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A Psycholinguistic Investigation of the Automatization Process in Sentence Comprehension for Japanese EFL Learners: Effects of Lexical Information on Parsing

A Dissertation Submitted to
the Graduate School of Intercultural Studies
Kobe University

In partial fulfillment of
the requirements for the degree of
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By

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ABSTRACT

The present study examines how lexical information relates to reading comprehension of Japanese EFL learners through three psycholinguistic experiments. In Chapter 1, the critical issues and current problems of reading comprehension of Japanese EFL learners are described. Then, the term "automaticity" of language processing is defined and characterized. It refers to an automatic or unconscious processing of language and is characterized by its fast and unstoppable processing. It is assumed that one of the main factors that causes difficulties in fluent reading is insufficiently automated parsing which may result from the learners' lack of knowledge of lexical information.

In Chapter 2, these problems are discussed along with an outline of human information processing system from the current perspective of psycholinguistics, focusing on the language processing system. The mechanisms of sentence processing are presented and two contrastive models, modular and interactive sentence processing are discussed. Some previous studies on the relation between lexical information and word recognition and sentence processing both in L1 and L2 are reviewed. One of the problems that leads Japanese EFL learners to insufficiently automated parsing can be a lack of knowledge of syntactic categories. In order to investigate the relation between the knowledge of syntactic categories and reading comprehension, Experiment 1 was implemented in an off-line manner.

Chapter 3 presents details of Experiment 1which investigated how knowledge of syntactic categories affects reading comprehension of Japanese EFL learners. Forty-six Japanese university students learning English as a foreign language participated in the experiment. They were first required to take a syntactic category test, and then, take a reading comprehension test. For the syntactic category test, scores were evaluated in two ways, and on the reading comprehension test, reading rate and correct answer rate were measured. The data were analyzed using a correlation test and a one-way ANOVA. First, the results demonstrated that there was a correlation between the syntactic category test and correct answer rate of the reading comprehension test; however, no correlation was observed between the syntactic category test and reading rate. Second, the stimulus words of the syntactic category test were divided into four groups according to word familiarity and frequency, and the mean scores of the syntactic category test of each group were compared. Significant differences among them were observed and the mean score of high

familiarity and frequency words was significantly higher than that of low familiarity and frequency words. Also, significant correlations were observed between the syntactic category test score and correct answer rates of the reading comprehension test in high familiarity and high frequency words. Third, the stimulus words of the syntactic category test were divided into seven syntactic categories, and the mean scores of each category were compared. The scores for nouns and verbs were significantly higher than other open-class words, adjectives and adverbs. Correlations between the syntactic category test and correct answer rate of the reading comprehension test varied depending on the type of syntactic category.

From the outcomes of Experiment 1, it was concluded that for Japanese EFL learners, (1) the knowledge of syntactic categories affects accuracy of reading comprehension, (2) the relationship between the knowledge of syntactic categories and reading comprehension varies depending on word familiarity and frequency, (3) the relationship between the knowledge of syntactic categories and reading comprehension varies depending on the type of syntactic category.

Since Experiment 1 demonstrated that the syntactic category knowledge of verbs has a strong relationship to reading comprehension, further study focused on how syntactic information of verbs relates to sentence processing. Experiment 2 investigated the use of verb subcategorization information during sentence comprehension using a self-paced reading task and the embedded anomaly technique. Thirty five Japanese undergraduate and graduate students learning English as a foreign language participated in the experiment. They were divided into three groups according to an English proficiency test. In order to observe when the syntactic structure is determined, filler-gap (FG) sentences were constructed as stimuli. Four types of verbs were used: simple transitive verbs, dative verbs, infinitive complement verbs and intransitive preference verbs. The plausibility of the direct object of the embedded verb was also manipulated. The results demonstrated that the high proficiency learners utilized verb subcategorization information of transitive preference verb on-line; however, they did not utilize information from other types of verbs. The low proficiency learners had difficulty processing FG sentences. These outcomes suggest a need for studies that investigate factors that improve representations of subcategorization information in mental lexicon and promote the ability to use it.

Chapter 5 presents details of Experiment 3. The purpose of the experiment is to examine whether the exposure to specific syntactic structures affects sentence comprehension of Japanese

EFL learners. Forty university students learning English as a foreign language participated in the experiment. First, participants performed a self-paced reading task on FG sentences using the embedded anomaly technique. Second, they performed one of the following tasks on simple declarative sentences with three types of verbs used in Experiment 2: reading aloud, repetition without looking, word-order correction tasks with reading aloud, and word-order correction tasks with repetition without looking. Then, they performed FG sentence processing a second time. The results of the pre-tasks and post-tasks were compared to examine the effects of the activities. The results showed that the word-order correction tasks with repetition without looking were the most effective for FG sentence processing. This implies that tasks that relied heavily on working memory may have contributed to sentence processing and that tasks with high cognitive demands facilitated representing lexical information in their mental lexicon and promoting parsing.

Chapter 6 presents the general discussion about the results obtained from the three experiments. Lastly in Chapter 7, a number of possibilities to promote automatization process in sentence comprehension of Japanese EFL learners are presented.

CHAPTER 1

INTRODUCTION

1.1 Problems

What kinds of knowledge underlie language comprehension and how is this knowledge utilized? What is the critical difference between L1 comprehension and L2 comprehension? Although these questions have been discussed for decades, numerous issues around language comprehension remained to be examined. Grabe (2004) pointed out ten instructional implications for reading both in L1 and L2: ensure word recognition fluency, emphasize vocabulary learning, activate background knowledge, ensure general comprehension skills (grammar knowledge and parsing skill), teach text structures and discourse organization, promote strategic readers, build reading rate, promote extensive reading, develop motivation, and plan a coherent curriculum. Grabe also stated the following:

> The real distinctions between L1 reading and L2 reading do not prevent researchers and practitioners from drawing major implications from L1 research findings in general, and especially from research on instructional issues. At the same time, it is essential to recognize that instruction will need to vary in important ways for L2 learners depending on context, learner needs, and language proficiency levels. (p.45)

English education in Japan has benefitted from remarkable contributions from the recent study of second language acquisition (SLA), especially on curriculum and material resources. However, the level of Japanese EFL learners' reading comprehension still requires significant improvement, and there are numerous problems for teachers to solve. It is generally assumed that the main factor that distinguishes L2 comprehension from L1 comprehension may be a lack of "automaticity" of language processing including quite low level word recognition and parsing. The term automaticity is frequently seen in Segalowitz's studies on word recognition. Segalowitz (1991) demonstrated that word recognition automaticity is an important factor in distinguishing the proficiency levels of very advanced L2 readers. Segalowitz, Segalowitz, and Wood (1998) stated that L2 university students who were more fluent readers had better word recognition automaticity

skills. And, they refer to automatic or unconscious access to mental lexicon that L1 readers or very advanced L2 readers possess (Segalowitz, 2003). Newell (1990) also characterizes an automatic process as follows:

> It is fast; it is unstoppable (ballistic); it is independent of the amount of information being processed and it involves no awareness of processing. In contrast, non-automatic processing, also called controlled processing, is characterized as follows: it is slow; it is capable of being inhibited; it depends on information load; and it involves awareness of processing. (p.136)

Takano and Noda (1993) define automaticity, from the perspective of cognitive psychology, as automatic information processing without attention. They state that the more our automaticity increases, the more our resource required for processing decreases. When we comprehend or produce language, we need to perform two types of information processing, language processing and thinking in parallel. Language processing includes word recognition and parsing, while thinking includes reasoning and judging. When we use a foreign language that is unfamiliar to us or not automatically processed, our resources required for these two tasks increase and sometimes exceed our capacity, which temporarily causes deterioration of thought. This phenomenon is called “foreign language side effect” and can be regarded as one of the critical problems for L2 learners (Takano & Noda, 1993, 1995).

1.2 Purpose of the Study

As mentioned above, one of the main distinctions between L1 and L2 is automaticity of sentence processing, which rests on both the knowledge and practice of lexical information. In other words, the difficulties in L2 reading seem to be caused by a lack of lexical knowledge of the learners. Based on this view, the present study intends to examine how the lexical information in mental lexicon relates to parsing in the Japanese EFL learners’ reading process. Recent research of sentence processing (e.g., Garnsey, Tanenhaus, & Capman, 1989; MaClelland, St. John, & Taraban, 1989; MacRae, Spivey-Knowlton, & Tanenhause, 1998; Tanenhause, Spivey-Knowlton, & Hanna, 2000; Trueswell, Tanenhause, & Garnsey, 1994) has reported that lexical information, both lemma and lexeme, including semantic, syntactic, morphological, phonological information may interact during sentence processing. Although it is still unclear that exactly how and when those

interactions occur during sentence processing, it seems likely that they facilitate the ability of analysis through synthesis and automaticity of sentence processing.

Recent studies of SLA have derived various types of reading instruction, including both bottom-up and top-down approaches, and they have already been employed as reading strategies in classrooms for many years. In the bottom-up approach, reading is a process of decoding written symbols from letters to words, clauses and sentences and readers use lexical and syntactic strategies to decode written forms to find meaning. In the top-down approach, reading is an interactive process between the reader's background knowledge about the topic and what is written. These strategies are usually focused on how to improve reading abilities; however, they do not explain why they are effective or what mechanism of the brain works on reading. In fact, very few of them are constructed following perspectives of either cognitive science or psycholinguistics. As brain mechanisms of language processing have been gradually unveiled through recent research in cognitive neuroscience, a goal of this study is to include not only a linguistic theory but also that of cognitive science. Since reading is regarded as a cognitive processing of visual information, exploration of sentence processing systems should be done through a cognitive approach.

The purpose of the present study is to reveal the factors that promote automaticity of parsing that most L2 learners lack from the perspective of cognitive science and to establish an L2 sentence-processing model. The final goal of the study is to apply the findings that are derived from the experiments to improve reading instruction and to develop effective pedagogies for reading instruction for Japanese EFL learners.

1.3 Overview

In Chapter 2, theoretical background of language information processing system is reviewed. Two contrastive models of sentence processing in L1: modular model and constraint-based model are also illustrated. Since sentence processing is considered to be performed in working memory, characteristics of working memory: a trade-off relation of storage and processing, and individual differences in working memory capacity are discussed. Then the roles of lemma information in sentence processing are argued, particularly how parsing is affected by syntactic properties of words. Next, recent studies on sentence comprehension in L2 are summarized, focusing on effects of lexical information on word recognition and sentence processing of Japanese EFL learners. The

residual problems of literature review are pointed out and the current problems in L2 reading are listed.

Chapter 3 presents details of Experiment 1 that investigates how the knowledge of syntactic category relates to reading comprehension of Japanese EFL learners. The methodology used in Experiment 1 was off-line and forty-six Japanese university students learning English as a foreign language participated in the experiment during the academic year of 2008. The results of the experiment are discussed.

