Modeling Morphological Representations of the Mental Lexicons of Japanese EFL Learners

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(Degree)
博士（学術）

(Date of Degree)
2010-03-25

(Date of Publication)
2011-07-26

(Resource Type)
doctoral thesis

(Report Number)
甲4834

(URL)
https://hdl.handle.net/20.500.14094/D1004834

博士論文

Modeling Morphological Representations of the Mental Lexicons of Japanese EFL Learners

—日本人英語学習者のメンタルレキシコンにおける形態的表象のモデル化—

平成 22 年 1 月

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Abstract

This dissertation investigates the morphological knowledge and morphological representation in the mental lexicon of intermediate level Japanese EFL learners and advanced Japanese speakers of English. Focusing on morphological knowledge, it explores whether low-intermediate level Japanese EFL learners at university can extract the meaning of derivatives when they know the meaning of the relevant base words (stems). The results of this dissertation show that such learners can extract the meaning of derivatives at a rate of around 80% when they possess the base word knowledge. This indicates that even if their suffix knowledge is not good as that in previous L2 studies, Japanese EFL learners at the university level can relate derivatives to their stems. Concerning morphological representation, the dissertation explores whether there are derivational relationships and whether there are morpheme-level representations in the mental lexicon of low-intermediate and intermediate level Japanese EFL learners and advanced Japanese speakers of English. The results of masked priming experiments show that there are indeed derivational relationships in their mental lexicon. For example, the derivative *happiness* and its stem *happy* are related in the learners' mental lexicon. The results also show, however, that morpheme-level representations do not exist in the mental lexicon of intermediate level Japanese EFL learners or in that of advanced Japanese speakers of English. In other words, suffixes such as the *–ness* in *happiness* or the *–er* in *officer* do not have their own independent representations in such learners' mental lexicons. L1 speakers of English are said to have independent morpheme-level (suffix) representations. Therefore, it can be said that Japanese EFL learners and advanced Japanese speakers of English have different mental representations from that of L1 speakers of English.

This dissertation consists of twelve chapters. Chapter 1 introduces key concepts related to the study such as vocabulary learning, derivational morphology, and psycholinguistic experiments. Chapter 2 reviews literature related to the dissertation: L1 studies of morphological structures in the mental lexicon, L2 studies of the structures of mental lexicons, and L2 studies of morphological knowledge. Four models are presented from previous L1 research. One recent study (Longtin and Meunier, 2005) shows that pseudo-derivatives (e.g., quickify) prime their stems (e.g., QUICK), indicating their lexicons have morpheme level (stems, affixes) representations. According to a

distinction proposed by Tyler and Nagy (1989), there are three levels in morphological knowledge; RK (relational knowledge), SK (syntactic knowledge), and DK (distributional knowledge). Learners with RK can extract the base form of a certain derivative when facing derivatives. SK refers to the knowledge related to the understanding of the syntactic information contained in certain suffixes. Learners with DK become aware of which part of speech a certain suffix attaches to. Tyler and Nagy (1989) showed that native speakers' acquisition order was RK→SK→DK. Previous L2 studies have only explored the SK (Schmitt and Meara, 1997; Mochizuki and Aizawa, 2000), showing the relatively poor knowledge of Japanese EFL learners at high school and university.

Chapters 3 and 4 explore the morphological knowledge of Japanese EFL university-level learners. This section investigates their RK. Chapter 3 explores this knowledge by conducting three tests (a vocabulary test [VLT], a suffix test, and a self-made derivative comprehension test). The results show that learners can figure out the meaning of derivatives through their knowledge of the stems (base words) at a relatively high rate (60 - 90%), even if they do not have suffix knowledge. Chapter 4 confirms the results of Chapter 3 by conducting interviews. The results of this part of the study show that 81.2% of derivatives were able to be comprehended through the use of stem (base word) knowledge.

Chapter 5 employs lexical decision tasks to explore the morphological representation in the mental lexicon of Japanese EFL learners whose vocabulary size is between 1,000 and 3,000 word families. The results show that stems whose inflectional family frequency is higher are not recognized more quickly, but stems whose derivational family frequency is higher are, indicating that inflections are not decomposed into constituents when they are recognized, and that members of the same derivational family have their own independent mental representation at the semantic level, but are linked each other.

Chapters 6 and 7 conduct a series of masked-priming experiments to explore the morphological representation of Japanese EFL learners whose vocabulary size is between 3,000 and 5,000 word families. The results show that derivative primes quicken the reaction times of their stems, but

pseudo-derivative primes do not quicken the reaction times of their stems. This indicates that derivational relationships exist in the mental lexicon of intermediate level Japanese EFL learners but morpheme-level (suffix) representations do not. The morphological representation of intermediate Japanese EFL learners seems to be different from that of L1 speakers of English.

Chapter 8 investigates the morphological representation of advanced Japanese speakers of English who have TOEIC scores of 890 or above or have a similar ability in English. The results indicate that their mental representation is similar to that of intermediate level Japanese EFL learners. In other words, their mental representation seems to be different from that of L1 speakers of English. It can be said that the mental lexicon of Japanese learners and speakers of English may be not developmentally but qualitatively different from that of L1 speakers of English.

Chapter 9 looks at the factors that affect the morphological knowledge of low-intermediate Japanese EFL learners, in other words, under what conditions they can more easily extract the meaning of derivatives with the knowledge of their stems. It is a re-analysis of the data obtained in Chapter 3. The results show that contextual help requires a minimal vocabulary size. Learners whose vocabulary size is large can receive help from the semantic relatedness between derivatives and their stems. Suffix difficulty does not affect the comprehension of derivatives with the use of derivational relationships. The results also show that high frequency derivatives are always comprehended more easily.

Chapter 10 focuses on morphological representation of intermediate level Japanese EFL learners in great detail. A re-analysis of the data obtained in Chapter 7 is conducted here. The results show that even if pseudo-derivatives are divided into groups by suffix difficulty or part of speech difference, this does not quicken the reaction times of their stems, indicating that there are no morpheme-level (suffix) representations in the mental lexicon of intermediate level Japanese EFL learners even if suffixes are easier or of a certain part of speech.

Chapter 11 is the general discussion section. It summarizes the results obtained in this study and discusses matters such as morphological knowledge and morphological representation of Japanese

EFL learners and advanced Japanese speakers of English. Pedagogical implications of this study are also discussed here. Chapter 12 concludes the dissertation, summarizing the significant results obtained.

Acknowledgements

First of all, I would like to thank Dr. Hirokazu Yokokawa, my supervisor, for his significant assistance in completing this dissertation. Despite his crowded schedule, he helped improve this dissertation by reviewing it in great detail. His vast knowledge of psycholinguistics and English language teaching meant that talking with him about research and English education was really enjoyable. I do not know how to express my gratitude to him and I am looking forward to conducting collaborative research in the near future if possible. Dr. Timothy Greer also assisted me by reviewing this dissertation. I was really impressed by his diligent contribution to my work, which came at a very busy time for him. My poor English in the first version was greatly improved through his carefully considered suggestions. Professor Tadamitsu Kamimoto at Kumamoto Gakuen University gave me meaningful comments on my research topics. I was inspired by his deep insights on vocabulary learning research to start my mental lexicon research. His observations on my research were always encouraging and supported my research life. I would also like to thank Professor Yuji Sato at Kumamoto Gakuen because I would have been unable to enter the world of research and education without his introduction to the field. I would also like to thank the members of the research project on the acquisition, processing, and learning of second language based on cognitive science at Kobe University: Katsuaki Okihara (leader), Yoshio Miki, Masayuki Kato, Hirokazu Yokokawa, Timothy Greer, Yuan Yuan, Mai Matsunaga, Kazuhiro Imamura, Chieko Nagai, and Miwa Morishita. Presenting at regular meetings with them really helped to improve the quality of this dissertation.

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Chapter 1

Introduction

1.1 Purpose of the thesis

The purpose of this dissertation is to clarify the internal structure of the mental lexicon of Japanese EFL learners. A variety of studies have been carried out in order to discover the vocabulary knowledge and the state of mental lexicon of Japanese EFL learners of different proficiencies. However, the morphological aspects have been little mentioned. Broadly speaking, English words consist of stems and their derivatives. For example, the word *happiness* is a derivative of the stem *happy*. Although they are derivationally (morphologically) related, whether or not such relationships exist in the mental lexicon of Japanese EFL learners has not been clear. L1 speakers do have such relationships (Longtin and Meunier, 2005; Meunier and Longtin, 2007). If L2 learners like Japanese EFL learners have such relationships in their mental lexicon, vocabulary learning may be streamlined, meaning that derivatives may not have to be taught as separate items, since the learners could use the relationships to extract the meaning of derivatives. There are so many words in English: It is said that educated L1 speakers of English know some 20,000 word families (Nation, 2001, p. 9). In order to learn such a huge vocabulary effectively, it is necessary to carefully select words to learn. Knowing about the derivational (morphological) relationships in learners' mental lexicon will tell us what kinds of words should be taught.

1.2 The importance of vocabulary learning

In the 21st century, more and more people are communicating across cultures, and opportunities to use other languages are increasing. In such situations, vocabulary plays an important role. Without adequate vocabulary knowledge, it is difficult to convey a precise meaning to interlocutors, potentially leading to communication break down. Vocabulary learning is therefore a very important part of enhancing communicative abilities.

1.3 Unsystematic ways of vocabulary learning

Although it is very important to learn vocabulary to date, there have been few systematic ways of

teaching it. For example, in Japan, grammar is taught through a systematic syllabus. Easier grammatical points are taught earlier than more difficult points. On the other hand, vocabulary learning is usually left for self-study, and learners have to memorize words on their own. Some teachers may tell the learners how to memorize words but there is no consensus on how words should be learned. The issue of which words to be learned is also left up to learners. Although there are some frequency-based methods of learning, in which high-frequency words are learned earlier, these are not widely spread. If there are derivational relationships in the mental lexicon of Japanese EFL learners, some systematic vocabulary learning could be developed. This means that derivatives could be omitted from vocabulary lists to be learned. Learners would have to learn only stems. This would reduce the amount of words to be learned so the burden of learners would be lessened. This is one reason this study was conducted.

1.4 The necessity of measuring several aspects of vocabulary knowledge

When we consider vocabulary knowledge, one of its first components may be the size (or breadth). How many words learners or L1 speakers know may be of concern. Regarding the character of vocabulary knowledge, the more words they know, the more proficiently they can speak since they can convey many meanings in great detail. Therefore, vocabulary size is actually an important aspect.

However, there are many other aspects involved in vocabulary knowledge. In fact, Nation (2001, p. 26) has shown that there are nine aspects in vocabulary knowledge. Three of them are form-related: spoken form, written form, and word parts. Another three are meaning-related: form and meaning, concept and referents, and associations. The final three are use-related: grammatical functions, collocations, and constraints on use (register, frequency, etc). If this classification is adopted, derivational knowledge is related to word part knowledge.

This dissertation investigates how suffixed derivatives and their stems are related in the mental lexicon of Japanese EFL learners of the intermediate and high levels. A suffix knowledge test, a derivative knowledge test, and several psycholinguistic experiments clarify what kind of knowledge they have in their minds. Whether and how those kinds of knowledge are different from

L1 speakers is also investigated.

1.5 Some characteristics of Japanese EFL learners

The participants in this study are low-intermediate and intermediate level Japanese EFL learners and advanced Japanese speakers of English who have been learning English mainly in Japan. Japanese is a language which is very distant from English so it is said that Japanese EFL learners face a lot of difficulty learning English. The Japanese and English languages are different in syntax and phonology as well as the morphological aspects that are focused in this dissertation. In English, there are many suffixes (e.g., -ness) which do not have meaning but grammatical functions. Such suffixes seldom exist in Japanese. Therefore, it can be said that Japanese EFL learners have difficulties learning morphological aspects of English.

Besides this linguistic difference, most Japanese EFL learners start English learning at the age of 12 after they enter junior high school. This means that they start learning English after the so-called critical period (Lenneberg, 1967). It has been said that after the critical period, it becomes difficult for learners to acquire the abstract components of language (Dekeyser, 2000). Derivational suffixes are typical of such abstractness. It has been said that these abstract components are not so difficult for second language acquires with high intelligence. However, for most of learners, it is difficult. Therefore, the morphological representations in the mental lexicon of these learners may differ from those of L1 speakers.

Even if there is a difference between Japanese EFL learners and L1 speakers, it may be a proficiency factor. To eliminate this factor, advanced Japanese speakers of English participated in the latter part of this dissertation to investigate whether L2 learners' morphological representation is qualitatively different from that of L1 speakers.

1.6 The characteristics of derivational morphology

There are three main kinds of morphological relationships in English: inflectional, derivational, and compound relationships. Except for irregular changes, inflectional relationships are regular so it is easy for English learners to recognize the relationships. Compound relationships are also not so

difficult for English learners since components of compounds have their own meanings. They only have to sum up the meanings of components to figure out the meanings of compounds. However, it is difficult for learners to see derivational relationships. Derivational suffixes are usually abstract and have only grammatical (parts of speech) functions, so it is difficult for learners to figure out the meaning of derivatives. In this sense, derivatives are the most difficult components of morphological relationships.

There are both prefixed derivatives (e.g., unhappy) and suffixed derivatives (e.g., happiness) in English. Prefixes usually have meaning, while suffixes do not. Therefore, prefixed derivatives and suffixed derivatives are qualitatively different. Treating these different things at the same time would contaminate the research results. Therefore, this dissertation only deals with suffixed derivatives and their relationships with their word stems. Suffix knowledge is another theme of this dissertation.

Inflections are not the main theme of this dissertation. However, there have not been many studies exploring inflectional relationships in the mental lexicon of L2 learners. In Chapter 5, I also explore inflectional relationships in learners' mental lexicons to discover the difference between inflectional and derivational relationships.

1.7 Psycholinguistic experiments

The experiments conducted in the latter part of this dissertation are psycholinguistic experiments. Previous studies concerning the vocabulary knowledge of Japanese EFL learners have not used this method to a great extent. Psycholinguistic methods can extract how vocabulary knowledge is used in real time communications. They deal not only with the state of knowledge but also the learners' access to the knowledge. I mainly use masked-priming experiments to research morphological relationships in the mental lexicon. This method has been often used in L1 study, but L2 studies have not used this method to date. This dissertation explores the vocabulary knowledge of Japanese EFL learners from a different perspective.

1.8 The merits of using L2 learners in the psycholinguistic experiments

Studies about morphological structures in the mental lexicons of L1 speakers have usually used adult speakers as participants since psycholinguistic experiments are not usually suitable for younger speakers. Therefore, we only know about the developed structure of morphological relationships. On the other hand, the morphological structures in the mental lexicons of Japanese EFL learners may be developing so we can observe how these structures change with their language development. Conducting psycholinguistic experiments with such learners as participants is not problematic since they are cognitively mature adults. Considering this, using EFL learners as participants seems a relevant way to explore other aspects of mental lexicons and morphological development.

1.9 Morphological knowledge of Japanese EFL learners

Previous studies have investigated the morphological knowledge of Japanese EFL learners (Schmitt and Meara, 1997; Mochizuki and Aizawa, 2000; Details of these studies are provided in Chapter 2), showing that their morphological knowledge was rather poor. However, these studies only investigated static or explicit knowledge of affixes. Therefore, a picture of learners' morphological representations cannot be directly constructed from these results. Besides this, such studies only investigated the knowledge of affixes. How morphologically related words such as *prefer* and *preference* are comprehended by those learners also needs to be shown. For example, if learners encounter the word *player* they have never met before and they know the meaning of its stem *play*, they may find out the meaning of *player* since they can see the relationship between *play* and *player*. Such knowledge has not been explored in the context of Japanese EFL studies, and it may lead to mental representations of morphological relationships.

1.10 Possible applications of this study

1.10.1 Possible application 1: Streamlining vocabulary learning

Vocabulary learning is highly demanding for EFL learners. As mentioned earlier, native speakers are said to have knowledge of about 20,000 word families[1] (Nation, 2001, p. 9). (How many items

[1] A word family is defined as "a base word with its inflections and derivatives (stimulate + stimulated, stimulates, stimulating, stimulation, stimulant, stimulative)" (Schmitt & McCarthy,

one family contains will be discussed below.) This goal is very difficult to reach for EFL learners. Some research has shown that somewhat fewer word items are sufficient for second language purposes (Harada, 2006; Hazenberg and Hulstijn, 1996; Laufer, 1992). Even so, a recent survey shows that EFL learners have to learn at least 6,000 – 7,000 word families (Nation, 2006).

Considering the situation in Japan, where English is rarely spoken, it is very hard to learn such a large number of words. Usually, Japanese learners of English learn vocabulary items through word cards or word books through rote learning methods. This way is both demanding and arduous. Lessening the burden on these learners is necessary considering the importance of vocabulary functions in communication in English and the time-consuming nature of vocabulary learning.

Although there has been no decisive way to reduce the burden of vocabulary learning, using morphological relationships may be one way to proceed. Using derivational relationships, we can infer the meaning of derivatives (*happiness* and *happy*). For productive skills like speaking and writing, we have to remember every part of a word. On the other hand, for receptive skills like listening and reading, we do not have to remember every part of words (Melka, 1997). Of course, derivatives are not as transparent as inflections. The change of word form to derivatives is often arbitrary and difficult to acquire. However, finding relationships between derivatives and base words is not so difficult since their forms are similar.

With regard to teaching and editing word books, reducing the number of words to learn is necessary to ease the burden of learners and to maximize the efficiency of class activity. If learners can understand the meaning of *happiness* because they know the stem *happy*, teaching *happiness* is a waste of time. Therefore, investigating morphological knowledge and its mental representations for the learners of each developmental stage is meaningful. This study will explore how the knowledge and its representations change based on their vocabulary sizes.

1997, p. 331). Therefore, one family contains many other related items. Laufer (1992, p. 130) claimed that knowledge of 3,000 word families is equal to that of 5,000 lexical items, meaning that one family contains 1.6 word items (lemma) on average.

1.10.2 Possible application 2: Applying to the research of sentence comprehension and production

Knowledge of mental representations is also necessary for the study of sentence comprehension and production. In the context of sentence comprehension, enhancing the speed of reading can be considered related to the mental representations. Some researchers have proposed models including two access routes (morphological decomposition route and whole word route; Caramazza, Laudanna, & Romani, 1988; Caramazza, Miceli, Silviery, & Laudaanna, 1985; Frauenfelder & Schreuder, 1992; Schreuder and Baayen, 1995; Schreuder, Burani,, & Baayen, 2003). To know whether learners can use this kind of method is crucial in conducting reading comprehension research. Regarding sentence production, using the correct parts of speech (POS) is difficult for EFL learners. For example, learners often say, “Playing the piano is enjoy”*, instead of “enjoyable”. Using the correct parts of speech can be considered related to mental representations of morphological relationships.

Chapter 2

Literature Review

2.1 Morphological knowledge of L2 learners

2.1.1 Three kinds of morphological (derivational) knowledge

Before considering how much and what kind of morphological knowledge Japanese EFL learners have, we have to distinguish between three kinds of morphological knowledge. Tyler and Nagy (1989) showed that native speakers of English experience a developmental sequence through Phase 1 (relational knowledge, RK), Phase 2 (syntactic knowledge, SK) and Phase 3 (distributional knowledge, DK). If learners have RK, they can extract the base form of a certain derivative when facing derivatives. For example, when learners with RK see *happiness* for the first time, they can figure out the meaning by extracting the base form *happy* in the form of the derivative. This phase does not require learners to have explicit knowledge of suffixes (e.g., *-ness*). Suffixes usually provide learners with the syntactic functions of derivatives and those functions do not always have to be known when reading or listening is taking place since that information is already provided by the contexts surrounding the derivatives.

SK refers to the knowledge related to the understanding of the syntactic information contained in certain suffixes. In the example of *happiness*, SK refers to the knowledge of the function of the suffix *–ness*, which changes words into nouns. This knowledge enables us to infer the part of speech of unfamiliar words and can facilitate the comprehension of the whole word. Finally, with DK, learners become aware of which part of speech a certain suffix attaches to. For example, this sort of knowledge allows us to know that the suffix *–ness* only attaches to adjectives, not to nouns or verbs. Tyler and Nagy (1989) showed that the order in which native speakers acquired this knowledge was RK→SK→DK.

2.1.2 Schmitt and Meara (1997)

Regarding the distinction between the three kinds of morphological knowledge (Tyler and Nagy, 1989), only SK has been explored with regard to Japanese EFL learners. Schmitt and Meara (1997)

investigated suffix knowledge of Japanese EFL students in high schools and universities, asking the participants which suffixes were allowable to each of 20 verbs (receptive suffix knowledge). They also asked them to provide suitable suffixes to the verbs (productive suffix knowledge). The results show that the rate of correct answers was 42/47%[2] for productive knowledge and 62/66% for receptive knowledge. It was also shown that the productive suffix knowledge correlated significantly with vocabulary sizes at 0.27/0.35 and the receptive suffix knowledge correlated at 0.37/0.41. Considering the suffixes tested were elemental,[3] their SK seems to be immature.

2.1.3 Mochizuki and Aizawa (2000)

Mochizuki and Aizawa (2000) made an attempt to redress the flaws of Schmitt and Meara (1997).[4] They asked high school and university students into which part of speech a certain suffix[5] changes words. They used pseudo-words in order to examine suffix knowledge of the participants. The rate of correct answers was 67%. The correlation coefficient of suffix knowledge with vocabulary size was a little higher in this study (0.54). This result also showed that Japanese EFL learners are in the developmental stage with respect to SK.

2.1.4 Schmitt and Zimmerman (2002)

The productive derivational knowledge of ESL students[6] was investigated by Schmitt and Zimmerman (2002). The participants were provided one word and asked to write all its four derivational forms (nouns, verbs, adjectives, and adverbs). The results showed that they could produce 58.8% of the derivatives when they were provided with one word family member. In other

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[2] This research was longitudinal (a one-year study) and the numbers before "/" represent the percentage score at T1 (at the beginning of the study) and the numbers after "/" represent the percentage score at T2 (at the end of the study).

[3] Schmitt and Meara chose suffixes of basic words so there were no criteria to choose them. However, from the list presented in the paper, the suffixes are considered to be elemental.

[4] First, in Schmitt and Meara (1997), there was no clear criterion with which they chose the suffixes to be tested. Second, they provided real words and asked them to provide the suffixes or choose the right suffixes from alternatives. Because of that, it can be said that this study tested the knowledge of verbs rather than the knowledge of suffixes.

[5] The tested suffixes were "in Levels 3-6 of Bauer and Nation's (1993) Affix Levels and those used in more than two words in the "Vocabulary Lists" (Nation, 1996)" (Mochizuki and Aizawa, 2000, p. 295); *–ity, -y, -ish, -less, -able, -ism, -ness, -ous, -ly, -al, -ize, -er, -ist, -ment, -ful* and *-ation*.

[6] None of the L1s of the participants were Indo-European languages to avoid the facilitating effect of Roman languages' morphological system. Most of the participants were from Asia and their English levels are considered high (An average of TOEFL scores was around 550).

words, they could produce only 2 - 3 derivatives for each word family. From this, they concluded that knowing a member of a word family does not always facilitate producing derivatives.

2.1.5 Summary

Concerning SK mentioned in section 2.1.1, the studies of Schmitt and Meara (1997) and Mochizuki and Aizawa (2000) showed that Japanese EFL learners as a whole do not have proper morphological knowledge. Even second language speakers whose English language proficiency seems to be higher than Japanese EFL learners do not have proper productive knowledge of morphologically related words (Schmitt and Zimmerman, 2002). These studies seem to show that morphological knowledge is difficult to acquire and to learn for nonnative speakers. However, as L1 learners' knowledge proceeds in RK→SK→DK order, L2 learners might acquire relational knowledge (RK) of morphologically related words earlier than syntactic knowledge (SK). This is investigated in Chapters 3 and 4.

It was also found that morphological knowledge (SK) correlates with vocabulary sizes (Schmitt and Meara, 1997; Mochizuki and Aizawa, 2000). Whether there is a threshold[7] to acquire SK in vocabulary sizes, whether RK also correlates with vocabulary sizes and whether RK and SK differently correlate with vocabulary sizes will be also explored in Chapters 3 and 4.

2.2 Morphological (derivational) representations in the mental lexicons of L1 speakers

2.2.1 Difference of derivational relationships from inflectional relationships

This dissertation mainly deals with derivational relationships between such words as *happy* and *happiness*. The relationships between these words are often arbitrary and difficult to acquire. On the other hand, inflectional relationships between words (*happy* and *happier*) are often clear and easy. Changes from stems to their inflections are regular in forms and meaning. For example, the inflection *played* is compounded with a stem *play* and a suffix *–ed*. The change in the meaning is straightforward (present → past) and the change in the form is also clear (*-ed* is added). This rule can be applied to other inflectional changes. On the other hand, derivational relationships are not so straightforward. The derivative *happiness* is compounded with the stem *happy* and the suffix *–ness*.

[7] This means that certain amount of vocabulary size is the necessary condition to acquire SK.

The change in the meaning (function) is adjective to noun. However, the same change in meaning can be realized with the suffix *–dom* (*freedom*). Speakers have to decide which suffixes should be added to each stem and cannot automatically assign the same suffixes to the same meaning changes.

The question here is whether or not the two differently related word relationships are differently represented in the mental lexicons of L1 speakers. For inflectional relationships, the rules are regular so it can be assumed that only stems are represented and suffixes are added in the processing of words. On the other hand, derivational relationships are arbitrary, so the whole word may be represented in their mental lexicons.

Stanners, Neiser, Hernon, and Hall (1979) found that a regular inflection, such as *thinks*, primes the stem, *think*, as much as the stem primes itself in a priming experiment (cf. section 2.4.2). This implies strong relationships between stems and their inflections. Stanners *et al.* (1979) also found that derivationally related words primed their base words less strongly than do the base words themselves (or their regular inflections). This suggested that derivatives constitute separate, though related, lexical entries. However, the results of Nagy, Anderson, Schommer, Scott and Stallman (1989) have shown that inflectional and derivational frequencies have affected reaction times of their stems equally. Frequency changes from 10 to 100 times in a million words of text cause a 19 msec. decrease by inflectional frequencies and a 20 msec. decrease by derivational frequencies.

There has been some debate over whether inflectional and derivational relationships are represented in the same manner. Concerning L2 learners, derivational relationships are more opaque than inflectional ones so the representations of the two relationships may be different, especially when they are in the early stages of development. Inflectional relationships are not mainly investigated in this dissertation but are a related feature. How these relationships are different from derivational ones is explored in Chapter 5 with lexical decision tasks.

2.2.2 Four models of morphological (derivational) relationships in the mental lexicons of L1 speakers

Four models (Models 1 - 4) have been proposed with regard to morphological (derivational) relationships in the mental lexicons of L1 learners. Model 1 proposed that morphologically related words are discretely represented and have no relationship to each other (Buttherworth, 1983). Model 2 proposed that every morphologically related word has its own representation but also has links between each other (Bradley, 1979). Model 3 proposed that morphologically complex words do not have their own representations. Only stems, affixes and their combinatory restrictions are represented in the model (Taft and Forster, 1975). In the example of *happiness*, there is no representation of the whole word, happiness. The stem *happy*, suffix *–ness* and their combinatory restriction (happy and –ness are able to be combined) are represented. Model 4 is similar to Model 3, but morphologically complex words also have their own representations (Taft, 1994).

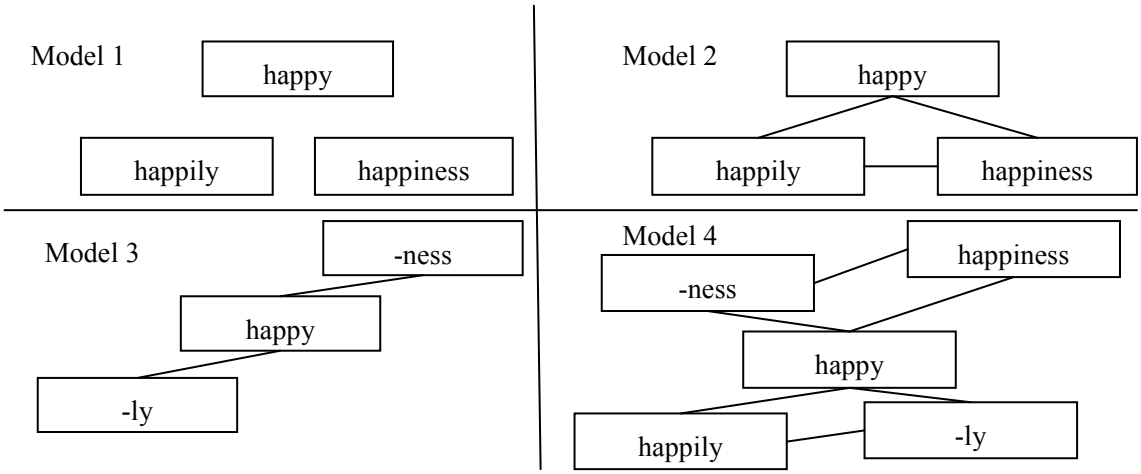

Figure 2.1 Four models of morphological structures in mental lexicons

Of the four models, which is compatible with L1 and L2 speakers? The results of psycholinguistic experiments have shown that Models 3 or 4 are suitable for L1 speakers (see section 2.2.3). For L2 speakers like Japanese EFL learners, it is hard to imagine that their mental representations are structured like L1 speakers because it seems difficult for them to figure out morphological (derivational) relationships at the beginning due to their arbitrariness. Therefore, developmental changes may happen to them like Model 1 through 2 to 3. This nature of changing mental representations is worthy of attention and will be pursued in this dissertation.

2.2.3 Longtin and Meunier (2005)

Representations in the mental lexicon can be seen at the form level and the semantic level. The representations at the form level are accessed earlier than the representations at the semantic level when words are recognized.

L1 derivational representations at the form level were investigated by Longtin and Meunier (2005). They conducted a morphological masked priming experiment with L1 speakers of French (university students) in order to explore the mental representations of morphologically related words. In their experiment, morphologically related pseudo-word primes (e.g., *brusqueur*) were briefly (47ms) presented before target words (e.g., *BRUSQUE*) appeared on the screen. The timing difference between the onsets of primes (pseudo-derivatives) and targets (stems) was so short (47ms) that the semantic features of pseudo-derivatives were not accessible before the targets were accessed. Therefore, it can be said that they investigated the derivational relationships at the form level. In a lexical decision task, participants had to decide whether the target words were real words or non-words as quickly and as accurately as possible. The results showed that pseudo-derivative primes affected lexical decision time as much as real derivationally related words, suggesting that there are representations smaller than words[8] (morphemes) and morphological decomposition occurs during lexical processing. Therefore, among the four models above (cf. the section 2.2.2), Models 3 and 4 are considered most likely because morphemes have their own representations. There are morpheme level (suffix) representations at the form level in the mental lexicon of L1 speakers of French. French and English are similar in morphological structure so it can be said that morphemes (suffixes) have their own representations in the mental lexicon of L1 speakers of English.

2.2.4 Meunier and Longtin (2007)

The L1 derivational representations at the semantic level were investigated by Meunier and Longtin (2007). They investigated the morphological (derivational) representation by cross-modal priming experiments in which participants (L1 speakers of French) heard primes

[8] If words are represented as a whole, pseudo-words cannot affect the lexical decision time of morphologically related words since they do not have their own representations, so they cannot activate anything.

(pseudo-derivatives) and performed lexical decision tasks on targets at the same time. Because the participants were able to recognize primes, it can be said that they investigated the later (semantic) processing of morphologically complex words (cf. masked-priming experiment in which participants are not able to recognize primes because primes are so briefly presented). They found that only semantically interpretable pseudo-derivative primes quickened the reaction times of their stems. Semantically non-interpretable pseudo-derivative primes did not quicken the reaction times of their stems although they did when masked-priming experiments were performed. Their results suggest that Model 2 of the four models presented above (cf. section 2.2.2) may be suitable for derivational representations at the semantic level in the mental lexicon of L1 speakers of French because if suffixes and stems were represented as in Models 3 or 4, semantically non-interpretable pseudo-derivatives could activate the mental representation of the suffixes and stems separately resulting in a priming effect. However, this is not the case. Model 2 may be suitable for L1 speakers of French or English but one point should be altered. That is, the concept unrealized with existing words should be represented at the semantic level in the L1 speakers' mental lexicons. Without this concept representation, pseudo-derivatives can never activate any semantic representation.

2.2.5 Summary

Four models have been proposed for derivational relationships in the mental lexicons of L1 speakers of English. The empirical study (Longtin and Meunier, 2005; 2.1.3) has shown that there are morpheme-level representations at the form level in their mental lexicons. Models 3 and 4 (2.1.2) are compatible with the results. There have been debates on whether inflectional relationships are stronger than derivational ones (Stanners *et al.,* 1979; Nagy *et al.*, 1989). However, it seems that there are no morpheme-level representations at the semantic level in their mental lexicons (Meunier and Longtin, 2007). Model 2 is compatible with the results.

2.3 Proposed structures of the mental lexicons of L2 learners

To my knowledge, there have been few studies concerning mental representations of morphological relationships in the mental lexicons of L2 speakers including Japanese EFL learners. However, reviewing the general nature of the state and development of the mental lexicons of Japanese EFL

learners will yield some suggestions.

2.3.1 Separate lexical representations and common conceptual representations

There is a question whether L1 lexicons and L2 lexicons are independent and not related each other. If they were completely independent, bilinguals could not conduct translation tasks. Usually, they can do this, so it can be considered that the two lexicons are not completely independent. Kadota (2003) summarized previous research results, noting that the results of cross-language priming experiments[9] have confirmed that there is a cross-linguistic priming effect, supporting the existence of common lexical system of memory and processing. The above results show that L1 and L2 lexical items belong to each memory system, however, the conceptual representations underling them are common.[10]

Morphologically (derivationally) related words share formal and semantic features. Using the above distinction, the formal relationship is lexical and the semantic one is conceptual. Investigating how morphologically related words are represented in the mental lexicons of second or foreign language learners will yield important insight into the general structure of their mental lexicons. If the above arguments are true, formal relationships may be weaker than semantic relationships since the former are represented only in second languages but the latter exist in both in first and second languages. The results from tests on L1 speakers have shown that morphological relationships exist even if there are no semantic relationships between tested morphologically related words (Longtin and Meunier, 2005). This may not be true for L2 speakers.

