jury	4	a group of people in a court of law swearing to give fair **judgements** on presented evidence	2b	0.14	0.22	AA
				jurisdiction	6	the right to make legal **judgements**	2a	0.18	0.25	AA
				juror	9	one of a group of people in a court of law swearing to give fair **judgements** on presented evidence	2b	0.14	0.22	AA
-cur(s)-	run	as in	**cur**rent			the running of water				
				currency	4	money that **runs** (passes) from person to person in a country	3c	0.86	0.75	AA
				cursor	7	a shape that **runs** forwards and backwards on a computer screen indicating where a typed letter appears	3b	0.17	0.44	AD

				con**cur**rent	8	**running**(occurring) together	3c	0.17	0.44	AD
				cursory	9	**running** over (doing) sth rapidly without attention to detail	3c	0.22	0.4	AD
				ex**cur**sion	9	a **running** out somewhere(a journey)	3c	0.67	0.7	AA
-course-, -co(u)r-	run	as in	**course**			line to **run** along				
				corridor	3	a passage **running** through a building	4a	0.17	0.33	AD
				courier	6	a **running** messenger	4a	0.25	0.71	AA
				dis**course**	8	a speech or article that **runs** long	4a	0.5	0.67	AA
				*inter***course**	9	**running** to and fro (communication) *between* people	4c	0.43	0.55	AA
				re**course**	9	a **running** back (turning to sb) for help	4c	0.6	0.75	AA
				con**course**	10	**running** (moving) together of people	4c	0.5	0.67	AA
-sign-	sign	as in	**sign**							
				significance	2	the meaning to be found in **signs** like words and events	2b	0.18	0.33	AA
				signify	7	to be a **sign** of	2a	0.29	0.57	AA
				signet	9	a thing with your **sign** on it, which is first letters of your name.	2b	0.33	0.67	AA
				de**sign**ate	6	to represent sth using a **sign**	2a	0.25	0.44	AA

				con**sign**	5	to deliver with the recipient's name **signed**	2b	0.5	0.57	EA
				signature	3	one's name **signed** by oneself	2a	0.29	0.44	AA
				signatory	7	sb that has **signed** an agreement	2a	0.22	0.44	AA
				signal	2	a **sign**	1	0.33	0.67	AA
				in**sign**ia	10	badges that are **signs** of one's office	2a	0.25	0.5	AA
-scrib(e)-	write	as in	de**scrib**e			**write** about the features of sth				
				scribble	3	**write** hastily or carelessly	4a	0.5	0.6	AA
				sub**scribe**	4	to **write** down one's name as a buyer of shares or a periodical	4b	0.63	0.67	AA
				pre**scribe**	5	to **write** advice for the use of medicine	4a	0.63	0.67	AA
				scribe	6	sb in the past who made copies of pieces of **writing**	4a	0.71	0.75	AA
				tran**scribe**	5	to put speech into **written** form	4a	0.56	0.6	AA
				in**scribe**	8	to **write** words and symbols on sth	4a	0.71	0.75	AA
-script-	write	as in	**descript**ion			a piece of **writing** about the features of sth				
				pre**script**ion	3	a **written** order for the use of a medicine	4b	0.7	0.83	AA
				script	3	**written** characters	4a	0.56	0.55	AA

				con**script**ion	6	compulsorily **writing** one's name in the list of servicemen to join the armed forces	4b	0.7	0.75	AA
				manu**script**	6	book as first **written** by hand	4a	0.42	0.46	AD
				scripture	7	the sacred **writings** of Christianity contained in the Bible	4b	0.56	0.55	AA
				post**script**	10	a remark **written** at the end of a letter	4a	0.45	0.46	AD
				sub**script**ion	10	the action of **writing** down one's name as a buyer of shares or a periodical	4b	0.7	0.75	AA
-gen-	a kind	as in	**gen**eral			all of a **kind**				
				generate	2	to cause a **kind** of thing to begin	3a	0.57	0.75	EA
				generous	3	giving to all of a **kind**	3a	0.57	0.63	EA
				gender	4	of the male or female **kind**	3a	0.67	0.43	AA
				genre	7	a **kind** of literature	3a	0.33	0.57	AA
				gentile	10	the **kinds** of people who are not Jewish	3a	0.5	0.43	AA
				homo**gen**eous	10	of the same **kind**	3a	0.22	0.36	AA
-gen(erat)-	generate	as in	**generat**e *			to produce				
				generator	4	a machine that **generates** electricity	2a	0.88	0.78	EA
				de**generat**e	5	to **generate** worse conditions	2a	0.78	0.8	EA
				re**generat**e	7	to **generate** new strength again for sth and make it develop again	2b	0.78	0.8	EA