Chapter 4 presents details of Experiment 2 that examines the use of verb subcategorization during sentence comprehension by Japanese EFL learners, using a self-paced reading task with the plausibility judging task in an on-line manner. Thirty-five Japanese university students learning English as a foreign language participated in the experiment during the first semester of 2009. The results of the experiment and the findings obtained from Experiment 2 are presented.

Chapter 5 includes details of Experiment 3, which examines types of activities that affect sentence processing. Forty university students learning English as a foreign language participated in the experiment. The results demonstrate that tasks with high cognitive demands promote sentence comprehension.

Chapter 6 presents the general discussion on the results from the three experiments, and lastly Chapter 7 presents the conclusion of the study and further research.

CHAPTER 2

LITERATURE REVIEW

In this Chapter, first the human information processing system is reviewed, focusing on the language processing system. Then sentence processing mechanisms in both L1 and L2 are discussed. Lastly, residual problems identified in the literature review are reported.

2.1 Language Information Processing System

What kinds of brain mechanisms operate and how do they function when we comprehend language? Over the past few decades, answers to these questions have been gradually uncovered by studies of cognitive neuroscience, especially by using on-line and functional neural imaging techniques, which enable researchers to observe local fluctuations on sentence processing in real time. Before discussing some studies of sentence processing, a review of the fundamental theories of human language information system will be valuable.

According to cognitive psychology, environmental stimuli – sounds, sights and other sensory events – are processed in three steps as shown in Figure 1, encoding, storage and retrieval, by a set of mental structures. Encoding refers to transferring stimuli to mental code that is able to be utilized in human systems, and it is divided into three groups; visual coding, phonological coding and semantic coding. Storage is a mental activity, forming memory, and consists of sensory memory, short-term memory (working memory), and long-term memory. Retrieval refers to withdrawing some knowledge that is already stored in memory, and this information processing system is used in various activities, including using language. Aitchison (2003) shows that humans have a mental lexicon that has an enormous capacity for lexical information in working memory.



Figure 1. Language information processing system

Sensory memory takes in stimuli that is perceived every day and retains them for a brief time.

As shown in Figure 2, within the sensory memory, there is iconic (visual) memory and echoic (auditory) memory. Although it is assumed that the former can retain a large amount of information, it stays for only a short amount of time, only for approximately one second (Sperling, 1960), whereas the latter stays longer, for approximately four seconds (Darwin, Turvey & Crowder, 1972). This difference is probably important in language processing. Carroll (2004) stated, "The relatively longer duration of auditory memory may enable us to reanalyze messages that we did not understand initially" (p.47). It is thus considered that sensory memory has a short duration, yet it is long enough to transfer information to the next step, short-term memory (working memory).

Short-term memory holds information for longer periods in order to process cognitive activities, pursue tasks, or to mentally solve problems. Yet, the capacity of memory is limited; it can hold approximately seven plus or minus two unrelated items of information and it vanishes in approximately fifteen seconds without rehearsal. However, memory capacity can be increased by grouping individual items of information into larger units, a process called chunking (Miller, 1956). While short-term memory is viewed as the passive storage of information, working memory has both a storage and a processing function.

Long-term memory is a repository of an individual's knowledge of the world. This holds all of the information retained from the past, including general knowledge, such as the rules of grammar and vocabulary, or personal experiences, such as memories of childhood. Tulving (1972) has distinguished between two types of long-term memory: semantic memory and episodic memory. The former refers to organized knowledge of words, concepts, symbols, and objects including broad information such as general knowledge, motor skills, spatial knowledge, social knowledge, and social skills. Semantic memory holds all of the information in permanent memory that is not related to a particular time or place. In contrast, the latter, episodic memory holds traces of events that are specific to time or space. This is the memory where records of personal experiences are kept. There are also two types of memory: declarative memory and procedural memory. The former refers to organized general knowledge which is able to be described in language, whereas the latter refers to motor skills such as typing, swimming, and bicycling, which is difficult to describe in language, and requires repeating the procedures to acquire the skills (Tulving & Creig, 2000).

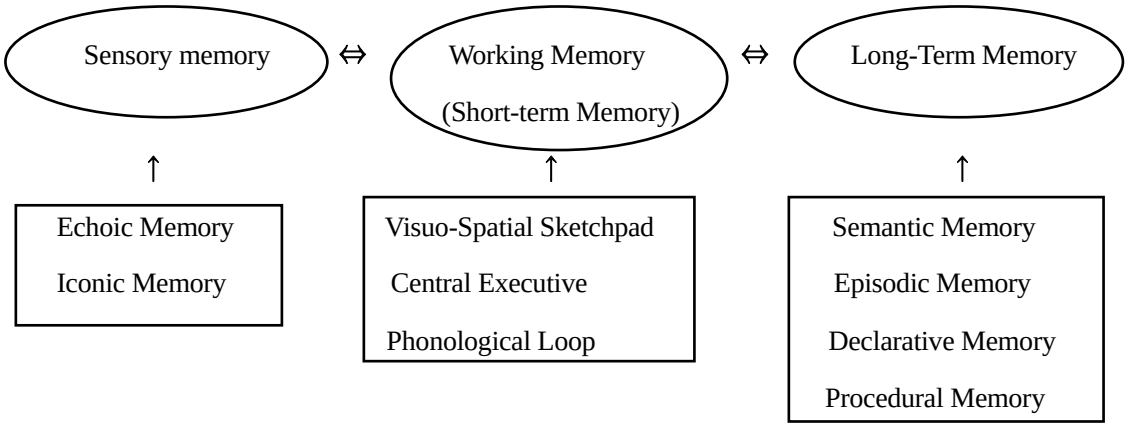


Figure 2. Model of memory

Working memory consists of two sub-systems; phonological loop and visuo-spatial sketchpad and central executive (Baddeley & Logie, 1999). Phonological loop concerns language processing such as understanding conversations or written sentences and consists of a phonological short-term store and sub-vocal (inner voice) rehearsal, a mechanism to retain information. The visuo-spatial sketchpad is a system used to store visual or spatial information such as figures or diagrams for the short term (see Figure 3).

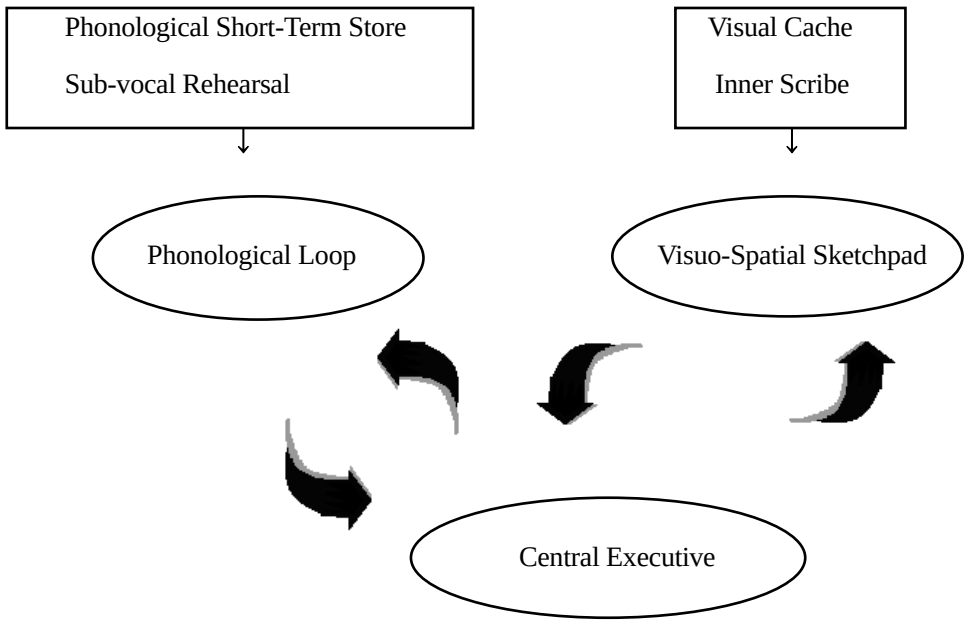


Figure 3. Working memory model. Adapted from Baddeley and Logie, 1999.

2.2 Sentence Processing System

2.2.1 Mechanisms of Sentence Processing

In this section, these concepts are applied to the problem of written language comprehension. When a sentence is read, even during silent reading, the letters are phonologically encoded before being transferred to the phonological short-term store to retrieve word recognition (Kadota, 1984, 1987). This inner voice, sub-vocalization, plays an important role in reading. Encoded visual information thus accesses the mental lexicon and retrieves semantic representation in long-term memory in the brain. It has been considered that word recognition in reading has two ways to provide access to semantic representation; the phonological (indirect) route and the visual (direct) route (Coltheart, 1980). In the phonological route, visual input is encoded to phonological representation after orthographic representation, and then a semantic representation is accessed. In the visual route, visual input directly accesses a semantic representation using orthographic representation. As shown in Figure 4, Kadota (1998a, 2002) demonstrated that both indirect and direct routes are used and called it a dual access model of visual presentation. Poor readers usually use the phonological route more frequently, whereas good readers use the visual route more frequently. Since English has deep orthography and the relationship between phonemes and spelling is irregular, (e.g., Spanish has shallow orthography; the relationship between phonemes and spelling is highly regulated), it is difficult for beginners to encode orthography into phonological representation.

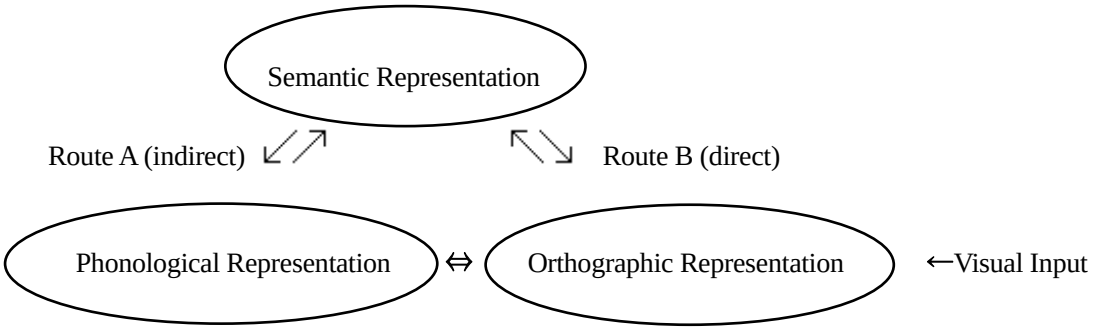


Figure 4. Dual access model of visual presentation. Adapted from Kadota, 1998a.