2.3.2 Links among L1 forms, L2 forms, and concepts (a developmental feature of the mental lexicons of Japanese EFL learners)

L2 learners facing new languages do not learn new concepts (Kroll, 1993), but they map new L2 word forms onto already acquired concepts. That is, L2 learners already have concepts and only

[9] L1 translations are shown before the conceptually related L2 words.

[10] It has been agreed that lexical representations and conceptual representations are independent (French and Jacquet, 2004). The links between lexical items are called “lexical” and those between lexical items and their concepts are called “conceptual”.

have to make new links between new L2 forms and those concepts.[11] The concepts are already linked to L1 forms. What kind of relationships are there among these three elements?

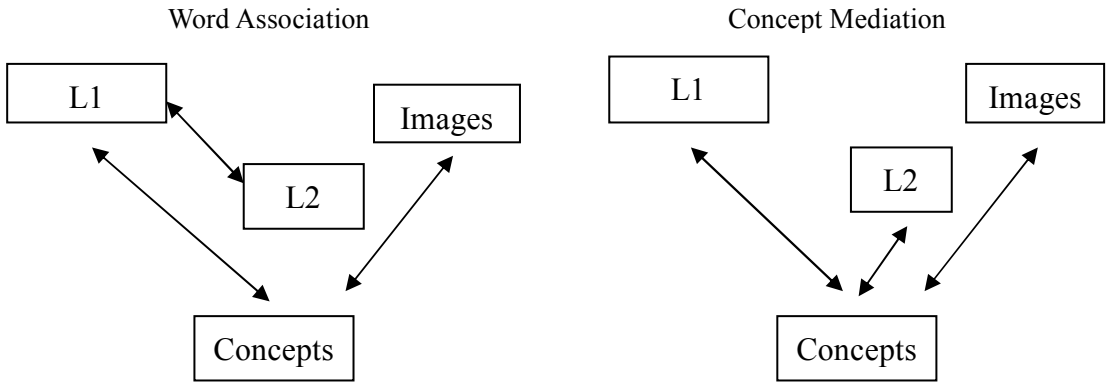

Figure 2.2 Two models of links among L1 and L2 forms and concepts

Two models have been proposed (Kroll and Tokowicz, 2001), a word association model and a concept mediation model. The former indicates that L1 forms mediate L2 forms and concepts. The latter indicates that concepts mediate L1 and L2 forms. Now it is considered that L2 learners experience a change from the word association model to the concept mediation model. It has been shown that the time necessary for translation tasks between L1 and L2 languages is shorter than that for picture naming tasks in L2, but this difference diminishes with proficiency changes of learners.

With regard to derivational relationships, derivatives and their base words are similar in forms and meanings. At earlier stages, L2 forms are linked to L1 forms so derivational relationships might be affected by L1 form similarity. In other words, even if derivationally related words are semantically similar, the difference in L1 translation equivalents may harm the development of the derivational relationships. This interruption by L1 languages may be an interesting question. This dissertation will not mention this aspect, but it should be explored in the future.

[11] On the other hand, L1 speakers usually have to acquire word forms and concepts at the same time since L1 children do not have the concepts before they learn words.

2.3.3 Different structures by part of speech

Piper and Leicester (1980) employed a word association technique (asking participants as many associations as possible for stimuli) to find that different parts of speech showed different results in the number of paradigmatic responses by participant groups (native speakers, advanced EFL learners, and beginners). Noun stimuli equally extracted these responses for different groups, but verbs and adjectives did most for native speakers, middle for advanced EFL learners, and fewest for beginners. This suggests that mental representations of nouns develop earlier and are linked to more items than other categories.

Considering the nature of derivatives, stems and their derivatives are usually different parts of speech. If stems occupy the central position of derivational relationships, noun-stemmed derivational relationships may develop earlier than verb- or adjective-stemmed ones. Besides this, English has more verb-originated derivatives and Japanese has more noun-originated derivatives. This difference may bear interesting results. This dissertation will not explore this part-of-speech difference, but this aspect should be explored in the future.

2.3.4 Summary

There have been few studies concerning derivational representations in the mental lexicons of L2 learners. Therefore, this dissertation mainly employs methods already conducted in L1 studies. Although, the effects of opaque relationships in meaning (2.3.1), L1 forms (2.3.2), and different parts of speech (2.3.3) will not be explored in this dissertation, finding links between morphological relationships and other features is crucial in clarifying the structures of mental lexicons of Japanese EFL learners.

2.4 Psycholinguistic methods to explore morphological representations

There have been mainly two methods to explore the morphological relationships in mental lexicons; lexical decision tasks with frequencies as a criterion and priming experiments. This dissertation employs the former in Chapter 5 and the latter in Chapters 6, 7, and 8. I mention advantages and disadvantages of the two methods here, by reviewing related L1 studies.

2.4.1 Lexical decision tasks with frequencies as a criterion

As employed in the influential paper by Taft (1979), lexical decision tasks with frequencies as a criterion have been popular in psycholinguistic studies to explore the structures of mental representations. People can usually process more frequent words more quickly. The question is whether the frequencies affecting reaction times are based on stems, inflections, or derivational families. If the frequencies of derivational families affect reaction times of stems or derivatives, it can be assumed that mental lexicons are structured in a word-family (derivational) manner.

Nagy, et al. (1989) employed this measure and suggested the care must be taken, saying that targets in lexical decision tasks should be stems (not derivatives) since participants may select special ways of morphological decomposition (happiness → happy + -ness) when most of the targets are derivatives. In line with their studies, the present dissertation uses stems as targets in Chapter 5 to investigate derivational relationships in the mental lexicons of Japanese EFL learners.

2.4.2 Priming experiments

Another way of exploring mental representations is through a priming experiment. This method is usually a lexical decision task, too, but primes are inserted before targets are presented. If primes and targets are related, primes activate the representations of targets. As a result, their reaction times become quicker. This can be applied to morphological relationships.

There are three main kinds of priming experiments: masked, unmasked, and cross-modal. A masked priming experiment inserts primes for a very short time (around 50ms.) so they are invisible to participants. Primes are covered by targets after this time period so the processing time for primes is very short. Therefore, it is argued that masked-priming experiments can be used to explore the early stages in lexical processing.

An unmasked priming experiment similarly inserts primes but they are visible to the participants. The time for presenting primes is longer than in masked-priming experiments so later stages in lexical processing can be investigated.

A cross-modal priming experiment presents primes auditorily and targets are visually presented. Since participants hear primes, they consciously process them. Therefore, like unmasked priming experiment, later stages in lexical processing are explored with this type of experiment.

Two studies have been conducted concerning the difference between a masked-priming experiment (Longtin and Meunier, 2005) and a cross-modal priming experiment (Meunier and Longtin, 2007). Both studies used interpretable and non-interpretable combinations (pseudo-derivatives) of stems and suffixes as primes, but only the former study found a facilitative effect of the primes of non-interpretable combinations,[12] suggesting that cross-modal priming experiments observing later stages of lexical processing distinguish semantic features. Time course difference between formal and semantic features can be found in these two kinds of experiments.

The present study employs a masked-priming experiment (Chapters 6, 7, and 8) to explore early stages of lexical processing. The results of Longtin and Meunier have shown that semantic features do not affect the reaction times of targets. However, as mentioned in 2.3.1, conceptual representations may be stronger than formal representations for L2 learners so semantic features may play a role in early stages. This dissertation does not test this hypothesis but it should be investigated in the future to further reveal morphological structures.

2.5 Summary

To my knowledge, few studies explored morphological relationships in the mental lexicons of L2 or Japanese EFL learners. The results of L1 studies suggest that morpheme-level mental representations exist in their mental lexicons. There have been debates over the strength of derivational relationships when compared with inflectional ones. The results of L2 studies imply that the strength of conceptual representations, interruptions by L1 forms, and the different representational nature of parts of speech may produce different results on derivational representations of L2 mental lexicons form L1 ones. This overview of the studies of L2 (Japanese EFL) learners has suggested that previous research has only observed one aspect of morphological

[12] Both studies observed facilitative effects of the primes of interpretable combinations of stems and suffixes.

knowledge (SK) and morphological (derivational) relationships (RK) have not been observed yet. Two kinds of experiments can be employed to investigate morphological representations in mental lexicons; lexical decision tasks with frequencies as a criterion and priming experiments.

From the next chapter, the methods, results, and discussions of conducted experiments and interviews will be mentioned. Chapters 3, 4, and 9 explore morphological (derivational) knowledge (RK) of Japanese university-level EFL learners. Chapters 5, 6, 7, 8, and 10 focus on their morphological (derivational) representations.

Chapter 3

Exploring derivational knowledge through paper and pencil tests

3.1 Introduction

As a starting point for this investigation into morphological relationships in the mental lexicon of Japanese EFL learners, Chapters 3 and 4 will explore their morphological knowledge. Unless learners have morphological knowledge, it is not worth considering whether they have morphological representations in the minds.

3.1.1 Three kinds of morphological knowledge

As mentioned in the literature review sections (Chapter 2), there are three kinds of morphological knowledge: RK (relational knowledge), SK (syntactic knowledge), and DK (distributional knowledge). Tyler and Nagy (1989) showed that L1 speakers of English experience a developmental sequence from RK through SK to DK. If learners have RK, they can extract the base form of a certain derivative on meeting a new word. For example, when learners with RK see *happiness* for the first time, they can figure out the meaning by extracting the base form *happy* in the form of the derivative. This phase does not require learners to have explicit knowledge of suffixes (e.g., *-ness*). Suffixes usually provide learners with the syntactic functions of derivatives and those functions do not always have to be known when reading or listening is taking place since that information is already provided by the context surrounding the derivatives.

SK refers to that knowledge related to the understanding of the syntactic information contained in certain suffixes. In the example of *happiness*, SK refers to knowledge of the function of the suffix *–ness*, which changes words into nouns. This knowledge enables us to infer the parts of speech of unfamiliar words and can facilitate the comprehension of the whole word. Finally, with DK, learners become aware of which part of speech a certain suffix attaches to. For example, this knowledge allows us to know that the suffix *–ness* only attaches to adjectives, not to nouns or verbs. Tyler and Nagy (1989) showed that native speakers' acquisition order was RK→SK→DK.

3.1.2 Points to investigate in this chapter

As mentioned in sections 2.1.2 and 2.1.3, Japanese EFL learners do not have sufficient SK. In other words, their knowledge of suffixes is immature and suffix knowledge may be too abstract for them to acquire. However, L1 speakers of English acquire RK (relational knowledge) before SK. Presumably RK is easier since it only entails finding relationships between morphologically related words. Even if L1 speakers do not know the functions of suffixes, they may be able to find derivational relationships between derivatives and their stems because they are similar in form and meaning.

This chapter examines how Japanese EFL learners are able to employ derivational relationships when they comprehend derivatives. Three tests are conducted: a vocabulary size test (VLT; Vocabulary Levels Test), a suffix knowledge test (Mochizuki and Aizawa, 2000), and a self-made derivative comprehension test. By using these three tests, explicit knowledge of suffixes (SK), derivative comprehension (RK) and the relationship between these two constructs and with vocabulary sizes are observed.

3.2 Method

3.2.1 Participants

One hundred and twenty-four university students majoring English participated in this experiment. The results of 49 of the participants were only analyzed for the suffix test mentioned below. The remaining 75 participants were divided into three vocabulary groups termed 1,000 holders, 2,000 holders, 3,000 holders[13] according to the Vocabulary Levels Test (VLT, mentioned below) and their results were analyzed for the suffix test and derivative comprehension test mentioned below. The numbers of participants of each vocabulary group were 31/30[14] for 3,000 holders, 27 for 2,000 holders and 17 for 1,000 holders. Their proficiencies are considered low-intermediate.

[13] These numbers indicate vocabulary sizes in terms of word families. For example, 1,000 holders had at least 1,000 word-family vocabulary but did not have as much vocabulary as 2,000 word families. This classification was done using the results of VLT. Participants who scored at least 24 items out of 30 in the 3,000 word-family section were regarded 3,000 holders. It applies to the 2,000 word-family section. If they failed to meet the criterion in the both sections, they were termed 1,000 holders.

[14] One participant was late and could not answer the derivative comprehension test.

3.2.2 Materials

3.2.2.1 A vocabulary size test: Vocabulary Levels Test

This vocabulary size test was originally developed by Nation (1983). It is now well accepted as the standard vocabulary measurement all over the world. In this test, learners have to match three words out of six with three definitions. It has five levels (2,000, 3,000, 5,000, 10,000 word-family levels and academic words)[15] each of which has 30 questions. Version 2 of VLT in Schmitt, Schmitt and Clapham (2001) was used in this study. For the purpose of this experiment, I excluded the 10,000 word level section and translated the definitions into Japanese, in consideration of the level of the participants.[16] This test was also used as a tool to measure the base word knowledge of the participants. This is described in the derivative comprehension test section.

3.2.2.2 The suffix knowledge test

The SK test given to the participants is similar to the test conducted by Mochizuki and Aizawa (2000) (See Appendix A for the test material). In this test, the participants were asked to circle parts of speech into which suffixes change base forms. For example, if the suffix *–ity* is attached to a base form, it changes the base form into a noun. Therefore, if participants circled "noun", it would be a correct answer. Mochizuki and Aizawa investigated the explicit knowledge of suffixes by presenting pseudo-words, not real words. They held that if real words had been presented, the knowledge of real words would have been tested. For the same reason, pseudo-words were used in the present study. The nine suffixes investigated in the present study were *–er, -able, -ment, -ence, -ity, -ous, -ation, -ness* and *–y*, all of which would attach to the derivatives later in the derivative comprehension test even though Mochizuki and Aizawa considered 16 suffixes suitable criteria for Japanese EFL learners. This test was a complementary sub-test to explore how suffix knowledge affects derivative comprehension so it did not cover all of the basic suffixes as in Mochizuki and Aizawa.

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[15] The academic words test is designed to measure the vocabulary knowledge needed to study and research at university and is not made by the frequency count.

[16] Translating definitions into the learners' L1 can increase the reliability of the vocabulary test as this process can exclude the possibility that lack of reading comprehension ability inhibits answering questions correctly (Kamimoto, 2003).

3.2.2.3 The derivative comprehension test

Finally, the derivative comprehension test is a self-made multiple-choice test. Sixteen derivatives (9 from 2000 word-family (WF) level, 7 from 3000 WF level) whose base words had been tested in VLT were selected as test items. (See Appendices B and C for the conducted test material.)

Table 3.1 Tested base words and derivatives

2000 word-family level	
Base words in VLT	Derivatives
elect	electorate
admire	admiration
prefer	preference
noise	noisy
manufacture	manufacturer
arrange	arrangement
introduce	introduction
tax	taxpayer
develop	development

3000 word-family level	
Base words in VLT	Derivatives
import	importable
administer	administration
nerve	nervous
pursue	pursuit
aware	awareness
stable	stability
endure	endurable

The rate of derivative comprehension (RK ratio, referred below) was investigated only for items whose base words were answered correctly in the VLT. Participants had to choose the right definition out of six choices in this derivative comprehension test. The test differed from usual multiple-choice tests is that the choices were three pairs, each of which had two semantically close words (e.g., *happy* and *happiness*). These choices were given because if only semantically different choices were presented, participants could choose the answer from the vague semantic knowledge. It was intended to investigate the participants' knowledge in more detail. In this way, syntactic knowledge of derivatives could be seen.

Example choices for *electorate*

1. *senkyomin* (electorate) 2. *senkyosuru* (elect) 3. *saiban* (trial) 4. *saibankan* (judge) 5. *koujou* (factory) 6. *kouin* (factory worker)

Half of the items were contextualized. As a result, two test versions were invented to present every word alone and in context. Each participant took only one version of the test. The intension was to investigate real receptive skills like reading or listening. There is always some contextual assistance in comprehending derivatives. Some people might argue that if there is contextual aid, it is not clear whether the test is measuring guessing ability or comprehension of derivatives. Nation (2001, p. 353) said that vocabulary tests with contexts might examine other things besides vocabulary knowledge. However, contextual role is very large in derivative comprehension and that lack of knowledge of suffixes function could be supplemented by the context. Here, much care was taken to provide the least semantic help for participants. Contexts were presented in order to facilitate syntactic comprehension.

3.2.2.4 Measurement of RK

The purpose of this section is to investigate how much relational knowledge (RK) participants have. In this study, an "RK ratio" is calculated by testing base words and derivatives separately. For example, in testing the six words: *elect, electorate, manufacture, manufacturer, endure*, and *endurable*, the base words were *elect, manufacture* and *endure* and the others were derivatives. If a participant answered *elect, electorate, manufacture* and *endurable* correctly, how can we calculate the RK ratio?

First, I checked the responses for the base words. Of the three base words above, let's suppose the two base words, *elect* and *manufacture*, were answered correctly. Then, the RK ratio would be calculated only for the derivatives of the base words that were answered correctly. Therefore, in this case, the correct answer *endurable* would be excluded. Second, I checked how many derivatives a participant could answer. In this case, the participant only answered *electorate*. Therefore, the ratio would be 1/2 = 0.5. This ratio was used as a basis for investigating relational knowledge of participants, and was calculated on an individual basis.

3.3 Results

Table 3.2 shows that the rate of correct responses by the participants in the suffix test was below 60%, indicating the explicit suffix knowledge of the participants was immature.

Table 3.2 The suffix knowledge test

Mean	5.26 (58.8%)
SD	2.07
Max	9
Min	1
Cronbachα	.629

Table 3.3 The suffix knowledge scores of three vocabulary groups

V. Size	3000	2000	1000
N	31	27	17
Score	75.6%	55.1%	43.1%

Table 3.4 Paired comparison (Scheffe)

Compared groups	*p*
3000 — 2000	.001
3000 — 1000	.000
2000 — 1000	.133

Table 3.3 shows that the more vocabulary the participants had, the more explicit suffix knowledge they seemed to have. The results of a statistic analysis (ANOVA) showed a statistically significant difference ($F = 17.893$, $p<.01$) among the three vocabulary groups.

Paired comparisons (Scheffe) show that there were significant differences between the 3000 holders and 2000 holders and between the 3000 holders and 1000 holders ($p < .01$; Table 3.4). No significant difference was found between the 2000 holders and 1000 holders. Therefore, it can be said that a 3000 word-family vocabulary is the key factor for acquiring the explicit suffix knowledge.

Table 3.5 RK ratio

V. Size	3000	2000	1000
N	30	27	17
2000 level	88.6%	80.0%	74.7%
3000 level	83.1%	73.3%	62.9%
Total	86.2%	77.5%	70.2%

Table 3.5 shows the results for the RK ratio. This data is the ratio of correct responses in the derivative comprehension test[17] when the base word of the derivatives was answered correctly in the VLT. The '3000' column indicates that the participants could comprehend the meaning of the derivatives of 3000 word family level and 2000 word family level at the rate of above 80% if they had a 3000 or more word-family vocabulary. The '2000' column shows that 2000 holders could comprehend the meaning of the derivatives of 2000 word family level at the rate of 80%. The overall tendency indicates that they have a relatively high relational knowledge. If they have base word knowledge, they can understand almost 60~90% of derivatives.

To confirm whether there were differences among the three vocabulary size groups, statistic analyses were conducted. There were two versions in the derivative comprehension test, so the analyses were conducted separately. The results showed significant differences among the vocabulary groups both for Version 1 ($F = 3.950$, $p < .05$) and Version 2 ($F = 5.575$, $p < .01$). Paired comparisons (Scheffe) showed that in both tests, differences existed only between 3000 holders and 1000 holders (Tables 3.6, 3.7). It can be assumed that the derivative comprehension grows rather slowly with vocabulary increases. If the vocabulary of the learners increases to some extent, then there can be seen a significant difference.

[17] The Cronbachα for the raw score of the derivative comprehension tests was .702 for the Version 1 and .673 for the Version 2. These rates were a little low but considered reasonable regarding the number of items (16).

Table 3.6 The result of Scheffe multiple comparison (Version 1)

Compared groups	*p*
3000 — 2000	.180
3000 — 1000	.040
2000 — 1000	.747

Table 3.7 The result of Scheffe multiple comparison (Version 2)

Compared groups	*p*
3000 — 2000	.373
3000 — 1000	.008
2000 — 1000	.095

Table 3.8 The RK ratio divided by the results of the suffix test (*N*=74)

	Derivatives whose suffix was not answered correctly	Derivatives whose suffix was answered correctly
C. of derivatives	81.5%	87.7%

Table 3.8 indicates that if the participants knew the meaning of base words, they could comprehend the derivatives at the rate of 81.5% without explicit suffix knowledge. This result was obtained from the results of the suffix test (cf. 3.2.2.2) and the derivative comprehension test (cf. 3.2.2.3). The right column shows that if they had explicit suffix knowledge, the rate improved slightly. However, the difference is rather small: about 6%. This result indicates that even without explicit suffix knowledge, Japanese EFL learners in a university can find morphological relationships.

3.4 Discussion

The participants showed limited explicit suffix knowledge. This result supports the findings of Mochizuki and Aizawa (2000). Although 3000 holders have relatively higher level (75.6%) suffix knowledge, the participants as a whole did not show a satisfactory level of explicit suffix knowledge. The significant difference between 3000 holders and 1000 and 2000 holders indicates that having a 3000 word family vocabulary is the key factor for acquiring explicit suffix knowledge.

Nagy and Anderson (1984, p. 326) said that facing only high frequency words leads to a lack of word formation knowledge because high frequency words do not contain many affixes. From this perspective, 1000 and 2000 holders might not have faced enough low frequency words to build the word formation knowledge. The third 1000 word-family knowledge may affect the explicit suffix knowledge building. Of course, we have to interpret this result cautiously since the number of tested suffixes was small. Complementary experiments should be conducted in the future.

Even so, this fact may be useful in terms of syllabus design. Having suffix knowledge facilitates inference of unfamiliar words. With this knowledge, learners of English can analyze the words into parts so as to figure out the meaning. Although the above results show that this knowledge is not necessarily required in derivative comprehension when base words are known, for unfamiliar words, in other words, for words for which no morphologically related word is known, suffix knowledge is crucial. Suffix knowledge is also important to produce unknown derivatives. If learners of English do not know the correct form of the derivative *happiness*, they can produce the derivative through the knowledge of its base word (stem) *happy* and its suffix *–ness*. In this sense, suffix knowledge is important in productive skills such as speaking and writing. Syllabus designers should keep this in mind and pay much attention to word selection to enhance the suffix knowledge of learners.

Although the participants did not show great suffix knowledge, they were able to understand derivatives at the rate of about 80% when they had their base word knowledge. The lack of suffix knowledge does not necessarily lead to the lack of comprehension of derivatives. Those derivatives whose suffixes were not answered correctly in the suffix test were often answered correctly in the derivative comprehension test if their base word was answered correctly in VLT. These results suggest that explicit suffix knowledge is not necessarily required for comprehension of derivatives when their base words are known.

In the derivative comprehension test, it is shown that the growth of relational knowledge with the vocabulary increase was rather slow. There seems to be no threshold of vocabulary sizes in derivative comprehension. This may mean that learners of English start learning how to

comprehend derivatives in early stages. Therefore, 1,000 holders could comprehend up to 60% of the derivatives of 2,000 and 3,000 word family levels. However, some cautions are needed here. The participants in this experiment were all university students. It can be assumed that they must have already known that similarity in form leads to closeness in meaning. Junior or senior high school students might show different results.

Considering the acquisition order of morphological knowledge, it can be said that the claim that RK precedes SK is empirically verified since the participants could comprehend derivatives with their base word (stem) knowledge at the rate of around 80% but could answer the function of suffixes only at the rate of below 60%. Of course, we have to carefully interpret the results of the suffix and derivative comprehension tests because they were qualitatively different. A more sensitive suffix test might have detected more incomplete knowledge of suffixes. However, the results showing that (a) derivatives whose suffixes had not been answered correctly could be still answered at a high rate (above 80%) and that (b) 3,000 holders showed a significantly higher knowledge of suffixes even though the development of RK ratio seemed to be earlier suggest that the acquisition order of morphological knowledge of EFL learners is also from RK to SK. I have not directly tested the relationships between base words and derivatives yet, so I can't say they really have RK at this point. However, it can be said that the participants have shown a tendency to acquire RK earlier than SK. The conclusion concerning this claim is shown after we research the direct relationships between base words and derivatives in the next chapter.

3.5 Conclusion

Summarizing the results of Chapter 3, I revealed the following six points.

1. The suffix knowledge of Japanese EFL learners is not high.
2. The third 1,000 word-family vocabulary may affect the acquisition of explicit suffix knowledge.
3. The lack of explicit suffix knowledge does not necessarily harm the comprehension of derivatives.
4. The rate of the development of RK is rather slow.
5. Japanese EFL learners in university may already know derivational relationships.

6. RK (relational knowledge) seems to precede SK (syntactic knowledge) for Japanese EFL learners as for L1 speakers.

3.6 Limitations in this chapter and points to be improved in the next chapters

It was found in this chapter that when the low-intermediate level Japanese EFL learners have base word knowledge, they can relatively easily comprehend derivatives. However, this conclusion should be interpreted carefully at this point. Base word knowledge and derivative comprehension separately were investigated separately, so learners may remember these two groups of words separately and there may be no relationship between them. For example, let's say that a participant answers *manufacture, manufacturer, elect* and *electorate* correctly. The rate of derivative comprehension (RK ratio) is 100% because that participant can comprehend at the rate of 100% the derivatives whose base words has been answered correctly. However, if that participant knows the derivatives, *manufacturer* and *electorate* separately from the base words, it cannot be said that the base word knowledge facilitates the derivative comprehension. Therefore, the direct relationship between the two constructs, base word knowledge and derivative comprehension, needs to be clarified.

There is another limitation to the results in this chapter. The outcome was obtained through the use of multiple-choice tests. In the test situation, the participants only had to choose the meaning out of alternatives. However, in real-life communication, people have to recall the meaning of words. There are no alternatives when we have to comprehend what others are saying. Laufer, Elder, Hill and Congdon (2004) indicated that there are four levels (strengths) of lexical knowledge: productive recall, receptive recall, productive recognition, and receptive recognition. They defined recall as being able to access the form (productive) or meaning (receptive) without being provided with form choices (productive) or meaning choices (receptive).

This chapter only deals with receptive knowledge. In the definition of Laufer and her colleagues, the two tests of knowledge of receptive recall and receptive recognition are as follows.

Receptive recall knowledge test

The task is to demonstrate understanding of the meaning of the L2 word (e.g., *melt*) that is embedded in a phrase, or a short sentence to be completed by the test-taker. In the following instance, there are a range of acceptable responses (e.g., *water, fluid, liquid*).

When something *melts*, it turns into _____

Receptive recognition test

The task is to choose the meaning of the target word from the four options provided.

Melt

a. choose b. accuse

c. make threats d. turn into water (Laufer, Elder, Hill and Congdon, 2004, p. 207)

We can find from the example of the two tests above that test-takers should have a larger amount of knowledge in the receptive recall test because there is no choice. On the other hand, in the receptive recognition test, they can answer the question even with minimal knowledge because they are provided with choices. Therefore, the receptive recall knowledge is more advanced knowledge than the receptive recognition knowledge. The results of Laufer *et al*. suggested that their participants could answer larger proportions of questions in the receptive recognition test than in the receptive recall test.

Returning to the present study, I already have explored the receptive recognition level knowledge because I provided choices. When the participants had knowledge of base words at the recognition level, almost all of them could comprehend the derivatives at the recognition level at the rate of about 60~90%. However, I have not explored whether this accounts for receptive recall knowledge as well. To conclude that base word knowledge facilitates derivative comprehension, it is also worth exploring the morphological knowledge at other levels. In other words, the study has already determined shallower knowledge but has not investigated deeper level knowledge. This should be explored so that the whole picture regarding the relationships between base words and derivatives can be seen.

To summarize the above contents, two points need to be taken into consideration in the following chapter.

1. The direct relationships between base words and derivatives should be investigated. Do learners use morphological information when comprehending morphologically related words?
2. The strength of knowledge of each base word and derivative should be tested. If a different criterion of knowledge is adopted, do learners show the same result?

To resolve these two problems, Chapter 4 uses an interview procedure. Analyzing interviewees' utterances, I explore their depth of knowledge and direct relationships between base words and derivatives.

Chapter 4

Exploring derivational knowledge further through interviews

4.1 Introduction

The results of Chapter 3 suggest that if low-intermediate level Japanese EFL learners in a university have base word knowledge, they do not have much difficulty in comprehending derivatives. It was also found that suffix knowledge is not necessarily required for comprehending derivatives. The correct answering rates were similar between derivatives whose suffixes had been answered correctly and derivatives whose suffixes had NOT been answered correctly. However, Chapter 3 tested the base word knowledge and derivative knowledge separately, so I have not yet been able to explore the direct relationships between the two kinds of knowledge. To say that low-intermediate level Japanese EFL learners have RK (relational knowledge), the direct relationships between the two pieces of knowledge needs to be determined.

In this chapter, I explore these relationships by conducting interviews. The knowledge level (cf. the section 3.6) of each base word and derivative are also investigated. Results from Chapter 3 only suggest that the recognition level base word knowledge facilitates derivative comprehension. I have to account for whether recall level knowledge facilitates recall level comprehension.

Summarizing the above contents, this chapter will investigate the following two questions through conducting interviews.

1. Do low-intermediate Japanese EFL learners use morphological information when comprehending derivatives?
2. Does their recall level base word knowledge facilitate their recall level derivative comprehension?

4.2 Method

4.2.1 Participants

Eight participants were selected based on the results of the test presented in Chapter 3. These participants were separated into four groups in terms of their vocabulary size and derivative comprehension rate (RK ratio), as outlined in Chapter 3.

Table 4.1 Four participant groups

	Group 1	Group 2	Group 3	Group 4
N	2	2	2	2
Vocabulary size	More than 3,000 word families		Less than 2,000 word families	
Derivative comprehension rate (RK ratio) in Chapter 3	High (over 80%)	Low (under 80%)	High (over 80%)	Low (under 80%)

Qualitative difference in terms of derivative comprehension among these four groups was also investigated in addition to the two questions above.

4.2.2 Materials

Twenty words were selected from 2000 word family level's words appearing in Schmitt's VLT test Version 1 (Schmitt, 2000). These words are, in other words, high frequency words. Meanings of these words (at the recall and recognition levels) were tested as base word knowledge. High frequency words were selected so that the participants could answer as many base words as possible. If participants (especially of low vocabulary groups) did not know the meaning of base words, the relationships between base words and derivatives could not be clarified. Therefore, high frequency words were selected.

Derivatives of the base words were selected from the word family list devised by Paul Nation. On the list, each word family is headed by its base form. For example, *acceptability, acceptable, acceptance, accepted, accepting and accepts* are grouped together, headed by *accept*. One word

was randomly selected from each base word. No adjustments were conducted with respect to selecting derivatives considering the level of the participants so that I could determine the applicability of the base word knowledge to comprehend derivatives. That is, easy base words were selected to ensure, as far as possible, that the participants would know them. However, the aim was to test their ability to apply their knowledge of base words to any derivatives, so no level adjustment was conducted to choose the derivatives.

The base words and derivatives selected are shown in Table 4.2.

Table 4.2 Tested base words and derivatives

Base words	Derivatives	Base words	Derivatives
victory	victorious	recognize	recognition
secret	secrecy	deliver	delivery
trick	trickster	improve	improvement
shadow	shadowy	urge	urgent
wealth	wealthy	private	privately
climb	climber	sorry	sorrow
examine	examination	brave	bravely
bake	baker	electric	electricity
connect	connection	local	locally
limit	limitation	usual	usually

(The above words are put in the order of the base word test.)

As noted in Chapter 3, context seems to play a big role in comprehending derivatives. Therefore, I had to check the situation in which contexts were provided. For this purpose, contexts were created with the following two criteria (see Appendices E and F for the provided contexts). First, contextual sentences were made from words within the 2000 word-family level (quoted from Paul Nation's word family list) because low vocabulary holders participated in this experiment. Contexts should have been adjusted to prevent non-experimental variables (such as misreading the context)

from affecting the results. However, even with this high frequency vocabulary, the participants might not have been able to comprehend the context because of their insufficient lexical knowledge. In this case, Japanese definitions were provided by the interviewer.

Second, contexts were carefully constructed so as not to provide the participants with semantic hints. If contexts had provided these kinds of hints, I could not have grasped the true ability of the participants to comprehend the meaning of derivatives. Contexts were made to facilitate the syntactic comprehension of derivatives. Contexts were also made for base words to compare the knowledge level (mentioned in section 4.2.3) of base words and derivatives.

The procedure described in section 4.2.3 includes multiple-choice tests. Therefore, I had to make alternative answers for each base word and derivative (see Appendices E and F for the choices provided). The choices were given to the participants with contexts. Much care was taken to prevent the participants from answering with test-taking techniques. If there had been only one alternative fitting the blank of a provided sentence, they would have chosen this answer. Therefore, only semantically suitable alternatives to the contexts were made.

There was another important point to consider in constructing the alternatives, which was also taken into account carefully in Chapter 3. I had to explore whether the participants could comprehend derivatives with syntactic correctness. Therefore, each cluster of alternatives consisted of three pairs (semantically different) of two semantically similar but syntactically different choices.

An example of one cluster is as follows.

The choices for *trick*

1. *tejina* (trick) 2. *kijutsushi* (trickster) 3. *gaiken* (appearance) 4. *gaikentekina* (surface) 5. *shuushuuhin* (collection) 6. *shuushuusuru* (collect)

(The context for *trick* was *His trick is wonderful*.)