				genuine	3	true to what is first **produced**	3a	0.43	0.57	AA
				gene	4	part of a cell that **produces** similar features in children	3b	0.29	0.5	AA
				genesis	5	how sth is first **produced**	3a	0.57	0.5	AA
				genetic	6	of the part of a cell that **produces** similar features in children	3b	0.33	0.56	AA
				genius	6	the ability to **produce** new ideas	3a	0.38	0.38	AA
				indi**gen**ous	6	**produced** naturally in a land	3a	0.22	0.3	AA
				in**gen**uity	8	cleverness in **producing** new ideas and things	3b	0.36	0.3	AD
				en**gen**der	8	to **produce** a situation	3a	0.4	0.45	AA
				con**gen**ital	9	**produced** within a person	3a	0.36	0.36	AA
				genital	9	of the **productive** organs	3a	0.5	0.44	AA
				in**gen**ious	9	able to **produce** clever new ideas	3a	0.3	0.3	AA
-equa-, -equi-	equal	as in	**equa**l							
				ad**equa**te	2	**equal** to what is required	2a	0.43	0.5	AA
				equivalent	3	**equal** in value or meaning	2a	0.2	0.5	AA
				equation	4	statement that two mathematical expressions are **equal**, indicated by the sign "="	2b	0.4	0.5	AA
				equity	5	the quality of being **equal** and fair	2a	0.33	0.5	AA
				equilibrium	6	state of being **equal** and balanced	2a	0.2	0.27	AA

				equator	7	imaginary line dividing the earth into two **equal** parts of the south and the north	2b	0.33	0.57	AA
				equitable	8	treating people **equally** and fairly	2a	0.25	0.56	AA
				equivocal	8	having two **equally** possible meanings	2b	0.44	0.56	AA
- iqui- is a variant of -equa-				in**iqui**ty	8	the quality of being **unequal** and unjust to others	2b	0.25	0.25	AA
-form-	form	as in	**form**							
				formal	2	of outward **form**	2a	0.75	0.67	EA
				per**form**	2	go through the whole required **form**	2b	0.6	0.57	EA
				trans**form**	3	to change the **form** or nature of sth	2a	0.38	0.44	AA
				uni**form**	3	unchanging in **form** or character	2a	0.5	0.57	EA
				format	3	the **form** of a book such as its shape, size and design	2b	0.6	0.67	EA
				con**form**	4	to stick to the required **form**	2b	0.5	0.57	EA
				formula	4	showing a relationship by using a written **form**	2a	0.5	0.57	EA
				re**form**	4	to improve by changing the **form** (way)	2c	0.6	0.67	EA
				de**form**	6	spoil the **form** of sth	2a	0.6	0.67	EA
				formative	10	important in **forming** the development of sth	2a	0.43	0.44	AA
-morph- is a variant of –form-				**morph**ology	10	the study of the **forms** of things	2a	0.13	0.22	AA

-hand/i/-	hand	as in	**hand**							
				handle	2	part of sth held with the **hand**	2a	0.8	0.67	EA
				handicap	3	disadvantages you have as if your **hands** have been tied together	2c	0.5	0.5	EA
				handy	3	convenient as if you can easily get it with your **hands**	2c	0.8	0.8	EA
				handicraft	9	craft needing skill with the **hands**	2a	0.4	0.5	AA
-struct-	structure	as in	**struct**ure							
				de**struct**ion	2	the action of damaging the **structure** of sth to end its existence	2b	0.56	0.55	EA
				in**struct**	2	to build **structures** in sb's mind	2a	0.56	0.55	EA
				con**struct**	4	to build a **structure** like a building or machine	2a	0.5	0.5	EA
				ob**struct**	5	to create a **structure** which stops sb	2a	0.56	0.55	EA
				infra**struct**ure	6	the basic **structures** and facilities needed by a society	2b	0.58	0.64	EA
				super**struct**ure	9	**structure** built on sth else	2a	0.64	0.64	EA
-stro- is a variant of -struct-	structure			de**stro**y	2	to damage the **structure** of sth to end its existence	2b	0.33	0.27	AA
-strue- is a variant of -struct-	structure			con**strue**	9	analyze the **structure** of a sentence	2a	0.3	0.42	AA
-sta-, -stan-, -stat-	stand	as in	**stan**d							

				stable	2	firmly **standing** and not likely to move	2a	0.4	0.5	AA
				stall	2	a **stand** selling goods in a market	2a	0.4	0.6	AA
				status	2	position or **standing** in society	2a	0.33	0.5	AA
				di**stant**	2	of two things **standing** far apart	2a	0.57	0.57	EA
				circum**stan**ce	2	conditions **standing** around an event	2a	0.4	0.33	AA
				in**stant**	3	happening quickly without anything **standing** in between two events	2b	0.57	0.57	EA
				stance	6	the way sb **stands**	2a	0.8	0.67	EA
				static	4	**standing** still not moving or changing	2a	0.33	0.5	AA
				ob**sta**cle	5	sth that **stands** in one's way	2a	0.29	0.38	AA
				statue	6	a figure of a person that **stands** on a supporting base	2b	0.6	0.5	EA
				pede**sta**l	7	a base (or foot) on which an art work **stands**	2a	0.22	0.33	AA
				stature	9	the height of a person in his **standing** position	2a	0.6	0.43	AA
-stoo- is a variant of -sta-, -stan-, -stat-				**stoo**l	5	a simple wooden seat that **stands** on three or four legs	2b	0.4	0.4	AA
-join-, -junct-	join	as in	**join**							