After word recognition, a syntactic parser assigns grammatical structure to an input sentence, and then the meaning of the sentence is processed. Other factors such as contextual or discourse information influence sentence processing at a later stage (Fodor, 1983; Frazier, 1987). In this view, parsing is performed initially by a syntactic module that is not influenced by the meaning of the sentence or by general world knowledge. However, over a few decades there has been increasing evidence in favor of an opposing model, that is, semantic, pragmatic, syntactic and contextual information all seem to play an immediate role in determining the structure of a sentence (e.g., Gorrell, 1987; Swinney, 1979).

Hashida (1995) demonstrated that there are two contrastive architectures for natural language processing: a procedure-based architecture and a constraint-based architecture. In the former model, as shown in Figure 5, sentence processing is restricted by the order of different modules, and sentences are analyzed by working on syntax first, then semantics, and finally pragmatics. Such a serial architecture restricts information along the horizontal sequence of modules. In the latter model, as shown in Figure 6, there is no specific order for accessing each module, and the constraint modules interact on sentence processing. Such architecture might be more plausible than the former in natural language processing, because semantic clues could be more informative than the syntax one. For example, semantic information often contributes to disambiguation of syntactically ambiguous sentences.

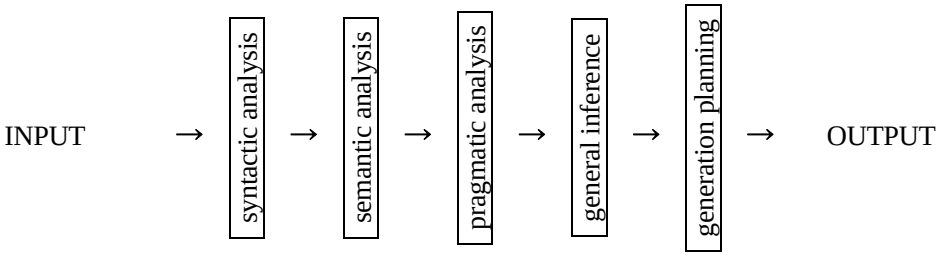


Figure 5. Procedure-based architecture for natural language processing. Adapted from Hashida, 1995, p.139.

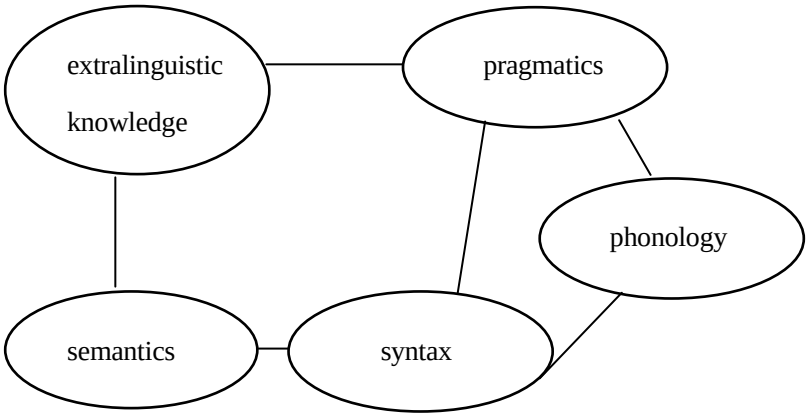


Figure 6. Constraint-based architecture for natural language processing. Adapted from Hashida, 1995, p.140.

2.2.2 Modular versus Interactive Sentence Processing

In sentence processing, this constraint-based model is widely accepted (e.g., Bates & Goodman, 1997; Tanenhaus et al., 2000). Contrary to this view, Ferreira and Clifton (1986) demonstrated that readers experienced equal difficulty with temporarily ambiguous reduced relative clauses when the first noun was either animate or inanimate. In this view, a structure is assigned exclusively on the basis of a structural principal (Fraizer, 1987). However, Trueswell, Tanenhaus and Garnsey (1994) found that semantic information influences syntactic ambiguity resolution. They demonstrated in two eye movement experiments that the animacy of a noun had effects on difficulty of temporarily ambiguous reduced relative clauses. Recent study of neurocognition also shows that in comprehension all information is used and combined in direct mapping of word information onto overall interpretation (Hagoort, Brown, & Osterhout, 1999). Carroll (2004) stated in his study of sentence comprehension and memory, “in constraint-based model, we simultaneously use all available information in our initial parsing a sentence” (p.131).

In summary, after word recognition, the next step in the process of understanding a sentence is to assign elements of structure to linguistic categories. This procedure is known as parsing and syntactic, semantic, pragmatic and phonological information is used to comprehend sentences. An ongoing debate is whether these forms of information are used simultaneously or whether syntactic information is processed first.

2.2.3 Trade-Off Relationship between Storage and Processing in Working Memory

As previously mentioned, many of the processes of sentence comprehension are assumed to occur in parallel. Therefore, a person retains processed information while processing incoming information, that is, information is processed and retained at the same time. Working memory is assumed to have these two functions, storage and processing. This theory proposes that all enabled processes can execute simultaneously, and generate partial products concurrently (Just & Carpenter, 1992). However, since processing resources of working memory are limited, these two functions would be in conflict with one another, competing for the same limited pool of resources.

This trade-off relationship between storage and processing occurs under an allocation scheme that takes effect when activation limits are about to be exceeded. When task demands are high, then processing will slow down and some parts may be forgotten. The time needed for the course and content of language processing within this system depends on the capacity for storage and processing. When the task demands exceed the available resources, both storage and processing functions are degraded. This theory is called *capacity constrained comprehension* (Just & Carpenter, 1992). It is assumed that good readers can efficiently allocate resources for storage and processing.

2.2.4 Individual Differences in Working Memory Capacity

Just and Carpenter (1992) stated that "the nature of person's language comprehension depends on his or her working memory capacity" (p.124). They revealed systematic individual differences in reading comprehension that are related to working memory. They propose that individuals vary in the amount of activation they have available for meeting the computational and storage demands of language processing. This results in quantitative differences among individuals in the speed and accuracy with which they comprehend language.

To assess individual differences in working memory capacity, they used the *Reading Span Task* (Daneman & Carpenter, 1980), which was devised to simultaneously require the storage and processing resources of working memory. The participants are required to read aloud a set of unrelated sentences. After reading the sentences, the participants try to recall the final word. The test score is determined by how many sentences for which the participant can correctly recall the final words. There can be a trade-off relationship between the two simultaneous tasks, storage and

processing. The theory of the test is that high span readers consume less of the working memory resource for the comprehension processes of reading sentences.

Just and Carpenter (1992) examined the reading time on sentences, separating subjects by reading span. The results showed that the high span readers used non-syntactic information (animacy) to resolve the syntactic ambiguity. In other words, the syntactic processing of high span readers was not modular but interactive. Thus, they demonstrated that people who have larger amount of working memory capacity may process sentences in reading more efficiently. Individual differences in working memory capacity may impact language processing, particularly on syntactically ambiguous or complex sentences. However, advocates of a specialized working memory for language processing argue that individual differences are usually not implicated in language comprehension (Caplan & Water, 1999). In an L2 setting, Nakanishi (2007) investigated the relationship between working memory capacity and processing of garden-path sentences by using reading span tests and psycholinguistic experiments. The results showed that Japanese EFL learners had difficulty in processing garden-path sentences regardless of working memory capacity, which was not consistent with the results from Just and Carpenter.

2.2.5 Role of Lemma Information in Syntactic Processing

Each word form (lexeme) in the mental lexicon is associated with syntactic word information (Levelt, 1989; Roelofs, 1992, 1993). This latter type of lexical information is referred to as lemma information. Lemmas specify the syntactic properties of words, such as the syntactic category or word class: noun, verb, adverb, adjectives preposition and conjunction. Verb lemmas contain information on syntactic frames, namely, the argument structures and on the thematic roles of syntactic arguments, the thematic structure. Hagoort et al. (1999) provided an example as follows:

> The lemma for the verb, *donate* specifies that it requires a subject-NP, and a direct object-NP, with the optional addition of an indirect object-PP. In a sentence like *John donates a book to the library*, *John* is a subject NP, *a book* is a direct object-NP, and *to the library* is an optional indirect PP. In addition, the mapping of this syntactic frame onto the thematic roles is specified. For *donate* the subject is the *actor*, the direct object is the *theme*, and indirect object is the *goal* or the *benefactive* of the action expressed by the predicate. (p. 274)

It is generally assumed that in comprehension, structure building is done by incrementally relative to lemma activation. Hagoort et al. also stated:

> Once a lemma is retrieved on the basis of the listening or written input, the relevant lemma information is immediately inserted into the constituent structure built for the preceding lemmas. This on-line assignment of structure to an incoming string of written or spoken words is referred to as parsing. (p.275)

One of the problems of comprehension is that the sentence structure often has locally syntactic ambiguity. Since more than one structural assignment is possible at many points in the sentence, the incremental nature of structure building causes a garden- path phenomenon.

MacDonald, Pearlmutter, and Seidenberg (1994) proposed that crucial regions of syntactic structure are lexically assigned. Then, overall sentence structure can be seen from linking the syntactic fragments that are activated based on lemma input. This view of a constraint-based lexicalist proposes that syntactic information is stored as part of a word's lexical representation. When the word is accessed, stored syntactic information is used to suggest what structure the word can appear in and what structures the word is likely to appear in (Tanenhaus, 1995). MacDonald and Seidenberg (2006) propose, "The lexical representation of a word might include not only information about its spelling, pronunciation and meaning(s), but also its grammatical functions and the types of syntactic structure in which it participates" (p.583). Thus, whole sentence structure is not retrieved from memory but has to be built from smaller fragments. This requires that lemmas and syntactic fragments of structure building are kept active until a whole sentence is processed. Then, computational resources are needed to complete this processing in working memory.

Traxler and Tooley (2007) propose that argument relations are constructed on the basis of lexically stored syntactic representation. They suggest that structural information is tied to specific lexical items (lemmas) and parsing of argument relations relies on lexically stored and lexically accessed structural information. From the results of their eye-movement experiment, they demonstrated that an ambiguity solution for argument structure proceeded more efficiently as a reader's vocabulary knowledge increased. They concluded that "individuals who have greater vocabulary knowledge and sharper boundaries between specific lexical items, may have stronger associations between infrequent argument structures and their corresponding syntactic frames"

(p.69).

Thus, many studies in L1 have pointed out that lexical information plays a central role in resolving problems in parsing processes.

2.3 Sentence Processing of Japanese EFL Learners

In this section, the problems in EFL reading of Japanese learners are presented and discussed. One of the critical issues of parsing for them is assumed to be a lack of automaticity. To examine what factor causes the difficulties in parsing, some previous studies on sentence processing of Japanese EFL learners are reviewed.