Suffix tests were added to the base word test. The syntactic functions of twenty suffixes were asked (For example, a suffix *–ness* turns words into nouns). In Chapter 3, only suffixes that can be attached to the tested derivatives were examined. In this chapter, the knowledge of all of suffixes (16) tested in Mochizuki and Aizawa (2000) and four suffixes attaching to derivatives tested in the interview was examined. The other suffixes attached to derivatives tested in the interview were included in the 16 suffixes above. The same care as in Chapter 3 was taken to prevent the participants from answering through word knowledge alone. Suffixes were compounded with pseudo-stems. Therefore, the true knowledge of suffixes could be explored.

An example question is as follows.

The test for a suffix *–able*

Circle the part of speech the underlined suffix change words into.

1. rombort<u>able</u> quif<u>able</u> slomit<u>able</u> n. v. a. adv.

(See Appendix D for the whole test.)

4.2.3 Procedure

Base word knowledge and suffix knowledge were tested first. After a two-week interval, derivative knowledge was tested. The knowledge was tested individually. For the test of base word knowledge and suffix knowledge, the procedure was as follows. An answering sheet containing the suffix test and the base word test was distributed to each participant. The participants were asked to answer all the questions provided as much as possible. In the base word knowledge test, they had to provide Japanese definitions to each base word. In the suffix test, they had to circle the right answer.

Upon completion of the test items, the participants' answers to the base word knowledge test were checked by the interviewer. If the correctness of the answer was not clear, an electronic dictionary was used to investigate whether those answers were acceptable. If the answers provided passed these criteria, then the knowledge level for these base words was assigned as 1A. The answers were scored with two points: semantic correctness and syntactic correctness.

The knowledge level for each word was assigned as follows.

1A: Correct definitions were provided without a contextual help and the answers were syntactically correct (e.g., *happiness* for *happiness*).

1B: Correct definitions were provided without a contextual help but the answers were NOT syntactically correct (e.g., *happy* for *happiness*).

2A: Correct definitions were provided with a contextual help and the answers were syntactically correct.

2B: Correct definitions were provided with a contextual help but the answers were NOT syntactically correct.

3A: Correct definitions were not provided even with a contextual help. However, semantically and syntactically correct alternatives were chosen out of six choices.

3B: Correct definitions were not provided even with a contextual help. However, semantically correct but syntactically incorrect alternatives were chosen out of six choices.

Table 4.3 The knowledge level

Knowledge level	Recall or Recognition	Context	Syntactic functions
1A	Recall	Without	Correct
1B	Recall	Without	Incorrect
2A	Recall	With	Correct
2B	Recall	With	Incorrect
3A	Recognition	With	Correct
3B	Recognition	With	Incorrect
4	No knowledge		

If participants could provide correct definitions without contextual help (in the first phase), the knowledge level for that word was assigned as 1A and the investigation for this word ended. If they provide semantically correct but syntactically incorrect answers, the knowledge level for that word was assigned as 1B and the investigation continued to the next phase (They would be provided with contexts). If they provided completely wrong answers or they could not answer, they also went to

the next phase.

In the second phase, they were provided with contexts. As described above, these sentences had minimum semantic clues and were made to facilitate syntactic comprehension. If participants could provide semantically and syntactically correct definitions with this contextual help, the knowledge level for that word was assigned as 2A and the investigation for that word ended. If they provided semantically correct but syntactically incorrect answers, the knowledge level for that word was assigned as 2B and the investigation continued to the next phase (They would be provided with 6 alternatives). If they provided completely wrong answers or they couldn't answer, they also went to the next phase.

In the final phase, they were provided with 6 alternatives (Japanese definitions). As described in the section 4.2.2, these six alternatives consisted of three semantically different pairs of syntactically different words. For example, one cluster contained the following six words: *senkyosuru* (elect), *senkyomin* (electorate), *seizousuru* (manufacture), *seizougyousha* (manufacturer), *konomu* (prefer), and *konomi* (preference). From these alternatives, they were asked to choose the right answer. If they could successfully choose semantically and syntactically correct answers from the alternatives, the knowledge level for that word was assigned as 3A and the investigation for that word ended. If they chose semantically correct but syntactically incorrect answers (e.g., *prefer* for *preference*), the knowledge level for that word was assigned as 3B and the investigation for that word ended. If they chose a completely wrong answer, the knowledge level for that word was assigned as 4 and the investigation ended.

To summarize the procedure, the investigation continued until they could provide or choose semantically and syntactically correct answers (1A, 2A or 3A level), they chose the semantically correct but syntactically incorrect answer (3B level), or they chose the completely wrong answer (4 level).

Table 4.4 Ten levels of knowledge for each word

1A
1B – 2A (assigned as 1B – 2A)
1B – 2B – 3A (assigned as 1B – 3A)
1B – 2B – 3B (assigned as 1B)
2A
2B – 3A (assigned as 2B – 3A)
2B – 3B (assigned as 2B)
3A
3B
4

The knowledge level for each word was recorded with two criteria: the first determined at what level they could successfully provide semantically and syntactically correct definitions or choose semantically and syntactically correct answers; the second considered at what level they provide semantically correct but syntactically incorrect definitions or choose semantically correct but syntactically incorrect answers. Therefore, if a participant provided a semantically correct but syntactically incorrect definition with contextual assistance (2B level) and chose a semantically and syntactically correct answer (3A level), the knowledge level was assigned 2B – 3A.

If a participant could provide or choose semantically and syntactically correct answer in the first time (in the above table, the case 1A, 2A, 3A show this), only 1A, 2A or 3A were recorded. If a participant could never come up with the semantically and syntactically correct answer (in the above table, the case 1B – 2B – 3B, 2B – 3B and 3B show this), only 1B, 2B or 3B were recorded.

The above description shows the procedure for base words. After a two-week interval, the participants were interviewed to determine their ability to apply their base word knowledge to comprehend derivatives. At this time, the knowledge level for each derivative was assigned as for base words, except that the meaning was asked verbally at the beginning of the interview. In addition to this difference, I investigated how they comprehended derivatives. In other words,

whether they used morphological information was examined. For example, when faced with a derivative, *preference*, whether they used the similarity between the forms of the base word *prefer* and the derivative *preference* to comprehend the derivative was checked. For each derivative, the knowledge level was assigned as for base words. After the knowledge level assignment was completed, they were asked how they had comprehended the derivatives. That is, whether they used morphological information (analyzed the derivatives) or remembered the whole derivatives without relating them to the base words. An example of the interview questions is shown below.[18]

Interviewer: How did you comprehend this word *preference*? Did you separate the word into parts or did you understand it as a whole?

Participant: I separated it.

I: Where did you separate the word?

P: Between *r* and the third *e*.

I: How did you figure out the meaning?

P: The word, *prefer,* is *konomu* (a Japanese word, *prefer* in English), and *–ence* functions as a noun. Therefore, *preference* is *konomi*.

How they remembered derivatives in relation to base words was asked, too. An example taken from this section of the interview is as follows.

Interviewer: Did you remember *preference* in relation to *prefer*?

Participant: Yes. I connected these two words when I remembered the meaning.

4.3 Results

4.3.1 Quantitative analysis

First, the knowledge level of each base word and derivative was recorded. The knowledge levels were assigned as 1A ~ 4, when I conducted interviews. I had a record sheet to write down the level of each word. After the interview finished, I transcribed the contents of the interview. When

[18] The original interview was conducted in Japanese and this is my translation. The following contents of the interview are as well.

answers were ambiguous and impossible to judge as correct or wrong, they were checked again with the contents of the interview. Then, the knowledge level of each word was finally assigned.

The focus of the knowledge level is whether participants could comprehend derivatives at a stricter level (the recall level) when they had base word knowledge at the recall level. To investigate this, a quantitative analysis was conducted. As in Chapter 3, the derivative comprehension rate (RK ratio) was calculated with respect to derivatives (e.g., *preference*) whose base word (e.g., *prefer*) had been answered correctly.

The results showed that if the participants had base word knowledge at the recall level (1A level), they could comprehend derivatives (at least with a contextual help[19]) at the recall level (1A or 2A) at 78.0%. This figure is similar to that obtained in Chapter 3 (recognition level knowledge). Even if the stricter criterion was adopted, participants showed a similar tendency in terms of derivative comprehension.

The difference among the participants of different vocabulary sizes was also observed as in Chapter 3 in which the more vocabulary the participants had, the more derivatives they could comprehend. As described in section 4.2.1, four groups participated in the experiment analyzed in this chapter. Two groups consisted of four students whose vocabulary sizes were more than 3,000 word families. The other two groups consisted of four students whose vocabulary sizes were less than 2,000 word families.

The results of the quantitative analysis showed that low vocabulary holders (less than 2,000 word families) could comprehend 69.2% of derivatives when they had base word knowledge. High vocabulary holders (more than 3,000 word families), on the other hand, could comprehend 82.9% of derivatives when they had base word knowledge.

[19] Why we used the data with a contextual help for derivative comprehension is that in a real communicative situation, there are always contexts so learners can use this information. The presence of the contextual help is thought to help us explore the real picture of derivative comprehension.

Of course, there were individual differences between the participants. The rates of derivative comprehension were 94.1%, 89.5%, 78.9%, and 66.7% for high vocabulary holders; 88.9%, 75.0%, 71.4%, and 37.5% for low vocabulary holders. However, the fact that the overall tendencies were similar between the results of Chapter 3 and the results of this chapter suggest that rich vocabulary knowledge facilitates derivative comprehension at the recall level as at the recognition level.

Table 4.5 Derivative comprehension rates (RK ratio) at the recall level of each participant

Vocabulary size	More than 3,000		Less than 2,000	
RK ratio in Chapter 3,	High	Low	High	Low
Name of the group	Group 1	Group 2	Group 3	Group 4
Mean for each vocabulary group (%)	82.9		69.2	
RK ratio of each	94.1	89.5	88.9	75.0
participant (%)	78.9	66.7	71.4	37.5

As mentioned in section 4.2.1, there were differences in the results of the experiment conducted in Chapter 3 in terms of derivative comprehension rates (RK ratio) for the four different groups. The results in this chapter showed that this difference was not maintained. The RK ratios of Group 1 participants who showed high RK ratios in Chapter 3 and had larger vocabulary sizes were 94.1% and 78.9%. The rates of Group 2 participants who showed low RK ratios in Chapter 3 and had larger vocabulary sizes were 89.5% and 66.7%. The RK ratios of Group 3 participants who showed high RK ratios in Chapter 3 and had smaller vocabulary sizes were 88.9% and 71.4%. The RK ratios of Group 4 who showed high RK ratios in Chapter 3 and had smaller vocabulary sizes were 75.0% and 37.5%. These results suggest that learners may show different RK ratios on different test items.

The score of one participant was extremely low (37.5%). Later in this chapter (cf. section 4.3.3.2), it is found that she (participant No. 8 in Table 4.7) was also not good at comprehending unfamiliar derivatives. The reasons for her poor performance are investigated in the section 4.3.3.2.

To summarize the quantitative analysis, the participants showed the same tendency at the recall level as at the recognition level. That is, if they had base word knowledge at the recall level, they could comprehend the derivatives at a rate of around 70 to 80%. It was also found that the more vocabulary they had, the more derivatives they could comprehend. On the other hand, the individual results of derivative comprehension were not maintained. This suggests that relational knowledge is not universal to every word in the learners' mind. RK may be connected to words. It is also possible that learners in the developmental stage may have unstable knowledge so the participants who achieved good results of Chapter 3 were not necessarily good at the results presented in this chapter. These claims are analyzed later in section 4.4.

4.3.2 Qualitative analysis 1: Relational knowledge with derivatives (familiar and unfamiliar derivatives mixed)

The second main point of this chapter is to investigate whether participants use morphological information when comprehending derivatives. When I interviewed the participants, I checked whether they comprehended derivatives as a whole (e.g., *happiness*) or separated them into parts (e.g., *happy* + *-ness*). After the completion of the interviews, I transcribed the interviews and checked comprehension methods (as a whole or separation) again to confirm the initial judgments. Some answers were ambiguous in terms of the comprehension methods and were carefully checked against the content of the interviews.

Overall, there is a tendency for these participants to comprehend derivatives using morphological knowledge (relational knowledge, RK). Let me explore the contents of the interviews now.

baker

Q: What is the meaning of this word?

A: I think this means a person who bakes.

Q: Why do you think so?

A: *Bake* is a verb meaning cook and *–er* means a person.

recognition

Q: What is the meaning of *recognition*?

A: *Ninshiki* (recognition)?

Q: When figuring out the meaning, did you separate the word or comprehend it as a whole?

A: I separated it. *Recognize* means to understand or something and part of this is *-tion*, then I thought this is a noun.

climber

Q: What is the meaning of *climber*?

A: Tozansha (climber).

Q: Did you separate the word or comprehend it as a whole?

A: *Climb* means *noboru* (in Japanese) and *–er* attaches. Therefore, I thought it is a noun.

Q: When *–er* attaches, what kind of noun does a word turn into?

A: A person.

Q: Could you separate the word?

A: Between *b* and *e*.

electricity

Q: What is the meaning of *electricity*?

A: *Denki* (electricity).

Q: Did you separate the word or comprehend it as a whole?

A: *Electric* is a word related to electricity and it is a noun.

Q: So, did you know that *–ity* attaches to a noun?

A: I feel so from the form.

limitation

Q: What is the meaning of limitation?

A: *Genkai* (Limitation)?

Q: Did you separate the word or comprehend it as a whole?

A: *Limit* means *kagiru* (in Japanese) and *–tion* attaches. Therefore, it is a noun.

Q: So, did you separate it?

A: Yes.

Q: Where could you separate it?

A: Before *t*.

Q: So, after *a*?

A: Yes.

secrecy

Q: What is the meaning of *secrecy*?

A: I don't know. But, *secret* or something?

Q: How about with this sentence (*I promised secrecy*.)?

A: Keep secret or something? I don't know.

Q: What is the meaning of this whole sentence?

A: *I promised to keep it secret* (a correct answer).

Q: Did you separate the word to comprehend it?

A: No, I didn't.

Q: If I asked you to separate it, where would you do it?

A: Between *e* and *c*.

Calculating the rate of morphological information use, 81.2% of the derivatives successfully comprehended at the recall level at least with contextual assistance and base word knowledge were understood through the use of morphological information. The rate of use was a little higher with high vocabulary holders. Three thousand holders used morphological information at the rate of 82.8%. Participants having vocabulary of less than 2,000 word families used it at the rate of 77.8%. The difference was slight. Therefore, it can be said that whatever their vocabulary size was, these learners tended to use morphological information.

The quantitative analysis in section 4.3.1 shows that participants whose derivative comprehension rate (RK ratio) had been better in Chapter 3 didn't necessarily show a better ratio in this chapter. The rates of morphological information use for participants of each group are shown now.

Table 4.6 The rate of morphological information use for each group

Vocabulary size	More than 3,000		Less than 2,000	
RK ratio in the previous chapter, Name of the group	High Group 1	Low Group 2	High Group 3	Low Group 4
Rate of morphological information use (%)	100 62.5	90 82.4	87.5 60	100 66.7

The number of participants was small so it is difficult to see any trends in the differences among these four groups from Table 4.5. The interviews also didn't reveal any evidence concerning a qualitative difference in comprehending derivatives between these groups. From all these results it can be concluded that the participants used morphological information with 60-100% of the derivatives. These low-intermediate level Japanese EFL learners have relational knowledge which is used to comprehend derivatives through the knowledge of other morphologically related words (base words).

4.3.3 Qualitative analysis 2: Relational knowledge with unfamiliar derivatives

The qualitative analysis in section 4.3.2 shows that the participants usually used morphological information when comprehending derivatives. However, so far the study has yet to establish whether they could use this strategy when comprehending unfamiliar derivatives. For the purpose of vocabulary expansion, learners should be able to comprehend unfamiliar derivatives using morphological information. If they cannot figure out their meaning, it cannot be said that they have adequate RK (relational knowledge) for expanding their vocabulary sizes.

4.3.3.1 Method

To investigate whether participants could use morphological information to figure out the meaning of unfamiliar derivatives, their answer sheets were checked again. On the answer sheets, I had checked how each derivative had been remembered. There were three patterns:

1. The derivative was unfamiliar to a participant.

2. A participant had seen the derivative and remembered it in relation with their base word.

3. A participant had seen the derivative but remembered it separately from their base word.

There were ambiguous answers in terms of the unfamiliarity of derivatives. These answers were checked against the contents of the interviews. Eventually, I found that derivatives whose base words were answered at 1A level (the recall level without a contextual help) were unfamiliar to the participants (pattern 1) in a total of 36 cases.

4.3.3.2 Results

The participants could comprehend unfamiliar derivatives at the recall level with base word knowledge at a rate of 50%. Even if the derivatives were unfamiliar to them, they could figure out the meaning of half of them. High vocabulary holders were a little better at this (High vocabulary holders → 52.9%, low vocabulary holders → 47.4%). No tendency was apparent in relation to the differences in the derivative comprehension rate (RK ratio) in Chapter 3.

How were these unfamiliar derivatives comprehended? Surprisingly, all of these derivatives were comprehended through the use of morphological information. This strategy use is apparent in the following extracts from the interviews.

trickster

Q: What is the meaning of this word?

A: I have not seen this word.

Q: With this context, can you figure out the meaning?

A: *He is a trickster* (the provided context).

Q: What is the meaning of *trickster*?

A: I know the meaning of *trick*, but I don't know *-ster*.

Q: Can't you guess the meaning of the whole word?

A: *Sagi, sagi, ..., sagishi* (*trickster*, a correct answer)?

Q: Did you figure out the meaning by extending the meaning of *trick*?

A: Yes.

Q: In this case, did you separate the word?

A: Yes.

Q: Where did you separate?

A: Between *trick* and *-ster.*

Q: So, you saw this word for the first time?

A: Yes.

limitation

Q: What is the meaning of *limitation*?

A: *Seigen* (Limitation).

Q: Did you separate the word?

A: Yes.

Q: Where did you separate it?

A: After *limit*. I don't know the meaning of *–ation*. However, I can associate *limit* with *time-limit*. Then, I felt that's where it should be separated.

Q: Did you see this word for the first time?

A: Yes.

shadowy

Q: What is the meaning of *shadowy*?

A: *Kagenoaru* (shadowy).

Q: How did you find the meaning?

A: *Shadow* is attached to *–y.*

Q: Where did you separate the word?

A: Here (between *w* and *y*).

Q: Did you know the word *shadowy*?

A: No, I didn't.

The above extracts show that the participants used morphological information to infer the meaning of unfamiliar derivatives. Now, let me concentrate on the individual differences. The correct inferring rates differed among the participants. The scores for each participant were as follows:

Table 4.7 Derivative comprehension rates (RK ratio) for unfamiliar derivatives

Participant No.	Vocabulary Size	DC rate in Chapter 3	Success rate for inferring unfamiliar derivatives (%)
1	More than 3,000	High	75
2			33.3
3		Low	40
4			60
5	Less than 2,000	High	100
6			20
7		Low	50
8			0

Table 4.6 shows that there were huge differences in terms of their abilities to comprehend unfamiliar derivatives. Of course, the number of unfamiliar derivatives was so small that these differences are not generalizable. However, exploring factors that lead to these differences may suggest some points. Next I will investigate what made the differences between the results of the participants in terms of the comprehension of unfamiliar derivatives.

I focus on two of the participants: No. 5 and No. 8. They had similar vocabulary sizes but their applicabilities of base word knowledge to derivatives were very different. In the results of both Chapter 3 and this chapter, student No. 5 was far more capable than student No. 8. I will explore the effects of the following four factors considered important in the comprehension of unfamiliar derivatives.

1. The results of the suffix test: Suffixes are an important component in comprehending derivatives. The results of Chapter 3 show that when comprehending derivatives with base word knowledge,

the participants did not always have to have explicit suffix knowledge. However, the truthfulness of this claim should be corroborated because suffixes are one of the important components in derivatives. Therefore, suffix knowledge factor was incorporated here.

2. A tendency to remember words in relation to morphologically related words: This is related to a strategy use. The participants with this tendency may be accustomed to connecting morphologically related words.

3. An ability to separate derivatives into parts correctly: How well participants can separate derivatives into parts correctly reflects their ability to extract base forms in derivatives. Nation (2001, p. 272) said that learners have to separate derivatives correctly to analyze them. Therefore, this is considered an important component in comprehending derivatives with base word knowledge.

4. Base word knowledge: This knowledge is considered important when figuring out the semantic meaning of derivatives. Here, the base word knowledge refers to the knowledge of all of the tested base words (20) in this chapter.

The result of the comparison is in Table 4.8.

Table 4.8 Comparison of four factors in two participants

Student No.	5 (100%)	8 (0%)
Suffix test result	60%	60%
Tendency to remember words in relation with morphologically related words	50%	60%
How well they can separate derivatives into parts correctly	84.2%	100%
Base word knowledge	45%	40%

Table 4.8 does not show large differences between each pair of figures. These four factors which concern linguistic knowledge do not seem to relate to the ability to comprehend unfamiliar

derivatives with base word knowledge. What makes the difference may be rather complex. This concerns inference so some cognitive abilities may be related to it.

4.3.4 Other interesting findings

This chapter used an interview procedure. The extracts from the interviews showed some interesting points.

1. The one-way relationship between base words and derivatives

improvement

Q: Did you relate *improvement* to *improve*?

A: Yes. When *improvement* appears, I relate it to *improve*. However, when *improve* appears, I don't retrieve *improvement* because I remember *improve* more strongly than *improvement*.

This is an interesting finding. The above contents of the interview show that he uses base word knowledge to comprehend derivatives. But he doesn't use derivative knowledge to comprehend base words. He said that when the base word knowledge is stronger than that of the derivative, he doesn't use the derivative knowledge.

What is meant by "stronger" knowledge by the participant cannot be known from his comment but some frequency effects may be involved. The more learners are exposed to words, the stronger the knowledge of the words becomes. In addition, Katakana words (loanwords) in Japanese may be related to this strength. If some English words are familiar as Katakana words, the knowledge of these words may be "stronger".

2. The discrepancy between what participants said in the interview and the results of the suffix test

The participant who said that *–ity* in *electricity* attaches to a noun could not answer the right part of speech of *–ity* in the suffix test. There were many other cases as such, meaning that the suffix test did not necessarily reflect their knowledge of suffixes. When a suffix attaches to a word, the whole word may have a phonetic sense that cannot be detected from a discrete suffix test. Alternatively,

explicit suffix knowledge may not matter in comprehending each derivative. Suffixes may function as an indicator of parts of speech only when they attach to a real word. Besides this, the suffix test required participants to have an explicit knowledge of grammar. They had to know explicitly what "noun" or "verb" means in order to answer the questions in the test. This may be a barrier preventing them from representing their accurate knowledge of suffixes. In Chapter 3, I concluded that low-intermediate Japanese EFL learners do not have adequate suffix knowledge. This claim may be too simple. There is a possibility that their knowledge of suffixes was so slight that it was undetectable.

3. The effect of loanwords on comprehending derivatives

One participant showed that she comprehended derivatives through the use of the knowledge of Japanese words that are clearly of English origin (loanwords).

Q: What is the meaning of this word?

A: *Tozansha* (Climber).

Q: How did you find it?

A: There was a TV program called "climber-heights". This was about climbers. Therefore, I guessed so.

This participant is a student whose score in comprehending unfamiliar derivatives was 100%. Good learners such as this participant may have the capability to apply all of the knowledge available to them to comprehend unknown words. Her vocabulary size was rather small (less than 2,000 word families) but she overtook the 3,000 holders in terms of comprehension of unfamiliar derivatives. This kind of flexibility in utilizing available knowledge may concern how they can comprehend unfamiliar derivatives with base word knowledge because finding the meaning of unfamiliar words is a highly cognitive matter.

4. Comprehending derivatives from another derivative

Some participants employed their knowledge of derivatives whose base words were also derivatives and asked the meaning. For example, to comprehend the meaning of *baker*, a

participant used her knowledge of *bakery*. She used the knowledge of derivatives to comprehend the meaning of base words. It was found that this direction toward comprehending derivatives is also available in addition to 1. The difference may concern frequency and familiarity. If derivatives are more familiar or more frequent, they may be able to be used as a hint to comprehend base words. It can also be considered that this familiarity and frequency are related to loanwords in Japanese. In the above example, *bakery* is a loanword and this may have helped the learner to comprehend the word.

4.4 Discussion

Six points should be discussed. First, the results indicate that the participants could comprehend derivatives at a rate of about 80% at the recall level with base word knowledge. This supports the findings of Chapter 3 that base word knowledge leads to about 80% understanding of derivatives. Even if the stricter criterion (recall level) was adopted, the learners still showed 80% understanding of derivatives. This suggests that they may not have difficulty in understanding derivatives if they have base word knowledge in a real communicative situation. Of course, in authentic conversations, we have to deal with other factors such as speed and anxiety. However, in light of the knowledge of learners, it can be said they have sufficient relational knowledge (RK) to understand the meaning of derivatives.

Second, it was found that they use morphological information with quite a lot of derivatives: more than 80% of the derivatives tested. This fact also supports the notion that they have relational knowledge (RK). They can use morphological information in figuring out the meaning of morphologically related words. All of these results suggest that they have adequate relational knowledge in terms of derivative comprehension.

Third, the difference between the high vocabulary holders and low vocabulary holders existed as found in the results of Chapter 3. The more words they knew, the easier they understood the meaning of derivatives. On the other hand, the rates of morphological information use of two vocabulary groups (the more than 3,000 word-family group and the less than 2,000 word-family

group) were similar.[20] These two facts suggest that the way to comprehend morphologically complex words does not change with vocabulary growth. However, the increase of vocabulary items facilitates the comprehension of derivatives. This may be related to network building in the mental lexicons of learners.

Qian and Schedl (2004) showed that the more vocabulary learners have, the denser their lexical networks are. In the results of this chapter, the lexical network of 3,000 word-family holders may be denser than that of less than 2,000 word-family holders. The denser the lexical network is, the easier learners can associate words to other words. It is considerable that one word has more connections with the components of its word families in the mental lexicon of 3,000 word-family holders than in the mental lexicon of less than 2,000 word-family holders.

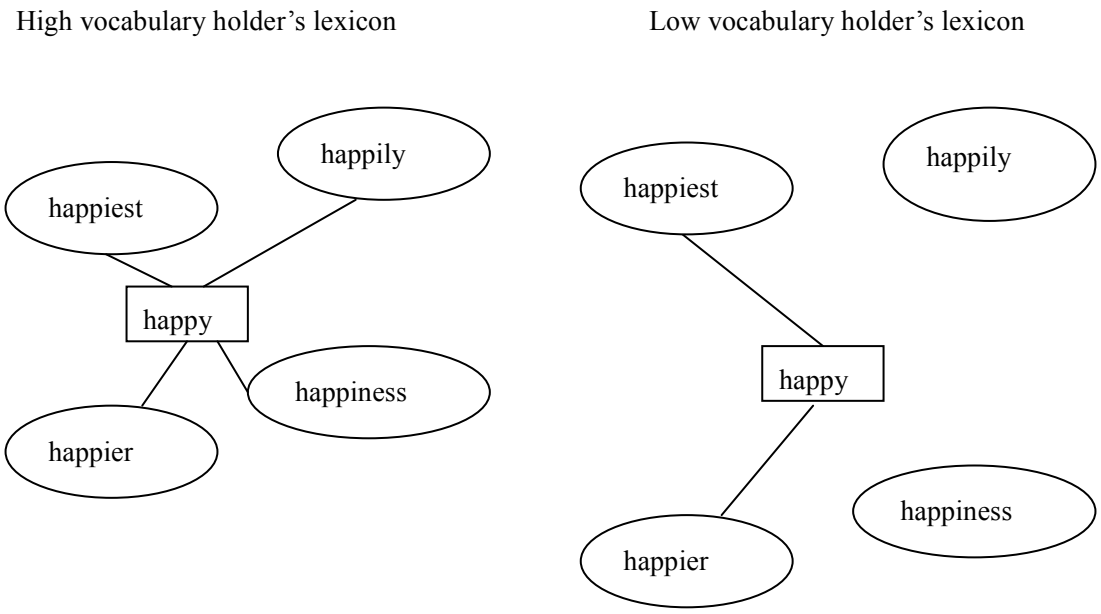

Figure 4.1 Network structures of high and low vocabulary holders

In Figure 4.1, it can be seen that a word family contains more words in the mental lexicon of high vocabulary holders than in that of low vocabulary holders. This difference in terms of network building of word families may affect the difference of the rate of derivative comprehension.

[20] However, one participant had extreme difficulty comprehending derivatives with base word knowledge but I could not find a reason for this.

Fourth, the inter-group differences in terms of derivative comprehension rates (RK ratios) in Chapter 3 were not maintained in this chapter. The participants who scored high in the derivative comprehension test of Chapter 3 did not necessarily have a high score in the study conducted in this chapter. This suggests that the ability to comprehend derivatives is not a single component. It may be different for each word family. Therefore, the whole ability of derivative comprehension may be a conglomerate consisting of components of each word family. Testing relational knowledge may have to contain more items to grasp the whole picture. Of course, we need to be cautious in interpreting this result. The number of participants was small in this interview. If more participants had participated, the differences may have been maintained. There is also a possibility that their RK is unstable so each test reveals different states of the knowledge.

Fifth, it was found that the participants could comprehend unfamiliar derivatives using morphological information at a rate of about 50%. This suggests that when unfamiliar words are morphologically related to words that learners already know, they can comprehend half of them. It is difficult to interpret this rate (Is it large or small?). However, it can be said that they have an ability to comprehend some unfamiliar derivatives when they have base word knowledge. This suggests some pedagogical implications. Teachers may not have to teach the meaning of every word in class. If morphologically related words have been introduced earlier, they do not always have to teach learners the meaning of derivatives. If the calculation by Nagy and Anderson (1984) is adopted in which proportions of derivatives in the texts of elementary school in the United States were investigated, Japanese EFL learners have relational knowledge to expand their vocabulary size up to 1.5 times by the use of relational knowledge to suffixed derivatives.

Sixth, the difference between those learners good at comprehending unfamiliar derivatives and those learners not good at it could not have been explained by any of the four factors (the suffix test results, the tendency to remember words in relation with morphologically related words, how well they can separate derivatives into parts correctly, and the base word knowledge). This lack of explanation leads to two interpretations. One is that the results do not reflect the true comprehension of unfamiliar derivatives. The number of unfamiliar derivatives was small (36 cases) so the results may not have reflected the whole picture of learners' ability to comprehend

unfamiliar derivatives. The other is that other factors are related to the comprehension of unfamiliar derivatives. Other factors such as cognitive abilities may affect the comprehension since inferring the meaning of them is a highly cognitive matter. However, I could not directly test the learners' cognitive ability due to the limitations of the experimental conditions. These other factors should be considered in future research.

4.5 Conclusion

This chapter found the following six points.

1. Low-intermediate Japanese EFL learners can comprehend derivatives through base word knowledge at a recall level of around 80%.
2. Around 80% of derivatives are comprehended through morphological information. This supports the claim that they have an adequate relational knowledge (RK).
3. Participants who had larger vocabulary sizes showed better comprehension of derivatives.
4. Derivative comprehension rates (RK ratios) differ when different test items are used.
5. Half of the unfamiliar derivatives were comprehended through morphological information.
6. The difference between the participants who were good at comprehending derivatives and the participants who weren't could not be explained with the four investigated factors.

In considering the above six points, it can be said that the claim that low-intermediate level Japanese EFL learners have adequate RK (relational knowledge) has been corroborated through the research in this chapter. They used morphological information to comprehend derivatives. They could comprehend even unfamiliar derivatives with the information to some extent. An overall tendency that the relational knowledge grows with a vocabulary increase was also revealed. Vocabulary growth may be connected to the increase of relational knowledge through network building.

Even though the participants demonstrated sufficient relational knowledge (RK), the study is yet to determine whether their word knowledge is stored in a word-family manner or in a single-word

manner. In other words, whether words are grouped together or separated in the mental lexicon of these learners has not been determined. This point is followed up in the next chapters.

Chapter 5

Exploring derivational structures through lexical decision tasks: Frequency as a criterion

5.1 Introduction

Chapters 3 and 4 investigated how low-intermediate level Japanese EFL learners use derivational relationships in comprehending derivatives. Chapter 3 has shown that even if their suffix knowledge was not very good, they were able to comprehend the meanings of derivatives when they knew the meanings of their stems at the rate of around 80%. Chapter 4 has confirmed that they used derivational relationships when they comprehend derivatives. In fact, 81.2% of derivatives were comprehended in such a way.

Although it is now known that derivatives can be comprehended through the use of their base word (stem) knowledge, how they are represented in the mental lexicon of Japanese EFL learners is yet to be discovered. In this chapter, I examine how inflectional and derivational relationships are represented in the mental lexicon of low-intermediate level Japanese EFL learners. The main theme of this dissertation is to examine how derivational relationships are represented. However, there have been few studies exploring inflectional relationships in the mental lexicon of EFL learners so this chapter also aims to shed light on this question.

Let's begin with an overview of the characteristics of inflectional and derivational relationships. Changes from stems to their inflections are usually regular in form and meaning. For example, the inflection *played* is compounded with the stem *play* and the suffix *–ed*. The change of meaning is straightforward (present → past) and the change of form is also clear (*-ed* is added). This rule is applied to other inflectional changes.[21] On the other hand, derivational relationships are often opaque. A derivative *happiness* is compounded from the stem *happy* and the suffix *–ness*. The

[21] Adding *–er* or *–est* to adjectives can be considered an inflectional or derivational change. From the former position, adding such suffixes does not change parts of speech. From the latter position, adding them changes syntactic structures. The present study adopts the former interpretation for considering the English teaching context in Japan.

change of meaning (function) is adjective to noun. However, the same change in meaning can also be realized with suffixes, such as *–dom* (*freedom*). Speakers have to decide which suffix should be added to each stem and cannot automatically assign the same suffixes to achieve the same meaning changes. This chapter examines how these two different relationships are represented in the mental lexicon of low-intermediate level Japanese EFL learners.