				joint	2	a point at which parts of a structure are **joined**	2b	0.75	0.8	EA
				*dis***join**ted	4	*not* **joined** together/separated at the joints	2a	0.43	0.5	AA
				joiner	4	a person who **joins** pieces of wood to make doors and furniture	2b	0.75	0.67	EA
				ad**join**	6	one thing is next to sth as if the two are **joined** together	2c	0.75	0.67	EA
				re**join**	7	to **join t**ogether again	2a	0.6	0.67	EA
				junction	2	the place where parts **join**	2a	0.17	0.33	AA
				con**junct**ion	6	words that **joins** other words or clauses	2b	0.22	0.18	AA
				juncture	7	a place where parts of a process **join**	2a	0.17	0.25	AA
-lit- is a variant of –let-	letter	as in	**let**ter							
				literal	2	involving **letters** of an alphabet	2a	0.43	0.5	AA
				literacy	4	the ability to recognize **letters** and to read and write	2b	0.38	0.44	AA
				literate	4	familiar with **letters** and therefore be able to read and write	2b	0.43	0.44	AA
				ob**lit**erate	7	to make sth invisible such as **letters**, foot prints	2b	0.33	0.36	AA
				lettering	10	written **letters** of a particular type	2a	0.43	0.67	AA

-locate, -local-	place	as in	**local**			of place				
				a**llocate**	2	to set things in different **places** for different people to use	3b	0.33	0.5	AA
				locate	2	to find the exact **place** of sth	3a	0.6	0.67	EA
				dis**locate**	5	to move sth away from its normal **place**	3b	0.38	0.44	AD
				locality	5	**place** in which an event occurs	3a	0.38	0.63	AA
				locus	10	a particular **place** where sth occurs	3a	0.4	0.6	AA
				reall**locate**	7	to set things in different **places** again for different people to use (allocate again)	2a	0.75	0.8	EA
-long-, -l-ng-	long	as in	**long**							
				l**engt**h	2	noun of **long**	1	0.5	0.5	EA
				pro**long**	5	to make sth last a **longer** time	2a	0.5	0.57	EA
				li**ng**	8	a **long** sea fish	2a	0.67	0.75	EA
				e**long**ate	9	to make sth **longer**	2a	0.43	0.5	AA
				ob**long**	9	a shape **longer** than it is wide	2a	0.6	0.67	EA
-nam-, -nom-, -nym-	name	as in	**nam**e							
				sur**nam**e	3	one's family **name**	2a	0.6	0.57	EA
				nick**nam**e	5	a familiar or humorous **name** given to sb	2a	0.5	0.5	EA

				re**nam**e	7	give a new **name** to	2a	0.6	0.67	EA
				nominate	4	put one's **name** forward for election	2a	0.29	0.25	AA
				nominal	6	existing in **name** but not in fact	2a	0.33	0.29	AA
				mis**nom**er	7	wrong use of a **name**	2a	0.29	0.38	AA
				nominee	7	the person whose **name** is put forward for election	2b	0.33	0.29	AA
				de**nom**ination	8	a branch of religion with its own **name**	2a	0.2	0.17	AA
				ano**nym**ous	3	without a **name**	2a	0.25	0.22	AA
				syno**nym**	8	a **name** given to sth which has similar meaning to the name of another thing	2b	0.29	0.25	AA
				acro**nym**	8	word formed from the initial letters of a name	2b	0.29	0.25	AA
				ano**nym**ity	9	being without **name**	2a	0.22	0.22	AA
				pseudo**nym**	10	an unreal **name** taken by an author	2a	0.25	0.2	AA
-nown is a variant of –nom-				re**nown**	7	famous with their **name** known to many people	2b	0.2	0.17	AA
noun is a variant of –nom-				**noun**	6	a word which is the **name** for a thing	2a	0.33	0.25	AA
-mount- , -m-n-	mountain	as in	**mount**ain							
				mount	3	**mountain**	1	0.67	0.63	EA
				para**mount**	7	more important than others as if high above a **mountain**	2c	0.4	0.42	AA

				sur**mount**	10	to overcome obstacles as if to reach the top of a **mountain**	2c	0.5	0.45	AA
				pro**min**ent	3	sticking out just as a **mountain** sticks out of the earth's surface	2c	0.3	0.25	AA
				me**n**ace	4	threatening feeling like the one caused by a high mountain	2c	0.33	0.38	AA
				e**min**ent	6	distinguished like a high **mountain**	2c	0.38	0.3	AA
-cess-	go	as in	pro**cess**			actions **gone** through				
				ac**cess**	2	the means or opportunity to **go** into a place	3b	0.5	0.57	AA
				ex**cess**	2	the amount of sth that **goes** beyond what is expected	3b	0.5	0.57	AA
				re**cess**ion	2	the act of **going** back from a position	3a	0.29	0.4	AA
				con**cess**ion	5	**going** along with sb's opinions	3a	0.43	0.45	AA
				re**cess**	5	part of a room where the wall **goes** back from the usual part	3b	0.5	0.71	AA
				prede**cess**or	6	the former holder of a job or position (sb who **goes** before you)	3c	0.56	0.55	AA
				pro**cess**ion	6	line of persons or vehicles **going** in an orderly way	3b	0.71	0.7	AA
				suc**cess**ion	6	the **going** (coming) of one thing after another	3c	0.29	0.4	AD