2.3.1 Effects of Semantic Information on Parsing

Satoi, Yabuuchi and Yokokawa (2002) pointed out that semantic information led to disambiguation on parsing of syntactically ambiguous sentences. They examined how Japanese EFL learners perform syntactic and semantic processing on syntactically ambiguous sentences by implementing an on-line experiment. The research topics included (1) how Japanese EFL learners process a garden-path sentence compared with L1 speakers, (2) whether the difficulty of parsing varies depending on type of garden-path sentence, (3) how semantic information influences processing of garden-path sentence in parsing. Forty-eight students majoring in English participated in the experiment. Three types of garden-path sentence were used: reduced relative clause, object-subject ambiguity, and double object ambiguity. For each type, three types of sentence were constructed as stimuli: temporarily ambiguous sentences, semantically biased sentences and unambiguous sentences. The participants were given a self-paced reading task and comprehension question for each stimulus. The tasks were conducted on a mainframe personal computer with the psychological experiment software SuperLab Pro (Cedrus Corporation, 1995), and the rate of correct answer and response time of each phrase were measured.

The results showed that (1) the Japanese EFL learners have difficulty in parsing at the moment when temporarily ambiguity occurs, which is the same for L1 speakers, (2) the difficulty in parsing varies depending on the type of garden-path sentence: double object ambiguity was the most difficult and took the longest time to process of all three types of sentence, (3) Japanese EFL

learners use semantic information in real time for parsing.

2.3.2 Pause Effects on Parsing

Nagai (2008) examined the effects of phonological information and inter-phrase pauses on parsing for Japanese EFL learners by implementing an on-line experiment. One of the purposes of the study was to prove the effect of giving students auditory and visual information simultaneously, namely reading-while-listening instructions that were conducted in classrooms in high school (Suzuki 1991, 1998) through a cognitive scientific manner. The study also investigated how lexical information – syntactic, semantic, pragmatic and phonological information – influences parsing for Japanese EFL learners. In the experiment, four different types of sentences were constructed as stimuli: syntactically ambiguous sentences, semantically biased sentences, pragmatically biased sentences and syntactically unambiguous sentences. Three different types of presentation were performed: visual presentation, simultaneous presentation of visual and auditory presentation at natural speed, and simultaneous presentation with 500ms artificial inter-phrase pauses. Fifty-two university students participated in the experiment and were given an alternative comprehension question after each stimulus. The experiment task was conducted on a computer with the psychological experiment software SuperLab Pro. The rates of correct answers and response times were measured and the data were analyzed using a one-way ANOVA.

The results demonstrated that simultaneous presentation with artificial inter-phrase pauses was most effective on parsing of three types of presentation and that the effect was stronger for low proficiency learners than on high proficiency learners. The findings of the study support the positive effect of phonological information on parsing for Japanese EFL learners and demonstrated the effectiveness of reading instruction using listening material with artificial pauses (Suzuki, 1991, 1998) from the perspective of a cognitive mechanism.

Nagai (2008, 2009) pointed out three main theories with regard to the system of processing of auditory and visual language information that are supported by these outcomes: sub-vocalization, dual access model of visual presentation, and pause effects based on a perceptual sense unit. The concepts of sub-vocalization and dual access model of visual presentation are already mentioned in 2.2.1.

With respect to pause effects, Kohno (1981, 1993, 2001) argued from his experimental studies

that humans have two types of listening mechanism; holistic phonological processing and analytic phonological processing. The former function processes auditory stimuli holistically all at one time (time-independent) and the latter processes them analytically one by one (time-dependent). By using these two types of functions, individuals can synthetically analyze and comprehend a sentence, and this is called analysis by synthesis on listening comprehension. Kohno (1993) defined a PSU (Perceptual Sense Unit) as a unit that humans can perceive, and indicated the range of its memory was seven plus or minus two syllables. He found that short intervals, less than 330ms inter-syllable intervals, were most effective in holistic processing in PSU, while more than 420ms inter-PSU intervals were most effective in analytic processing among units. From the findings, he concluded that short intervals, less than 330ms among syllables, and more than 420ms intervals among phrases most efficiently contribute to human listening comprehension. Therefore inter-phrase pauses give listeners time to analyze the semantic and syntactic relationships among units and improve the ability to do analysis by synthesis. This theory may account for the effectiveness of listening materials that have artificial inter-phrase pauses for sentence processing.

Thus, phonological information may promote automaticity of syntactic processing of a sentence and contribute to constructing propositional structure of chunks or phrases. And this automatic processing seems to be promoted both with word recognition and syntactic analysis. While reading, the readers can always go back and reread, but this is not possible while listening. In reading-while-listening, learners are not allowed to reread. By constantly giving such instruction for a certain period of time, it might be possible to improve learners' reading skills, allowing them to automatically comprehend English sentences without mentally translating them into Japanese.

In order to successfully promote this automatic processing during instruction, teachers should pay appropriate attention to the amount of each semantic chunk of auditory stimuli that is presented to students. If the amount is more than their processing capacity or PSU, it will not work. Therefore, particularly in the earlier stages of the instruction, auditory stimuli should have a short duration for each chunk and rather long inter-chunk pauses.

In contemporary English education in Japan, traditional reading instruction is mostly conducted using only visual stimuli. However, since the effectiveness of phonological information and pauses on sentence processing have been well established, there are potential benefits for

reading instruction while simultaneously using listening materials.

Moreover, the results support constraint-based architecture for natural language processing (Hashida, 1995; see 2.2.2), on which lexical information such as syntactic, semantic, pragmatic and phonological information interacts with parsing. All the lexical information seemed to be controlled by one general procedure, on which there were no specific sequences, but each constraint of modules related to another and worked on sentence processing. In other words, interactions between each constraint of lexical information worked on sentence processing in parallel in L2 settings as well as in L1 settings. The participants' proficiency also seemed to function as one of those constraints. How the constraints worked and to what extent they worked might have differed depending on participants' English proficiency.

The effects of each form of information appeared differently depending on the type of presentation and proficiency as follows:

(1) The high proficiency learners utilized semantic, pragmatic and syntactic information for parsing effectively in visual presentations and utilized phonological information with pauses effectively in simultaneous presentations.

(2) The high proficiency learners tended to utilize semantic information of visual stimuli most efficiently or automatically in parsing.

(3) In the low proficiency group, simultaneous presentations with pauses had a significant effect on response time compared to visual presentations on semantically biased sentences, suggesting that it improved reading speed. On the other hand, it showed that semantic information on visual presentations did not contribute much to reading speed of syntactically ambiguous sentences. The low proficiency learners utilized semantic, pragmatic and syntactic information effectively for the most part, but they tended to depend on pragmatic information more than other information in parsing particularly in auditory presentations. This was probably because the pragmatic information helped them distinguish the agent from the patient of the sentence, but they could not utilize semantic information that high proficiency learners usually could utilize automatically for parsing. In addition, the effect of pragmatic information was stronger than phonological information at natural speed. In simultaneous presentations they utilized phonological information with pauses most effectively for parsing of syntactically ambiguous sentences.

(4) Syntactic information did not contribute much to reading speed of either high proficiency or

low proficiency learners, probably because the sentences got longer by inserting the relative pronoun or conjunction “that.”

(5) Although the difference did not reach statistical significance, the correct answer rate decreased in both groups and response time increased in the high proficiency group in simultaneous presentations at natural speed on semantically biased sentences. This showed that phonological information at natural speed tended to interfere with comprehension of semantically biased, less ambiguous sentences.

In the study, several other cognitive mechanisms that probably would account for the above findings were observed.

First, phonological information had an effect on the participants’ sentence comprehension in general, because longer duration of auditory stimuli in sensory memory may have helped transfer stimuli to the next stage, working memory, and contributed to the accuracy of parsing.

Second, phonological information may have made it easier for the participants to retrieve lexicon and contributed to the speed of word recognition. It was effective particularly for poor readers who did not have enough knowledge of English orthography.

Third, artificial inter-phrase pauses in auditory stimuli probably gave the participants enough time for analytic sentence processing, so that they could improve their ability to analyze syntactic and semantic relationships between phrases. On the other hand, auditory stimuli at natural speed did not give the participants enough time to synthetically analyze the sentences, and it was difficult specifically for the readers who could not recognize syntactic or semantic chunks. In other words, artificial inter-phrase pauses clearly revealed syntactic and semantic chunking units and contributed to improving their ability to do synthetic analysis (Halle & Stevens, 1964), and seemed to promote automaticity of parsing.

2.3.3 Access to Lexical Information in Word Recognition

Kadota (1998b, 1998c) investigated which type of lexical information, syntactic category, semantic information, or phonological information was most correctly and promptly accessed in word recognition by conducting experiments. In Kadota’s (1998b) experiment, twenty-one Japanese EFL university students participated and were required to identify the type of relationship between two words that were visually presented. The answer was chosen from three types of

relationships: (1) the same syntactic category, (2) synonym, (3) homonym. Seven pairs of words in each type were chosen from "JACET basic words 4000" as stimuli. In Kadota's (1998c) experiment, thirty-six Japanese EFL university students participated and they were required to answer whether a pair of words have (1) the same syntactic category, (2) the same meaning, (3) the same phoneme. The task was conducted on a personal computer and the rates of correct answers and response times were measured and analyzed by a one-way ANOVA.

The results showed in both experiments that the response times of syntactic category tasks were significantly longer than that of meaning tasks and phonological tasks (syntactic category > meaning, $p < .05$; syntactic category > phoneme, $p < .01$). This indicates that access to meaning or phonological representation is prompt and an automatic process, whereas access to syntactic categories is relatively slow and an un-automated process. Kadota (1998b, 1998c) stated that the syntactic category seems to be processed after the meaning and phoneme are processed.

2.3.4 Familiarity and Frequency Effects of Words in EFL Reading

Yokokawa, Yabuuchi, and Tanimura (2004) investigated the relationship between word familiarity and frequency, and the process of word recognition by implementing a psycholinguistic experiment. Twenty-six university students learning English as a foreign language participated in the experiment. They gave the participants lexical decision tasks that required them to judge whether a presented word was a real word or non-word. They also gave the participants semantic decision tasks. The results demonstrated that word familiarity had stronger effects on word recognition than word frequency. The stimuli were selected from four groups within 2,999 words of an English word familiarity and frequency list (Yokokawa, ed., 2006): (1) high familiarity and frequency group, (2) high familiarity and low frequency group, (3) low familiarity and high frequency group, (4) low familiarity and frequency group.

Takahashi (2005) examined how word familiarity relates to word recognition and sentence processing. Four groups of verbs were selected from about six hundred verbs in the "J-EFL English word data base;" (1) words of high familiarity and frequency, (2) words of high familiarity and low frequency, (3) words of low familiarity and high frequency, (4) words of low familiarity and frequency. Thirty university students majoring in English participated and were given lexical decision tasks on a computer screen in the first experiment. The results showed that the effect of

word familiarity was stronger on both correctness and rate of judgment than that of word frequency. In the second experiment, the participants were given tasks of garden-path sentence processing using the verbs in the first experiment in order to examine the relationship between word familiarity and frequency and sentence processing. The results also showed that the effect of word familiarity was stronger on sentence processing than that of word frequency.