There have been several studies investigating inflectional and derivational relationships in the mental lexicon of L1 English speakers. Stanners, Neiser, Hernon, and Hall (1979) found that a regular inflection, such as *thinks*, primes the stem, *think*, as much as the stem primes itself. This implies a strong relationship between stems and their inflections. On the other hand, their study found that derivatives prime their stems less strongly than do the stem words themselves (or their regular inflections), suggesting that the derivatives constitute separate, though related, lexical entries. However, Fowler, Napps, and Feldman (1985), in an experiment designed to disentangle the effects of episodic and lexical priming, found that derivatives primed their stems as strongly as did inflections or the stems themselves. In summary, on one hand, there is a study suggesting the same relationships between inflections and derivatives to their stems. On the other hand, there is a study suggesting different relationships between inflections and derivatives to their stems. The qualitative difference between inflectional and derivational relationships mentioned above may cause different relationships in the mental lexicon. The mental lexicon of L2 English learners might be similar to that of L1 speakers. However, there have been few studies investigating the difference.

There have been two ways to know morphological representations in mind as far as the author knows: (a) a lexical decision task with frequencies as a criterion; (b) a lexical decision task with priming paradigm. The former task compares the reaction times of targets different in frequencies in morphological family. For example, surface frequencies of two stems of child and voice are almost identical; 24385, 25206, respectively in BNC (British National Corpus). However, their derivational family (stems + all inflections + all derivational families) frequencies are different; 73861, 27665, respectively. If stems more frequent in derivational family are accessed more

quickly, a hypothesis that there is a derivational relationship in the mental lexicon can be demonstrated.

The latter task compares the reaction times of targets when primed with morphologically related words and unrelated words. In such an experiment, a prime word is presented to participants before a target is presented. For example, the target *HAPPY* is primed with *happiness* and *blue* in such an experiment. A derivationally related prime such as *happiness* activates the mental representation of *happy* if they have a morphological relationship in mind. It quickens the reaction time of the target *HAPPY* so the reaction time will be quicker than when primed with the unrelated word *blue*.

This chapter uses the former task: a lexical decision task with frequencies as a criterion. The rationale is that if words more frequent in morphological family are processed more quickly, the hypothesis that there is a morphological relationship in the mental lexicon is supported. However, there is one study denying frequency effects on L1 derivational relationships. Schreuder and Baayen (1997) conducted a lexical decision task with frequencies as a criterion to L1 speakers of Dutch. The observed results show that the reaction times of monomorphemic nouns with a large derivational family size[22] were quicker than those nouns with a small derivational family size when cumulative derivational family frequencies were controlled. On the other hand, when derivational family sizes were controlled, cumulative derivational family frequency did not affect the reaction times of monomorphemic nouns. From these results, Schreuder and Baayen claimed that derivatives have their own discrete and linked semantic representations and activation from one representation will spread into other representations. Therefore, a larger family size benefits from such activation (A larger family has more activated representations).

The fact that derivational frequency itself did not affect lexical access for L1 speakers has shown that derivational relationships are different from inflectional relationships. In fact, inflectional frequency did affect lexical access (Taft, 1979). In this chapter, the control between derivational family frequency and derivational family size is not conducted as in Schreuder and Baayen (1997). However, if there is a frequency effect, that may be the size effect because it is difficult to accept

[22] Derivational family size means that the number how many words belong to one family.

that only L2 learners benefit from the frequency effect.

This chapter uses lexical decision tasks to investigate how inflectional and derivational relationships are represented in the mental lexicon of Japanese EFL learners whose proficiency levels are low-intermediate.

5.2 Method

The participants (Japanese EFL learners in a university) took lexical decision tasks recording reaction times of stems. The targets were pairs of stems almost identical in stem frequency but different in word-family frequency. The rationale is that if their mental lexicons are morphologically structured, difference in frequency of word families (inflections or derivatives) affects the reaction times. The inflectional and derivational relationships were compared separately.

5.2.1 Participants

Thirty-eight Japanese EFL learners in a university participated voluntarily in this experiment. They were paid 500 yen each. They were separated into three groups (3,000 holders, 2,000 holders and 1,000 holders) by the results of a vocabulary test (VLT, Version 2 in Schmitt, Schmitt and Clapham, 2001). The numbers for each group were 16, 16, and 6 respectively.

5.2.2 Materials

Using frequency counts of Kilgarriff (2006), 17 pairs of words whose frequencies are almost identical in stem (base word) but different in inflectional family (stem + inflections) and 20 pairs of words whose frequencies are almost identical in stem but different in derivational family (stem + inflections + derivatives)[23] were compiled. The parts of speech[24] and lengths in each pair were the same. In counting frequencies, opaquely related derivatives were excluded considering the proficiency of the participants.

[23] Derivatives occurring less than 800 times per 100 million were not listed in Kilgarriff's lemmatized data so inevitably were excluded from frequency counts. However, considering the proficiencies of the participants, this exclusion seemed not to affect results so much.
[24] Words used as more than one part of speech were excluded not to skew the results.

5.2.2.1 Inflectional pairs

Every effort was made to keep the frequencies of each stem pair identical but this could not be achieved perfectly. The stem pairs were not significantly different in stem (surface) frequency ($p > .05$) as a whole. They were significantly different in inflectional family frequency ($p < .05$) as a whole, but they were not significantly different in derivational family frequency ($p > .05$). The amount of difference in frequency of inflectional family of each stem pair was from 1.2 to 2.6 times. Therefore, it can be said that the pairs were different only in inflectional family frequency. A list of all the word pairs is shown in Appendix G.

5.2.2.2 Derivational pairs

Every effort was made to keep the frequencies of each stem pair identical but this could not be achieved perfectly. The stem pairs were not significantly different in stem (surface) frequency ($p > .05$) as a whole. They were not significantly different in inflectional family frequency ($p > .05$), but they were significantly different in derivational family frequency ($p < .01$) as a whole. The amount of difference in frequency of derivational family of each stem pair was from 1.2 to 13 times. Therefore, it can be said that the pairs were different only in derivational family frequency. The whole word pairs are in Appendix H.

Table 5.1 Differences in frequency of three levels of pairs of each group

	Stem frequency	Inflectional frequency	Derivational frequency
Inflectional	identical	**different**	identical
Derivational	identical	identical	**different**

5.2.2.3 Pseudo-words

Seventy-four pseudo-words were made using a non-word database (Rastle, Harrington and Coltheart, http://www.maccs.mq.edu.au/~nwdb/nwdb.html). They were adjusted to be the same lengths as the tested words.

5.2.2.4 List composition

Thirty-four stems from inflectional pairs, 40 stems from derivational pairs, and 74 pseudo-words

were complied as a target list, thus, the total number of tested items were 148. Twenty-four practice items (half of them were pseudo-words) were also prepared.

5.2.3 Procedure

Lexical decision tasks were conducted. I used the computer software *SuperLab Pro* as a measurement tool of recognition speeds. The participants had to decide whether words presented on a screen were English ones or non-words. They were instructed to press the keys as quickly and as accurately as possible. The details of the experiment are as follows.

First, the participants took pre-test treatments. They read a sheet explaining the test procedure. A test conductor (the author) also explained it verbally and asked them if they had any questions. They were instructed to use their index fingers to press the assigned keys. Their dominant hands were used to press the key assigned as English (real) words.

Each target was presented in a randomized order in the center of the screen. Intervals of 1500 msec. were inserted between each target. During the interval, [_] was presented on the screen to keep the eyes of participants on the point where the next target would appear. The feedback message "incorrect" was presented if answers were not correct. The feedback message "too slow" was presented if participants' answering time was longer than 5 seconds. The whole procedure took 15 minutes on average and there was no rest.

5.2.4 Analysis

Recognition speeds and correctness rates were compared between inflectional pairs and derivational pairs separately. First, a one-way ANOVA was conducted to explore the frequency effect as a whole. Then, a 3 x 2 ANOVA (3 vocabulary sizes x 2 word-family frequencies) was conducted to observe the interaction between the frequency effect and vocabulary sizes of participants.

5.3 Results

All results mentioned below are the tailored output of raw data. The conducted tailoring process

was as follows. First, the answers whose reaction times were over 3000 ms and under 300 ms were defined incorrect, irrespective of their correctness, since these reaction times are considered too fast or too slow, leading to a suspicion that the participants did not actually judge the realness of targets. Second, participants and targets whose rates of correctness were below 80% were removed. Two participants, three inflectional pairs, and seven derivational pairs were removed in this process. In the end, 36 participants, 14 inflectional pairs, and 13 derivational pairs remained to be analyzed. In inflectional pairs, the inflectional frequency of target stems more frequent in inflectional family was 1.7 times as high as that of target stems less frequent in inflectional family. In derivational pairs, derivational frequency of target stems more frequent in derivational family was 1.7 times as high as that of target stems less frequent in derivational family. As for the derivational family size mentioned in section 5.1, words more frequent in derivational family have 2.5 times as many family members as words less frequent in derivational family ($p < .01$). Third, calculating the means of reaction times, the data outside of 2.5 SD of individual participants or items were removed.

5.3.1 Inflectional relationships

Table 5.2 Reaction times

Infl. Freq.	Results	
	RT(ms)	S.D.
More	748	131
Less	746	108

Table 5.3 Reaction times x Vocab. size

Infl.	Vocab. Size		
Freq.	1000	2000	3000
More	736	739	760
Less	807	747	726

5.3.1.1 Reaction times

As shown in Table 5.2, there was no statistically significant effect of frequency in inflection (F_1 (1, 35) = 0.012, $p > .05$; F_2 (1, 13) = 0.029, $p > .05$). Frequency in inflection did not affect reaction times of the individual words belonging to their inflectional family.

However, interestingly, the interaction between vocabulary size and inflectional frequency was significant by participants F_1 (2, 33) = 3.654, $p < .05$; and almost significant by items F_2 (2, 39) =

3.157, p = .054. As Table 5.3 shows, reaction times of words more frequent in inflection do not change much with vocabulary size. On the other hand, reaction times of words less frequent in inflection lessen with vocabulary size. In other words, the participants with a larger vocabulary size could recognize words less frequent in inflectional family more quickly. But, this effect did not appear for words more frequent in inflection. This result was beyond my intention and will be discussed later.

Table 5.4 Error rates

Infl. Freq.	Results	
	ER(%)	S.D.
More	4.4	5.7
Less	2.8	4.5

Table 5.5 Error rates x Vocab. size

Infl.	Vocab. Size		
Freq.	1000	2000	3000
More	4.3	5.2	3.6
Less	7.1	1.4	2.7

5.3.1.2 Error rates

As shown in Table 5.4, there was no statistically significant effect of frequency in inflection F_1 (1, 35) = 2.059, $p > .05$; F_2 (1, 13) = 3.059, $p > .05$. Frequency in inflection did not affect error rates of the individual words belonging to their inflectional family.

The interaction between vocabulary size and inflectional frequency was also not significant F_1 (2, 33) = 2.188, $p > .05$; F_2 (2, 39) = 2.320, $p > .05$; See Table 5.5.

5.3.2 Derivational relationships

Table 5.6 Reaction times

Derivational	Results	
frequency	RT(ms)	S.D.
More	780	122
Less	812	128

Table 5.7 Reaction times x Vocab. Size

Deri.	Vocab. Size		
Freq.	1000	2000	3000
More	831	784	760
Less	886	815	785

5.3.2.1 Reaction times

As shown in Table 5.6, there was a statistically significant effect of frequency in derivational family by participants $F_1(1, 35) = 7.850$, $p < .01$ but not by items $F_2(1, 12) = 0.622$, $p > .05$. The difference between these two analyses may be caused by the number of tested items. Thirteen items may have been too few to bear statistically significant results. If there had been more items, there may have been significant by-item results. It is plausible that derivational relationships quicken reaction times of their base words.

Table 5.7 shows that the interaction between vocabulary size and derivational frequency was not significant $F_1(2, 33) = .346$, $p > .05$; $F_2(2, 36) = .244$, $p > .05$. Irrespective of vocabulary size, words more frequent in derivative were consistently recognized more quickly.

Table 5.8 Error rates

Deri. Freq.	Results	
	ER(%)	S.D.
More	4.3	4.9
Less	5.1	6.5

Table 5.9 Error rates x Vocab. size

Deri. Freq.	Vocab. Size		
	1000	2000	3000
More	4.6	3.6	4.8
Less	7.7	4.6	4.8

5.3.2.2 Error rates

As shown in Table 5.8, there was no statistically significant effect of frequency in derivational family $F_1(1, 35) = 0.464$, $p > .05$; $F_2(1, 12) = 0.183$, $p > .05$. Frequency in derivational family did not affect error rates of the individual words belonging to their inflectional family.

The interaction between vocabulary size and derivational family frequency was also not significant $F_1(2, 33) = 0.312$, $p > .05$; $F_2(2, 36) = 0.208$, $p > .05$; See Table 5.9.

5.4 Discussion

5.4.1 Difference between inflectional and derivational relationships

It is interesting that derivational relationships quickened the reaction times of their base words, but inflectional relationships did not. These unexpected results may be explained by two arguments.

First, Japanese EFL learners whose vocabulary size is between 1,000 and 3,000 word families do not decompose words into constituents. If they decomposed words, words such as *plays* or *apples* would be decomposed into stems and suffixes. Therefore, every time inflections were processed, mental representations of their stems such as *play* or *apple* would be strengthened so it would cause frequency effects on lexical decision tasks of the stems (See Fig. 5.1). However, the results obtained do not support this view. Words more frequent in inflectional family were not recognized quickly. Even if inflectional relationships were usually regular, Japanese EFL learners may not decompose inflections as L1 speakers do. However, this might be caused by the proficiencies of the participants. If more advanced learners had participated in the experiment, the results might have changed.

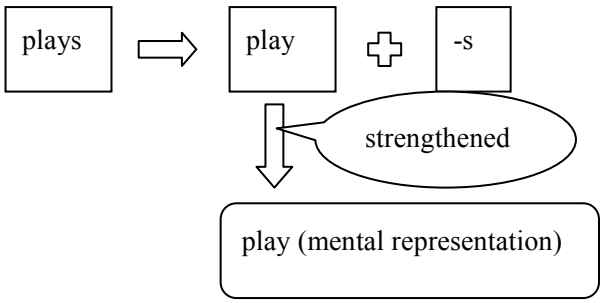

Figure 5.1 Model of decomposition of inflections

Second, as Schreuder and Baayen (1997) have shown, the effect of derivational frequency may have been caused by derivational family size effect and semantic representations. They suggested that each derivative has its own representation at the semantic level, arguing that the fact that derivational family size (not derivational frequency) affects the reaction times of stems is evidence of such structures in the mental lexicons of L1 speakers. Activation of one derivational family spreads into the other families, so activated representations of all other family members affect the reaction times. In line with their argument, the present results show that each derivative has its own semantic representation so activation spreading from one family member to another affects reaction times for the word. On the other hand, inflections do not have their own mental representations in terms of semantics. An inflectional family may share mental representations (See Fig. 5.2). As a result, there is no family member in semantic representations. As a natural outcome, no spread activation occurs since there is only one mental representation in the mental lexicon for inflectional relationships. This difference in mental representation between inflectional and derivational

relationships may be the cause of the imbalanced results.

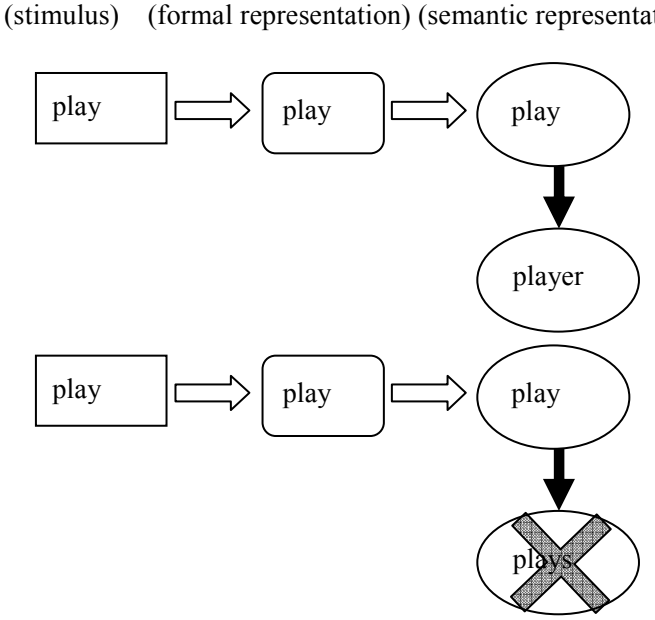

Figure 5.2 Mental representations of derivational and inflectional relationships

5.4.2 Interpretation of unnatural effect of vocabulary size in inflectional relationships

The results of the reaction time of inflectional relationships were unnatural. The more vocabulary the participants had, the more negative effects inflectional relationships had in recognizing words. In other words, the more frequently inflections occur, the harder it was for them to recognize stems when they have greater vocabulary sizes. At first glance, this seems strange. Normally, the more inflectional family occurs, the smoother its stem can be processed. Consequently, its reaction times are quickened. Why do higher vocabulary holders process words with frequent inflections in this way?

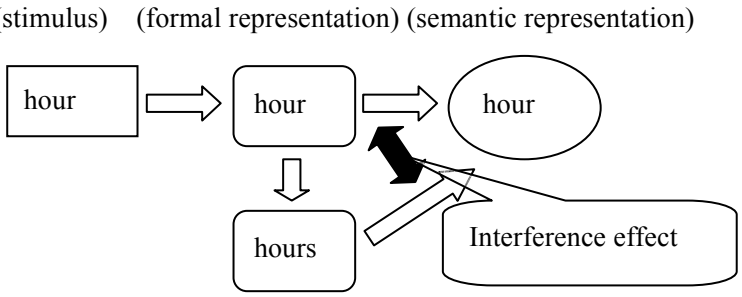

Figure 5.3 Mental representations of inflectional relationships

The unnatural results may be explained by interference effects. The more inflections occur, the more their activations are strengthened. However, as discussed in section 5.4.1, the participants do not seem to decompose inflections into stems plus suffixes. Therefore, activation of inflection does not lead to activation of its stem. Consequently, the frequent occurring of inflections does not ease recognition of stems. At the same time, inflections and their stems are similar in form. Stimulus of stems in the present experiment may have activated both stems and inflections so the activation route to semantic representation may have been too congested (See Fig. 5.3). In other words, the participants may have had difficulty identifying stems because they were distinct representation from inflections and at the same time inflections are more frequent. Selecting words whose frequency in inflectional family is more frequent may have taken more time than selecting words whose frequency in inflectional family is less. For example, when they saw the stem *hour*, whose frequency is 11334 per 100 million in the BNC, *hours*, whose frequency is 18884, in their mental lexicons was also activated. Since frequency of *hours* is more than that of *hour*, activation of *hours* may be stronger than that of *hour*. However, participants had to decide whether the word form *hour* is a real word or not. Therefore, the activation of *hours* may have interfered with the lexical decision of *hour* since they have distinct representations at the level of form.

The above explanation is simply a hypothesis. We will need to test this hypothesis by further experimentation in the future.

5.4.3 Frequency effect in inflectional relationships

Frequency plays a major role in inflectional relationships in mental representation. It has been shown that high frequency inflections have their own representations, whereas low frequency ones do not (Alegre & Gordon, 1999 for L1 speakers of English). High frequency inflections are often accessed so it is more efficient to have their own representations to reduce accessing cost. In the present experiment, all the words were highly frequent (surface frequency surpassed at least 3,000 times per 100 million in BNC). Therefore, the lack of decomposition of inflections in this data set may be caused by frequency effects. In future studies, low frequency inflectional families should be investigated in order to explore whether Japanese EFL learners decompose inflections into constituents. If not, a kind of L2 constraint may be found.

5.4.4 L1 effects

Portin, Lehtonen, Harrer, Wande, Niemi, and Laine (2008) indicated that L1 morphological structures affect L2 morphological structures. They show that Chinese speakers of Swedish do not decompose morphologically complex words in Swedish, but Hungarian speakers of Swedish do. They argue that the difference is caused by different L1 morphological structures. The results of the present study are in line with their study. The morphological structures of Japanese and English are largely different. The fact that Japanese EFL learners do not decompose morphologically complex English words may have been caused by this difference in the morphological structure. However, this conclusion should be cautiously checked. The difference might have been caused by proficiency difference. The participants who took part in the experiment in the present study are considered intermediate in terms of their proficiency. If more proficient learners participate in future experiments, different results might be acquired.

5.5 Conclusion

Although unexpected, it was found that derivational relationships, not inflectional relationships, have frequency or size effects. These results suggest that Japanese EFL learners do not decompose morphologically complex words into constituents and that derivatives have their own semantic representations. Inflectional relationships are often taught explicitly at secondary school in Japan. On the other hand, derivational relationships are not necessarily taught. The fact that unnecessarily taught derivational relationships exist in their mental lexicons may affect the argument of implicit learning vs. explicit teaching. In other words, teachers may not have to teach every relationship that exists in a second language. Learners may have their own unconscious mechanism to absorb such relationships. In future studies, additional experiments should be conducted to investigate other relationships and other participants of different proficiency further. High achievers (e.g., those who have TOEIC scores of 900 or more) should be the focus of future study to investigate whether L2 learners in a foreign environment have native-like morphological representations in mind.

The next chapter will conduct a masked-priming experiment to explore the morphological structures of the mental lexicons of Japanese EFL learners form a different perspective.

Chapter 6

Exploring derivational structures through a masked-priming experiment

6.1 Introduction

The results of Chapter 5 have shown that inflectional and derivational relationships are differently represented in the mental lexicon of the participants. Inflections did not seem to be decomposed into constituents. Stems and their inflections are considered to have their own representations. This interpretation came from the results showing that words more frequent in inflectional family were not recognized more quickly. If inflections had been decomposed into constituents, the mental representation of stems would have been strengthened each time inflections are decomposed. In effect, words more frequent in inflectional family would have been recognized more quickly. However, the results did not reflect this.

Words more frequent in derivational family were recognized more quickly in the study conducted in Chapter 5. However, it is highly unlikely that this result shows that derivatives were decomposed into constituents. Derivatives were more irregular than inflections. It is difficult to think that only derivatives are decomposed into constituents. This result seems to show that a derivational family size concerns. Schreuder and Baayen (1997) claimed that derivatives have their own discrete and linked semantic representations and activation from one representation will spread into other representations. Therefore, a larger family size benefits from such activation (A larger family has more activated representations). In Chapter 5, words more frequent in derivational family were words which had a larger family size. This size difference may have been the cause of reaction time difference between words more frequent in derivational family and words less frequent in derivational family. Therefore, the results in Chapter 5 have shown that derivatives have their own distinct semantic representations and they are linked in the mental lexicon of Japanese EFL learners whose vocabulary size is between 1,000 and 3,000 word families as in the mental lexicon of L1 speakers of English. The interesting point was that at the semantic level derivational families are linked to each other.

This chapter investigates the formal representations of derivational relationships through a masked-priming experiment. In this experiment, the relationships of primes and targets are observed by presenting primes very shortly (50 ms) before targets are presented in lexical decision tasks. This type of experiment is said to observe the earlier processing of words. Word forms are usually processed earlier than word meanings so this experiment observes the processing of word forms. In other words, how primes and targets have relationships at the form level can be observed in this experiment. This chapter clarifies whether there is a derivational relationship at the form level. Derivatives and their stems are used as primes and targets respectively in order to explore whether there is a derivational relationship at the form level.

Another point with the masked-priming experiment is whether derivatives are decomposed into constituents at the form level. This is clarified in Chapter 7 using pseudo-derivatives as primes. If pseudo-derivative primes affected the recognition of their stems, it is plausible that a decomposition process occurs at the form level, since pseudo-derivatives can never activate any mental representations if there are only whole-word representations.

This chapter uses three kinds of primes (derivatives, stems themselves, and unrelated words) to clarify whether there is a derivational relationship at the form level in the mental lexicon of Japanese EFL learners. The participants were those with intermediate level proficiencies. Using stem primes, it also investigates whether this kind of priming experiment is suitable for Japanese EFL learners. It is thought that if there are relationships between words used as primes and targets in the mental lexicon, the processing of the primed targets will be quicker, reflected in the quicker reaction time in a lexical decision task.

6.2 Method

6.2.1 Participants

Thirty-two Japanese EFL learners at a university in Western Japan participated in the experiment. All the participants but one [25] were native speakers of Japanese and had normal or

[25] One participant was a native speaker of Chinese. But her performance in the experiment was so poor that her result was excluded in the analysis.

corrected-to-normal vision. Most of them had started learning English at secondary school so they had studied it in a formal circumstance for at least 6 years. Their vocabulary sizes (as determined by Schmitt's (2000) Vocabulary Levels Test) were 3,000 - 5,000 word families. A 500-yen book card was given to each participant as a reward for taking part in the experiment.

6.2.2 Materials

Forty-two targets and three condition primes for each target were prepared. To increase the probability of recognition, high frequency words were chosen as targets and primes. They surpass a 1,000 occurrence criterion in the BNC (British National Corpus). Three condition primes are: derivatives, stems (targets) themselves, and unrelated words.

Derivative and unrelated word primes were prepared to compare the priming effects of derivatives. The differences of reaction times and error rates of these two conditions were analyzed to explore the existence of derivational relationships in the mind. Stem (target) primes were prepared to confirm whether this experiment can be justified to elicit priming effects from Japanese EFL learners since this kind of experiment has been rarely conducted with L2 learners.

Mean lengths of two kinds of primes (derivatives, unrelated words) were controlled (9.1 and 9.1 respectively). The Mean length of stem primes was 6.4. Since derivatives are compounded with stems and suffixes, mean lengths of stem primes and the other two condition primes cannot be similar. Mean frequencies in the BNC of the three kinds of primes (derivatives, stems, and unrelated words) were controlled (6176, 6180, and 6035 respectively).

The 126 test pairs (3 priming conditions x 42 targets) were split into three experimental lists. In each list, one third of the targets was preceded by a derivative prime, one third by a stem prime and one third by an unrelated control prime. The three lists were counterbalanced so that each target was preceded by the three primes across lists but appeared only once in each list.

Forty-two filler pairs with word targets were added to each list. These were unrelated word pairs (elect/THEORY). Eighty-four pairs with non-word targets were also added: 14 related

derivative/non-word pairs (achievement/OCHIEVE); 14 related stem/non-word pairs (brief/BRIET); 56 unrelated word/non-word pairs (hook/OBUSE). All non-word targets were created by changing one or two letters of an existing word, making sure that the results conformed to the phonotactic constraints of English. Therefore, each participant had to perform a lexical decision task on 168 targets, 84 words and 84 non-words (See Appendix I for the experimental items).

6.2.3 Procedure

A masked-priming procedure was conducted. For each trial, a forward mask of hash marks (########) appeared in the middle of the screen for 500 ms; the forward mask was immediately followed by the prime, in lower case, displayed for 50 ms and then immediately masked by a backward mask (########), displayed for 150 ms; the backward mask was immediately followed by the target, in upper case; the target remained on the screen for 5000 ms or until a response was given. Backward masks are not usually inserted in experiments on L1 speakers, but in the present study, they were inserted so as to complement the slower lexical processing of L2 learners (as in Finkbeiner, Forster, Nicol and Nakamura, 2004). The fonts of the forward and backward masks were different so that the primes did not pop up.

Reaction times were measured from the onset of the target display. Primes and targets were displayed with a 120 point Times New Roman font in black on a white background. The experiment was run on a PC-compatible microcomputer using *SuperLab Pro* software, with on-line randomization of trial order. Responses were entered via the keyboard of a computer. Participants used their dominant hand for the "yes" (i.e., "word") response.

Participants first received written instructions as to the task to perform. They were seated in front of a computer screen (about 50 cm from their eyes) in a quiet room. The presence of a visual prime was not mentioned. Participants were told that in each trial, a string of letters would appear on the screen and they would have to decide as quickly and accurately as possible whether the letter string was an English word or not (lexical decision task). The total duration of the experiment was 15 min.

6.2.4 Analysis

Reaction times and error rates were submitted to by-participant and by-item analysis of variance with priming condition (derivatives, stems, unrelated words) as a within participants independent variable.

6.3 Results

The correct responses longer than 3000 ms were assigned incorrect since it is considered the responding time was too long. After this, error rates were calculated and five participants and eight items exceeding 30% error rates were rejected since it was considered too high (the error rate averaged to 19% for the other participants and 8.4% for the other analyzed items). Only reaction times for correct "yes" responses within the 2.5 SD of mean reaction times of each participant and item were retained for RT analyses (outliers corresponded to 3.2% for the participant data and 4.0% for the item data). The results are summarized in Table 6.1. The RT and error rated data were submitted to by-participant and by-item analyses of variance with priming condition (derivative, stem itself, unrelated) as a within participants independent variable.

Table 6.1 Experiment 1: average RT (ms) and error rates by priming condition (standard deviations in brackets)

Priming condition	Results	
	RT	Errors (%)
Derivative	1101 (236)	7.20
Stem itself	1052 (232)	7.97
Unrelated	1169 (260)	9.92

6.3.1 Reaction times

Priming relation had a significant main effect by participants and by items F_1 (2, 52) = 7.07, p = .002; F_2 (2, 66) = 15.3, p = .000. Planned comparisons showed that the 68 ms facilitation effect between the derivative condition and the unrelated condition was significant, t_1 (1, 26) = 2.17, p = .035; t_2 (1, 33) = 2.71, p = .008, and facilitation effect between the stem condition and the unrelated condition (117 ms) was also significant, t_1 (1, 26) = 3.75, p = .000; t_2 (1, 33) = 5.53, p

= .000. The difference between the derivative condition and the stem condition (49 ms) was only significant by items, t_1 (1, 26) = 1.58, p = .12; t_2 (1, 33) = 2.82, p = .006.

6.3.2 Error rates

The main effect of priming relation was not significant by participants and by items $F_1 < 1$; F_2 (2, 66) = 1.63, p = .20.

6.4 Discussion

Four points should be discussed from the experiment conducted in this chapter. First, the results of stem facilitation effect show that this kind of masked-priming experiment is suitable for L2 learners. When primed with a stem itself, the participants could recognize the target stems more rapidly than when primed with an unrelated word. This confirmed the validity of this experiment. In other words, it can be said that we can observe the existence of lexical relationships by using masked-priming experiments. When primes affect the recognition speeds of targets, it indicates that words used as primes and targets have some relationships.

Second, a significant facilitation effect with derivative primes indicates that there are derivational relationships in the mental lexicon of the participants. Unless there are some kinds of relationships between derivatives and their stems, the facilitation effect cannot be obtained. However, the results should be cautiously interpreted. Derivatives and stems do not have only morphological relationships. They are also orthographically overlapped. Whether the obtained facilitation effect was caused by morphological or orthographical relationships will be tested in the next chapter.

Third, since this was a masked-priming experiment, it can be said that the facilitation effect was obtained by formal relationships. The results of Chapter 5 have shown that there is a derivational relationship at the semantic level. At the moment, the orthographic relationship might have caused the effect so it is not conclusive that there is a derivational relationship at the form level. However, the possibility of the existence of the relationship at the form level can be said to have increased.

Fourth, the difference between the derivative condition and the stem itself condition indicated by

by-item analyses shows that derivatives have a weaker effect on stem processing when compared with the stem itself. This suggests that although there are morphological relationships between derivatives and their stems, there are some distances between them. This tendency is in line with L1 studies. Stanners, Neiser, Hernon, and Hall (1979) shows that inflections and stems themselves have the same effect when used as primes in stem recognition priming experiments. However, derivatives have weaker effects. The difference of inflection and derivative primes may indicate the difference of internal structures of those relationships. Whether Japanese EFL learners have the same structure should be investigated in future experiments.

In summary, the results of this chapter indicate that there are some derivational relationships in the mental lexicon of Japanese EFL learners of intermediate level proficiencies. However, whether morphological or orthographical relationships have produced the results cannot be known. Besides this, the results did not distinguish between Models 2 – 4 mentioned in section 2.2.2. Whether there are morpheme-level representations cannot be seen. The next chapter would complement these shortcomings by using other kinds of primes.

6.5 Conclusion

This chapter explored morphological relationships in the mental lexicon of Japanese university level EFL learners of intermediate proficiencies. It was found that morphologically related words had priming effects in a lexical decision task, suggesting the existence of a morphological relationship in their mental lexicon. This result will clarify the internal structure of the mental lexicons of EFL learners from one direction. However, as discussed in the previous section, it is necessary to conduct additional experiments to confirm the morphological structure. Besides this, it is also necessary to conduct experiments among lower level learners. From which point morphological structures develop is also an interesting question for further research. It is necessary to continue exploring morphological structure to get the whole picture.

Chapter 7

Exploring derivational structures through a second masked-priming experiment

7.1 Introduction

The results of Chapter 5 have shown that words more frequent in derivational family were recognized more quickly, indicating that derivatives have their own semantic representations linked to their stems in the mental lexicon of Japanese EFL learners whose vocabulary size was between 1,000 and 3,000 word families. In other words, at the semantic level, derivatives and their stems have relationships in the mind of those EFL learners.

The results of Chapter 6 with a masked-priming experiment have shown that there seemed to have been derivational relationships at the form level in the mental lexicon of Japanese EFL learners whose vocabulary size was between 3,000 and 5,000 word families. However, additional experiments are necessary to confirm the relationships. First, the effect of orthographic relationships was not eliminated in Chapter 6. In the present chapter, orthographically related word primes are used to compare the effect of morphological and orthographic relationships.