				ab**scess**	7	parts of a wound that have **gone** away by rotting	3b	0.33	0.57	AA
				micropro**cess**or	10	part of the computer that does the **processing**	3b	0.5	0.5	AA
-cest- is a variant of -cess-	go	as in		an**cest**or	6	a person from who you are descended (who **goes** before you)	3c	0.25	0.33	AD
-ceas- is a variant of -cess-	go	as in		**ceas**e	4	to **go** (come) to an end	3c	0.33	0.43	AD
-ced-, -ceed-	go	as in	pro**ced**ure/pro**ceed**			actions **gone** through/ to **go** forward				
				pre**ced**e	3	to come (**go**)before in time	3c	0.5	0.63	AA
				con**ced**e	6	to **go** along with opinions	3a	0.57	0.44	AA
				re**ced**e	7	to **go** back from a previous position	3a	0.67	0.63	EA
				*inter***ced**e	10	to **go** *between* two parties and ask for a favour for one or act as a peacemaker	3b	0.43	0.36	AD
				ex**ceed**	4	to **go** beyond what is allowed by a limit	3b	0.5	0.57	AA
-not-	idea	as in	**not**e			a record of **ideas**				
				de**not**e	8	to represent an **idea**	3a	0.6	0.67	EA
				notation	9	the system of marks to represent **ideas**	3a	0.5	0.38	AA
				con**not**ation	8	an additional **idea** a word suggests	3a	0.38	0.27	AA
				notion	4	**idea** or opinion	3a	0.5	0.5	EA
				notional	7	of **ideas** or opinions	3a	0.33	0.38	AA
-num-	number	as in	**num**ber							

				numeral	8	a word expressing a **number**	2a	0.38	0.63	AA
				numerical	5	adjective of **number**	2a	0.22	0.56	AA
				numerous	3	a large **number** of sth	2a	0.38	0.63	AA
				*in***num**erable	9	a large **number** of sth *not* to be able to count	2b	0.33	0.5	AA
				e**num**erate	10	to mention a **number** of things one by one	2b	0.33	0.5	AA
				numeracy	10	the ability to understand and work with **numbers**	2b	0.33	0.56	AA
-person-	person	as in	**person**							
				personality	3	qualities that make up a **person**'s character	2b	0.4	0.55	AA
				personnel	4	**persons** employed in an organization	2a	0.57	0.67	EA
				parson	5	**a person** working in a church as a priest	2a	0.75	0.83	EA
				personalize	6	to put a name on sth to show it belongs to a particular **person**	2b	0.44	0.55	AA
				*im***person**al	8	*not* influenced by **personal** feeling	2a	0.5	0.6	EA
				personage	10	important **person**	2a	0.57	0.67	EA
				personable	10	of a **person** pleasing in personal appearance and manner	2b	0.5	0.6	EA
				im**person**ate	10	pretend to be another **person**	2a	0.44	0.55	AA
"parson" is a variant of –person-				**parson**	5	a person working in a church as a priest	2a	0.75	0.83	AA

-posit-, -pos(t)-	put	as in	**posit**ion			a place where sb or sth is **put**				
				im**pos**e	2	to **put** a tax or duty on	3a	0.25	0.3	AA
				op**posit**e	2	**put** sb or sth in a position against another one	3b	0.57	0.5	AA
				pose	3	to **put** sb into a particular position to be photographed	3b	0.33	0.38	AD
				dis**pos**e	3	to **put** away	3a	0.22	0.27	AA
				com**pos**e	4	to **put** things or parts together	3a	0.22	0.27	AA
				de**posit**	4	the money **put** in a bank	3a	0.38	0.5	AA
				ex**pos**e	4	to **put** sth out for all to see	3a	0.22	0.3	AA
				pro**posit**ion	4	sth **put** forward (proposed)as a plan	3c	0.67	0.73	AA
				com**post**	5	materials **put** together to rot	3a	0.11	0.36	AA
				posture	6	the way you **put** your body when sitting or standing	3b	0.17	0.5	AA
				dis**posit**ion	7	the action of **putting** things in order	3a	0.67	0.73	EA
				superim**pos**e	7	**put** one thing on top of another	3a	0.15	0.2	AA
				de**pos**e	8	to **put** down sb from office	3a	0.25	0.3	AA
				re**posit**ory	8	a place where things are **put** in storage	3a	0.2	0.55	AA
				predis**pos**e	9	to **put** sb in a condition in advance by giving him influence	3b	0.17	0.21	AD
				decom**pos**e	10	to separate sth into the parts that are **put** together to form it	3b	0.18	0.23	AD

				trans**pos**e	10	to **put** two things in each other's former position	3b	0.18	0.23	AD
-vost- is a variant of -posit-, -pos-	put	as in		pro**vost**	7	a person **put** before others as the head of a university college	3b	0.14	0.4	AD
-pound- is a variant of -posit-, -pos-	put	as in		com**pound**	4	sth formed by several parts **put** together	3a	0.11	0.18	AA
-sim-, -sem-, -sam-	similar,same	as in	**sim**ilar/**sam**e							
				as**sem**ble	2	to gather in a place for the **same** purposes	2a	0.43	0.38	AA
				simultaneous	4	happening at the **same** time as sth	2a	0.4	0.33	AA
				re**sem**ble	5	to be **similar** to	2a	0.38	0.33	AA
				simulate	5	to pretend to be **similar** to sth	2a	0.5	0.63	EA
				as**sim**ilate	8	to become **similar** to and part of another social group	2a	0.63	0.6	EA
				reas**sem**ble	10	to gather again in a place for the **same** purposes	2a	0.33	0.3	AA
-sect-, -seg-	section (cut off)	as in	**sect**ion			(part **cut** off)				
				sector	4	a **section**	1	0.6	0.71	EA
				in**sect**	5	a small creature like an ant, wasp, etc having a body divided into **sections**	2b	0.43	0.44	AA
				segment	6	a **section**	1	0.43	0.38	AA
				sect	7	a **section** of a religion that differs from the main group	2b	0.6	0.57	EA