From above findings they concluded that word familiarity has a strong influence on word recognition and sentence processing of Japanese EFL learners.

2.4 Residual Problems

The literature review has thus shown that lexical information – syntactic, semantic, pragmatic, phonological information, word familiarity, and word frequency – strongly relates to word recognition and sentence processing in both L1 and L2. However, there are very few studies that focus on the relationship between syntactic information of lexicon and sentence comprehension in L2. As shown by Kadota (1998b, 1998c), access to a syntactic category takes much longer than access to a semantic or phonological representation. Then, it can be argued that one of the factors that prevents Japanese EFL learners from automatic sentence processing can be a lack of knowledge of syntactic categories. First of all, how much knowledge about syntactic category Japanese EFL learners have should be determined, particularly university students, because the knowledge of syntactic categories is believed to be the foundation of the knowledge for syntactic information. Also, the relationship between that knowledge and reading comprehension needs to be examined. Therefore, to reveal the relationship between syntactic information of lexicon and sentence processing, this study first investigated how knowledge of syntactic categories affects reading comprehension of Japanese EFL learners in an off-line manner.

CHAPTER 3

EXPERIMENT 1: How Knowledge of Syntactic Categories Relates to Reading Comprehension of Japanese EFL Learners: Evidence from an Off-Line Investigation

This chapter presents the details of an investigation that was implemented on October 6th in 2008 at Konan Women's University in Kobe. It includes research questions, hypotheses, methods, results, discussion and conclusion.

3.1 Research Questions

In order to examine the relationship between the knowledge of syntactic categories and reading comprehension of Japanese EFL learners, three research questions were posed for Experiment 1.

1. Is there a correlation between knowledge of syntactic categories and reading comprehension of Japanese EFL learners?
2. Does the relationship between the knowledge of syntactic categories and reading comprehension of Japanese EFL learners vary depending on word familiarity and frequency?
3. Does the relationship between the knowledge of syntactic categories and reading comprehension of Japanese EFL learners vary depending on the type of syntactic category?

3.2 Hypotheses

To answer the above research questions, three hypotheses have guided the present study.

1. There is a positive correlation between the knowledge of syntactic categories and reading comprehension of Japanese EFL learners.
2. The relationship between the knowledge of syntactic categories and reading comprehension of Japanese EFL learners varies depending on word familiarity and frequency.
3. The relationship between the knowledge of syntactic categories and reading comprehension of Japanese EFL learners varies depending on the type of syntactic category.

3.3 Methods

3.3.1 Participants

Forty-six undergraduate students learning English as a foreign language at Konan Women's University participated in the experiment in the second semester of 2008. Their age ranged from 18 to 20. They majored in English, Japanese, or cross-cultural study, and their English proficiency level could be described as intermediate. The score range of the first term test was from 60% to 80 %. None of them had known auditory or visual disorders.

3.3.2 Materials

A syntactic category test consisted of 97 words including seven syntactic categories; noun, verb, adjective, adverb, preposition, conjunction and article; 20, 20, 20, 16, 10, 8, and 3 words, respectively (see Appendix A). The stimuli were selected from four groups within 2,999 words of English word familiarity and frequency list (Yokokawa, ed., 2006). The criteria and number of the stimuli of four groups are shown in Table 1.

Table 1 Criteria and Number of Stimuli Words

Group 1	High familiarity and frequency (within 890 words, ±150 words difference) n.(5)+v.(5)+adj.(5)+adv.(5)+prep.(5)+conj.(5)+art.(3) = 33words
Group 2	High familiarity (within 524 words) and low frequency (617 words difference or over from familiarity) n.(5)+v.(5)+adj.(5)+adv.(1) = 16 words
Group 3	High frequency (within 524 words) and low familiarity (1,000) words difference or over from frequency) n.(5)+v.(5)+adj.(5)+adv.(5)+prep.(5)+conj.(3) = 28words
Group 4	Low familiarity and frequency (over 2,500 words, ±150 words difference) n.(5)+v.(5)+adj.(5)+adv.(5) = 20 words

The reading comprehension test (Mikulecky & Jeffrie, 2005) consisted of a 408-word passage and eight comprehension questions. A passage was printed on the front of the test sheet and comprehension questions were printed on the back of the sheet. Each question was followed by four choices (see Appendix B).

3.3.3 Procedure

Syntactic Category Test

Ninety-seven words were randomized on the test, and two types of word order were

constructed to avoid an impact on the sequence of stimuli. Participants were given two tasks on the test. First, they chose a syntactic category of a stimulus word from seven syntactic categories and marked it on their test sheet. Second, they wrote the Japanese equivalent of the stimulus word (see Table 2 and Appendix A). They were instructed to answer following the sequence of the questions as fast as possible. The test was approximately twenty minutes long.

Table 2 Example of a Syntactic Category Test

1. during	noun	verb	adjective	adverb	preposition	conjunction	article	( )

Reading Comprehension Test

After the syntactic category test, the reading comprehension test was conducted. Participants were instructed to read a passage as fast and correctly as possible. Reading time was measured and written on the front sheet in seconds by participants. After reading the passage, they answered eight comprehension questions that were printed on the back of the sheet without looking at the passage on the front of the sheet. Each question was followed by four answers and they chose the best answer and marked it on their test sheet.

3.3.4 Evaluation

Two means of evaluation were conducted for the results of syntactic category test as shown in Table 3. Evaluation 1 (henceforth Test 1) was scored only for correct answers of syntactic category, while Evaluation 2 (henceforth Test 2) was scored for both correct answers of syntactic category and word meaning. Most of the stimuli had a single syntactic category; however, for the words that had more than one syntactic category, any appropriate choice was regarded as a correct answer.

Table 3 Evaluation of a Syntactic Category Test

Evaluation 1 (Test 1) Score only for syntactic category (full score = 97)
Evaluation 2 (Test 2) If the participant is correct on both syntactic category and meaning, his or her score is 3. If only correct on meaning, the score is 2. If only correct on syntactic category, the score is 1. If both are wrong, the score is 0 (full score = 291).

On the reading comprehension test, reading time was measured, and first the numbers of words they read per minutes (henceforth wpm) was calculated, wpm = 408 words/reading time (seconds) ×60 . Next, reading efficiency (henceforth RE) that evaluated both reading rate and accuracy was calculated. RE = wpm × correct answer rate.

3.3.5 Data Analysis

In order to investigate Research Question 1, the overall correlations were examined between the scores of the syntactic category test (Test 1 and Test 2) and wpm, correct answer rates and RE of the reading comprehension test respectively. In addition, the variables that showed a significant relationship in the overall correlation test – the syntactic category test and correct answer rates of the reading comprehension test – were then further analyzed. The participants were divided into three groups according to their syntactic category test scores, and the mean scores of each group were compared using a one-way ANOVA.

In order to investigate Research Question 2, the stimulus words of the syntactic category test were divided into four groups according to word familiarity and frequency (see Table 1). First, the mean scores of the syntactic category test of each group were compared using a one-way ANOVA, and correlations were examined between the variables that showed a significant relationship in the overall correlation test – each group's syntactic category test scores and correct answer rates of the reading comprehension test.

In order to investigate Research Question 3, the stimulus words of the syntactic category test were first divided into two groups, open-class words and closed-class words and the mean scores of the syntactic category test of each group were compared using a one-way ANOVA. Then, correlations were examined between the variables that showed a significant relationship in the overall correlation test – each group's syntactic test score and correct answer rate of the reading comprehension test. Next, the stimuli words were divided into seven syntactic categories, and the mean scores of the syntactic test score of each category were compared. Correlations were examined between the variables that showed a significant relationship in the overall correlation – each category's syntactic test scores and correct answer rates of the reading comprehension test. Pearson's correlation test was used and statistical analyses were conducted using Excel Statistics 2002 for Windows.

3.4 Results and Discussion

This section presents the results of the data analysis and discussion about outcomes. As mentioned in the last section, four different types of data analysis were conducted.

3.4.1 Relationships between the Syntactic Category Test and the Reading Comprehension Test

In order to examine Research Question 1, the following analyses were conducted. First, the means and standard deviations of the syntactic category test scores, wpm, correct answer rates, RE of the reading comprehension test were calculated. The results appear in Table 4.

Table 4 Means of Test 1, 2, wpm, Correct Answer Rate, and RE

Test 1 % (SD)	Test 2 % (SD)	wpm wpm (SD)	Correct Answer Rate % (SD)	RE RE (SD)
59.70 (10.72)	58.75 (9.18)	72.51(24.69)	79.62 (20.24)	58.40 (26.56)

Correct answer rates of the both syntactic tests were below 60% which was much lower than expected. This suggests that Japanese university students' knowledge of syntactic categories is weak in terms of the level of explicit knowledge. However, it cannot be concluded that they are lacking in knowledge of syntactic categories. It is still possible to assume that they have a general sense or implicit knowledge of syntactic categories because they seemed to be able to distinguish syntactic categories although they could not explicitly identify the names of syntactic categories.

Next, correlations between the syntactic category test and the reading comprehension test were calculated. Table 5 shows the results.

Table 5 Correlations between Syntactic Category Tests and Reading Comprehension Tests

	Test 1	*p*	Test 2	*p*
wpm	-.06		-.03	
Correct Answer Rate	.31	*	.48	**
RE	.14		.25	

Note. * < .05, ** < .01

Overall, no significant correlations were found between either Test 1and reading rate or Test 1 and reading efficiency. However, a statistically significant correlation was observed between Test 1 and correct answer rate of the reading comprehension test (r = .31, p < .05). Although the

relation between Test 2 and reading comprehension had a similar tendency, a stronger correlation was observed between Test 2 and correct answer rate than between Test 1 and correct answer rate (r = .48, p < .01). These outcomes suggest that the knowledge of syntactic categories including word meaning has a stronger relationship with accuracy of reading comprehension; however, knowledge of syntactic categories alone still relates to accuracy of reading comprehension. Thus, the knowledge of syntactic categories affects reading comprehension of Japanese EFL learners and it suggests that the readers with greater knowledge of syntactic categories tend to have more accurate reading comprehension.

3.4.2 Comparisons among Three Groups

Since the results in 4.1 showed a significant correlation between the syntactic category test and correct answer rates of the reading comprehension test, the participants were divided into three groups – a high score group (henceforth Group A), middle score group (henceforth Group B) and low score group (henceforth Group C) – according to Test 1 and 2 scores of the syntactic category test, and each group's mean for correct answer rates were compared. Table 6 shows each group's mean score, standard deviation of the syntactic category test, and the score ranges of the three groups.