Second, the experiment in Chapter 6 did not distinguish between models 2 – 4 presented in section 2.2.2. Even if the priming effect observed in Chapter 6 was not an orthographic but morphological, there are some models which present morphological relationships in the mental lexicon. The question is whether there is a morpheme-level (suffix) representation in the mental lexicon of Japanese EFL learners as in the mental lexicon of L1 speakers. Longtin and Meunier (2005) used pseudo-derivative primes to observe how morphemes are represented. Their results have shown that pseudo-derivatives (e.g., *happidom*) did prime their stems (e.g., *HAPPY*), indicating that there are morpheme-level representations in the mental lexicon of L1 speakers. The rationale is that if there were only whole word level representations, it would be highly unlikely that pseudo-derivatives do activate any mental representations since there is no mental representation corresponding to pseudo-derivatives. If there are morpheme-level representations, decomposed stems plus suffixes of pseudo-derivatives can activate each morpheme-level representation,

resulting in the conclusion that decomposed pseudo-derivatives quicken the reaction times of their stems.

The experiment conducted in the present chapter uses pseudo-derivative primes to investigate whether there are morpheme-level representations in the mental lexicon of Japanese EFL learners whose vocabulary size is between 3,000 and 5,000 word families.

7.2 Method

7.2.1 Participants

Forty-three Japanese EFL learners at a university in western Japan voluntarily participated in the experiment. All the participants were native speakers of Japanese and had normal or corrected-to-normal vision. Most of them had started learning English at secondary school so they had studied it in a formal circumstance at least for 6 years. Each possessed a vocabulary size between 3,000 and 5,000 word families (Vocabulary Levels Test; Schmitt, 2000). A 500-yen book card was given to each participant as a reward for taking part in the experiment.

7.2.2 Materials

Twenty-eight targets and four condition primes for each target were prepared. To increase the probability of recognition, high frequency words were chosen as targets and primes. They surpass an 800 occurrence criterion in the BNC. The four condition primes are: derivatives, orthographically related words, pseudo-derivatives, and unrelated words. Derivative and unrelated word primes were prepared to compare the priming effects of derivatives. It was considered that the comparison of reaction time differences between the derivative (e.g., *artist*) and an orthographically related word (e.g., *article*) conditions to an unrelated word (e.g., *decision*) condition would show whether the results of Chapter 6 were obtained through morphological or orthographical relationships. Reaction time differences between the derivative and pseudo-derivative (e.g., *artish*) conditions from the unrelated word condition were compared in order to investigate whether there were morpheme-level representations in the mental lexicons of the participants. Mean lengths of four kinds of primes were controlled (6.9, 6.6, 7.0, and 7.0 respectively). Mean frequencies in the BNC of three kinds of primes (derivatives, orthographically related words, and unrelated words)

were also controlled (5833, 6022, and 5673 respectively).

7.2.2.1 List composition

The 112 test pairs (4 priming conditions x 28 targets) were split into four experimental lists. In each list, one fourth of the targets was preceded by a derivative prime, one fourth by a orthographically related word prime, one fourth by a pseudo-derivative prime, and one fourth by an unrelated control prime. The four lists were counterbalanced so that each target was preceded by the four primes across lists but appeared only once in each list.

Twenty-eight filler pairs with word targets were added to each list: 21 unrelated word pairs (camera/THEORY) and 7 unrelated pseudo-derivative/word pairs (sharpism/CONSIST). Fifty-six pairs with non-word targets were also added: 7 related derivative/non-word pairs (achievement/OCHIEVE); 7 related orthographically-related word/non-word pairs (architect/ERCH); 7 related pseudo-derivative/non-word pairs (assessless/ISSESS); 7 unrelated pseudo-derivative/non-word pairs (validize/KEAVY); 28 unrelated word/non-word pairs (hook/OBUSE). All non-word targets were created by changing one or two letters of an existing word, making sure that the results conformed to the phonotactic constraints of English. Therefore, each participant had to perform a lexical decision task on 112 targets, 56 words and 56 non-words. Sixteen trial pairs of primes and targets were also prepared. All of the primes were words, half of the targets were words, and the other half were non-words (See Appendix J for the experimental items).

7.2.3 Procedure

A masked-priming procedure was conducted. For each trial, a forward mask of hash marks (########) appeared in the middle of the screen for 500 ms; the forward mask was immediately followed by the prime, in lower case, displayed for 50 ms and then immediately masked by a backward mask (########), displayed for 150 ms; the backward mask was immediately followed by the target, in upper case; the target remained on the screen for 5000 ms or until a response was given. Backward masks are not usually inserted in the experiments of L1 speakers, but in the present study, they were inserted so as to complement slower lexical processing of L2 learners (as

in Finkbeiner, Forster, Nicol and Nakamura, 2004). The fonts of the forward and backward masks were different so that the primes did not pop up.

Reaction times were measured from the onset of the target display. Primes and targets were displayed with a 120 point Times New Roman font in black on a white background. The experiment was run on a PC-compatible microcomputer using *SuperLab Pro* software, with on-line randomization of trial order. Responses were entered via the keyboard of a computer. Participants used their dominant hand for the "yes" (i.e., "word") response.

Participants first received written instructions as to the task to perform. They were seated in front of a computer screen (about 50 cm from their eyes) in a quiet room. The presence of a visual prime was not mentioned. Participants were told that in each trial, a string of letters would appear on the screen and they would have to decide as quickly and accurately as possible whether the letter string was an English word or not. The total duration of the experiment was 15 min.

7.2.4 Analysis

Reaction times and error rates were submitted to by-participant and by-item analysis of variance with the priming condition as a within participants independent variable.

7.3 Results

The correct responses longer than 3000 ms were assigned incorrect since it was considered the response time was too long. After this, error rates were calculated and three participants and two items exceeding 30% error rates were rejected since it was considered too high (the error rate averaged to 16% for the other participants and 5.7% for the other analyzed items). Only reaction times for correct "yes" responses within the 2.5 SD of mean reaction times of each participant and item were retained for RT analyses (outliers corresponded to 3.3% for the participant data and 3.2% for the item data). The results are summarized in Table 7.1. The RT and error rates data were submitted to by-participant and by-item analyses of variance with priming condition (derivative, stem itself, unrelated) as a within participants independent variable.

7.3.1 Reaction times

Priming relation had a significant effect by participants and by items F_1 (3, 117) = 2.91, $p < .05$; F_2 (3, 75) = 4.04, $p < .05$. Planned comparisons showed that the 38 ms facilitation effect between the derivative condition and the unrelated condition was significant, t_1 (1, 39) = 2.93, $p < .01$; t_2 (1, 25) = 3.40, $p < .01$. There were no significant differences between the other condition pairs, $p > .05$.

Table 7.1 Average RT (ms) and error rates by priming condition (standard deviations in brackets)

Priming condition	Results	
	RT	Errors (%)
Derivative	771 (118)	5.18
Orthograph	789 (115)	5.48
Pseudo-derivative	785 (115)	6.37
Unrelated	809 (114)	5.30

7.3.2 Error rates

The main effect of priming relation was not significant by participants and by items F_1 (3, 117) = 0.15, $p > .05$; F_2 (3, 75) = 0.26, $p > .05$.

7.4 Discussion

Derivative primes quickened the reaction times of their stems, though orthographically related words did not. This indicates that not formal relationships but morphological relationships affected word recognition. It is considered that derivationally related primes activated their stems before the participants saw the targets (stems), suggesting the existence of derivational relationships in their mental lexicons.

Pseudo-derivative primes did not quicken the reaction times of their stems as real-derivative primes did. This indicated that morpheme-level representations may not exist in their mental lexicons. If they did, pseudo-derivative primes would quicken them since decomposed stems of pseudo-derivatives activate the mental representations of their stems. To summarize, it is suggested

that Model 2 mentioned in section 2.2.2 represents the mental lexicons of Japanese university EFL learners whose vocabulary sizes are between 3000 and 5000 word families.

The results of Chapter 6 have shown that derivatives quickened the reaction times of their stems, indicating that the participants had derivational relationships in the mental lexicon. The results of this chapter have confirmed that not orthographical relationships but derivational relationships affected the reaction times of stems. They also clarified the derivational representations of the participants, indicating that there are no morpheme-level (suffix) representations in their mental lexicon. The results of this chapter indicate that the participants do not decompose derivatives into constituents. If they did so, pseudo-derivatives would prime their stems but the results did not demonstrate this.

Regarding formal representations, the results indicate that there are derivational relationships in the mental lexicon of the participants. Since F_1 and F_2 analyses were significant, these results can be generalizable to Japanese EFL learners of the same proficiency. It is interesting that the results indicate the derivational relationships on one hand but do not indicate morpheme-level representations on the other. This means that there are only whole-word representations, but these representations are linked each other morphologically. For example, the derivative *happiness* is represented not as constituents (separate entries; e.g., *happy* and *–ness*) but as a whole word. This representation is linked to the stem *happy*. The results indicate that these relationships were different from orthographic relationships. Orthographically-related primes did not affect the recognition of their stems.

The difference between morphological and orthographic relationships is in the formal structure and meaning relationships. Since a masked-priming experiment was used and the relationships found are formal ones, meaning relationships are considered difficult to determine. Therefore, the participants may have acquired morphological structures at the form level in the mental lexicon. However, they cannot decompose morphologically complex words into constituents. This non-decomposable structure of morphological relationships may exist in the mental lexicon of Japanese EFL learners. This structure is unique since morphological relationships and the

non-existence of morpheme-level representations exist at the same time.

Morphological relationships are related to a sub-lexical process. They may have found common parts of words repeated in the exposure. This finding process may be linked to the unique morphological relationships. Whether or not these unique relationships different from L1 morphological relationships are applicable to other L2 speakers should be explored in future study.

The suggestion that morpheme-level representations do not exist in the mental lexicon of the participants is in line with L2 morphological (suffix) knowledge research. As mentioned in the section 2.1.2, Schmitt and Meara (1997) investigated suffix knowledge of Japanese EFL students in high school and universities, asking the participants which suffixes were allowable to each of 20 verbs (receptive suffix knowledge). They also asked them to provide suitable suffixes to the verbs (productive suffix knowledge). The result shows that the rates of the correct answers were 42/47% for productive knowledge and 62/66% for receptive knowledge. Mochizuki and Aizawa (2000) asked high school and university Japanese EFL students into which part of speech a certain suffix changes words (section 2.1.3). They used pseudo-words in order to examine suffix knowledge (not word knowledge) of the participants. The rate of correct answers was 67%. Summarizing these two studies, it can be concluded that Japanese EFL learners are in a developmental stage regarding suffix knowledge.

The participants of the present study do not seem to have morpheme-level representations in the mental lexicon. This means that they do not have suffix representations. Suffixes are usually more abstract than prefixes or other morphemes (Nagy, Diakidoy and Anderson, 1993) so it is difficult to acquire their own representations. Suffixes do not have their own meanings. It is quite understandable that Japanese EFL learners do not have proper suffix knowledge since they do not have suffix representations.

However, it is interesting that even if high school or university Japanese EFL learners do not have suffix representations, they can answer which part of speech certain suffixes change attached stems into. It is difficult to think that the participants in Schmitt and Meara (1997) and Mochizuki and

Aizawa (2000) were more proficient than the participants in the present study. The vocabulary sizes of the participants of Mochizuki and Aizawa (2000) and the present study do not seem to be largely different. They may have some knowledge or an ability to generalize word-ending information. The amount of exposure they have got through formal teaching may be sufficient for some suffixes to be known. The suffixes do not have their own mental representations. However, their functions can be imagined from the accumulation of the exposure of a number of whole words the suffixes belong to. The incompatible results of suffix knowledge and non-existence of suffix representations should be carefully explored in the future.

The results obtained have shown that the morphological (derivational) representations of Japanese EFL learners at the proficiency of the participants are different from those of L1 speakers. L1 speakers of English or French have morpheme-level representations (Longtin and Meunier, 2005). In other words, they have suffix or stem representations. They decompose morphologically complex words into constituents when lexical access is conducted. On the other hand, the participants of the present study process morphologically complex words as a whole. They do not seem to have morpheme-level mental representations. Of the four models (section 2.2.2), Models 3 and 4 are suitable for L1 speakers and Model 2 is suitable for the participants of the present study. Although this suggestion is limited to EFL learners whose L1 is distant from L2 speakers, the indication that morpheme representations are different between L1 speakers and L2 learners is worth noting.

The suggestion that only whole-word representations exist indicates that the participants have to spend more storage than L1 speakers. For example, if the derivatives *happiness* and *usefulness* are distinctly presented, 19 letters have to be memorized (the fact must be not so simple). However, if *happy*, *useful*, and *-ness* are represented, only 15 letters have to be memorized. Therefore, the participant storage pattern is more memory-spending. This fact may be linked to L2 poor lexical knowledge. Two hypotheses can be considered. First, they do not have a large lexicon so they can use more memory to vocabulary. Second, they use too much storage so they cannot memorize more words. Which is true cannot be explored by the present study and should be explored in the future.

The suggestion that the participants do not decompose words into constituents may be linked to poor reading of L2 learners. L1 speakers may use a word-decomposition strategy to enhance their comprehension of texts. They may use many kinds of information in parallel. For example, they may use lexical information and suffix information in parallel to process information quickly. If the participants cannot do such things, the reading efficiency will be poorer. Morphological decomposition may be linked to processing information. When readers see a word *happily*, they can find that the word is an adverb. This kind of information may be linked to speeding up syntactic processing. The L2 mental representations must be clarified to answer such questions, too.

Why the participants do not have abstract morpheme-level representations may be linked to the critical period discussion. Language system usually deals with abstract information, and it has been said that adult L2 learners cannot cope with it (Dekeyser, 2000). The participants have started learning English after the so-called critical period. Most of them have started when they enter secondary school so at the age of 12 or 13. Therefore, dealing with such abstract information may be difficult for them.

7.5 Conclusion

The results of this chapter indicate that there are derivational relationships in the mental lexicon of adult Japanese EFL learners whose vocabulary size was between 3,000 and 5,000 word families. It was confirmed that the priming effects observed in Chapter 6 were caused by derivational relationships, not orthographic relationships. The results showing that pseudo-derivatives did not quicken the reaction times of their stems indicate that morpheme-level representations do not exist in the mental lexicon of those learners.

The question now is whether these mental representations are just those for the learners of the participant level proficiencies or those of Japanese EFL learners as a whole. Whether the indication that there are not morpheme-level representations can be applied to all Japanese EFL learners will be investigated in the next chapter through experiments in which advanced Japanese EFL learners participate.

Chapter 8

A third masked-priming experiment involving highly proficient speakers

8.1 Introduction

The results of Chapter 5, which used lexical decision tasks with frequencies as a criterion, have indicated that derivational relationships at the semantic level exist in the mental lexicon of Japanese EFL learners whose vocabulary size is between 1,000 and 3,000 word families. The results of Chapters 6 and 7 with masked-priming experiments have shown that there are also derivational relationships at the form level in the mental lexicon of Japanese EFL learners whose vocabulary size is between 3,000 and 5,000 word families. The results of Chapter 7 have shown that not orthographic but morphological relationships affected the priming effect obtained in Chapters 6 and 7. They also have shown that morpheme-level representations do not exist in the mental lexicon of those EFL learners. In other words, suffixes such as *–ness* or *–ly* do not have their own mental representations in the mental lexicon of intermediate level Japanese EFL learners. This finding was supported by the research results showing that pseudo-derivative primes did not affect the reaction times of their stem targets. This mental representation without morpheme-level representations is different from that of L1 speakers. Longtin and Meunier (2005) have shown that pseudo-derivative primes affected the reaction time of their stem targets. The fact that pseudo-derivative primes quickened the reaction time of their stems supports the view that derivatives are decomposed into constituents and morpheme-level representations exist in the mental lexicon of L1 speakers since pseudo-derivatives could never activate any mental representations if there were only whole word representations.

The key point of these previous chapters is that the mental representations of intermediate level Japanese EFL learners may be different from those of L1 speakers. There do not seem to be morpheme-level (suffix) representations in the mental lexicon of intermediate level Japanese EFL learners whose vocabulary size was between 3,000 and 5,000 word families. They may not decompose derivatives into constituents. The question in the present chapter is whether this difference is caused by a proficiency difference or a qualitative difference between L1 and L2

speakers. In other words, whether or not advanced Japanese EFL learners' mental representations are similar to those of L1 speakers is the theme of this chapter.

Most of the participants in Chapters 6 and 7 were Japanese EFL learners who started learning English at the age of twelve when they entered junior high school. Their overseas experiences were not recorded but it is considered that they were mainly raised in Japan. In other words, they were not in an environment where English is spoken daily before their so-called sensitive period for learning a second language had passed. However, it cannot be concluded that their mental representation differs from L1 speakers due to the age they commenced learning English because they may be in the developmental stage concerning derivational knowledge. Therefore, data also needs to be collected from advanced Japanese EFL learners in order to explore whether the difference between the mental representations of L1 speakers of English and Japanese EFL learners is developmental or qualitative. Whether learning a second language after the sensitive period affects the derivational representations of English learners is the focus of this chapter.

Derivational suffixes are so abstract that they are difficult to learn (Nagy, Diakidoy and Anderson, 1993). Dekeyser (2000) has shown that more salient grammar components such as word order, *do*-support in yes-no questions, and pronoun gender can be acquired by adult learners of English. On the other hand, age of arrival affected the acquisition of less salient grammar components such as present progressive auxiliary, articles (determiners), *wh*-questions, plurals, subcategorization, and adverb placement. Derivational suffixes are also less salient since their existence can be neglected if the stems of the derivatives are known and the syntactic structure of the sentence containing the derivatives is analyzed. For example, if someone knows the meaning of *happy* and correctly analyzes the structure of a sentence (*Her marriage brought happiness to her parents.*), the meaning and the part of speech of *happiness* can be known. Knowing the function of *–ness* is not necessary here. If derivational suffixes are such less salient components, even advanced Japanese EFL learners who started learning English after the sensitive period may not have the mental representations of them. Whether or not derivational suffixes are such grammar components is the theme of this chapter.

A masked-priming experiment is conducted to explore the mental representations of derivational relationships in the mental lexicon of advanced Japanese EFL learners. The materials used are the same as those used in Chapter 7. Derivatives, orthographically related words, pseudo-derivatives, and unrelated words are used as primes to investigate the derivational structure of advanced Japanese EFL learners.

8.2 Method

8.2.1 Participants

Twenty-three Japanese speakers of English participated in the experiment. Out of them, nine participants were undergraduates, five were graduates, eight were full-time university teachers, and one participant was an interpreter. The age range was from 20 to 59 years. Eleven participants were in their 20s, two were in their 30s, six were in their 40s, and four were in their 50s. The criteria for participation were the results of three kinds of English proficiency test: TOEIC, TOEFL, and STEP (eiken). Participants had to have a TOEIC score of more than 890, a TOEFL PBT score of more than 600, a TOEFL CBT score of more than 250, a TOEFL iBT score of more than 100, or STEP (eiken) first grade. Once mental representations are acquired, they are not thought to change drastically, so when the participants had taken the test was not included as an experimental variable. The average TOEIC score of the 17 participants who reported their TOEIC scores was 944. All of the participants had normal or corrected-to-normal vision. They had not been in a country where English is daily spoken for more than one year before they were 16 years old.[26] Therefore, it can be said that they had learned (not acquired like a first language) English in Japan where English is seldom spoken for communication purposes. Experience staying in a country where English is spoken daily after the age of 16 is not relevant since it is after the so-called sensitive period. The participants' vocabulary size was estimated to be between 5,300 and 9,300 word families according to the Vocabulary Levels Test (Schmitt, 2000). One thousand yen cash was given to student participants as a reward for taking part in the experiment.

[26] One participant reported that she had stayed in Britain for one year before the age of 16. Her results were excluded from the analysis.

8.2.2 Materials

The experimental materials are the same as were used in Chapter 7. Twenty-eight targets and four condition primes for each target were prepared. To increase the probability of recognition, high frequency words were chosen as targets and primes. They surpass an 800 occurrence criterion in the BNC. The four condition primes are: derivatives, orthographically related words, pseudo-derivatives, and unrelated words. Derivative and unrelated word primes were prepared to compare the priming effects of derivatives. It was considered that the comparison of reaction time differences between the derivative (e.g., *artist*) and an orthographically related word (e.g., *article*) conditions to an unrelated word (e.g., *decision*) condition would show whether the results of Chapter 6 were obtained through morphological or orthographical relationships. Reaction time differences between the derivative and pseudo-derivative (e.g., *artish*) conditions from the unrelated word condition were compared in order to investigate whether there were morpheme-level representations in the mental lexicons of the participants. Mean lengths of the four kinds of primes were controlled (6.9, 6.6, 7.0, and 7.0 respectively). Mean frequencies in the BNC of the three kinds of primes (derivatives, orthographically related words, and unrelated words) were also controlled (5833, 6022, and 5673 respectively).

8.2.2.1 List composition

The 112 test pairs (4 priming conditions x 28 targets) were split into four experimental lists. In each list, one fourth of the targets was preceded by a derivative prime, one fourth by an orthographically related word prime, one fourth by a pseudo-derivative prime, and one fourth by an unrelated control prime. The four lists were counterbalanced so that each target was preceded by the four primes across lists but appeared only once in each list.

Twenty-eight filler pairs with word targets were added to each list: 21 unrelated word pairs (camera/THEORY) and seven unrelated pseudo-derivative/word pairs (sharpism/CONSIST). Fifty-six pairs with non-word targets were also added: seven related derivative/non-word pairs (achievement/OCHIEVE); seven related orthographically-related word/non-word pairs (architect/ERCH); seven related pseudo-derivative/non-word pairs (assessless/ISSESS); seven unrelated pseudo-derivative/non-word pairs (validize/KEAVY); 28 unrelated word/non-word pairs

(hook/OBUSE). All non-word targets were created by changing one or two letters of an existing word, making sure that the results conformed to the phonotactic constraints of English. Therefore, each participant had to perform a lexical decision task on 112 targets, 56 words and 56 non-words. Sixteen trial pairs of primes and targets were also prepared. All of the primes were words, one half of the targets was words, and the other half was non-words.

8.2.3 Procedure

The procedure was identical to that of Chapter 7 except there was no backward mask in the experiment in this chapter. A masked-priming procedure was conducted. For each trial, a forward mask of hash marks (########) appeared in the middle of the screen for 500 ms; the forward mask was immediately followed by the prime, in lower case, displayed for 50 ms and then immediately masked by the target, in upper case; the target remained on the screen for 5000 ms or until a response was given. When the author started the experiments, backward masks were inserted between the primes and the targets for 150 ms. However, since the participants were advanced speakers of English, they were able to identify the existence of the primes when the backward masks were inserted. The author tried to eliminate the conscious identification of the primes with adjustments to the length of backward masks. However, even if the length of backward masks was extremely short (30ms), the participants reported that they could identify the primes. In the end, the backward masks were eliminated all together. Backward masks are not usually inserted in experiments on L1 speakers, but in Chapters 6 and 7, they were inserted so as to complement slower lexical processing of L2 learners (as in Finkbeiner, Forster, Nicol and Nakamura, 2004). However, in the current chapter, backward masks were not inserted so the condition was the same as the experiment for L1 speakers.

Reaction times were measured from the onset of the target display. Primes and targets were displayed with a 120 point Times New Roman font in black on a white background. The experiment was run on a PC-compatible microcomputer using *SuperLab Pro* software, with on-line randomization of trial order. Responses were entered via the keyboard of a computer. Participants used their dominant hand for the “yes” (i.e., “word”) response.

Participants first received written instructions as to the task to perform. They were seated in front of a computer screen (about 50 cm from their eyes) in a quiet room. The presence of a visual prime was not mentioned. Participants were told that in each trial, a string of letters would appear on the screen and they would have to decide as quickly and accurately as possible whether the letter string was a English word or not. The total duration of the experiment was 15 min.

8.2.4 Analysis

Reaction times and error rates were submitted to by-participant and by-item analysis of variance with the priming condition as a within participants independent variable.

8.3 Results

Correct responses longer than 3000 ms were designated as incorrect since it was considered the response time was too long. No participant or item was rejected since their error rates did not exceed 20%. Only reaction times for correct "yes" responses within the 2.5 SD of mean reaction times of each participant and item were retained for RT analyses (outliers corresponded to 3.0% for the participant data and 2.7% for the item data). For calculating error rates, every correct "yes" answer was retained even if they were outside the 2.5 SD thresholds. Reaction times (RT) and error rates (ER) were calculated only for 28 tested items (not for fillers or non-words).

8.3.1 Whole participants

Table 8.1 Average RT (ms) and ER by priming condition

(standard errors in brackets)

Priming condition	Results	
	RT	Errors (%)
Derivative	748 (25)	3.9
Orthograph	786 (29)	3.9
Pseudo-derivative	804 (32)	1.3
Unrelated	816 (37)	4.5

8.3.1.1 Reaction times

Priming relation had a significant main effect only by participants F_1 (3, 63) = 4.63, p = .005; F_2 (3, 81) = 1.37, p > .05. Planned comparisons (Bonferroni) showed that the 68 ms facilitation effect between the derivative condition and the unrelated condition was significant p = .037, and the 56 ms difference between the derivative condition and the pseudo-derivative was also significant p = .015. There was no significant difference between the other condition pairs.

8.3.1.2 Error rates

The main effect of priming relation was not significant by participants or by items F_1 (3, 63) = 1.00, p > .05; F_2 (3, 81) = 1.26, p > .05.

As was shown, priming relation had a significant effect on the reaction times. Derivative primes quickened the reaction times of their stems. This is in line with the results of Chapter 7 in which intermediate level Japanese EFL learners participated. It is, however, different from L1 results (Longtin and Meunier, 2005). Pseudo-derivatives did not have a facilitation effect. However, it may be too early to conclude that the mental representation of advanced Japanese speakers of English is different from that of L1 speakers. There is a possibility that there were some differences among the participants. Therefore, the participants were divided into several groups using three conditions: vocabulary sizes, proficiencies, and age.

8.3.2 Participants divided by vocabulary size

The participants were divided into two groups according to the results of a vocabulary size test. They took two sub-sections (a 5,000 word family section and a 10,000 word family section) of the Vocabulary Levels Test (Schmitt, 2000). The 5,000 word family section is easier and most of its items were answered correctly by the participants[27] so it was not suitable for dividing the participants. Therefore, the results of the 10,000 word family section were used to separate the population. Out of the 22 participants whose results were analyzed, the score on the 10,000 word family section of eight of the participants was 20 or more (M = 23.4, SD = 2.2). The score on the

[27] Out of 30 items of the section, at least 26 items were answered correctly by all of the participants but one (her score was 23).

10,000 word family section of twelve of the participants was 15 or less (M = 12.3, SD = 3.4). The score of the 10,000 word family section of the remaining two participants was 17. Therefore, the two middle scoring participants were excluded and a high vocabulary group and a low vocabulary group were formed. How this vocabulary difference affected results will be investigated through observation of the interaction between vocabulary sizes and priming effects.

8.3.2.1 Reaction times

Table 8.2 Average RT (ms) by priming condition and vocabulary size (standard errors in brackets)

Priming condition	Vocabulary size	
	high	low
Derivative	735 (43)	767 (35)
Orthograph	791 (50)	802 (41)
Pseudo-derivative	806 (55)	821 (45)
Unrelated	755 (63)	863 (51)

The interaction between priming relation and vocabulary size was not significant by participants or by items F_1 (3, 54) = 2.40, $p > .05$; F_2 (3, 162) = 2.30, $p > .05$.

8.3.2.2 Error rates

Table 8.3 Average ER (%) by priming condition and vocabulary size

Priming condition	Vocabulary size	
	high	low
Derivative	0.0	7.1
Orthograph	5.4	3.6
Pseudo-derivative	0.0	1.2
Unrelated	3.6	4.8

The interaction between priming relation and vocabulary size was not significant by participants or by items F_1 (3, 54) = 1.51, $p > .05$; F_2 (3, 162) = 1.85, $p > .05$.

Even when the participants were divided into the two vocabulary size groups, there was no indication that pseudo-derivatives quickened the reaction times of their stems. However, these non-significant results may have been caused by the number of high vocabulary size participants. There were only eight participants whose vocabulary size was assigned high. If there had been more participants whose vocabulary size was high, the situation would have changed. I consider that it is necessary to observe the situation in which there were more participants whose vocabulary size was high. Therefore, I assigned the group of participants whose score in the 10,000 section of VLT was 15 or more to the high vocabulary group (meaning the condition became more lenient). How the priming relation affected the results of these participants is observed. I did not observe the priming relation effect on the low vocabulary group since it was considered unnecessary. It is unlikely that the mental representation of the low vocabulary group was similar to that of L1 speakers when the number of the participation was lower.

Table 8.4 Average RT (ms) and ER by priming condition of high (lenient) vocabulary group (standard errors in brackets)

Priming condition	Results	
	RT	Errors (%)
Derivative	727 (26)	1.2
Orthograph	766 (37)	4.8
Pseudo-derivative	780 (42)	1.2
Unrelated	768 (27)	3.6

8.3.2.3 Reaction times of high (lenient) vocabulary group

The main effect of the priming relation was not significant by participants or by items F_1 (3, 33) = 2.16, $p > .05$; $F_2 < 1$.

8.3.2.4 Error rates of high (lenient) vocabulary group

The main effect of the priming relation was not significant by participants or by items F_1 (3, 33) = 1.00, $p > .05$; F_2 (3, 81) = 1.29, $p > .05$.

Even if the lenient condition was adopted, no evidence was observed for the facilitation effect of pseudo-derivatives.

8.3.3 Participants of higher proficiency

Although the participants in the experiment conducted in this chapter are all highly proficient, there were some differences between them. There is a possibility that the mental representation of more highly proficient participants was similar to that of L1 speakers. For the purpose of observing the mental representation of more highly proficient Japanese speakers of English, I selected 13 participants out of the 22 using the following condition: Participants who had scored 950 or more in TOEIC, participants who had scored 600 or more in TOEFL PBT, and participants who scored 24 or more out of 30 in the 10,000 section in VLT mentioned in 8.3.2.

Table 8.5 Average RT (ms) and ER by priming condition of highly proficient group (standard errors in brackets)

Priming condition	Results	
	RT	Errors (%)
Derivative	742 (27)	1.1
Orthograph	778 (36)	1.1
Pseudo-derivative	813 (40)	0.0
Unrelated	792 (31)	0.0

8.3.3.1 Reaction times

The priming relation had a significant main effect only by participants F_1 (3, 36) = 3.12, $p = .038$; $F_2 < 1$. However, planned comparisons (Bonferroni) showed that there was no significant difference between any condition pairs $p > .05$.

8.3.3.2 Error rates

The main effect of priming relation was not significant by participants or by items $F_1 < 1$; $F_2 < 1$. The results showed that even the highly proficient participants were not affected by pseudo-derivative primes when they recognized their stems.

8.3.4 Participants divided by age

Participants were diverse in terms of age in the experiment conducted in this chapter. The youngest participant was 20 years old and the oldest participant was 59 years old. The mean and standard deviation of their ages were 35.5 and 13.6 respectively. There are two possibilities: one that older participants were not good at the lexical decision task because of physical weakness, and the other that the mental representation of older participants was similar to that of L1 speakers because they had been exposed to more English materials than younger participants. Regardless of which hypothesis is chosen, age has to be taken as a variable.

The twenty-two participants whose results were analyzed were divided into two age groups: the younger group and the older group. The younger groups consisted of twelve participants who were younger than 40. The mean and standard deviation of their ages were 24.5 and 4.4 respectively. The older groups consisted of ten participants who were 40 or older. The mean and standard deviation of their ages were 48.6 and 7.4 respectively.

8.3.4.1 Reaction times

Table 8.6 Average RT (ms) by priming condition and age

(standard errors in brackets)

Priming condition	Age	
	Young	Old
Derivative	747 (35)	749 (38)
Orthograph	778 (40)	796 (44)
Pseudo-derivative	768 (43)	846 (47)
Unrelated	816 (51)	815 (56)

The interaction between the priming relation and age was not significant by participants or by items F_1 (3, 60) = 1.81, $p > .05$; $F_2 < 1$.

8.3.4.2 Error rates

Table 8.7 Average ER (%) by priming condition and age

Priming condition	Vocabulary size	
	Young	Old
Derivative	3.6	4.3
Orthograph	7.1	0.0
Pseudo-derivative	2.4	0.0
Unrelated	6.0	2.9

The interaction between the priming relation and age was not significant by participants or by items F_1 (3, 60) = 1.27, $p > .05$; F_2 (3, 162) = 1.06, $p > .05$.

The results showed that age was not a significant factor to the priming relation. The participants of the younger and older group did not show any difference.

8.4 Discussion

The aim of this chapter is to investigate the mental representation of advanced Japanese speakers of English in terms of derivational relationships and morpheme-level representations. The results of Chapter 7 have shown that the mental representation of Japanese EFL learners whose vocabulary size was between 3,000 and 5,000 word families was different from that of L1 speakers. Although there were derivational relationships in their mental lexicon, evidence for the existence of morpheme-level representation was not observed for these intermediate-level Japanese EFL learners.

However, one question still remains. Whether or not the difference between the mental representation of Japanese EFL learners and that of L1 speakers of English is caused by L1 and L2

difference or proficiency had not been investigated. Therefore, I made an attempt to answer that question by conducting an experiment in which the highest level Japanese speakers of English participated. They had not been abroad for more than a year before they reached the age of 16 so it can be said that they learned English as a foreign language. Their proficiency was very high. Therefore, if there was a difference between their results and those of L1 speakers, it can be said that that was caused by L1 and L2 difference, not by proficiency difference.

The results of this chapter indicate that the mental representation of advanced Japanese speakers of English is different from that of L1 speakers of English. Although derivative primes quickened the reaction times of their stems in the masked-priming experiment, pseudo-derivative primes did not. Longtin and Meunier (2005) showed that pseudo-derivatives had a priming effect on their stems. These results indicated that derivatives are decomposed into their constituents when they are recognized because if they were not decomposed, pseudo-derivatives would not activate any mental representation so there would be no priming effect for pseudo-derivatives.