				dis**sect**	8	to **cut** up a body into **section**s in order to study it	2b	0.43	0.4	AA
				sectarian	10	of a **section** of religion	2a	0.38	0.33	AA
				inter**sect**	7	two or more things that **cut** across each other	4a	0.33	0.33	AD
				segregate	5	**cut** one group apart from the rest	4a	0.25	0.22	AD
-sens-, -sent-	sense	as in	**sens**e			to feel				
				sentence	2	a grammatical unit used to express a **sense**	2b	0.57	0.63	EA
				sensible	2	having good **sense**	2a	0.57	0.63	EA
				non**sens**e	3	words that do not make **sense**	2a	0.5	0.56	EA
				sensitive	3	**sensing** changes and influences quickly	2a	0.5	0.57	EA
				sensual	7	of the pleasures of the **senses**	2a	0.8	0.67	EA
				sensor	8	a device that can **sense** physical conditions	2b	0.57	0.5	EA
				sensation	5	the ability to **feel**	3a	0.57	0.44	AA
				con**sens**us	7	the same **feelings** and opinions about sth	3b	0.44	0.44	AD
				re**sent**	4	to **feel** bitter and angry	3a	0.33	0.43	AA
				sentiment	4	general **feelings** or opinions	3a	0.33	0.33	AA
				con**sent**	5	having the same **feelings** and opinions about sth and therefore be in agreement	3b	0.43	0.38	AD

				ass**ent**	9	to have the same **feelings** or opinions and therefore agree	3b	0.6	0.43	AA
				dis**sent**	10	not having the same **feelings** and opinions as the suggested ones	3b	0.5	0.38	AA
“scent” is a variant of -sens-, -sent-				**scent**	6	a pleasant smell that can be **sensed**	2a	0.75	0.5	EA
-spec(t)-,-spic-,-scope-,	look	as in	re**spect**			to **look** upon sb with admiration				
				a**spect**	2	a particular way in which sth may be **looked** at	3b	0.71	0.71	AA
				in**spect**	2	to **look** at sth closely	3a	0.71	0.71	EA
				pro**spect**	2	sth **looked** forward to	3a	0.63	0.75	EA
				su**spect**	2	to **look** at sth with doubt	3a	0.71	0.71	EA
				spectacle	3	a striking sight worth **looking** at	3a	0.5	0.45	AA
				speculate	3	to **look** at sth and form opinions	3a	0.45	0.45	AA
				per**spect**ive	4	a particular way of **looking** at things	3a	0.56	0.5	EA
				spectrum	4	colours you see when you **look** at a rainbow	3b	0.5	0.5	AA
				re**spect**ive	4	**looking** at each as individuals	3a	0.78	0.7	EA
				spectacular	4	grand to **look** at	3b	0.38	0.38	AD
				retro**spect**	5	to **look** back at past events	3a	0.7	0.7	EA
				spectator	6	sb who **looks** at a game or a show	3a	0.5	0.45	AA

				in**spect**orate	7	officials who **look** at a schools or factories regularly	3b	0.45	0.42	AD
				specter	8	a ghost that can be seen (**looked** at)	3c	0.63	0.56	AA
				specify	4	to **look** at and name sth definitely	3a	0.33	0.44	AA
				specimen	6	an example of a class for people to **look** at to know the whole	3b	0.3	0.4	AD
				de**spic**able	7	deserving to be **looked** down upon	3a	0.44	0.4	AA
				con**spic**uous	9	easily seen when you **look**	3a	0.27	0.27	AA
				micro**scope**	4	an instrument **looking** at small things	3b	0.27	0.33	AD
				kaleido**scope**	10	a pattern or situation that is always changing and **looks** different	3b	0.17	0.29	AD
				tele**scope**	6	a piece of equipment used for **looking** at distant objects	3b	0.3	0.36	AD
				stetho**scop**e	9	an instrument for listening to one's chest as if **looking** at it	3c	0.18	0.31	AD
spy is a variant of –spec(t)-				**spy**	5	to **look** secretly	3a	0.29	0.29	AA
-scept- is a variant of -spec(t)-	look	as in		**scept**ic	6	sb who **looks** at accepted opinions with doubt	3b	0.33	0.33	AD
-pris-, -pre(he)n-	take	as in	sur**pris**e			sth which **takes** your attention unexpectedly				