Table 6 Means of Syntactic Category Test, SD and Score Range of Three Groups

Group	N	Test 1	Maximum	Minimum	Group	N	Test 2	Maximum	Minimum
		% (SD)	%	%			% (SD)	%	%
A	16	71.90 (4.27)	81.79	64.60	A	16	69.07 (4.26)	80.41	65.98
B	16	58.95 (3.11)	61.51	54.30	B	16	57.51 (2.51)	64.95	55.67
C	14	41.61 (5.24)	52.92	38.49	C	14	48.35 (4.23)	54.64	37.11

Table 7 shows the means of correct answer rates and standard deviations of the reading comprehension test for the three groups classified by Test 1 and Test 2 of the syntactic category test.

Table 7 Means of Correct Answer Rate and SD

Classified by Test 1			Classified by Test 2		
Group	N	Correct Answer Rate % (SD)	Group	N	Correct Answer Rate % (SD)
A	16	87.50 (13.97)	A	16	88.25 (12.07)
B	16	77.25 (22.18)	B	16	82.00 (19.14)
C	14	73.12 (21.02)	C	14	66.87 (22.43)

The data were analyzed using a one-way AVOVA. When the participants were divided according to Test 1 scores, the results showed that there was no significant difference among the three groups. When the participants were divided according to Test 2 scores, the results showed that there was a statistically significant difference among the three groups (F (2, 45) = 4.96, $p < .05$). Bonferroni's multiple comparison showed that there was a statistically significant difference between Group A and Group C ($p < .05$). This shows the knowledge of syntactic category including word meaning relates to the accuracy of reading comprehension, which was the similar tendency found in the overall analysis in 4.1.

3.4.3 Relationships between the Syntactic Category Test, and Word Familiarity and Frequency

In order to investigate Research Question 2, the following analyses were conducted. The stimulus words of the syntactic category test were divided into four groups according to word familiarity and frequency and the mean scores for each group were compared. Table 8 shows the mean scores and standard deviations of the syntactic category test for each group.

Table 8 Means of Test 1 and 2 of Word Familiarity and Frequency Groups and SD

Group	number of words	Test 1 (%)	SD	Test 2 (%)	SD
1	33	76.67	42.28	90.50	27.91
2	16	73.77	43.98	89.96	23.32
3	28	46.89	49.90	33.33	44.70
4	20	38.36	48.62	16.77	31.80

The data were analyzed using a one-way ANOVA. The results showed that Group 1 scored higher than Group 2, Group 2 scored higher than Group 3 and Group 3 scored higher than Group 4 in both Test 1and 2 (in ascending order, Group1 > Group2 > Group3 > Group4). There was a statistically significant difference among the four groups for both tests (Test 1: F (3, 4461) = 189.36, $p < .01$; Test 2: F (3, 4461) =1366.63, $p < .01$). Bonferroni multiple comparison showed that for Test 1, there was a statistically significant difference between Group 1 and 3, Group 1and 4 ($p < .01$); between Group 2 and 3, Group 2 and 4 ($p < .01$); between Group 3 and 4 ($p < .01$). For Test 2, the results were the same as for Test 1 in that there were statistically significant differences between Group 1 and 3, Group 1and 4 ($p < .01$); between Group 2 and 3,

Group 2 and 4 ($p < .01$); between Group 3 and 4 ($p < .01$).

Correlations were examined between the syntactic category test score and correct answer rate of the reading comprehension test for each group. The results appear in Table 9.

Table 9 Correlations between Test 1, 2 and Correct Answer Rate

Group	number of words	Test 1	*p*	Test 2	*p*
1	33	.24		.34	*
2	16	.31	*	.42	**
3	28	.24		.47	**
4	20	.18		.29	

Note. * < .05, ** < .01

A statistically significant correlation was observed between Test 1 score and correct answer rate of the reading comprehension test for Group 2 ($r = .31$, $p < .05$). For Test 2, stronger correlations were observed than for Test 1 (Group 1: $r = .34$, $p < .05$; Group2: $r = .42$, $p < .01$; Group 3: $r = .47$, $p < .01$).

These results demonstrate that there is a strong relationship between the knowledge of syntactic categories and word familiarity and frequency. The syntactic categories of high familiarity or frequency words are more often correctly recognized, and the influence of familiarity tends to be stronger than that of frequency. The most interesting result was that Test 2 for Group 3 had the strongest correlation with correct answer rate, which implies that Test 2 (the knowledge of syntactic category including word meaning) which is constructed with words from Group 3 (low familiarity and high frequency) may be able to most correctly predict participants' reading comprehension.

3.4.4 Relationships between the Syntactic Category Tests and Syntactic Categories

In order to investigate Research Question 3, the stimulus words of the syntactic category test were divided into seven syntactic categories. Table 10 shows the mean scores and standard deviations of the syntactic category test for each category.

Table 10 Means of Test 1,2 and SD of Seven Syntactic Categories

	number of words	Test1 (%)	SD	Test2 (%)	SD
Open Class Word	76	59.78	49.03	63.59	47.02
Noun	20	66.30	47.26	59.85	47.28
Verb	20	71.84	44.97	61.08	45.44
Adjective	20	50.54	49.99	54.81	47.47
Adverb	16	48.09	49.96	52.98	46.13
Closed Class Word	21	59.42	49.10	57.40	46.73
Preposition	10	47.30	49.93	56.15	48.32
Conjunction	8	66.03	47.35	65.67	46.26
Article	3	81.88	38.51	82.85	36.82

First, the stimulus words of the syntactic category test were divided into two categories, open-class words and closed-class words, and the mean scores of each category were compared using a one-way ANOVA. The results showed there was no significant difference between the two on either test (Test 1: open-class words, 59.78%, closed-class words, 59.42%; Test 2: open-class words, 63.59%, closed-class words, 57.40%).

Second, the stimuli were divided into seven syntactic categories, and the mean scores of each category were compared using a one-way ANOVA. The results showed that, in ascending order for Test 1, article > verb > noun > conjunction > adjective > adverb > preposition; for Test 2, article > conjunction > verb > noun > preposition > adjective > adverb. There was a significant difference among the seven categories for both tests (Test 1: F (6, 4661) = 36.61, $p < .01$; Test 2: F (6, 4661) = 11.20, $p < .01$). Bonferroni multiple comparison showed that for Test 1, the effect of article was statistically significant compared with noun, adjective, adverb, and preposition ($p < .01$), and with conjunction ($p < .05$); the effect of verb was statistically significant compared with adjective, adverb, and preposition ($p < .01$); the effect of noun was statistically significant compared with adjective, adverb, and preposition ($p < .01$); the effect of conjunction was statistically significant compared with adjective, adverb, and preposition ($p < .01$); in Test 2, the effect of article was statistically significant compared with verb, noun, adjective, adverb, and preposition ($p < .01$) and with conjunction ($p < .05$); the effect of conjunction was statistically significant compared with adjective ($p < .05$).

Articles and conjunctions were well recognized, probably because there were only three articles and eight conjunctions and they were all in the high familiarity and frequency group (Group 1). The scores of noun and verb were significantly higher than those of other open-class words

(adjective and adverb) both in syntactic category and meaning, which showed that the participants had grater knowledge of syntactic categories for noun and verb than for other syntactic categories. The results also revealed the difficulty in recognizing the category of adverb and preposition.

Next, correlations were calculated between the syntactic test scores and correct answer rates of the reading comprehension test for each category. The results appear in Table 11.

Table 11 Correlations between Test 1,2 and Correct Answer Rate

	number of words	Test1	*p*	Test 2	*p*
Open Class Word	76	.39	**	.47	**
Noun	20	.35	*	.21	
Verb	20	.36	*	.50	**
Adjective	20	.24		.32	*
Adverb	16	.22		.47	**
Closed Class Word	21	.04		.42	**
Preposition	10	-.01		.35	*
Conjunction	8	.12		.46	**
Article	3	-.05		.03	

Note. * < .05, ** < .01

For Test 1, there were significant correlations with correct answer rates of the reading comprehension test only for open-class words (verb, $r = .36$, $p < .05$; noun, $r = .35$, $p < .05$). For Test 2, there were relatively strong correlations with correct answer rates of the reading comprehension test for verb, adverb and conjunction (verb, $r = .50$, $p < .01$; adverb, $r = .47$, $p < .01$; conjunction, $r = .46$, $p < .01$), and moderate relationships for preposition and adjective (preposition, $r = .35$, $p < .05$; adjective, $r = .32$, $p < .05$).

These outcomes suggest that the readers with greater syntactic category knowledge of noun and verb and those with greater knowledge of both syntactic categories and word meaning of verb and adverb tend to read more correctly. Test 2 scores of verb, adverb and conjunction have stronger correlations with correct answer rates of the reading comprehension test than the others, which implies that Test 2 (the knowledge of syntactic categories including word meaning), which is constructed by verbs, adverbs and conjunctions, may be able to most correctly predict participant's reading comprehension.

3.4.5 Hypotheses Verification

Based on the results above, the hypotheses mentioned in 3.2 can be verified.

Research Question 1: *Is there a correlation between the knowledge of syntactic categories and reading comprehension of Japanese EFL learners?*

Overall, there was a moderate correlation between the knowledge of syntactic categories and accuracy of reading comprehension and a relatively strong correlation between the knowledge of syntactic categories including word meaning and accuracy of reading comprehension. These findings support Hypothesis 1: *There is a positive correlation between the knowledge of syntactic categories and reading comprehension of Japanese EFL learners*; however, no significant correlation was observed between the knowledge of syntactic categories and reading rate.

Research Question 2: *Does the relationship between the knowledge of syntactic categories and reading comprehension of Japanese EFL learners vary depending on word familiarity and frequency?*

The results of comparisons among the syntactic test scores of the four groups that were divided according to word familiarity and frequency show that there is a strong relation between the knowledge of syntactic categories and word familiarity and frequency. The syntactic category of a high familiarity and frequency word tends to be more correctly recognized and the influence of familiarity seems to be stronger than that of frequency. The correlations between syntactic category test scores and accuracy of reading comprehension are stronger for Group 2 (high familiarity and low frequency words) and Group 3 (low familiarity and high frequency words) than for Group 1 (high familiarity and frequency words) and Group 4 (low familiarity and frequency words). These findings support Hypothesis 2: *The relationship between the knowledge of syntactic categories and reading comprehension of Japanese EFL learners varies depending on word familiarity and frequency*.

Research Question 3: *Does the relationship between the knowledge of syntactic categories and reading comprehension of Japanese EFL learners vary depending on the type of syntactic category?*

The results of comparisons among the syntactic category test scores of each syntactic category show that some categories are better recognized than other categories, and the correlations

between the knowledge of syntactic categories and accuracy of reading comprehension in some categories are stronger than for other categories. These findings support Hypothesis 3: *The relationship between the knowledge of syntactic categories and reading comprehension of Japanese EFL learners varies depending on the type of syntactic category*.