The results of this chapter show that pseudo-derivatives did not have a priming effect, which indicates that advanced Japanese speakers of English do not decompose derivatives into constituents. There may be no morpheme-level representation in the mental lexicon of advanced Japanese speakers of English. These results are in line with those for intermediate Japanese EFL learners. As far as morphological representation is concerned, no development was observed between the mental lexicon of intermediate Japanese EFL learners and that of advanced Japanese speakers of English.

There was no difference even if other variables such as vocabulary sizes, proficiencies, and age were included. Even if the participants had a larger vocabulary size, their mental representation was not similar to that of L1 speakers. A larger vocabulary size is usually caused by a lot of exposure. Even if they had been exposed to many English materials, there was a qualitative difference in terms of derivational representation in the mental lexicon. The fact that older Japanese speakers of English did not have an advantage may have been caused by the same reason. A lot of exposure did not affect the change of mental representation in terms of derivational relationships.

It is interesting that highly proficient Japanese speakers of English have a different mental representation from that of L1 speakers. Even if they are advanced, their processing of derivatives is different from that by L1 speakers. They do not decompose derivatives into constituents. If they can decompose them, they can speed up text comprehension because parallel processing of word constituents is possible. For example, if they decompose the derivative *happiness* into its constituents *happy* and *–ness*, the parallel processing of the meaning of *happy* and the function of *–ness* can be achieved. Consequently, a sort of speeding up is possible. Japanese speakers of English may have a disadvantage in speeding up the text comprehension because they do not decompose derivatives into constituents.

It is notable that the results of younger participants and older participants were similar. In the experiment conducted in this chapter, the participants had to decide whether experimental items were words or non-words as quickly and as accurately as possible. Therefore, it can be said that the experimental task was physically demanding. Before I conducted the analysis including an age variable, I thought that older participants may have skewed the results because of their slower processing of words. However, I did not have to worry. The results of the younger and older participants were almost the same. Therefore, it can be said that older participants are suitable for this kind of experiments. But there is one caution. The older participants in this chapter all had professions related to English. Therefore, they engage in activities related to English language on a daily basis. If older people without such experience participated in this kind of experiment, the results could change. Age difference might skew the results.

The reason advanced Japanese speakers of English have different mental representations from that of L1 speakers of English cannot be seen from the results obtained in this chapter. However, some points are guessable. The difference between the mental representation of advanced Japanese speakers of English and that of L1 speakers of English is whether there is a mental representation for derivational suffixes (morpheme-level representations). In the L1 experiment (Longtin and Meunier, 2005), pseudo-derivatives quickened the reaction time of their stems. On the other hand, the experiment in this chapter has shown that pseudo-derivatives did not. The fact that

pseudo-derivatives quickened the reaction times of their stems means that pseudo-derivatives are decomposed into constituents. Of course, there is no mental representation for pseudo-derivatives. The fact that pseudo-derivatives can activate some mental representations in the mental lexicon means that the decomposed constituents of pseudo-derivatives are activated when pseudo-derivatives are recognized. In this sense, there is mental representation for derivational suffixes in the mental lexicon of L1 speakers of English.

The fact that pseudo-derivatives did not quicken the reaction time of their stems means that pseudo-derivatives are not decomposed into constituents and there is not a mental representation for derivational suffixes in the mental lexicon of advanced Japanese speakers of English. This fact may be related to the age at which they started learning English and the learning environment. They reported in a questionnaire that they had not stayed abroad before they reached the age of 16. Therefore, it can be said that they learned English as a foreign language, not as a first language. Dekeyser (2000) showed that less salient language components are difficult to acquire for older learners. Derivational suffixes are less salient because their function can be inferred if a surrounding context is properly analyzed. Even if the participants in this chapter were advanced, they started learning English too late to acquire less salient components of English language such as derivational suffixes.

The fact that mental representation of advanced Japanese speakers of English and that of L1 speakers of English are different can be interpreted in two ways. First, a good way to make the mental representation of Japanese speakers of English similar to that of L1 speakers of English can be considered. However, this is not realistic. The fact that advanced Japanese speakers of English showed a difference means that there is an unreachable goal for old learners of English. Second, learners and teachers of English have to admit that there is a difference between foreign language speakers and L1 speakers. Even if there is a difference between the mental representation of advanced Japanese speakers of English and that of L1 speakers of English, the advanced Japanese speakers of English have demonstrated high performance of English language in English tests. Learners of English have to develop a way of improving their English. However, the goal is not to be an L1 speaker of English.

Some readers may think that if older learners are not good at acquiring derivational suffixes, an early start of learning English is considerable. However, it is unrealistic to think that learners of English in a country where English is not spoken daily can acquire the same mental representation of that of L1 speakers because exposure to a large amount of English materials is necessary for that. Dekeyser (2000) has shown that speakers of L2 English are affected by the age they began staying in the USA. Even if Japanese learners of English were to start learning English at the age of 6 or 7, the mental representation for derivational suffixes would not change. The amount of exposure is far too insufficient. Parents, teachers, and learners of English have to focus on the fact that advanced Japanese speakers of English demonstrate high performance even if they do not have mental representation similar to that of L1 speakers.

8.5 Conclusion

The results of this chapter show that even advanced Japanese speakers of English do not have a mental representation similar to that of L1 speakers of English. There was no mental representation for derivational suffixes (morpheme-level representation). They did not decompose derivatives into constituents. They may have a disadvantage in comprehending English texts because parallel processing of stems and suffixes is not possible for them. The reason for the difference may be related to the age they started learning English and the environment in which they learned it. However, it should be remembered that advanced Japanese speakers of English demonstrate high performance even though they have a different mental representation from that of L1 speakers.

There is a limitation in concluding that advanced speakers of English have a different mental representation from that of L1 speakers. The number of participants in this experiment was small. Data from only 22 participants were analyzed. Especially, when the participants were divided into vocabulary size, proficiency, and age groups, the number of each group was very small. If there had been more participants, the results could have changed. Therefore, the results of this chapter should be carefully interpreted.

Chapter 9

Factors affecting morphological knowledge

9.1 Introduction

The analysis so far has found that Japanese EFL learners have morphological knowledge (RK) and that morphologically related words have relationships in the mental lexicon. From this chapter, which factors affect morphological knowledge and morphological representations will be investigated. In this chapter, how four factors (the presence of contexts, the semantic relatedness of the base words and derivatives, the difficulty of the suffixes attached to the derivatives and the difference in frequency between base words and derivatives) affect relational knowledge of Japanese EFL learners will be investigated. This chapter will reanalyze the data from Chapter 3 and investigate the cause of facilitation of RK.

9.2 Method

9.2.1 Participants

Seventy-four low-intermediate level EFL students in a Japanese university took part in this experiment. The participants were separated according to the results of the Vocabulary Levels Test (VLT, Schmitt, Schmitt and Clapham, 2001) into three groups called 1,000 word-family holders, 2,000 word-family holders and 3.000 word-family holders (hereafter, 1,000 holders, 2,000 holders and 3,000 holders). The numbers of the participants for each group were 17, 27 and 30, respectively.

9.2.2 Materials

Three tests were conducted (the suffix test, a vocabulary test and the derivative test), asking explicit suffix knowledge and knowledge of base words and derivatives. The suffix test asked the participants to indicate into which part of speech a certain suffix changes words. The test form was similar to Mochizuki and Aizawa (2000). VLT was used to measure participants' base word knowledge. The derivative test was a self-made multiple-choice test with six answers for each question that asked the meaning of the 16 derivatives of 2,000 and 3,000 word-family levels whose

base words had been asked in the VLT.

9.2.3 Analysis

The purpose of this experiment is to investigate how RK (cf. section 2.2.1) was influenced by the four factors (the presence of contexts, the semantic relatedness of the base words and derivatives, the difficulty of the suffixes attached to the derivatives and the difference in frequency between base words and derivatives). To start the analysis, how to measure RK is a problem. In this study, an RK ratio was calculated as in Chapter 3 by dividing the number of correctly answered derivatives by the whole number of derivatives of which base words had been answered correctly in the VLT. We will explore how the four factors above as independent variables influence RK ratio as a dependent variable through a series of 3 x 2 ANOVA tests including the investigation of the interaction of the vocabulary size to each variable. The influence of each independent variable was analyzed separately. Let us here explore what the four independent variables are.

9.2.3.1 The presence of contexts

In the derivative test (cf. 9.2.2), every derivative was tested with and without contexts. It can be claimed that when they have base word knowledge, it is easier to comprehend the meaning of derivatives with contextual help. When contexts are provided, we can analyze the sentence containing the target derivatives to figure out the function of derivatives. In the example of *happiness*, when we know the meaning of the base word *happy* but do not know the function of *–ness*, we can guess that *happiness* is related to *happy* because the forms of the two words are similar. However, we could not find out the syntactic function of happiness because we do not know the function of *–ness*. On the other hand, when the target word *happiness* is surrounded by a one-sentence context, it can be considered that learners can figure out the syntactic function of the derivative by analyzing the structure of the sentence. How this kind of contextual help affects the derivative comprehension will be investigated. Contexts were made within high frequency words (within 2,000 word-family vocabulary) in order to ensure that the context would be understandable.

9.2.3.2 The semantic relatedness of the base words and derivatives

Nagy and Anderson (1984) measured this variable by using a judge and six grades. In line with

their study, this present study used three raters to evaluate how deeply a certain derivative and the base word were related according to six grades. Using the results, 16 derivatives were divided into two groups, one of which had deeper relationships with the base words (11 derivatives; *admiration, noisy, manufacturer, importable, administer, arrangement, introduction, development, awareness, stability* and *endurable*) and the other of which had shallower relationships (5 derivatives; *electorate, preference, nervous, taxpayer* and *pursuit*). We will explore how this difference in the semantic relatedness affects the RK ratio.

9.2.3.3 The difficulty of the suffixes attached to the derivatives

The difficulty of coming up with the suffixes of the twelve derivatives was investigated through the suffix test (cf. 9.2.2). The number of suffixes was nine since some suffixes were attached to more than one derivative. There seemed to be a large difference between the scores of six suffixes scoring under 64% and those of three suffixes scoring over 81%. Therefore, seven derivatives with the difficult suffixes were assigned as difficult-suffix words and five derivatives with the easy suffixes were assigned as easy-suffix words.

9.2.3.4 The difference in frequency between base words and derivatives

It can be assumed that if derivatives are less frequent than base words, learners have more difficulty comprehending the derivatives due to a relative lack of opportunity to encounter them. In this experiment, the frequencies were investigated using Kilgarriff's 1997 data, based on an analysis of the BNC (British National Corpus). The ratio of the difference of the frequency was calculated as frequency of derivative / frequency of base word. For example, the frequency per 100 million words of the derivative *electorate* is 898. The frequency of the base word *elect* is 4329. So, the ratio is 898 / 4329 = 0.207. If the ratio is 1, the frequency of the derivative and the base word is identical. There seemed to be a cut-off point between the ten derivatives with the ratio under 0.6 and the six derivatives with the ratio over 0.6. Therefore, the former derivatives will be called low frequency derivatives and the latter high frequency derivatives.

9.3 Hypotheses

This chapter tested the following four hypotheses:

A. When contexts are provided, it is easier to comprehend derivatives through the use of base word knowledge. This tendency is stronger for low vocabulary holders because they complement the lack of vocabulary knowledge with contextual help.

B. Semantically transparent derivatives are easier to comprehend. This tendency is stronger for low vocabulary holders because high vocabulary holders have a suitable number of words so that even if derivatives are semantically opaque, they can guess the meaning with the use of their vocabulary knowledge.

C. Simple suffix derivatives are easier to comprehend. Suffixes are important components of derivatives. Therefore, they will affect derivative comprehension greatly. This tendency is stronger for low vocabulary holders because they do not have suitable vocabulary knowledge, so the lack of suffix knowledge damages comprehension of derivatives more greatly than for high vocabulary holders.

D. High frequency derivatives are easier to comprehend. Low vocabulary holders will be affected more greatly than high vocabulary holders because they might have seldom encountered low frequency words.

9.4 Results and Discussion

9.4.1 The presence of contexts

There was no main effect of contexts presence (F=2.111, p>.05). However, the interaction (vocabulary size × presence of contexts) was observed (F=3.223, p<.05). Figure 9.1 shows that participants who have a larger vocabulary (3,000 holders and 2,000 holders) were assisted with contextual help, while participants with less vocabulary (1,000 holders) were not, in contrast to hypothesis A. Actually, high vocabulary holders can make use of contextual help.

Table 9.1 Context effects

Vocabulary size	*N*	Mean with contexts (S.D.)	Mean without contexts (S.D.)
3,000 holders	30	0.93 (0.09)	0.80 (0.14)
2,000 holders	27	0.81 (0.19)	0.73 (0.21)
1,000 holders	17	0.65 (0.32)	0.72 (0.19)

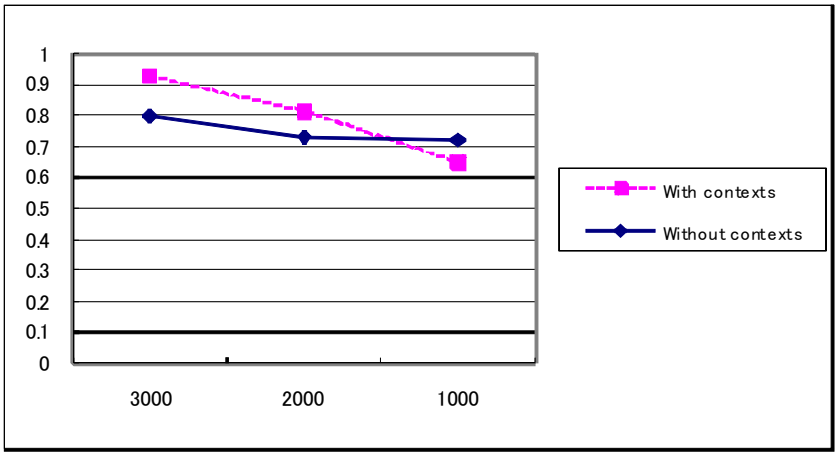

Figure 9.1 Context effects x vocabulary size

This result indicates that to make use of context, learners need a minimal vocabulary size. The contexts actually helped learners, but only more advanced learners. The contexts were made to facilitate the syntactic analysis of derivatives. The results suggest that this facilitation actually happened with larger vocabulary holders, but not with smaller vocabulary holders. What does this mean?

First, the contexts might have been too difficult for smaller vocabulary holders. As described in the Method section, contexts were made within high frequency (easy) words in order to be understandable. However, 1,000 holders have less than 2,000 word-family vocabulary. In effect, 2,000 word-family level words in the contexts might have prevented them from utilizing the context. This might be one cause.

Second, smaller vocabulary holders might have been less proficient in analyzing syntactic structures. We can guess that grammatical competence and lexical competence correlate to some extent. Therefore, 1,000 holders might have had less grammatical knowledge so that they had difficulty in analyzing the structures around the tested derivatives. That could have led to poor results in comparison with high vocabulary holders.

Anyway, whatever the reason, it can be said that utilizing contexts needs some minimal vocabulary. It was found in contrast to hypothesis 1 that contexts do not complement a lack of vocabulary knowledge. The threshold to utilize contextual help might be between 1,000 and 2,000 word families. However, we have to interpret the results cautiously. The contexts were made with easier words in this study. In authentic materials, learners might have to have more vocabulary to utilize the surrounding contexts.

9.4.2 The semantic relatedness between base words and derivatives

There was no main effect of the semantic relatedness (F=.751, p>.05). However, the interaction (vocabulary size × semantic relatedness) was observed (F=3.465, p<.05). The graph below showed that larger vocabulary size group (3,000 holders) could make use of the semantic relationship between morphologically related words, while lower vocabulary holders (2,000 holders and 1,000 holders) could not. This was in contrast to hypothesis B. In reality, high vocabulary holders can effectively use semantic relatedness.

Table 9.2 Semantic relatedness effects

Vocabulary size	*N*	Mean for deeper (S.D.)	Mean for shallower (S.D.)
3,000 holders	30	0.88 (0.09)	0.81 (0.14)
2,000 holders	27	0.75 (0.19)	0.82 (0.17)
1,000 holders	17	0.65 (0.25)	0.74 (0.25)

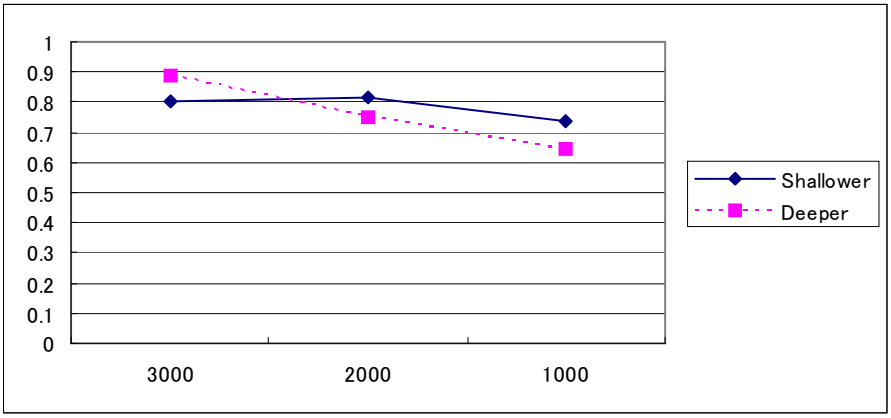

Figure 9.2 Semantic relatedness effects x vocabulary size

How can we interpret this result? The lexical network might be related. Qian and Schedl (2004) showed that vocabulary breadth and depth correlate—in other words, when learners' vocabulary grows, the network in their lexicon gets denser. Words are more closely bound together in higher vocabulary holders' lexicons.

According to the findings of this chapter, words in a word family might be grouped together in 3,000 holders' mental lexicons. For example, *happy, happier, happiest, happily and happiness* could be grouped together in the lexicon. This effect of grouping might have affected the results. Three thousand holders' words in the mental lexicon are grouped in a word-family manner so that they have access to the relationships within word families. However, in the mental lexicon of 2,000 and 1,000 holders, the relationships within word families are sparse so they might have had difficulty utilizing the semantic relationships between derivatives and base words.

This finding was not in line with the results of Chapters 5 through 7. Regardless of vocabulary sizes, the results of those chapters have shown that derivatives and their stems have their own mental representations in the mental lexicon and linked each other. The proficiencies of the participants were almost the same between this and those chapters. Therefore, the interpretation that small vocabulary holders cannot utilize morphological relationships may not be based on mental representations. The fact that RK was affected by the interaction between vocabulary sizes and semantic relatedness may come from more explicit knowledge. Since paper and pencil tests

were conducted to produce the results in the present chapter, some explicit knowledge factors may be related.

We predicted in hypothesis B that higher vocabulary holders would be able to figure out the meaning of derivatives that are semantically distant from base words due to their high vocabulary knowledge. We may now predict that those things will happen with more advanced learners. Learners with 5,000 word families or more vocabulary might bear different results. This should be investigated in future research.

9.4.3 The difficulty of suffixes

Neither main effect (F=.578, p>.05) nor interaction (F=1.505, p>.05) was observed. This contradicted hypothesis C. The component we had considered important did not affect the RK ratio at all.

Table 9.3 Suffix difficulty effects

Vocabulary size	*N*	Mean for easy suffix (S.D.)	Mean for difficult suffix (S.D.)
3,000 holders	30	0.94 (0.13)	0.94 (0.09)
2,000 holders	27	0.73 (0.30)	0.84 (0.20)
1,000 holders	17	0.73 (0.25)	0.70 (0.31)

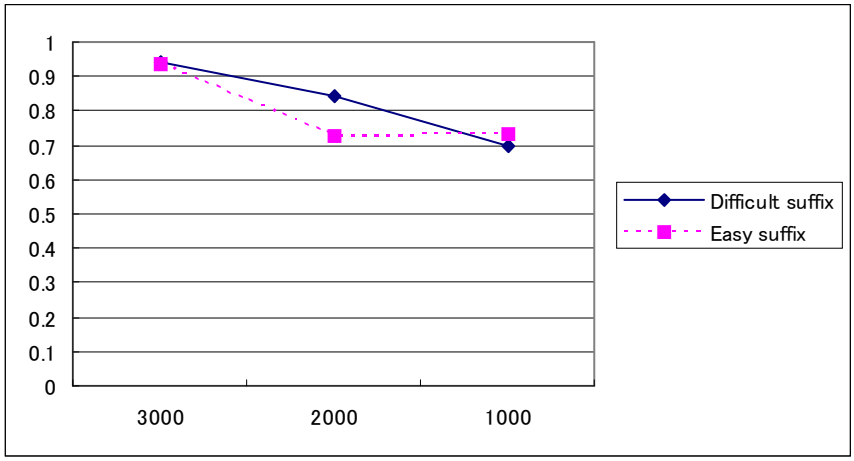

Figure 9.3 Suffix difficulty x vocabulary size

How can we interpret this result? This finding supports the results of section 3.3, which show that lack of suffix knowledge does not necessarily lead to lack of derivative comprehension. With respect to comprehension skills such as reading or listening, the results showed that learners do not always need to have explicit suffix knowledge. Suffixes usually supply syntactic information. However, in a real communicative situation, this information is provided by the context. Therefore, we do not always have to have proper knowledge of suffixes when we have base word knowledge because the semantic meaning can be provided with base words similar in forms with derivatives. As far as relational knowledge (RK) is concerned, it can be said that suffix knowledge might not be necessary.

However, we need to be cautious to some extent. In this study, a simple one-sentence context was used so that it was not so difficult to analyze the sentences. When learners have to read more complex materials, suffix knowledge might affect the derivative comprehension. This should be investigated in the future.

9.4.4 The difference in frequency between base words and derivatives

Only the main effect (F=20.352, p<.01) was observed (for the interaction, F=2.128, p>.05). For every group, if the frequency of the derivative was relatively high in comparison to that of the base word, the RK ratio was higher. Regardless of the vocabulary size of participants, more frequent

derivatives were easier to comprehend. This result partially disproved hypothesis D. Frequency actually affects the RK ratio. However, the influence was maintained through all of the participant groups.

Table 9.4 Frequency effects

Vocabulary size	*N*	Mean for more frequent (S.D.)	Mean for less frequent (S.D.)
3,000 holders	30	0.95 (0.10)	0.81 (0.11)
2,000 holders	27	0.80 (0.24)	0.75 (0.15)
1,000 holders	17	0.82 (0.18)	0.62 (0.22)

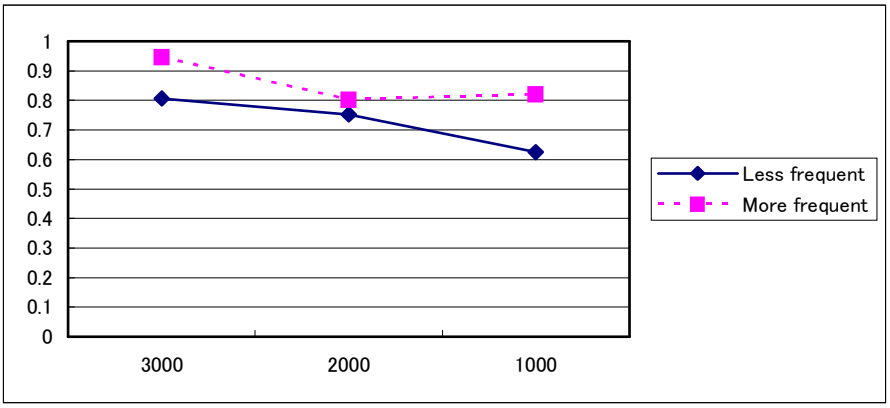

Figure 9.4 Frequency effects x vocabulary size

How can we interpret this result? First, we can assume that learners have to face derivatives at least once to comprehend them. If they do not encounter a derivative at all, it would be difficult to figure out the meaning. The results of Chapter 4 showed that novel derivatives were comprehended at the rate of around 50% if they have base word knowledge. The rate was below that of normal derivatives (about 80%, novel and familiar derivatives are mixed in this condition). Summing up the results of this and other chapters, it can be suggested that novel (unfamiliar) derivatives are more difficult to comprehend. Preferably, learners should have faced a derivative once to comprehend it.

Second, it was found that frequency effect is maintained across all learner groups. Larger

vocabulary holders cannot complement the frequency effect by their vocabulary size. We can assume that derivatives of relatively low frequency are rarely encountered even for larger vocabulary holders, and the frequency effect was therefore maintained. If participants having higher levels vocabulary (5,000 – 10,000 word-family holders) had been included, they might bear different results. The frequency effect might diminish. This should be investigated in the future.

9.5 Conclusion and pedagogical implications

Four things were found in this chapter. First, to utilize contextual information, learners have to have a minimal vocabulary size. Second, some sort of lexical network in learners' mind is important in comprehending derivatives. Third, suffix difficulty does not affect derivative comprehension. Fourth, frequency effect influences all of the learners' groups' derivative comprehension.

When introducing derivatives to learners, we have to be careful of the order we introduce them. What we found is that, regardless of the suffix difficulty, semantically more related and more frequent derivatives are easier to comprehend. In syllabus design, we have to keep in mind that this order should be kept so as to facilitate learners' relational knowledge development. If we ignore this order, learners' development of morphological knowledge might be delayed. Semantically distant and less frequent derivatives are more difficult to comprehend, so these derivatives should be introduced later. This sort of treatment might be compatible with a natural acquisition order.

The next chapter investigates what factors affect derivational representations in the mental lexicon through reanalyzing the results of Chapter 7. Whether or not suffix representations exist is investigated again by separating easy and difficult suffixes.

Chapter 10

A detailed investigation of derivational representations

10.1 Introduction

The results of Chapter 7 have shown that pseudo-derivative primes did not affect the reaction times of their stems, indicating that there is no morpheme-level representation in the mental lexicon of Japanese EFL learners whose vocabulary size is between 3,000 and 5,000 word families. Although there is a derivational relationship at the formal level, morphemes such as derivational suffixes are not considered to have independent mental representations in the minds of such learners.

These results were different from what we know about morphological representations in L1. Longin and Meunier (2005), a French L1 study, have shown that pseudo-derivative primes quickened the reaction time of their stems, indicating there are morpheme-level mental representations in the mental lexicon of L1 speakers of French. Since French and English are similar in morphological systems, it is natural to think that similar morpheme-level mental representations exist in the mental lexicon of L1 speakers of English.

The results of Chapter 7, however, dealt with every morpheme as a whole. Therefore, if each morpheme is carefully examined, the possibility that there are morpheme-level representations may exist. In this chapter, the representations of derivational suffixes are examined. Suffixes can be divided by difficulty and parts of speech. Mochizuki and Aizawa (2000) asked high school and university students which parts of speech 16 suffixes change words attached into and divided these suffixes into 4 difficulty groups. It can be considered that easy suffixes are acquired earlier and may have independent representations in the mental lexicon.

Suffixes are different in part of speech. Since the experiment conducted in Chapter 7 explored formal representations, it is difficult to consider that part of speech factors affect mental representations. Syntactic representations are considered to be deeper and related to semantic representations. However, the possibility that part of speech factors are related to formal

representations regarding derivational relationships cannot be denied until the results demonstrate this.

This chapter also investigates how frequency affects derivational relationships. There are considered to be two models regarding frequency effects. In model one, the frequency of derivative primes affects the priming effect observed in Chapter 7, indicating that formal representations are frequency-based. If formal representations are frequency-based, more frequent derivative forms are recognized earlier so as to increase the priming effect. In model two, the frequency of derivative primes do not affect the priming effect, indicating that formal representations are not frequency-based. Contrary to the above model, if formal representations are not frequency-based, more frequent derivative forms and less frequent derivative forms would not be recognized differently so the difference in frequency does not affect the priming effect. Which model is true will clarify the nature of formal representations.

In short, this chapter reanalyzes the data obtained in Chapter 7 in order to explore whether independent suffix representations exist when suffixes are divided by difficulty and parts of speech. Whether frequency affects priming effects is also explored.

10.2 Method

10.2.1 Participants

Forty-three Japanese EFL learners at Kobe University in western Japan voluntarily participated in the experiment. All the participants were native speakers of Japanese and had normal or corrected-to-normal vision. Most of them had started learning English at secondary school so they had studied it in a formal circumstance for at least 6 years. Each possessed a vocabulary size between 3,000 and 5,000 word families (Vocabulary Levels Test; Schmitt, 2000). A 500-yen book card was given to each participant as a reward for participating.

10.2.2 Materials

Twenty-eight targets and four condition primes for each target were prepared. To increase the probability of recognition, high frequency words were chosen as targets and primes. They occurred

at least 800 times in the BNC. The four condition primes are: derivatives, orthographically related words, pseudo-derivatives, and unrelated words. Orthographically related word primes were prepared in order to find out whether the priming effect obtained in Chapter 6 was caused by morphological relationships or orthographic relationships. Therefore, they are not relevant in this chapter. Derivative and unrelated word primes were prepared to compare the priming effects of derivatives. Reaction time differences between the pseudo-derivative (e.g., *artish*) condition and the unrelated word condition were compared in order to investigate whether there were morpheme-level representations in the mental lexicons of the participants. The mean lengths of four kinds of primes were controlled (6.9, 6.6, 7.0, and 7.0 respectively). The mean frequencies in the BNC of three kinds of primes (derivatives, orthographically related words, and unrelated words) were also controlled (5833, 6022, and 5673 respectively).

10.2.2.1 List composition

The 112 test pairs (4 priming conditions x 28 targets) were split into four experimental lists. In each list, one fourth of the targets was preceded by a derivative prime, one fourth by an orthographically related word prime, one fourth by a pseudo-derivative prime, and one fourth by an unrelated control prime. The four lists were counterbalanced so that each target was preceded by the four primes across lists but appeared only once in each list.

Twenty-eight filler pairs with word targets were added to each list: 21 unrelated word pairs (camera/THEORY) and seven unrelated pseudo-derivative/word pairs (sharpism/CONSIST). Fifty-six pairs with non-word targets were also added: seven related derivative/non-word pairs (achievement/OCHIEVE); seven related orthographically-related word/non-word pairs (architect/ERCH); seven related pseudo-derivative/non-word pairs (assessless/ISSESS); seven unrelated pseudo-derivative/non-word pairs (validize/KEAVY); 28 unrelated word/non-word pairs (hook/OBUSE). All non-word targets were created by changing one or two letters of an existing word, making sure that the results conformed to the phonotactic constraints of English. Therefore, each participant had to perform a lexical decision task on 112 targets, 56 words and 56 non-words. The experiment was preceded by a practice session consisting of 16 trials.

10.2.3 Procedure

A masked-priming procedure was conducted. For each trial, a forward mask of hash marks (########) appeared in the middle of the screen for 500 ms; the forward mask was immediately followed by the prime, in lower case, displayed for 50 ms and then immediately masked with a backward mask (########), displayed for 150 ms; the backward mask was immediately followed by the target, in upper case; the target remained on the screen for 5000 ms or until a response was given. Backward masks are not usually inserted in the experiments of L1 speakers, but in the present study, they were inserted so as to complement slower lexical processing of L2 learners (as in Finkbeiner, Forster, Nicol and Nakamura, 2004). The fonts of the forward and backward masks were different so that the primes did not pop up.

Reaction times were measured from the onset of the target display. Primes and targets were displayed with a 120 point Times New Roman font in black on a white background. The experiment was run on a PC-compatible microcomputer using *SuperLab Pro* software, with on-line randomization of trial order. Responses were entered via the keyboard of a computer. Participants used their dominant hand for the "yes" (i.e., "word") response.

Participants first received written instructions as to the task to perform. They were seated in front of a computer screen (about 50 cm from their eyes) in a quiet room. The presence of a visual prime was not mentioned. Participants were told that in each trial, a string of letters would appear on the screen and they would have to decide as quickly and accurately as possible whether the letter string was a English word or not. The total duration of the experiment was 15 min.

10.2.4 Suffix division (difficulty, attached to pseudo-derivatives)

One of the purposes of the investigation in this chapter is to find out whether there are morpheme-level (suffix) representations in the mental lexicon of the participants, depending on the difficulty of suffixes. For that purpose, suffixes attaching to pseudo-derivatives were divided into four levels (levels 1 - 4) in line with Mochizuki and Aizawa (2000). They asked high school and

university students into which part of speech a certain suffix[28] changes words. They divided the participants into three vocabulary size groups: 3,000 word holders, 4,000 word holders, and 5,000 word holders. The Level 1 suffixes, -ation, -ful, and –ment, were answered correctly by 3,000 word holders at a rate of at least 80%. The Level 2 suffixes, –ist and –ize, were answered correctly by 4,000 word holders at a rate of at least 80%. The Level 3 suffixes, –ness and –ism, were answered correctly by 5,000 word holders at a rate of at least 80%. The level 4 suffixes, –less, -ish, -y, and –ity, were answered correctly by 5,000 word holders at a rate of at least 60%. The results of Chapter 7 show that the participants did not have morpheme-level representations when suffixes were treated as a whole. However, there is a possibility that easy suffixes do exist as representations in their minds. This will be investigated in this chapter.

10.2.5 Suffix division (parts of speech, attached to pseudo-derivatives)

The results of Chapter 7 have shown that there is no morpheme-level representation in the minds of the participants. However, if the suffixes attached to pseudo-derivatives were divided into suffixes that represent different parts of speech, the situation may change. Nouns are said to be easier than verbs or adjectives to acquire. Therefore, suffixes representing nouns may be acquired earlier so there may be representations of noun suffixes. The suffixes representing each part of speech and attached to pseudo-derivatives were as follows. Noun suffixes are –ation, -ness, -ist, -ism, -ity, and –ment. Verb suffix is –ize. Adjective suffixes are –ish, -ful, -y, and –less. How these part of speech differences affect the priming effects of pseudo-derivatives will be investigated.