				prison	2	a building where wrongdoers are kept after they are **taken** by the police	4c	0.43	0.44	AD
				enter**pris**e	4	challenging work **taken** in hand	4b	0.5	0.5	AA
				com**pris**e	5	if sth comprises a number of things, it **takes** them in as its parts.	4c	0.57	0.63	AA
				ap**pren**tice	4	sb **taken** in as a learner learning a trade from a killed employer	4c	0.25	0.3	AD
				prey	5	an animal that is **taken** and eaten by another animal	4c	0.33	0.33	AD
				ap**prehen**d	6	to be **taken** by the police for a crime	4b	0.25	0.3	AD
				com**prehen**d	7	to **take** in information or knowledge	4b	0.2	0.3	AD
				predatory	7	**taking** away others' property by force	4b	0.2	0.17	AD
				entre**pren**eur	9	a person who **takes** a business in hand	4b	0.2	0.33	AD
				*in*com**prehen**sible	7	(information or knowledge) *not* able to be **taken** in	4c	0.13	0.25	AD
				ap**prehen**sion	8	**taking** in knowledge or information	4b	0.2	0.23	AD
				com**prehen**sive	3	that **takes** in much	4b	0.17	0.31	AD
				entre**pren**eurial	10	willing to **take** challenging work in hand	4b	0.15	0.27	AD
-flo-r-	flower	as in	**flo**we**r**							

				flour	4	the powder made by grinding wheat which is regarded as the best part of the wheat just as the **flower** of a plant	2c	1	0.67	EA
				flourish	4	to develop well and be successful as if **flowers** bloom	2c	0.33	0.44	AA
				flora	6	plants of a particular area bearing or not bearing **flowers**	2c	0.6	0.57	EA
				cauli**flo**wer	7	a type of cabbage with a big **flower** head	2b	0.5	0.55	EA
				floral	7	adjective of **flower**	1	0.5	0.5	EA
				florist	7	sb who grows or sells **flowers**	2a	0.43	0.43	AA
-flir- is a variant of -flo-r-	flower	as in		**fl**i**r**t	6	behave in a sexually attracted way as if a bee is attracted to a **flower**	2c	0.25	0.43	AA
-fol- is a variant of -flo-r-	flower	as in		**fol**io	10	a leaf of paper like a petal of **flower**	2a	0.4	0.29	AA
-val(u)-	value	as in	**valu**e							
				valid	2	having **value** or effect	2a	0.6	0.6	EA
				equi**val**ent	3	equal in **value** or meaning	2a	0.2	0.36	AA
				e**valu**ate	5	to find out the **value** of sth	2a	0.63	0.63	EA
				de**valu**e	5	to make sth have less **value**	2a	0.71	0.71	EA
				pre**val**ent	6	**valued** by many people therefore common at a time	2b	0.22	0.4	AA
				valentine	7	the card sent to sb whom you **value** and love	2a	0.38	0.4	AA

-plant-	plant	as in	**plant** *							
				im**plant**	5	to put ideas in people as if to put **plants** in soil	2c	0.6	0.71	EA
				trans**plant**	5	take up **plants** and plant them in another place	2b	0.5	0.5	EA
				plantain	7	a common wild **plant** in lawns	2a	0.71	0.63	EA
				re**plant**	9	to **plant** a tree again in a different place	2b	0.6	0.71	EA
				plantation	7	area of land **planted** with trees	2a	0.63	0.5	EA
-press-	press, pressure	as in	de**press** *			to **press** one down (make one low in spirits)				
				com**press**	5	to **press** together to make it smaller	3c	0.57	0.63	AA
				op**press**	5	**press** down on people (to treat them cruelly)	3c	0.8	0.71	AA
				sup**press**	6	to exert **pressure** to stop people from opposing the government	3c	0.67	0.63	AA
				re**press**	8	to put **pressure** on oneself not to show one's feelings	3b	0.67	0.71	AA
-vers-, -vert-	reverse	as in	re**vers**e *			**turn** sth the other way around				
				in**vers**e	7	**reversed** in position, direction or relation	2a	0.6	0.71	EA
				versus	3	**turned** to be against	4a	0.6	0.67	AA
				ad**vers**e	5	**turning** against sb	4a	0.6	0.71	AA
				di**vers**e	5	being **turned** into different kinds	4a	0.6	0.71	AA
				di**vers**ify	5	to **turn** sth into different kinds	4a	0.38	0.44	AD

				di**vers**ion	6	**turning** sth aside or in a different direction	4b	0.33	0.44	AD
				per**vers**e	6	thoroughly **turned** to the wrong way	4a	0.4	0.63	AA
				con**vert**	3	**turn** to be a different form	4a	0.5	0.57	AA
				di**vert**	4	to **turn** in another direction	4a	0.6	0.67	AA
				re**vert**	4	to **turn** back into a former state	4a	0.8	0.67	AA
				inad**vert**ent	6	with attention **turned** away and thoughtless	4a	0.2	0.36	AD
				per**vert**	8	to **turn** sb thoroughly to the wrong way	4a	0.43	0.57	AA
				extro**vert**	9	**turned** out towards others	4a	0.33	0.33	AD
				vertebra	9	any part of the backbone which can **turn** in different directions	4b	0.38	0.38	AD
				vertebrate	10	having a backbone which enables the body to **turn** in different directions	4b	0.25	0.33	AD
				sub**vert**	9	to **turn** a government upside down	4a	0.33	0.43	AD
				sub**vers**ive	10	**turning** a government upside down	4a	0.38	0.5	AA
-min(i)(m)-	small	as in	**minim**um *			amount				
				mince	4	cut into **small** pieces	3a	0.29	0.43	AA
				minimise	5	reduce sth to the **smallest** possible amount	3a	0.71	0.63	EA
				miniature	5	very **small** painting of a person	3a	0.43	0.44	AA
				minibus	5	a **small** bus	3a	0.57	0.57	EA
				di**mini**sh	5	to make **smaller** in amount	3a	0.57	0.44	AA