3.5 Concluding Remarks and Implications

In Experiment 1, there are three main results to consider. First, the results clearly revealed that Japanese university students' knowledge of syntactic categories, at least their explicit knowledge, was low although the instruction of syntactic categories has already been employed in classrooms in Japan over several decades. This suggests that instruction of syntactic categories may have been unsuccessful. However, the outcome that the knowledge of syntactic categories affects reading comprehension indicates that the more they obtain syntactic category knowledge, the better their reading comprehension will become. Then, it can be argued that promoting their reading ability through giving more appropriate instruction on syntactic categories could be worthwhile. Another result to consider is that the syntactic category knowledge of verbs had a stronger relationship to reading comprehension than the other six syntactic categories, including noun, adjective, adverb, preposition, conjunction, and article. This means that a lack of syntactic information knowledge of verbs may play a role in their insufficient reading comprehension ability. It can be concluded that the knowledge of syntactic categories of Japanese EFL learners relates to reading comprehension. Thus, Experiment 1 revealed that reading comprehension of Japanese EFL learners relates to their knowledge of lexical information in particular to syntactic information of verbs.

Although relationships between the knowledge of syntactic categories and reading comprehension were observed in this off-line experiment, a few questions remained to be discussed. A significant relationship between the knowledge of syntactic categories and reading rate was not observed in overall correlation analysis (4.1), or other analyses (4.2, 4.3). However, it cannot be concluded that there is no relationship between the knowledge of syntactic categories and reading rate. Another question is which of the two, word familiarity or frequency, more strongly influences the relationship between the knowledge of syntactic categories and reading comprehension. Although word familiarity tended to have a stronger relationship, it cannot be

concluded that its influence is stronger than that of word frequency. In order to clarify these questions, it is necessary to conduct a more elaborate experiment with more precise data analysis. However, there might be a limitation to examine these issues in an off-line manner.

For further studies on the relationships between lexical information and reading comprehension, it is essential to examine the relationship between lexical information and sentence processing or parsing in an on-line manner. The participants next take a self-paced sentence-processing task that presents a target sentence phrase by phrase on a computer screen, which allows local fluctuations on sentence processing to be examined in real time. The experiments should be conducted on a computer by using psychological experiment software that is able to automatically measure participants reading time in milliseconds. Following the results of Experiment 1, which showed that reading comprehension has a relationship with the syntactic category knowledge, particularly that of verbs, syntactic information of verbs is focused in the next chapter.

CHAPTER 4

EXPERIMENT 2: Verb Subcategorization Information during Sentence Comprehension by Japanese EFL Learners: Evidence from a Self-Paced Sentence Anomaly Task

4.1 Introduction

Since Experiment 1 (Nagai & Yokokawa, 2009) showed the syntactic category knowledge, particularly the knowledge of verbs, affects reading comprehension of Japanese EFL learners, Experiment 2 was conducted to investigate lexical influence on parsing, focusing on how Japanese EFL learners utilize verb subcategorization information while they comprehend a sentence. The method used in the experiment was on-line through the use of a psychological experiment software. The experiments were implemented in June 2009 at Konan Women's University and Kobe University. This chapter includes previous studies, research questions, methods, results, discussion and conclusions.

4.2 Previous Studies

4.2.1 Filler-Gap Dependencies

In sentence processing studies, the sentences with long-distance dependencies ("filler-gap" sentences) are often used as stimuli in order to investigate when the syntactic structure is determined (e.g., Tanenhaus, Boland, Garnsey, & Calson, 1989). In a filler-gap sentence, the "filler" must be associated with a "gap" that occurs later in the sentence at least in English. For example, in sentence (1), the wh-question phrase *which movie* is semantically interpreted as the direct object of the verb *watch*. In this case, the filler is *which movie*, and the gap is posited and filled after *watch*.

(1) Which movie did the man watch __ at midnight?

If a reader immediately accesses and uses the subcategorization information that the verb *watch* takes a direct object, then the gap-filling will take place at the verb position. Tanenhaus et al. state that "filler-gap sentences are especially well suited to examining how verb-based lexical information is used in parsing because the verb plays an important possible gap positions" (pp. 37-38).

4.2.2 Sentence Anomaly Task

Tanenhaus et al. (1989) conducted an experiment to investigate lexical influence on parsing with long-distance dependencies. In order to determine when a gap was posited and filled, they used a plausibility judgment task that they referred to as the "embedded anomaly technique" in which participants pressed a "No" key if the sentence stopped making sense. They conducted a self-paced reading task with word-by-word presentation using verbatim recall as a secondary task to obtain more precise information about the time course of gap-filling. In the experiment, two types of verbs were used: verbs that are typically used transitively and verbs that are typically used intransitively, and two types of fillers were used: fillers that were plausible as the object of the verb and fillers that were implausible objects. For example, in sentence (2), *horse* is a plausible object of the verb *race*, whereas *rock* is an implausible object.

(2) The sheriff wasn't sure which *horse/*rock* the cowboy *raced* down on the hill.

The results demonstrated that for transitive preference verbs, gaps are posited and filled immediately at the verb, even when the filler is implausible, whereas gaps are not initially posited following intransitive verbs. They also compared the verbs that are typically used with both an object and an infinitival complement (e.g., *remind*) with verbs that do not take infinitival complement (e.g., *call*). Again, they used the embedded anomaly technique in a self-paced word-by-word reading task. The results for the call-type verbs are the same as the results they obtained in the previous studies: gaps are posited and filled at the embedded verbs, even when the filler is implausible. In contrast to the call-type verbs, there is no plausibility effect at the embedded verb in either the judgment or reading time for remind-type verbs, but object gaps are filled at complementizer *to* only when the filler is a plausible object of the verb. From these results, they reported that the lexical information of transitive preference verbs and infinitive complement verbs are immediately accessed and used in parsing sentences with filler-gap dependencies.

Boland, Tanenhaus, Calson, and Garnsey (1989) conducted experiments to further explore the use of verb subcategorization in the gap-filling process. They examined the difference between simple transitive and infinitive complement verbs, and included a new type of verb, dative verbs. They also used a sentence anomaly task in a self-paced word-by-word reading task. The results showed that gaps were posited and filled at a word after embedded verbs in the sentences with dative verbs. This study, like Tanenhaus et al. (1989) mentioned above, suggests that verb

subcategorization information is immediately accessed and used in parsing sentences with filler-gap dependencies in L1.

In an L2 setting, Williams (2006) examined the degree to which L1 and L2 speakers interpret English sentences incrementally using stop making sense tasks in two experiments. Experiment 1 required participants to read sentences word by word to make on-line plausibility judgments. The results showed that both L1 and L2 speakers incrementally judge plausibility of the preferred structural analysis, which affected ease of reanalysis. Experiment 2 required participants to read the same sentences word by word to perform a memory task. The L1 speakers showed a similar pattern of results as in Experiment 1, whereas plausibility effects of the L2 speakers were delayed. However, they still seemed to perform immediate syntactic reanalysis. Williams concluded that syntactic processing was person- and task-independent, whereas incrementality of interpretation was more dependent on task demands for the L2 speakers than for the L1 speakers. It seemed that L1 and L2 speakers are similar with regard to lexical processing; however, semantic processing of L2 words is less efficient than for L1 words and appears to be person- and task-independent.

Yabuuchi, Satoi and Yokokawa (2001) investigated how Japanese EFL learners use verb subcategorization during sentence processing by conducting an experiment, using a self-paced reading task with a sentence anomaly task. In order to observe when the syntactic structure is determined, filler-gap sentences were constructed as stimuli, and three types of verbs were used: simple transitive verbs, dative verbs, and verbs that prefer infinitive complements. The plausibility of the direct object of embedded verb was also manipulated. The results showed that Japanese EFL learners have a similar tendency with regard to processing sentences including verbs typically used transitively as L1 speakers, but not for other types of verbs; dative verbs and verbs that typically take infinitive complement.

4.2.3 Residual Problems

The present study partly replicates Yabuuchi et al. (2001), and attempts to further explore the use of verb subcategorization in the gap-filling process of Japanese EFL learners. However, there are several residual problems in the previous study. First, the words used in the experimental sentences were not sufficiently controlled. They should be carefully controlled with length, frequency and familiarity. Second, the participants were not appropriately classified. They used

a TOEIC type grammatical test with thirty questions as a placement test, but it was not established if the score reflected their proficiency. The proficiency level of participants should be assessed by appropriate criteria and more clearly distinguished. Third, some inappropriate sentences were included in the stimuli. For example, in a sentence using an infinitive complement preference verb like "*The man wasn't sure which farmer the boy allowed to sell a horse",* the difference of reader's behavior from the behavior of transitive preference verbs cannot be determined because the gap is likely to be filled at the verb, *allowed.* Therefore, an experiment with improving these problems was conducted in the present study.

4.3 Research Questions

In order to examine how Japanese EFL learners use verb subcategorization information during sentence comprehension, two research questions guided Experiment 2.

1. How do Japanese EFL learners use subcategorization information in processing filler-gap sentences on-line?
2. How does proficiency level affect processing filler-gap sentences?

4.4 Method

4.4.1 Participants

Thirty five undergraduate and graduate students learning English as a foreign language at Konan Women's University and Kobe University participated in the experiment in the first semester of 2009. They were fourteen males and twenty-one females, and their ages ranged from eighteen to fifty seven. They were divided into three groups; high, intermediate, and low proficiency groups according to SLEP Test (Secondary Level English Proficiency Test) reading section scores. The score ranges for the high, intermediate, and low groups are 61-73 (n =14), 51-60 (n = 8), 27-48 (n = 13), and the mean score and standard deviations are 66 (4.4), 55 (2.7), 39 (6.8) respectively (full-score = 75). None of them had known auditory or visual disorders.

4.4.2 Materials

Based on three verb norming studies, Connine, Ferreria, Jones, Clifton, and Frazier (1984), Pickering, Traxler, and Crocker (2000), and Traxler (2005), four types of verb were selected: (1)

transitive preference verbs (more than 60% of direct object continuation), (2) intransitive preference verbs (less than 15% of direct object continuation and more than 60% of using as a intransitive verb), (3) dative verbs, (4) verbs that are typically followed by infinitive complement. Eight verbs of each type were chosen and they were placed in embedded questions in which the questioned noun phrase was the object of the verb in filler-gap sentences. Two types of fillers were used: fillers that were plausible as the object of the verb and fillers that were implausible objects. In addition, for each verb, the baseline condition in which there is no filler-gap dependency was constructed. Thirty-two sentences were constructed as experimental sentences using four types of verbs and another thirty-two sentences were constructed as distracters. Four sets of experimental sentences were constructed in order to counterbalance the design. Thus, 160 sentences were constructed overall (each participant read sixty-four sentences). All the words used in experimental sentences were more than 5.0 familiarity rate on a 7 point scale (7 = highly familiar; Yokokawa, ed., 2006). The number of syllables of a noun phrase in the embedded clause was also controlled. All the verbs used in embedded clauses, the examples of the experimental sentences, and the positions in which gaps were posited and filled in the previous studies (critical regions) are shown in Table 12.