10.2.6 Suffix division (difficulty, attached to real derivatives)

The results of Chapters 6 and 7 have shown that there is a morphological relationship between derivatives and their stems in the mental lexicon of the participants. I treated every suffixed derivative as a whole in those chapters. However, the distance between these morphologically related words may differ, depending on the difficulty of suffixes attached to each derivative. Derivatives attached by easier suffixes may have narrower distance to their stems. It is reasonable

[28] The suffixes tested were "in Levels 3-6 of Bauer and Nation's (1993) Affix Levels and those used in more than two words in the "Vocabulary Lists" (Nation, 1996)" (Mochizuki and Aizawa, 2000, p. 295); *–ity, -y, -ish, -less, -able, -ism, -ness, -ous, -ly, -al, -ize, -er, -ist, -ment, -ful* and *-ation*.

to consider that suffix difficulty does not have any effect on the distance since a whole-word is a unit of representations. However, some constituent-level factors may affect the representations and should be investigated to explore the whole structure of morphological representations. As in section 10.2.4, attached suffixes were divided into four levels. The Level 1 suffixes were –ment, -ful, and –ation. The Level 2 suffixes were –ist, -er, -al, and –ly. The Level 3 suffixes were –able, -ism, and –ness. The Level 4 suffixes were –y, -ity, and –less. Derivative used as primes attached by these suffixes were divided into these four categories and these categories were used as a factor affecting morphological relationships in the mind. Derivatives attached by other suffixes were excluded in this analysis.

10.2.7 Suffix division (parts of speech, attached to real derivatives)

As in section 10.2.6, we have to consider the distance between morphologically related words different in part of speech relationships. Some stem-derivative relationships may be denser than other such relationships because of the part of speech difference. In the experimental list, there are 28 stem-derivative pairs. Out of them, two pairs were excluded because of their low rate of answering. Out of the remaining 26 pairs of stem-derivatives, 18 derivatives were nouns, seven were adjectives, and one was a verb. Since there is only one verb, I compared the part of speech difference between nouns and adjectives.

10.2.8 Frequency

To investigate the mental representations, frequency factors cannot be neglected. In Chapter 9, it was found that high-frequency derivatives are easier to comprehend. Here, I consider the frequency of stems and derivatives. If frequency concerns the form-level representations, relatively high frequency derivative primes have more facilitative effects on recognizing their stems since formal representations of derivatives are activated earlier than those of relatively low frequency derivatives so activation from derivative representations to stem representations occurs earlier and increasing priming effects. On the other hand, if frequency does not concern the form-level representations and only concerns semantic-level representations, there is no difference for priming effects between relatively high and low frequency derivatives since the primes are only briefly

presented so semantic-level activation of primes does not influence the priming effects. Therefore, how frequency influences the priming effects will clarify the mental representations of words.

There were 28 derivative prime and target pairs. Out of these, two pairs were excluded in the data tailoring process mentioned below. The remaining 26 pairs were divided into two groups: one group consisted of 13 pairs of which relative frequencies of targets (stems) to derivative primes were higher (12.2) and the other group consisted of 13 pairs of which relative frequencies of targets (stems) to derivative primes were lower (1.88). The relative frequencies were calculated by dividing the averaged stem frequency in BNC by the averaged derivative frequency.

10.2.9 Analysis

I investigated morphological representations in the mind through several analyses. Whether or not the factors mentioned in section 10.2.4 – 10.2.5 affected morphological representations was investigated through an analysis in which the difference between priming effects of pseudo-derivative condition and unrelated word condition including the interaction between the effects of suffix difficulty and suffix difference (part of speech). Whether factors mentioned in section 10.2.6 – 10.2.8 affected morphological representations was investigated through the analysis in which the difference between priming effects of derivative condition and unrelated conditions including the interaction between the effects of suffix difficulty, suffix difference (part of speech), and frequency.

10.3 Results

Correct responses longer than 3000 ms were deemed incorrect since it was considered this response time was too long. After this, error rates were calculated and three participants and two items exceeding 30% error rates were rejected since this was considered too high (the error rate averaged to 16% for the other participants and 5.7% for the other analyzed items). Only reaction times for correct “yes” responses within the 2.5 SD of mean reaction times of each participant and item were retained for RT analyses (outliers corresponded to 3.3% for the participant data and 3.2% for the item data). The results are summarized in Table 7.1. The RT and error rated data were submitted to by-participant and by-item analyses of variance with priming condition (derivative, stem itself,

unrelated) as a within participants independent variable.

10.3.1 Suffix division (difficulty, attached to pseudo-derivatives)

Table 10.1 Priming effects (pseudo-derivatives) x suffix difficulty

Suffix difficulty	Pseudo-derivatives (ms)	Unrelated words (ms)
1 (easy)	850	848
2	730	789
3	774	781
4 (difficult)	757	793

The reaction times of targets primed by pseudo-derivatives and unrelated words divided into four suffix groups are shown in Table 10.1. The interaction between prime difference (pseudo-derivatives vs. unrelated words) and suffix difficulty was not statistically significant (F (3, 51) = .652, p > .05). Even pseudo-derivatives with easy suffixes did not have priming effects.

10.3.2 Suffix division (parts of speech, attached to pseudo-derivatives)

Table 10.2 Priming effects (pseudo-derivatives) x suffix difference (part of speech)

Part of speech of suffix	Pseudo-derivatives (ms)	Unrelated words (ms)
Noun	833	814
Verb	675	774
Adjective	775	812

The reaction times of targets primed by pseudo-derivatives and unrelated words divided into three suffix groups are shown in Table 10.2. The interaction between prime difference (pseudo-derivatives vs. unrelated words) and suffix difference was not statistically significant (F (2, 36) = .779, p > .05). Regardless of the part of speech of suffixes, pseudo-derivatives did not have priming effects.

10.3.3 Suffix division (difficulty, attached to real-derivatives)

Table 10.3 Priming effects (real-derivatives) x suffix difficulty

Suffix difficulty	Real-derivatives (ms)	Unrelated words (ms)
1 (easy)	841	894
2	738	772
3	885	947
4 (difficult)	717	706

The reaction times of targets primed by real-derivatives and unrelated words divided into four suffix groups are shown in Table 10.3. The interaction between prime difference (real-derivatives vs. unrelated words) and suffix difficulty was not statistically significant (F (3, 57) = .830, $p > .05$). Derivatives with easy suffixes and difficult suffixes had similar priming effects.

10.3.4 Suffix division (parts of speech, attached to real-derivatives)

Table 10.4 Priming effects (real-derivatives) x suffix difference (part of speech)

Part of speech of suffix	Real-derivatives (ms)	Unrelated words (ms)
Noun	783	819
Adjective	726	771

The reaction times of targets primed by real-derivatives and unrelated words divided into two suffix groups are shown in Table 10.4. The interaction between prime difference (real-derivatives vs. unrelated words) and suffix difference was not statistically significant (F (1, 39) = .125, $p > .05$). Noun Derivatives and adjective derivatives had similar priming effects.

10.3.5 Frequency

Table 10.5 Priming effects (real-derivatives) x frequency difference

Stem frequency / Derivative frequency	Real-derivatives (ms)	Unrelated words (ms)
High	745	776
Low	777	805

The reaction times of targets primed by real-derivatives and unrelated words divided into the two groups different in relative frequency of stems and derivatives are shown in Table 10.5. The interaction between prime difference (real-derivatives vs. unrelated words) and frequency difference was not statistically significant (F (1, 38) = .002, p > .05). Derivatives different in relative frequency to their stems had similar priming effects.

10.4 Discussion

The results of Chapter 7 showed that there are derivational relationships in the mental lexicon of intermediate-level Japanese EFL learners whose vocabulary size is between 3,000 and 5,000 word families. This was suggested by the fact that derivative primes quickened the reaction time of their stems. On the other hand, pseudo-derivative primes did not quicken the reaction time of their stems. This fact has indicated that there is no morpheme-level representation in their mental lexicons. In other words, suffixes such as the *–ness* of *happiness* or the *–ence* of *preference* do not seem to have independent mental representations in the mental lexicons of those intermediate Japanese EFL learners.

However, even if suffixes as a whole did not have independent mental representations, there is still a possibility that some kinds of suffixes have independent mental representations. Easier suffixes or suffixes of some parts of speech may have independent representations. The analyses in this chapter examined this possibility by separating suffixes into groups based on difficulty level and groups based on parts of speech. In separating suffixes, whether pseudo-derivatives with some kinds of suffixes had priming effects on their stems was investigated.

The results of the analyses conducted in this chapter show, however, that there is no evidence of priming effects of pseudo-derivatives even if the suffixes are easier. Even the pseudo-derivatives with suffixes whose parts of speech were correctly answered at a high rate in Mochizuki and Aizawa (2000) did not have a priming effect on their stems. Pseudo-derivatives with suffixes of any part of speech (nouns, verbs, and adjectives) did not have a priming effect on their stems.

Therefore, the results of the analyses in this chapter show that the mental representation of intermediate-level Japanese EFL learners is different from that of L1 speakers of English. Longtin and Meunier (2005) showed that pseudo-derivatives quickened their stems. Therefore, it can be said that derivatives are decomposed into constituents when they are recognized and that there are independent mental representations for morphemes (suffixes). If there were only whole word representations, pseudo-derivatives could not activate any mental representations so they could not quicken the reaction time of their stems. The difference of the mental representations between intermediate-level Japanese EFL learners and L1 speakers of English may be qualitative. If the difference is caused by proficiency difference and their mental representations are in a developmental stage, some easier suffixes may have independent representations in their mental lexicons, but this is not the case.

The notion that the difference in the mental representation for a derivational structure is qualitative is in line with the results of Chapter 8. In the experiment conducted in Chapter 8, involving advanced Japanese speakers of English, pseudo-derivatives did not quicken the reaction time of their stems. Most of the participants had TOEIC scores greater than 900. Therefore, they were very high achievers of English. Even such high achievers have a mental representation for the derivational structure unlike that of L1 speakers. This suggests that, concerning derivational structure, the mental representation does not change into the representation similar to that of L1 speakers. The results of the present chapter and Chapter 8 show that there is a qualitative difference between Japanese EFL learners and L1 speakers of English with regard to derivational structure. First language speakers of English decompose derivatives into constituents when they recognize them. Morpheme-level (suffix) representations exist in their mental lexicons. On the other hand, Japanese EFL learners and advanced Japanese speakers of English do not decompose derivatives

into constituents. Although derivatives and their stems have relationships with each other, there are no morpheme-level (suffix) representations in their mental lexicons.

As mentioned in the discussion section of Chapter 8, the indication that Japanese learners and Japanese speakers of English do not decompose derivatives into constituents may be related to their slower processing of English texts. If they were able to decompose derivatives into constituents, a parallel processing of stems and suffixes would be possible. For example, if the derivative *happiness* were decomposed into its constituents *happy* and *–ness*, the meaning of *happy* and the function of *–ness* would be processed simultaneously, shortening the processing time. However, Japanese learners and Japanese speakers of English do not seem to process derivatives in this way.

Whether Japanese EFL learners can process derivatives like L1 speakers of English cannot be known for certain from the finding of this dissertation. However, the fact that advanced Japanese speakers of English do not process derivatives like L1 speakers of English indicates that it may not be possible for Japanese EFL learners who have started learning English after the so-called sensitive period to process derivatives like L1 speakers. Though, it can also be said that they do not have to process them like L1 speakers because advanced Japanese speakers of English show high performance even if they do not process derivatives like L1 speakers. One solution may be related to early English education. If Japanese EFL learners start learning English before the sensitive period, the situation may change. Less salient components of English such as derivational suffixes can be acquired because they can absorb such language components through the use of L1 acquisition device. However, far more exposure is necessary for that, and this is not realistic when Japan's linguistic environment is considered.

As shown in section 10.3.3, the priming effects were similar for derivatives whose difficulty levels were different. I assigned the difficulty levels of suffixes by the criteria of Mochizuki and Aizawa (2000).[29] For example, the difficulty level of the suffix *–ation* of *information* was assigned level 1, the easiest. On the other hand, the difficulty level of the suffix *–ity* of *reality* was assigned level 4,

[29] They determined the difficulty level by asking high school and university students who were learning English which part of speech a certain suffix belongs to.

the most difficult. The results shown in section 10.3.3 indicate that the priming effect of *information* for *INFORM* and that of *reality* for *REAL* were similar. If the priming effects had been stronger for derivatives with easier suffixes, this would suggest that the distance between derivatives and their stems in the mental representation of intermediate level Japanese EFL learners is narrower when suffixes are easier. However, this is not the case. The distances between derivatives and their stems in their mental representations were similar even if the difficulty levels for suffixes were different.

This fact is in line with the notion that derivatives are not decomposed into constituents when they are processed. If they were, the difficulty levels of suffixes could affect the decomposition process. This is because derivatives with easier suffixes may be easier to decompose. Easier suffixes have stronger memory traces so they may have more independent mental representation. Consequently, derivatives with easier suffixes are easier to decompose. If the decomposition process were easier, there would be a stronger priming effect because the stem of the derivatives is extracted through an easier process. However, this is not the case. Derivatives are not decomposed into constituents in the mental lexicon of intermediate Japanese EFL learners.

Section 10.3.4 shows that derivatives whose parts of speech were different showed similar priming effects. Noun derivatives and adjective derivatives had similar priming effects. This fact indicates that formal representation is independent from parts of speech. Because the priming effects obtained in the experiment conducted here were masked-priming effects in which derivative primes were so briefly presented (50ms), the form relationships between derivatives and their stems were investigated. It has been claimed that formal features are processed earlier than semantic and syntactic features so masked-priming experiments explore the earlier, formal relationships. The results show that noun derivatives and adjective derivatives had similar priming effects, which is in line with this claim. There may be a time-course difference between the processing of formal features and the processing of semantic and syntactic features. If another priming technique such as cross-modal priming were used, the parts of speech difference could affect the results. I have to investigate the mental representation of Japanese EFL learners in this direction in future research.

Section 10.3.5 shows that frequency did not affect the priming effect. Even if relative frequencies of derivatives to the frequencies of their stems were different, the masked-priming effects were similar. This fact indicates that frequency is not represented at the level of formal representation. In other words, formal representation is independent from frequency effects. More frequent and less frequent words seem to have the same amount of memory traces with regard to formal representations. If more frequent derivatives had stronger memory traces, they would be activated more strongly and their priming effects would be stronger because the activation of the formal representation of derivatives will be transmitted to the formal representation of their stems earlier. If another priming technique such as cross-modal priming were used, the other features such as semantic ones could be explored. Consequently, there may be a possibility that the difference of the priming effects between derivatives whose relative frequencies to that of their stems are different can be observed.

This fact is in line with L1 results. Gagne and Spalding (2009) investigated frequency effects on compound processing of L1 speakers of English. They showed that compound processing is affected only by positional family frequency. For example, responses to *doghouse* were influenced by family members of the form *dog* + ____ and ____ + *house*, but not by family members of the form ____ + *dog* and *house* + ____. Their results suggest that experience with forms did not influence the compound processing. If forms influence the processing of compounds, compounds such as ____ + *dog* would affect the processing of *doghouse*. The suggestion that only experience with *dog* + ____ affects the processing of *doghouse* indicates that meaning feature influences the processing. The cumulative experience of *dog* + ____ results in cumulative experience of the meaning features of the word, *dog,* which is used as a modifier of compounds.

Even though they looked at compounds while I investigated derivatives, the results of my study and those of Gagne and Spalding's study are in line with the fact that frequency effects are caused by meaning factors. The mental representations of Japanese EFL learners and L1 speakers of English are similar in the sense that frequency is not related to formal representation.

10.5 Conclusion

In this chapter, I investigated the mental representation of intermediate level Japanese EFL learners whose vocabulary size was between 3,000 and 5,000 word families in this chapter. I separated pseudo-derivatives into groups by the criteria such as suffix difficulty and parts of speech. I separated derivatives into groups by criteria such as suffix difficulty, parts of speech, and relative frequency to their stems.

The results show that even if derivatives are separated into groups, there is no evidence that derivatives are decomposed into constituents. In other words, there does not seem to be a mental representation for morpheme-level constituents such as suffixes. Easier suffixes or suffixes of a certain part of speech do not seem to have their own mental representations in the mental lexicon of the intermediate level Japanese EFL learners.

The results indicate that the priming effects were similar between derivatives with easy suffixes and derivatives with difficult suffixes, demonstrating that the distances between derivatives and their stems in their mental representations were similar even if the difficulty levels for suffixes were different. The finding that noun derivatives and adjective derivatives had similar priming effects indicate that formal representation is independent from parts of speech. Frequency did not affect the priming effect, which shows that formal representation is independent from frequency effects.

There are some problems that should be addressed in future research. First, the number of derivatives contained in each group was small. Because the analyses conducted in this chapter were re-analyses of experiments already conducted in Chapter 7, the number of tested items was limited. Therefore, this small number of items may have affected the results, which indicated no difference between pseudo-derivatives and between derivatives that were different in some factors. Second, several kinds of participants should participate in future research. In this chapter, the participants were similar in feature such as their academic background, ability of English language, and age. Learners with different features may produce different results.

Chapter 11

General discussion

11.1 Overview of the results

I conducted one paper and pencil test (Chapter 3), one interview procedure (Chapter 4), four psycholinguistic experiments (Chapters 5, 6, 7, and 8), one re-analysis of the dissertation and pencil test (Chapter 9), and one re-analysis of the psycholinguistic experiment (Chapter 10). Chapters 3, 4, and 9 investigate static knowledge for derivational relationships. Chapters 5, 6, 7, 8, and 10 investigate mental representation for derivational relationships. Let me review the results of this dissertation chapter by chapter.

Chapter 3 investigated the relational knowledge of low-intermediate level Japanese EFL learners whose vocabulary size was between 1,000 and 3,000 word families. The relational knowledge is abbreviated as RK and this refers to the knowledge with which learners can extract the meaning of derivatives by relating them to their stems. For example, if learners do not know the meaning of *happiness* but know the meaning of *happy* and have RK, they can extract the meaning of *happiness* by relating *happiness* to the already known word *happy*. The results of Chapter 3 show that low-intermediate Japanese EFL learners were able to understand the meaning of derivatives at the rate of around 80% if they knew the meaning of their stems. Derivatives whose suffixes were not answered correctly in a suffix test were almost always answered correctly in a test in which the meanings of derivatives were asked. There was a tendency for learners whose vocabulary size was large to know the meaning of derivatives at a higher rate.

The suffix knowledge of low-intermediate level Japanese EFL learners was also investigated in Chapter 3. I asked which parts of speech basic nine suffixes (*–er, -able, -ment, -ence, -ity, -ous, -ation, -ness,* and *–y*) belong to. Fifty-eight point eight percent of suffixes were correctly answered. This poor performance in suffix test was in line with Mochizuki and Aizawa (2000), in which 67% of basis 16 suffixes were correctly answered. Their study focused on both high school and university learners of English.

Chapter 4 conducted an interview procedure to redress the flaw of Chapter 3. Although the results of Chapter 3 showed that around 80% of derivatives could be comprehended when low-intermediate Japanese EFL learners knew the meaning of their stems, there was a possibility that they did not recognize the relationships between the derivatives and their stems. The results of Chapter 4 showed, however, that 81.2% of derivatives were comprehended through the use of the relationships between derivatives and their stems. In this sense, it can be concluded that they have proper RK.

Chapters 3 and 4 investigated the derivational knowledge of low-intermediate Japanese EFL learners. Chapters 5 through 8 investigated the mental representations for derivational relationships of low-intermediate and intermediate Japanese EFL learners through psycholinguistic experiments. In Chapter 5, I conducted a lexical decision task using frequency as a criterion. The results showed that stems more frequent in derivational family were recognized more quickly, while stems more frequent in inflectional family were not. These results showed that inflections and derivatives are not decomposed into constituents when they are recognized. The activation spread from the mental representation of one derivational family member (e.g., happy) to those of other family members (e.g., happiness, happily, etc.) at the semantic level facilitates the recognition of the stems (e.g., happy). In other words, derivational relationships exist at the semantic level in the mental lexicon of low-intermediate level Japanese EFL learners. On the other hand, an inflectional family does not have more than one mental representation at the semantic level. Therefore, the activation does not spread from the mental representation to any mental representation. Consequently, no facilitation of word recognition occurs.

Chapter 6 investigated derivational relationships at the form level through a masked-priming experiment in which intermediate level Japanese EFL learners participated. In this experiment, primes were presented so shortly that early (formal) processing of derivatives was explored. The results showed that derivative primes quickened the reaction times of their stems. This indicates that there are derivational relationships at the form level in the mental lexicon of Japanese EFL learners.

Chapter 7 redressed the limitations of Chapter 6. Derivatives and their stems are related not only morphologically (derivationally) but also orthographically. The masked-priming experiment conducted in Chapter 7 introduced orthographically related primes to explore whether only orthographically related primes quickened the reaction times of their stems. The results showed that orthographically related primes did not quicken the reaction times of their stems. This indicates that not orthographic relationships but morphological (derivational) relationships produce priming effects.

Chapter 7 also made an attempt to differentiate between four models proposed to account for derivational structure (cf. section 2.2.2), taking up the theme of whether there are morpheme-level (suffix) representations. To clarify the structure, I introduced pseudo-derivative primes such as *artish*. Of course, there is no mental representation for pseudo-derivatives because neither learners nor speakers of English have ever seen such words. Therefore, if pseudo-derivatives have priming effects, it can be said that the pseudo-derivatives are decomposed into constituents. Their stems (i.e., ART) are recognized more quickly only in this situation. The results showed, however, that pseudo-derivatives did not quicken the reaction times of their stems. This fact indicates that derivatives are not decomposed into constituents and there is no mental representation for morphemes (suffixes).

The results of Chapters 6 and 7 show that mental representation for derivational relationships of intermediate level Japanese EFL learners is different from that of L1 speakers of English. Pseudo-derivatives quickened the reaction times of their stems when L1 speakers of English were participants (Longtin and Meunier, 2005). Therefore, morpheme-level (suffix) representations do exist in the mental lexicon of L1 speakers of English. Derivatives seem to be decomposed into constituents in their mental lexicon. One question arises here. Whether the difference in the structure of mental lexicons between intermediate level Japanese EFL learners and L1 speakers of English is developmental or qualitative should be investigated.

If the difference is developmental, intermediate level Japanese EFL learners would be in the developmental stage concerning derivational relationships in the mental lexicon, and that would

change to L1-like derivational relationships when they experience a certain amount of English materials. If the difference is qualitative, it would mean that the mental representation of intermediate level Japanese EFL learners is different because they learned English as a foreign language. If this latter hypothesis is chosen, the mental representation would not change to L1-like mental representation. To investigate which hypothesis is in line with fact, advanced Japanese speakers of English participated in the experiment conducted in Chapter 8.

The results of Chapter 8 showed that pseudo-derivatives did not quicken the reaction times of their stems. This indicates that even the mental representation of advanced Japanese speakers of English is different from that of L1 speakers of English. This supports the view that the mental representation for derivational relationships is qualitatively different between Japanese EFL learners and L1 speakers of English. Even if Japanese EFL learners experience a lot of English materials, their mental representation for derivational relationships will not approach that of L1 speakers of English.

In Chapter 9, I investigated which factors affect RK. In other words, in what conditions low-intermediate level Japanese EFL learners can extract the meaning of derivatives with the knowledge of their stems more easily was explored. This was a re-analysis of the data obtained in Chapter 3. The results showed that contextual help needed a minimal vocabulary size. Learners whose vocabulary size is small cannot use contextual help in understanding the meaning of derivatives effectively. Learners whose vocabulary size was large were able to be helped from semantic relatedness between derivatives and their stems. In other words, if the semantic relationships between derivatives and their stems are transparent, learners with a larger vocabulary size can easily extract the meaning of derivatives through the use of the relationships between derivatives and their stems. The results of Chapter 9 indicated that suffix difficulty does not affect the comprehension of derivatives with the use of derivational relationships. The results also showed that high frequency derivatives are always comprehended more easily.

In Chapter 10, I explored the possibility that some morpheme-level (suffix) representations may exist if suffixes are separated into groups. However, this was not the case. Even if

pseudo-derivatives were separated by attached-suffix difficulty or by the part of speech of suffixes, the pseudo-derivatives did not quicken the reaction times of their stems. This means that even easier suffixes or suffixes of a certain part of speech do not have their own mental representation in the mental lexicon of intermediate level Japanese EFL learners.

In Chapter 10, derivatives were also separated into groups by suffix difficulty, part of speech of suffixes, and relative frequency to their stems. The results showed that suffix difficulty and part of speech difference of suffixes did not affect priming effects. This indicates that the relationships between derivatives and their stems were similar even if suffixes attached to derivatives are different. The results also showed that relative frequency of derivatives to their stems did not affect priming effects, indicating that form representation is independent from frequency effects.

11.2 Derivational knowledge of low-intermediate Japanese EFL learners

Investigating derivational knowledge, Tyler and Nagy (1989) showed that L1 speakers of English experience a developmental sequence from RK (relational knowledge) through SK (syntactic knowledge) to DK (distributional knowledge) (cf. 2.1.1 for a detailed explanation). If learners have RK, they can extract the base form of a certain derivative when facing derivatives. SK refers to that knowledge related to the understanding of the syntactic information contained in certain suffixes. With DK, learners become aware of which part of speech a certain suffix attaches to. The theme of the former part of this dissertation is to investigate whether Japanese EFL learners experience the same developmental sequence.

When I reviewed earlier studies, it was found that few researchers had dealt with RK of Japanese EFL learners. There had only been two studies by Schmitt and Meara (1997) and by Mochizuki and Aizawa (2000) concerning SK as far as I knew. Schmitt and Meara (1997) investigated suffix knowledge of Japanese EFL students in high school and universities, asking the participants which suffixes were allowable to each of 20 verbs (receptive suffix knowledge). They also asked them to provide suitable suffixes for the verbs (productive suffix knowledge). The result shows that the

rates of the correct answers were 42/47%[30] for productive knowledge and 62/66% for receptive knowledge. It was also shown that the productive suffix knowledge correlated significantly with vocabulary size at 0.27/0.35 and the receptive suffix knowledge correlated with it at 0.37/0.41.

Mochizuki and Aizawa (2000) asked high school and university students into which part of speech a certain suffix[31] changes words. They used pseudo-words in order to examine the suffix knowledge of the participants. The rate of correct answers was 67%. The correlation coefficient of suffix knowledge with vocabulary size was a little higher in this study (0.54).

When I consider the results of the above two studies, it can be concluded that the SK of Japanese EFL learners at high school or university levels is immature. Even the function of basic suffixes was answered correctly at the rate of only 67% in Mochizuki and Aizawa (2000). However, there is a possibility that they have proper RK if their developmental sequence is in line with that of L1 speakers of English. Therefore, I tried to investigate RK of low-intermediate Japanese EFL learners through the use of paper and pencil tests in Chapter 3. Their SK was also investigated through the tests.

The results of Chapter 3 showed that low-intermediate level Japanese EFL learners had proper RK although they did not have proper SK. The meaning of around 80% of derivatives was able to be answered correctly in a derivative test in which the meaning of derivatives was asked with multiple choices when they had the knowledge of their stems (base words). RK seemed to develop with vocabulary size. Participants with a larger vocabulary size (3,000 word families) were able to answer the meaning of derivatives with the knowledge of their stems more effectively than participants with a smaller vocabulary size (1,000 word families). However, the fact that even learners with a smaller vocabulary size were able to answer around 60% of derivatives when they

[30] This research was longitudinal (a one-year study) and the numbers before / represent the percentage score at T1 (at the beginning of the study) and the numbers after / represent the percentage score at T2 (at the end of the study).

[31] The tested suffixes were "in Levels 3-6 of Bauer and Nation's (1993) Affix Levels and those used in more than two words in the "Vocabulary Lists" (Nation, 1996)" (Mochizuki and Aizawa, 2000, p. 295); *–ity, -y, -ish, -less, -able, -ism, -ness, -ous, -ly, -al, -ize, -er, -ist, -ment, -ful* and *-ation*.

knew the meaning of their stems showed that RK seems to be acquired early. Plus, derivatives whose suffixes had not been answered correctly could be still answered at the rate of 81.5%. This showed that RK is acquired earlier than SK because learners without suffix knowledge (SK) were able to answer the meaning of derivatives through the use of derivational relationships (RK).

Although the RK of low-intermediate Japanese EFL learners seems to be appropriate, their SK is not. I asked the function of nine basic suffixes in a suffix test conducted in Chapter 3. The results showed that only 58.8% of the suffixes were answered correctly. SK also seemed to develop with vocabulary size. Learners with a larger vocabulary size (3,000 word families) were able to answer more items than the learners with a smaller vocabulary size (2,000 or 1,000 word families). This may mean that the third thousand word family in English vocabulary may be a key factor in acquiring suffix knowledge.

The results show that (a) derivatives whose suffixes had not been answered correctly could still be answered relatively correctly and that (b) 3,000 word family holders showed a significantly higher knowledge of suffixes even though the development of RK seemed earlier, which suggests that the acquisition order of morphological knowledge of EFL learners is also RK→SK.

By conducting an interview procedure, the results of Chapter 4 corroborated the interpretation that low-intermediate Japanese EFL learners have proper RK. Because the derivative test and the stem (base word) test were conducted separately in the experiment in Chapter 3, there was a possibility that the learners knew the meanings of the stems and derivatives but they could not relate derivatives to their stems. The interview conducted in Chapter 4 investigated whether they could recognize the relationships between derivatives and their stems.

The results of Chapter 4 showed that 81.2% of the derivatives whose meanings were asked and answered correctly in the interview were comprehended through the use of derivational relationships. Learners with a larger vocabulary size used more derivational relationship information (82.8%) than learners with a smaller vocabulary size (77.8%). These facts suggest that low-intermediate Japanese EFL learners have proper RK and that learners with a larger vocabulary

size can use derivational relationships more effectively.

Summarizing the results of Chapters 3 and 4, it can be said that low-intermediate Japanese EFL learners can recognize derivational relationships. In other words, they have proper RK. The developmental sequence of morphological (derivational) knowledge is from RK to SK. I did not investigate DK (distributional knowledge) of Japanese EFL learners in this dissertation. Therefore, it cannot be concluded that they experience a developmental sequence from RK through SK to DK as L1 speakers of English do. However, with regard to RK and SK, the developmental sequence of Japanese EFL learners seems to be the same as that of L1 speakers of English.

The main aim of this dissertation is to investigate whether there are derivational relationships in the mental lexicon of Japanese EFL learners. The knowledge that Japanese EFL learners have proper RK underpins this. Because low-intermediate Japanese EFL learners can recognize derivational relationships, the possibility that there are derivational relationships in their mental lexicons becomes higher.

11.3 Morphological (derivational) representation in the mental lexicon of low-intermediate and intermediate Japanese EFL learners

The aim of the latter part of this dissertation is to investigate the mental representation of Japanese EFL learners and Japanese speakers of English for derivational (morphological) relationships. Chapter 5 investigated inflectional and derivational representations of low-intermediate Japanese EFL learners through lexical decision tasks using frequency as a criterion. Chapters 6 and 7 investigated derivational representation of intermediate Japanese EFL learners through masked-priming experiments. Chapter 8 investigated derivational representation of advanced Japanese speakers of English through the masked-priming experiments.

Reviewing the preceding studies, I found that few studies had investigated morphological (derivational) representation in the mental lexicon of L2 learners and in that of Japanese EFL

learners. Seeking referential models, I found that about four models[32] had been proposed in the L1 literature. Model 1 proposed that morphologically related words are discretely represented and have no relationship to each other (Buttherworth, 1983). Model 2 proposed that every morphologically related word has its own representation but also has links to other forms (Bradley, 1979). Model 3 proposed that morphologically complex words do not have their own representations. Only stems, affixes and their combinatory restrictions are represented in the model (Taft and Forster, 1975). In the example of *happiness*, there is no representation of the whole word, happiness. The stem *happy*, suffix *–ness* and their combinatory restriction (happy and –ness are able to be combined) are represented. Model 4 is similar to the third one, but morphologically complex words (whole words) also have their own representations (Taft, 1994).

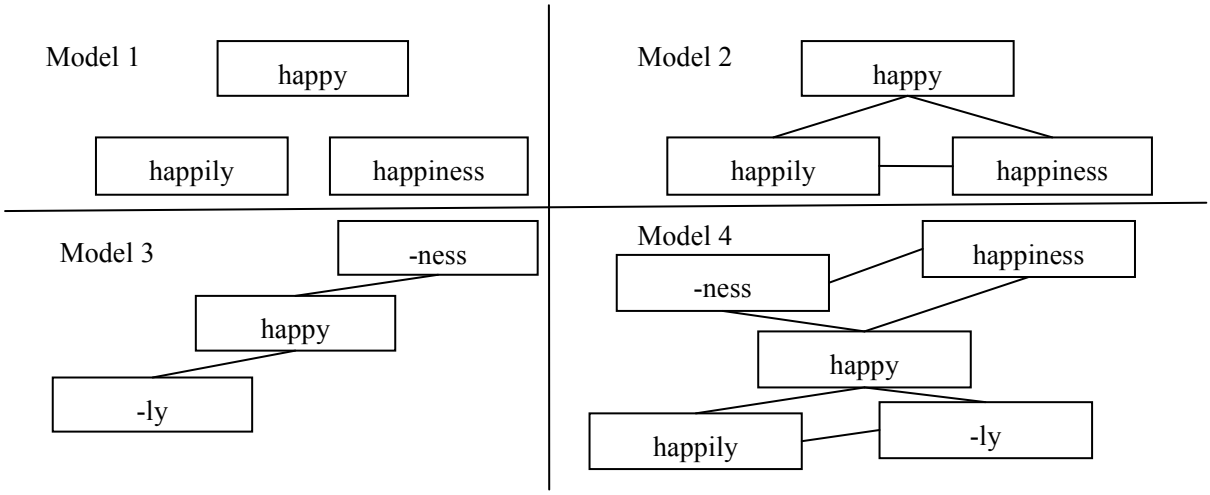

Figure 11.1 Four models of morphological structures in mental lexicons

Which model is suitable for L1 speakers of English? The form level and the semantic level for representations both exist in the L1 mental lexicon. Therefore, these two levels have to be considered separately. Representations at the form level are accessed earlier than representations at the semantic level when words are recognized.