				mini	3	of **small** size	3a	1	1	EA
				minimal	5	very **small** in degree or amount	3a	0.71	0.71	EA
-serv-	keep	as in	re**serv**e *			to keep sth for later use				
				con**serv**e	4	to **keep** natural things from being damaged	4a	0.5	0.63	AA
				pre**serv**e	4	to **keep** sth or sb from being destroyed	4a	0.5	0.63	AA
				con**serv**atism	8	**keeping** to traditional values and being opposed to change	4b	0.25	0.33	AD
				con**serv**atory	5	room with glass walls and roof used to **keep** plans from the cold	4b	0.25	0.3	AD
				re**serv**oir	6	a lake for **keeping** water for a town	4a	0.43	0.67	AA
-dict-, -dicate	say	as in	in**dicate** *			to **say** sth indirectly				
				dictate	3	to **say** or read aloud/to say what people must do	3a	0.63	0.67	EA
				de**dicate**	4	to **say** that a book or an artistic work is issued or performed in one's honor	3b	0.71	0.75	AA
				ab**dicate**	6	to officially **say** a king or queen will give up his/her throne	3b	0.71	0.75	AA
				pre**dicate**	10	the part of a sentence that **says** what the subject does or did.	3b	0.63	0.67	AA
				vin**dicate**	10	to **say** with evidence that sth is true or justified	3b	0.63	0.67	AA
				pre**dict**	3	**say** that sth will happen in the future	3c	0.44	0.44	AD

				contra**dict**	5	to disagree with sth by **saying** that the opposite is true	3b	0.45	0.42	AD
				ver**dict**	5	what a jury **says** about a case in a court of law	3b	0.57	0.44	AA
				in**dict**	6	to officially **say** that sb is guilty of a crime	3b	0.57	0.75	AA
				diction	10	style of **saying** sth or writing sth	3a	0.43	0.4	AA
-dit- is a variant of -dicate-	say	as in		**dit**to	7	what is **said** is also true of another thing	3a	0.38	0.33	AA
-dex- is a variant of -dicate-	say	as in		in**dex**	3	an alphabetical list of names or subjects in a book that **says** on which pages of the book they are mentioned	3b	0.57	0.38	AA
-meter	measure	as in	**meter** *			**measurement** of length				
				dia**meter**	5	the width **measured** by a straight line passing through the center of a circle	2b	0.57	0.63	EA
				para**meter**	7	a **measurable** factor forming one of a set of factors that define a system	2b	0.5	0.56	EA
				peri**meter**	8	the border **measured** around an enclosed area	2b	0.44	0.5	AA
				thermo**meter**	9	an instrument for **measuring** temperature	2a	0.5	0.45	AA

				baro**meter**	9	an instrument for **measuring** the pressure of the atmosphere	2b	0.5	0.56	EA
-vent-, -ven(e)-	come	as in	e**vent** *			the **coming** of sth				
				in**vent**	3	to make a new device or method **come** into being	3b	0.83	0.67	AA
				con**vent**ion	3	a large meeting where people **come** together to discuss some issues	3b	0.38	0.4	AD
				ad**vent**	6	the **coming** of an important event	2a	0.67	0.57	EA
				con**vent**	6	a building for nuns to **come** together and live	3b	0.57	0.57	AA
				circum**vent**	10	to **come** around a problem rather than meeting it directly	3b	0.44	0.4	AD
				a**ven**ue	3	a broad road by which one **comes** to a big house	3b	0.33	0.5	AA
				con**ven**ient	3	allowing things to **come** easily to you	3a	0.33	0.4	AA
				inter**ven**e	4	to **come** in between to prevent sth from being done	3b	0.38	0.44	AD
				re**ven**ue	4	money that **comes** into the state every year	3a	0.29	0.57	AA
				venue	5	the place where people come together for an event	2b	0.5	0.5	EA
				con**ven**e	7	to **come** or bring together	3a	0.29	0.43	AA
				recon**ven**e	8	to **come** together again for a discussion after break	3b	0.22	0.44	AD