Using masked-priming experiments, Longtin and Meunier (2005), a French L1 study, showed that pseudo-derivative primes quickened the reaction times of their stems, meaning that there are

[32] These models can be divided into more detailed models. However, to catch a broad picture, these simplified 4 models are thought to be suitable.

morpheme-level (suffix) representations at the form level in the mental lexicon of L1 speakers of French (A detailed explanation is in section 2.2.3). Therefore, either Model 3 or 4 is suitable for the mental representation at the form level of L1 speakers of French or English (French and English are similar in morphological structure so it is considered that English L1 speakers have similar mental representations).

Using cross-modal priming experiments, Meunier and Longtin (2007), a French L1 study, showed that semantically interpretable primes quickened the reaction times of their stems. On the other hand, semantically non-interpretable primes did not quicken the reaction times of their stems. These results mean that there are no morpheme-level (suffix) representations at the semantic level in the mental lexicon of L1 speakers of French or English (see detailed explanation in section 2.2.4). Therefore, Model 2 is suitable for the mental representation at the semantic level of L1 speakers of French or English.

But what about the mental representations of Japanese EFL learners? That is the theme of this dissertation. Chapter 5 investigated the mental representation of low-intermediate Japanese EFL learners whose vocabulary size was between 1,000 and 3,000 word families through lexical decision tasks using frequency as a criterion. The results showed that stems whose frequency in derivational family was higher were recognized more quickly than stems whose frequency in derivational family was lower. This evidence indicates that there are derivational relationships at the semantic level in the mental lexicon of low-intermediate Japanese EFL learners. This suggestion comes from the fact that stems whose frequency in inflectional family was higher were recognized as quickly as stems whose frequency in inflectional family was lower.

If the facilitation effect was caused by formal relationships, it is difficult to find a reason why inflectional family frequency did not affect the reaction times of their stems because the formal relationships of inflectional family are stronger than the formal relationships of the derivational family. The members of an inflectional family are usually related to each other by a regular rule. But the members of a derivational family are usually related irregularly. The difference between inflections and derivatives is in their semantic representations. There may be only one semantic

representation for one inflectional family and there may be one semantic representation for each member of derivational family. Therefore, a derivational family may have the same number of semantic representations as the number of members in the derivational family.

What occurs if the numbers of semantic representations are different between an inflectional family and a derivational family? For inflectional families, activation cannot spread to any representation from the activated semantic representation of the stem because there is only one semantic representation. On the other hand, for derivational families, activation can spread from the activated semantic representation of the stem to the other semantic representation of its derivational family, which quickens the reaction time of the stem itself.

In sum, it can be said that there may be one semantic representation for each member of derivational families. Activation spreads from one representation of a derivational family to the other representations of the derivational family, showing that there are derivational relationships at the semantic level in the mental lexicon of low-intermediate Japanese EFL learners. Of the four models (cf. Figure 11.1), Model 2 may be suitable to explain the situation with these Japanese EFL learners as for L1 speakers of English. It is inconsiderable that only L2 speakers as Japanese EFL learners have decomposed mental lexicons at the semantic level (Models 3 or 4) because decomposed mental lexicons seem to be advanced.

By using masked-priming experiments, Chapters 6 and 7 investigated derivational relationships at the form level in the mental lexicon of intermediate level Japanese EFL learners whose vocabulary size was between 3,000 and 5,000 word families. The results showed that derivatives quickened the reaction times of their stems, but orthographically related words and pseudo-derivatives did not. This evidence indicates that not orthographic relationships but morphological (derivational) relationships affected the recognition of words so derivational relationships do exist at the form level in the mental lexicon of those learners. The evidence that pseudo-derivatives did not quicken the reaction times of their stems indicates that there are no morpheme-level (suffix) representations at the form level in the mental lexicon of those learners. If there were morpheme-level representations in the mental lexicon, decomposed pseudo-derivatives could activate the

representations of morphemes, so the priming effects would be observed. The results are rather clear-cut. Model 2 is suitable for the mental representation at the form level in the mental lexicon of intermediate Japanese EFL learners.

The results of Chapter 10 showed that even if pseudo-derivatives were separated into groups according to the difficulty of suffixes attached to pseudo-derivatives and part of speech of suffixes attached to pseudo-derivatives, pseudo-derivatives did not have priming effects on their stems. This evidence indicates that even easy suffixes and suffixes of a certain part of speech do not have their own independent mental representations.

Summarizing derivational representations at the form level and at the semantic level, I found through the experiment conducted in this dissertation that at both levels, Model 2 (cf. Figure 11.1) is suitable for low-intermediate and intermediate Japanese EFL learners. Compared with L1 mental representations, the mental representation for derivational relationships is different at the form level and similar at the semantic level.

11.4 The mental representation of advanced speakers of English

In Chapters 5 through 7, I investigated the mental representation of low-intermediate and intermediate level Japanese EFL learners. The results show that their mental representation is different from that of L1 speakers of English. First language speakers of English have morpheme level representations at the form level in their mental lexicon (Longtin and Meunier, 2005). However, low-intermediate and intermediate Japanese EFL learners do not have such representations. Although it was found that there is a difference between the mental representation of L1 speakers of English and that of these learners, one question remained. Is this difference qualitative or developmental? In other words, whether Japanese learners or speakers of English have the different mental representation because they learn English as a foreign language or those learners have the different metal representation because they are in a developmental stage in terms of morphological representation. To clarify the nature of the difference, I conducted a masked-priming experiment involving advanced Japanese speakers of English using the same materials as in Chapter 7.

The results show that the mental lexicon of advanced Japanese EFL learners is similar to that of intermediate Japanese EFL learners. In other words, their mental lexicon is different from that of L1 speakers of English. Because the advanced Japanese speakers who participated in the experiment were highly proficient, it can be said that I found some limitations in foreign language learning. Even if those speakers show high performance in using English, their mental representation is different from that of L1 speakers of English.

Dekeyser (2000) showed that less salient language components are difficult to acquire for older learners of second languages. Although the participants in this dissertation are foreign language learners and there is a difference between second language acquisition and foreign language learning, the older learners of English in Dekeyser's study and the participants in the present study have common features in that they had not been exposed to much English when they were young. Derivational suffixes can be considered to be less salient because learners of English do not have to acquire them to figure out the meaning of derivatives. They can remember derivatives as a whole, not as parts. When they learn derivatives in context, they can figure out their meaning through analyzing the contexts and guessing the meaning of derivatives through the meaning of their stems. Context provides the function of suffixes so less attention may be focused on them.

The fact that Japanese learners and speakers of English have mental representations that cannot be decomposed into constituents is considered as one factor that slows the processing of English texts. If they decomposed derivatives into constituents when reading, their suffixes and stems could be processed in parallel. Therefore, their reading speed could be quickened. However, this is not the case for either Japanese EFL learners or Japanese speakers of English.

How can Japanese learners of English narrow the mental representation difference? First, there is one argument that they do not have to approach the mental representation of L1 speakers. Advanced Japanese speakers of English show high performance in using English. Therefore, even if there is a mental representation difference between these speakers and L1 speakers of English, they can use English very proficiently. Of course, the difference is not ignorable. But, I think it is important that Japanese speakers of English whose mental representation is different from that of

L1 speakers of English can use English at a high level. Foreign language speakers do not have to be native-like. It can be said that the present study demonstrates that foreign language speakers can achieve high performance without being native-like. This may be a goal for foreign language learners.

Second, there is an argument for early (elementary school) English teaching. In Japan, a new school curriculum will begin in 2011. In this new curriculum, 5th and 6th graders of elementary school will start learning English. Although the amount of learning is very small, it is notable that the age of starting English learning is lowered. If the claim of Dekeyser (2000) is adopted, less salient language components can be acquired by young learners of foreign languages. Learners who start studying English earlier may be able to acquire such components as morpheme-level (suffix) representations. However, there is one caution. In the curriculum presented, the amount of exposure is very small. To acquire native-like mental representation, the amount of exposure should be increased. Syllabus designers of English teaching should have this in mind although there are time constraints in the elementary school curriculum.

Third, there is an argument that teachers should change the teaching method. To my knowledge, there is not a systematic way of teaching suffixes in English when I consider the Japanese teaching environment. If suffixes are introduced with a rather systematic method, Japanese learners of English may be able to acquire morpheme-level (suffix) representation. There is one by-product with this method. Students can increase their vocabulary knowledge with the suffix knowledge. The same suffixes have the same functions so it is easier for them to acquire new vocabulary knowledge if they can successfully relate the function of suffixes to new words. Of course, there is debate over whether explicit teaching of suffixes leads to mental representation change. However, considering that there is the by-product with such methods, I suggest that some systematic ways of teaching suffixes are recommendable.

11.5 Representation vs. processing

Until the argument of the last section, I treated the evidence of processing difference as evidence of representational difference. In other words, I interpreted the fact that pseudo-derivatives are not

decomposed into constituents as evidence of the non-existence of suffix representation. However, I have to show one possibility here. That is, the mental representation of Japanese speakers of English may be native-like and the processing is not native-like.

The evidence that pseudo-derivatives did not quicken the reaction times of their stems indicates that there is a difference between the lexical processing of Japanese learners and speakers of English and that of L1 speakers of English. The fact that pseudo-derivatives did not quicken the reaction time shows that pseudo-derivatives are not decomposed into their constituents. If this decomposition occurred, decomposed stems would quicken the reaction times. I treated this evidence as showing that there are no morpheme-level representations in the mental lexicon of Japanese learners and speakers of English. However, there is a possibility that the morpheme-level representation exists but the processing is not like that of L1 speakers of English. In this model, although there are morpheme-level (suffix) representations and stem representations, derivatives are not decomposed into constituents because of the processing constraints. This model is compatible with the fact that Japanese EFL learners know the function of independent suffixes.

At the present research standards, it is difficult to distinguish mental representations from lexical processing. Researchers usually infer the representational structure through processing experiments. Therefore, it is difficult to determine which model is suitable for Japanese learners and speakers of English. However, the fact that there is a difference between the results of the present study and the results of L1 research shows that some difference exists between the mental lexicon of Japanese and that of L1 speakers. Where the difference exists is a question that remains.

11.6 Pedagogical implications

Because the present study is a fundamental one, direct application of this study to pedagogical environment is difficult. However, several points can be argued. First, I found through this study that the mental representation of Japanese learners and speakers of English is different from that of L1 speakers of English. Although there is an argument that they do not have to be always native-like, some efforts are necessary to acquire morpheme-level (suffix) representation because having suffixes representation improves the processing of texts. Some parallel processing of words

can be achieved if learners have suffixes representation.

One solution is exposure. If they process a large amount of texts, there is a possibility that suffix representation can be made. One point is important here: conscious attention to suffixes. As Dekeyser (2000) claimed, less salient language components are difficult to learn for older learners. Suffixes may be less salient language components because the function of suffixes can be analyzed with the contexts surrounding the derivatives attached by them. If Japanese EFL learners focus on suffixes every time they read texts and correctly assign the function of these suffixes, the possibility of acquiring suffix representation can be enhanced.

Another solution is the systematic teaching of suffixes. Suffixes are not taught systematically in Japanese high school or universities. If systematic teaching of suffixes is conducted, the situation may change. Morin (2003) investigated the effectiveness of teaching morphological information. In experimental groups, she taught the participants how to analyze morphologically complex words. For example, they were asked to make a list on the board of all words (e.g., comer) with the same base, (e.g., com-). The results showed that with respect to production of derivational morphology, the experimental group demonstrated significantly greater knowledge. This indicates that teaching morphological information has an impact on acquiring morphological knowledge. Although morphological knowledge and morphological representation are different, conscious attention to suffixes may enhance the morphological representation in the mental lexicon of foreign language learners.

Second, I found in this dissertation that relational knowledge (RK) is acquired earlier than syntactic knowledge (SK) by Japanese EFL learners as by L1 speakers of English. From this evidence, it can be said that teachers should introduce morphological relationships. They should know the fact that before learners of English acquire the function of suffixes, there is a phase in which they acquire derivational relationships. Therefore, teachers have to make the learners conscious about derivational relationships before teaching each function of suffixes. This step-by-step process will make the learners' acquisition process of derivational relationships smoother.

Third, I found that the third thousand word family vocabulary is the key for suffix knowledge acquisition. Suffix knowledge is convenient in reading English materials. That will be a hint in syntactic analysis. For the acquisition of the suffix knowledge, basic vocabulary knowledge until the second thousand word family vocabulary is not sufficient. A little lower frequency vocabulary is necessary for suffix knowledge acquisition. Teachers and syllabus designers have to be cautious about this, by choosing vocabulary so that some low frequency words are mixed. In that way, learners can find suffix functions.

Chapter 12

Conclusion

This dissertation investigated the mental representation for derivational relationships and morphological knowledge of Japanese EFL learners and Japanese speakers of English. The following five points were found throughout this study.

1. Derivational relationships exist at the form level in the mental lexicon of intermediate level Japanese EFL learners whose vocabulary size is between 3,000 and 5,000 word families.
2. There are no morpheme-level (suffix) representations in the mental lexicon of intermediate-level these Japanese EFL learners.
3. Derivational relationships exist at the semantic level in the mental lexicon of low-intermediate level Japanese EFL learners whose vocabulary size is between 1,000 and 3,000 word families.
4. Advanced Japanese speakers of English have similar mental representations to those of intermediate Japanese EFL learners.
5. The acquisition order of morphological knowledge of Japanese EFL learners is from RK (relational knowledge) to SK (syntactic knowledge).

Although I found some significant points regarding derivational relationships in the mental lexicon of Japanese EFL learners, there are some limitations in the present study. First, the number of participants was small, especially in the study of advanced Japanese speakers of English. Although I concluded in this study that the mental representation of advanced Japanese speakers of English is different from that of L1 speakers of English, there are other possibilities. Advanced Japanese speakers of English who have a larger vocabulary size or who have been exposed to a larger amount of English exposure may have similar mental representation to that of L1 speakers of English. Although I divided the advanced Japanese speakers of English into several groups according to certain criteria, the number of each group was very small. This might be a reason for the non-significant effect of pseudo-derivative primes in Chapter 8. Therefore, another experiment in which more advanced speakers of English participate should be conducted in the future.

Second, the experiment conducted in Chapters 7 and 8 was based on an L1 experiment (Longtin and Meunier, 2005) but different in materials because theirs was a French L1 study. We need to be cautious that there is a possibility that the difference between my results and their results was caused by material difference and not by mental representation difference. An experiment in which different materials are used should be conducted in the future.

Third, there was an experimental difference between this study and the L1 study (Longtin and Meunier, 2005). That is, a backward mask was inserted for 150ms in my study (Chapter 7) but this was not used in their study. This was inserted to enhance the processing of primes in order to complement the slower lexical processing of Japanese EFL learners. But this difference may have contributed to the finding of no existence of priming effects for pseudo-derivatives. Pseudo-derivatives do not have a mental representation so when there is much time for processing them, the activation may stop at the form representation. On the other hand, derivatives have their own mental representation so when there is much time to process them, the activation is communicated from the form level representation to the semantic level representation. This difference might be the cause of the difference of priming effects between pseudo-derivatives and derivatives. In future experiments, the timing of backward masks should be changed and the outcome observed.

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Appendices

Appendix A: The suffix test used in Chapter 3

下線部の接尾辞がつくと、どの品詞になるか、〇をつけてください。

例) tollunism	dourcalism	zessigism	(名) 動 形 副
1. krin<u>er</u>	parv<u>er</u>	neash<u>er</u>	名 動 形 副
2. rombort<u>able</u>	quif<u>able</u>	slomit<u>able</u>	名 動 形 副
3. enlevi<u>ment</u>	reagude<u>ment</u>	voje<u>ment</u>	名 動 形 副
4. dut<u>ence</u>	ravion<u>ence</u>	nolisic<u>ence</u>	名 動 形 副
5. huas<u>ity</u>	amig<u>ity</u>	zabor<u>ity</u>	名 動 形 副
6. wadl<u>ous</u>	blagel<u>ous</u>	creet<u>ous</u>	名 動 形 副
7. seclarb<u>ation</u>	wipu<u>ation</u>	haf<u>ation</u>	名 動 形 副
8. fachi<u>ness</u>	idd<u>ness</u>	nat<u>ness</u>	名 動 形 副
9. miad<u>y</u>	kiofin<u>y</u>	pokel<u>y</u>	名 動 形 副

Appendix B: The derivative test used in Chapter 3 (Version 1)

正しいと思われる日本語の意味を選択してください。

例)horse	1 馬	2 牛	3 猫	4 犬	5 ねずみ	6 象	1
例)Let's <u>go</u> to the city.							
例)上の下線部	1 遊ぶ	2 試す	3 行く	4 上げる	5 浴びる	6 する	3
electorate	1 選挙民	2 選挙する	3 裁判	4 裁判官	5 工場	6 工員	
admiration	1 富	2 富裕な	3 賞賛	4 賞賛する	5 告白	6 告白する	
preference	1 好み	2 好む	3 体重	4 体重の	5 学歴	6 学歴的な	
noisy	1 蒸し暑い	2 蒸し暑さ	3 地方	4 地方の	5 騒音	6 騒々しい	
manufacturer	1 配達	2 配達業者	3 製造	4 製造業者	5 販売	6 販売業者	
importable	1 非難する	2 非難されうる	3 区別する	4 区別されうる	5 輸入する	6 輸入されうる	

administer	１建設	２建設する	３行政管理	４行政管理する	５破壊	６破壊する	
nervous	１勇敢さ	２勇敢な	３空腹感	４お腹の減った	５神経	６神経質な	
Let’s change the arrangement of the tables.							
上の下線部	１色	２色彩の	３材料	４素材の	５配置	６配置する	
The introduction is easy.							
上の下線部	１導入	２導入する	３山登り	４登る	５勉強	６勉強する	
There are many taxpayers in this country.							
上の下線部	１納税者	２納税する	３弁護士	４弁護する	５運動選手	６運動する	
The development of the city was fast.							
上の下線部	１荒廃	２荒廃する	３発展	４発展的な	５調査	６調査する	
The pursuit of profit is the company’s main purpose.							
上の下線部	１追求	２追求する	３増加	４増加する	５産出	６作り出す	
There is a general awareness of the problem.							
上の下線部	１認識	２認識した	３解決	４解決する	５存在	６存在する	
The stability of a company is important to its success.							
上の下線部	１安定性	２安定した	３大きさ	４大きい	５上場	６上場する	
The pain is endurable.							
上の下線部	１耐える	２耐えられる	３忘れる	４忘れられる	５想像する	６想像できる	

Appendix C: The derivative test used in Chapter 3 (Version 2)

正しいと思われる日本語の意味を選択してください。

例)horse	1 馬	2 牛	3 猫	4 犬	5 ねずみ	6 象	1
例)Let's go to the city.							
例)上の下線部	1 遊ぶ	2 試す	3 行く	4 上げる	5 浴びる	6 する	3
arrangement	1 色	2 色彩の	3 材料	4 素材の	5 配置	6 配置する	
introduction	1 導入	2 導入する	3 山登り	4 登る	5 勉強	6 勉強する	
taxpayer	1 納税者	2 納税する	3 弁護士	4 弁護する	5 運動選手	6 運動する	
development	1 荒廃	2 荒廃する	3 発展	4 発展的な	5 調査	6 調査する	
pursuit	1 追求	2 追求する	3 増加	4 増加する	5 産出	6 作り出す	
awareness	1 認識	2 認識した	3 解決	4 解決する	5 存在	6 存在する	
stability	1 安定性	2 安定した	3 大きさ	4 大きい	5 上場	6 上場する	
endurable	1 耐える	2 耐えられる	3 忘れる	4 忘れられる	5 想像する	6 想像できる	
The electorate made the right decision.							
上の下線部	1 選挙民	2 選挙する	3 裁判	4 裁判官	5 工場	6 工員	
He showed his admiration for her by buying her flowers.							
上の下線部	1 富	2 富裕な	3 賞賛	4 賞賛する	5 告白	6 告白する	
I don't know the preferences of my girlfriend.							
上の下線部	1 好み	2 好む	3 体重	4 体重の	5 学歴	6 学歴的な	
It is noisy here.							
上の下線部	1 蒸し暑い	2 蒸し暑さ	3 地方	4 地方の	5 騒音	6 騒々しい	
That company is the biggest manufacturer in this town.							

上の下線部	1 配達	2 配達業者	3 製造	4 製造業者	5 販売	6 販売業者	
The product is importable.							
上の下線部	1 非難する	2 非難されうる	3 区別する	4 区別されうる	5 輸入する	6 輸入されうる	
It is difficult for the council to administer that town.							
上の下線部	1 建設	2 建設する	3 行政管理	4 行政管理する	5 破壊	6 破壊する	
He gets nervous when he drives.							
上の下線部	1 勇敢さ	2 勇敢な	3 空腹感	4 お腹の減った	5 神経	6 神経質な	

Appendix D: The suffix test and an answer sheet for base words used in Chapter 4

A. 下線部の接尾辞がつくと、どの品詞になるか、○をつけてください。

例	entloyee	kestee	exazinee	(名) 動 形 副
1.	rombortable	quifable	slomitable	名 動 形 副
2.	dutical	ravional	nolisical	名 動 形 副
3.	seclarbation	wipuation	hafation	名 動 形 副
4.	kriner	parver	neasher	名 動 形 副
5.	wabeful	boseful	creetful	名 動 形 副
6.	goozish	clybish	loyish	名 動 形 副
7.	tollunism	dourcalism	zessigism	名 動 形 副
8.	miadist	kiofinist	pokelist	名 動 形 副
9.	huasity	amigity	zabority	名 動 形 副
10.	givitize	objanize	feapize	名 動 形 副
11.	maheless	zearkless	bonerless	名 動 形 副
12.	wadly	blagely	courly	名 動 形 副
13.	enleviment	reagudement	vojement	名 動 形 副
14.	fachiness	iddness	natness	名 動 形 副
15.	zanlerous	wagmous	bepious	名 動 形 副

16.	heamy	jincy	virby	名　動　形　副
17.	agucacy	impancy	kampruptcy	名　動　形　副
18.	kongster	paltster	toungster	名　動　形　副
19.	konsition	pompletion	luggestion	名　動　形　副
20.	rekluent	lonkenient	tonktituent	名　動　形　副

B. 単語の意味を答えてください。

例)universal	普遍的な	7. examine		14. urge	
1. victory		8. bake		15. private	
2. secret		9. connect		16. sorry	
3. trick		10. limit		17. brave	
4. shadow		11. recognize		18. electric	
5. wealth		12. deliver		19. local	
6. climb		13. improve		20. usual	

Appendix E: Contexts and choices for base words in the interview used in Chapter 4

I cannot forget the feeling of the victory.
That is my secret.
His trick is wonderful.
That is his shadow.
He had a lot of wealth.
I like to climb.
It's difficult to examine the case.
I have to bake something.
Please connect those things.
The application is limited.

Didn’t you recognize me?
Please deliver this thing.
Please improve this situation.
He urged her to come to him.
This is a private affair.
I’m sorry.
He’s brave.
This is an electric company.
This is the local flight.
This is not usual.
victory
１．悲しみ　２．悲しい　３．勝者　４．勝利　５．喜び　６．喜ばしい
secret
１．秘密裏に　２．秘密　３．ノート　４．ノートの　５．趣味　６．趣味的な
trick
１．手品　２．奇術師　３．外見　４．外見的な　５．収集品　６．収集する
shadow
１．帽子　２．帽子の　３．順番　４．順番に　５．影　６．影になっている
wealth
１．財産　２．財産的な　３．本　４．本の　５．動物　６．動物的な
climb
１．食事　２．食事する　３．山登りをする　４．登山家　５．ゲーム　６．ゲームをする
examine
１．説明する　２．説明的な　３．持ち出す　４．持ち出す人　５．調査する　６．調査的な
bake

１．見つける　２．発見者　３．焼く　４．焼けた　５．捨てる　６．捨てるべき
connect
１．上げる　２．上げて　３．つなげる　４．つなげる人　５．楽しむ　６．楽しみ
limit
１．可能　２．可能性　３．重要　４．重要性　５．制限する人　６．制限される
recognize
１．気付く　２．気付き　３．謝る　４．謝罪　５．ついてくる　６．付随
deliver
１．下げる　２．撤退　３．配達　４．配達する　５．直す　６．修理
improve
１．改善　２．改善する　３．受け入れる　４．受容　５．明らかにする　６．明白な
urge
１．停止　２．やめさせた　３．催促　４．催促した　５．宣言した　６．宣言
private
１．外国の　２．外国　３．重大な　４．重大さ　５．個人的な　６．個人
sorry
１．すまなく思って　２．すまない思い　３．喜んで　４．喜び　５．怒り　６．怒って
brave
１．勇敢さ　２．勇敢な　３．慈悲深い　４．慈悲深さ　５．面白い　６．面白み
electric
１．機械　２．機械的な　３．電気の　４．電流の流れた　５．輸送　６．輸送機器の
local
１．快適な　２．快適さ　３．初めての　４．開始　５．地方　６．地方の
usual
１．美味しい　２．美味しさ　３．通例　４．通例の　５．音楽　６．音楽の

Appendix F: Contexts and choices for derivatives in the interview used in Chapter 4

Some limitations exist in the study.
He's a climber.
Her sorrow never disappeared.
The company makes electricity.
He's wealthy.
I usually go to school on weekdays.
She's a baker.
This is a shadowy corner of the room.
He's a trickster.
This is an urgent matter.
There is wide recognition of his performance.
There was an improvement in his health.
This school is operated privately.
Please take that examination.
Who was victorious?
He fought with the enemy bravely.
That incident occurred locally.
The delivery was delayed.
There is a connection between these things.
I promised secrecy.
limitation
１．発展性　２．発展　３．誤る　４．誤り　５．限界　６．制限する
climber
１．田舎者　２．田舎　３．政治家　４．政治　５．山登りをする　６．登山家

sorrow
１．なまり　２．なまる　３．ぎこちなさ　４．ぎこちない　５．悲しみ　６．悲しい
electricity
１．電気　２．電気の　３．食料品　４．食料の　５．機械　６．機械的な
wealthy
１．思慮深さ　２．思慮深い　３．明朗さ　４．明るい　５．富裕な６．財産
usually
１．組織的に　２．組織　３．注意　４．注意して　５．普通の　６．普通は
baker
１．物書き　２．書く　３．パン製造業者　４．焼く　５．走る　６．走者
shadowy
１．逆　２．逆の　３．影　４．影になっている　５．汚れ　６．汚れている
trickster
１．手品　２．奇術師　３．外交官　４．外交　５．漁師　６．漁
urgent
１．根深い　２．根深さ　３．催促する　４．緊急の　５．複雑な　６．複雑さ
recognition
１．普及　２．普及する　３．認識　４．気付く　５．影響　６．影響力のある
improvement
１．改善する　２．改善　３．問題　４．問題点のある　５．目的　６．目的のある
privately
１．自動的に　２．自動　３．私立で　４．私立　５．機械的に　６．機械
examination
１．調査する　２．試験　３．メモ　４．メモをする　５．休む　６．休み
victorious

１．勝った　２．勝利　３．悲しみ　４．悲しんでいる　５．来ている　６．来訪
bravely
１．効果的に　２．効果　３．正々堂々さ　４．正々堂々と　５．勇敢さ　６．勇敢に
locally
１．局地　２．局地的に　３．劇　４．劇的に　５．即座に　６．即効性
delivery
１．配達　２．配達する　３．到着　４．到着する　５．出発　６．出発する
connection
１．ドアの　２．ドア　３．哲学者　４．哲学　５．つなげる　６．つながり
secrecy
１．時間通りに来ること　２．時間　３．秘密　４．秘密を守ること　５．結婚　６．結婚に関する

Appendix G: Word pairs different in frequency of inflections

The words in the left column are more frequent in terms of inflections. The words in the right column are less frequent in terms of inflections.

The numbers next to a word is a raw frequency, inflectional frequency (including all inflections) and derivational frequency (including all inflections and derivatives) (from left to right).

country	31408	48177	52110	council	30132	34496	38507
child	24385	71008	73861	voice	25206	27665	27665
strong	15898	19558	35181	recent	15812	15812	28061
girl	15755	25366	26733	club	16331	20113	20113
game	14930	21181	21181	hair	14443	15020	15020
story	13661	18418	18418	heart	13729	15242	15242
hour	11334	30218	30218	wall	11804	17194	17194
window	10578	19340	19340	summer	11302	11563	11563
event	10387	20839	31012	blood	10133	10176	17453
piece	9294	14873	14873	mouth	9316	9930	9930
meal	4263	6654	6654	nose	4267	4726	4726
brother	8238	11757	11757	kitchen	8244	8866	8866
client	6087	10948	10948	manner	6063	6924	6924
song	3994	6846	6846	soil	3921	4737	4737
error	3839	5945	5945	chest	3799	3996	3996
bird	3443	9021	9021	golf	3415	3426	3426
enemy	3402	4872	4872	scope	3396	3419	3419

Appendix H: Word pairs different in frequency of derivatives

The words in the left column are more frequent in terms of derivatives. The words in the right column are less frequent in terms of derivatives.

The numbers next to a word is a raw frequency, inflectional frequency (including all inflections) and derivational frequency (including all inflections and derivatives) (from left to right).

person	24982	28981	56184	period	24290	28300	28300
real	22815	22982	96656	main	24686	24370	35409
death	20061	22712	37078	table	20142	23092	24349
history	19296	20064	31422	century	19696	23259	23259
data	18188	18188	22620	role	18210	21016	21016
private	16911	17022	21451	foreign	16234	16234	17484
normal	12451	12451	20716	modern	13144	13156	13156
science	10558	12644	23970	husband	11222	12263	12263
extent	10036	10071	30219	advice	10431	10473	20219
region	9027	13452	20683	source	9088	15747	15747
culture	8548	10196	16739	context	8453	9687	9687
memory	7588	10221	13633	studio	7585	8397	8397
ball	7045	8636	10721	skin	7019	7668	7668
prison	6421	7368	11942	coffee	6427	6614	6614
usual	6260	7630	26781	rural	6258	6258	6258
threat	5399	6767	13277	volume	5361	6974	6974
nation	4372	8508	50031	aspect	4352	11643	11643
angry	4226	4282	5375	alive	4254	4254	4254
pub	3816	5127	69784	cat	3801	5377	5377
rough	3311	3470	5790	solid	3257	3450	4432

Appendix I: Primes and targets used in Chapter 6

Primes			Targets
Derivatives	Stems	Unrelated words	
assessment	assess	dependent	ASSESS*
criticism	critic	destruction	CRITIC*
detective	detect	firmly	DETECT
honestly	honest	employment	HONEST
majority	major	healthy	MAJOR
possession	possess	geographical	POSSESS
safety	safe	various	SAFE
competence	compete	participation	COMPETE
conventional	convention	accordance	CONVENTION
department	depart	fitness	DEPART
merger	merge	classify	MERGE*
organic	organ	recovery	ORGAN
routine	route	usually	ROUTE
verbal	verb	efficiently	VERB*
assumption	assume	justification	ASSUME
density	dense	basically	DENSE*
effectively	effective	commercial	EFFECTIVE
implementation	implement	healthy	IMPLEMENT
nervous	nerve	operation	NERVE*
qualification	qualify	lightly	QUALIFY
slightly	slight	natural	SLIGHT
consistent	consist	knowledge	CONSIST
customer	custom	threaten	CUSTOM
generation	generate	engagement	GENERATE
occupation	occupy	dealer	OCCUPY
primitive	prime	calculation	PRIME
stranger	strange	dangerous	STRANGE
village	villa	maintenance	VILLA*
creation	create	historical	CREATE
desperately	desperate	flexibility	DESPERATE
firstly	first	importance	FIRST
information	inform	quietly	INFORM
perception	perceive	accessible	PERCEIVE*
rapidly	rapid	description	RAPID

*These targets were removed from the analysis.

Appendix I: Primes and targets used in Chapter 6 (continued)

Primes			Targets
Derivatives	Stems	Derivatives	
terrorist	terror	carefully	TERROR
commitment	commit	evaluation	COMMIT
constitution	constitute	decision	CONSTITUTE
defendant	defend	observation	DEFEND
ignorance	ignore	growth	IGNORE
officer	office	gradually	OFFICE
responsible	response	impression	RESPONSE
university	universe	weakness	UNIVERSE

Appendix J: Primes and targets used in Chapters 7 and 8

Primes				Targets
Derivatives	Orthographically related words	Pseudo-derivatives	Unrelated words	
artist	article	artish	decision	ART
counter	country	countful	weakness	COUNT
funny	function	funnize	neatly	FUN
investment	investigate	investation	machinery	INVEST
planner	planet	plannize	usually	PLAN
reality	realm	realness	basement	REAL
tendency	tender	tendable	amusement	TEND*
barrier	bare	barrist	academic	BAR
endless	endure	endy	maker	END
harmful	harmony	harmy	adjustment	HARM
lawyer	lawn	lawish	racial	LAW
pencil	penalty	penist	keeper	PEN

*This target was removed from the analysis in Chapter 7.

Appendix J: Primes and targets used in Chapters 7 and 8 (continued)

Primes				Targets
Derivatives	Orthographically related words	Pseudo-derivatives	Unrelated words	
portable	portion	portish	classify	PORT
tourism	tournament	tourless	easily	TOUR
carry	carpet	carize	growth	CAR
formal	format	formism	healthy	FORM
illness	illuminate	illity	player	ILL
painful	painter	painy	fitness	PAIN
pottery	potato	potless	dealer	POT
singer	single	singment	recovery	SING
winner	winter	winment	purely	WIN
costly	costume	costy	quotation	COST
freedom	freeze	freeish	linear	FREE
information	informal	informless	sticky	INFORM
reader	ready	readment	natural	READ
rubber	rubbish	rubbless	mainly	RUB*
summary	summer	sumish	various	SUM
witness	witch	wittist	noisy	WIT

*This target was removed from the analysis in Chapter 7.