				con**ven**or	9	a person who arranges for people to **come** together for a discussion	3b	0.29	0.38	AD
				contra**ven**e	8	to **come** in conflict with a law	3a	0.2	0.3	AA
				sou**ven**ir	8	sth you keep that makes a person or a place **come** into your mind	3b	0.33	0.38	AD
				co**ven**ant	9	legal agreement that different sides **come** together to make	3b	0.38	0.5	AA
-hibit-, -habit-	hold	as in	ex**hibit** *			to **hold** sth out as if to show or to display it				
				in**hibit**	5	to restrain and **hold** in	4c	0.71	0.71	AA
				pro**hibit**	6	to **hold** within limits and forbid to do sth	4c	0.5	0.63	AA
				habit	3	a tendency to **hold** onto a way of doing sth	4c	0.43	0.57	AA
				habitual	10	having the tendency to **hold** onto a way of doing sth	4c	0.38	0.4	AD
				in**habit**	6	to **hold** on or stay in the same place	4c	0.57	0.57	AA
				habitat	7	a place plants or animals **hold** on or stay in	4c	0.33	0.44	AD
				in**habit**ant	8	person **holding** on or living in a place	4c	0.4	0.4	AD
-mor(t)- is a variant of -murd-	death	as in	**murd**er *			cause **death** to sb				
				*im***mort**al	3	able to *not* to **die**	3a	0.2	0.25	AA
				mortal	3	that must **die**	3a	0.25	0.33	AA

				morbid	5	having an interest in unpleasant things like **death**	3b	0.33	0.38	AD
				mortuary	9	a room in which **dead** bodies are kept	3b	0.33	0.38	AD
-p-n-	pain	as in	**p**ai**n** *							
				penalty	3	**pain** caused to sb who has broken the law	2a	0.33	0.25	AA
				punish	3	to cause **pain** to sb for doing wrong things	2a	0.4	0.29	AA
				pine	6	become weak because of mental or physical **pains**	2b	0.5	0.6	EA
				punitive	8	intending to make sb suffer from **pain** for their wrong doings	2b	0.29	0.29	AA
				penal	9	causing pain to criminals by law	2a	0.5	0.33	AA
				im**pun**ity	10	freedom from pains for wrong doings	2a	0.25	0.25	AA
-n(o)unc-	say	as in	an**nounc**e *			to say sth to the public				
				pro**nounc**e	3	to **say** or announce in a formal way	3a	0.71	0.67	EA
				pro**nunc**iation	6	the way to **say** the sound of a word	3a	0.36	0.29	AA
				de**nounc**e	8	to **say** that sth or sb is wrong or evil	3a	0.67	0.75	EA
				re**nounc**e	8	to **say** formally that one will abandon sth	3a	0.67	0.75	EA
				pro**nounc**ement	9	sth **said** officially in public	3a	0.45	0.46	AA
-audi-, -dien-	listen	as in	**audienc**e *			listeners to a program, etc				
				audit	4	examination of accounts, which was done by **listening** in the past	3b	0.4	0.5	AA

				auditory	4	involving **listening**	3a	0.29	0.5	AA
				audible	6	can be heard when **listened** to	3a	0.4	0.5	AA
				auditorium	9	a public building in which the **audience** sit / in which people **listen** to reports or lectures or see performance.	3b	0.25	0.4	AD
				obe**dien**t	5	willing to **listen** to and follow orders	3b	0.43	0.44	AD
-(gua)rant-	guarantee	as in	**guarant**ee *							
				w**arrant**y	7	**guarantee**	1	0.71	0.5	EA
				guarantor	10	the person who gives a **guarantee**	2a	0.71	0.5	EA
-gress-	step	as in	pro**gress** *			development **step** by step				
-gred- is a variant of –gress-				in**gred**ient	4	sth that **steps** (enters) into the formation of a mixture	3c	0.2	0.3	AD
				di**gres**sion	6	**stepping** away from the subject of writing	3b	0.43	0.45	AD
				re**gress**	9	go back to **step** by step to a less developed state	3b	0.86	0.75	AA
				ag**gress**ive	3	ready to **step** forward to attack	3b	0.44	0.45	AD
				ag**gress**ion	6	the behavior of **stepping** forward to attack	3b	0.33	0.45	AD
				ag**gress**or	8	sb who **steps** into others' territory to attack	3b	0.5	0.5	AD
-grad-	degree	as in	**grad**e *			**degree**				

				graduate	4	to mark with **degrees** to measure sth /a person who holds a university **degree**	3a	0.29	0.5	AA
				de**grad**e	5	to lower the **grade/degree** of being respected	3a	0.67	0.71	EA
				centi**grad**e	6	the temperature scale that has 100 **degrees** from freezing point to boiling point	3b	0.44	0.5	AA
				gradient	7	**degree** of slope	3a	0.5	0.5	EA
				retro**grad**e	9	the **degree** of development goes backwards	3a	0.44	0.5	AA
				post**grad**uate	10	a person who holds a master or doctor's **degree**	3b	0.25	0.17	AD

Appendix II

Target words

nostril otter locus consign canister villa silt hedge daisy denote bait simulate batter impart locket addendum fortress siesta tor transact

Key words used for the keyword method group

1. nostril	闹死(人)	nao si ren
2. otter	奥特曼	ao te man
3. locus	楼	lou
4. consign	散	san
5. canister	看你	kan ni
6. villa	微辣	wei la
7. silt	修	xiu
8. hedge	黑痣	hei zhi
9. daisy	逮	dei
10. denote	挠头	nao tou
11. bait	背	bei
12. simulate	没有泪	mei you lei
13. batter	摆头	bai tou
14 impart	怕他	pa ta
15 locket	捞起它	lao qi ta
16. addendum	鹅蛋	er dan
17. fortress	垂死	chui si
18. siesta	压死	ya si
19. tor	逃	tao
20. transact	船赛	chuan sai