Table 12 Examples of Experimental Sentence and Verbs

1. Simple transitive preference verb (*call, choose, clean, kick, hear, paint, see, watch*)
The man / wasn't sure / which horse (*song) / the boy / *watched* / this morning.
[BL] The man / wasn't sure / whether / the boy / *watched* / the horse (*song) / this morning.
2. Intransitive preference verb (*hurry, move, race, run, sit, stand, swim, walk*)
The man / wasn't sure / which horse (*rock) / the boy / *raced* / this morning.
[BL] The man / wasn't sure / whether / the boy / *raced* / the horse (*rock) / this morning.
3. Dative verb (*bring, buy, give, pass, send, show, teach, tell*)
The teacher / was sure / which news (*boy) / the coach / *told* / to the student / at school.
[BL] The teacher / was sure / whether / the coach / *told* / the news (*boy) / to the student / at school.
4. Infinitive complement verb (*advise, allow, expect, force, order, permit, push, want*)
The teacher / was sure / which party (*woman) / the coach / *permitted* / the student / to attend / at school.

[BL] The teacher / was sure / whether / the coach / *permitted* / the student / to attend / the party (*woman) /at school.

Note. Asterisks indicate implausible fillers. Underlines indicate gap-filling positions. BL = baseline.

4.4.3 Instruments

In order to pace the presentation of stimuli, and record reading times, the experiment task was conducted on a mainframe personal computer (Sony VAIO Notebook Computer running Microsoft Windows XP) using the psychological experiment software SuperLab Pro (Cedrus Corporation, 1995).

4.4.4 Procedure

Each participant in the experiment was tested individually while seated in front of a personal computer. A self-paced phrase-by-phrase reading task was conducted using the psychological experiment software program. All phrases appeared in the center of the computer screen. Before the experiments started, the instructions were given and a practice session was conducted with four trials. Each trial began with the mark "+++++" on the screen. When participants pressed the spacebar for the first time, the mark changed to the first phrase in the sentence. When participants pressed the spacebar for the second time, the first phrase changed to the second phrase. Participants were instructed to continue pressing the spacebar as long as the sentence continued to make sense. When they thought the sentence had stopped making sense, they were immediately to press a different key. This was called a "no-response." The time between presentations of a phrase was measured to millisecond accuracy by the program. This allowed for two ways to observe implausibility: increased reading times and increased number of no-response at a particular position. The experiment was approximately twenty minutes long including instructions and trial tests.

4.4.5 Data Analysis

Reading times and no-response rates at the critical regions between plausible and implausible filler-gap sentences were compared. To answer the research questions mentioned in 4.3, the data of each type of verb and proficiency group were separately analyzed using two-way ANOVAs:

(plausible: implausible) x (FG: baseline). The results of the intermediate proficiency group were not analyzed. All statistical analyses were conducted using Excel Statistics 2008 for Windows.

4.5 Results and Discussion

As described previously, increased reading times and increased number of no responses at the critical regions indicate that gaps are posited and filled at that position. In order to examine whether Japanese EFL learners posited and filled the gaps at the same position as L1 speakers, reading times and no-response rate at the critical regions between ambiguous plausible sentences and ambiguous implausible sentences were compared.

4.5.1 Simple Transitive Verbs

Table 13 and Figure 7 show mean reading times and no-response rates for each region of sentences with simple transitive verbs for the high proficiency group. There was a significant interaction between plausibility and ambiguity at the embedded verb position (P5). Increased reading time was found at the position of implausible FG sentences. They were read 459 ms slower than plausible sentences, which led to a main effect of plausibility (F (1, 51) = 7.42, $p < .01$, $\eta^2 = .12$). This suggests that the gaps were posited and filled at the embedded verb. No-response rates started to increase at the embedded verb position (P5) of FG sentences, but there was no significant plausibility effect. Increased no-response rates (36%) were also observed at a word after the verb (P6), suggesting the gap-filling was delayed compared to L1 speakers. Overall no-response rate for implausible FG sentences was 68%, which is lower than that of L1 speakers from previous studies. From these results, it seems that high proficiency learners tend to process FG sentences using subcategorization of simple transitive verbs; however, they do not do so as automatically as L1 speakers.

Table 13
Mean Reading Time and No-Response Rate of Simple Transitive Verbs: High Proficiency Group

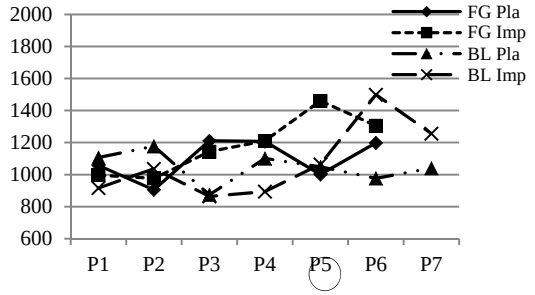
A: Mean Reading Time (ms) and SD

	P1	P2	P3	P4	P5	P6	P7
FG Transitive Pla	The man	wasn't sure	which horse	the boy	watched	this morning.	
	1057(557)	905(223)	1211(435)	1207(701)	1001(336)	1198(561)	
FG Transitive Imp	The man	wasn't sure	which song	the boy	watched	this morning.	
	997(280)	977(302)	1143(472)	1210(493)	1460(763)	1305(768)	
BL Pla	The man	wasn't sure	whether	the boy	watched	the horse	this morning.
	1106(724)	1177(644)	874(281)	1101(619)	1048(368)	977(359)	1040(405)
BL Imp	The man	wasn't sure	whether	the boy	watched	the song	this morning.
	916(436)	1036(598)	864(251)	894(306)	1064(410)	1499(738)	1256(657)

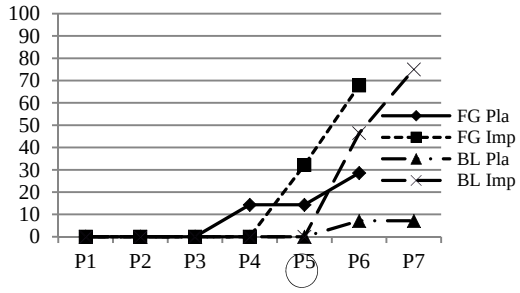
B: Mean No-Response Rate (%)

	P1	P2	P3	P4	P5	P6	P7
FG Transitive Pla	The man	wasn't sure	which horse	the boy	watched	this morning.	
	0	0	0	14.29	0	14.29	
FG Transitive Imp	The man	wasn't sure	which song	the boy	watched	this morning.	
	0	0	0	0	32.14	35.71	
BL Pla	The man	wasn't sure	whether	the boy	watched	the horse	this morning.
	0	0	0	0	0	7.14	7.14
BL Imp	The man	wasn't sure	whether	the boy	watched	the song	this morning.
	0	0	0	0	0	46.43	28.57

A: Mean reading time (ms)



B: Cumulative no-response rate (%)



[FG] The man / wasn't sure / which horse (*song) / the boy / watched / this morning.
[BL] The man / wasn't sure / whether / the boy / watched / the horse (*song) / this morning.

Figure 7. Mean reading time and no-response rate of simple transitive verbs: high proficiency group
Note. FG Pla = plausible filler-gap sentence, FG Imp = implausible filler-gap sentence, P 1 = phrase one, Ⓟ= critical region (gap-filling position in the L1 studies), asterisk = implausible object of embedded verb, underline indicates a critical region.

Table 14 and Figure 8 indicate mean reading times and no-response rates for each region of sentences with simple transitive verbs for the low proficiency group. Increased reading times and no-response rates already appeared at P3 position (*which*) in FG sentences. There was no

significant plausibility effect either for reading time or no-response rate at the embedded verb of FG sentences. Overall no-response rate for implausible FG sentences was 65%, which is similar to the results of the high proficiency group. However, no-response rate was 42% for plausible FG sentences, which is higher than the high proficiency group. Taken together, it seems to be quite difficult for low proficiency learners to process sentences with complex structure.

Table 14
Mean Reading Time and No-Response Rate of Simple Transitive Verbs: Low Proficiency Group

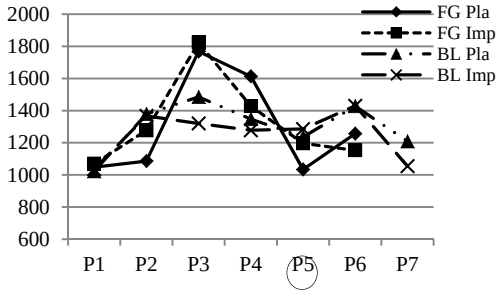
A: Mean Reading Time (ms) and SD

	P1	P2	P3	P4	P5	P6	P7
FG Transitive Pla	The man	wasn't sure	which horse	the boy	watched	this morning.	
	1048(642)	1086(589)	1768(665)	1613(818)	1034(263)	1257(656)	
FG Transitive Imp	The man	wasn't sure	which song	the boy	watched	this morning.	
	1069(448)	1277(598)	1823(724)	1428(724)	1196(795)	1153(832)	
B L Pla	The man	wasn't sure	whether	the boy	watched	the horse	this morning.
	1023(705)	1379(731)	1485(693)	1347(788)	1236(779)	1428(736)	1209(542)
BL Imp	The man	wasn't sure	whether	the boy	watched	the song	this morning.
	1036(683)	1367(673)	1320(660)	1278(879)	1286(860)	1430(911)	1055(454)

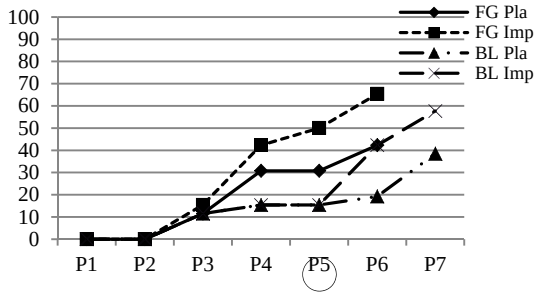
B: Mean No-Response Rate (%)

FG Transitive Pla	The man	wasn't sure	which horse	the boy	watched	this morning.	
	0	0	11.54	19.23	0	11.54	
FG Transitive Imp	The man	wasn't sure	which song	the boy	watched	this morning.	
	0	0	15.38	26.92	7.69	15.38	
B L Pla	The man	wasn't sure	whether	the boy	watched	the horse	this morning.
	0	0	11.54	3.85	0	3.85	19.23
BL Imp	The man	wasn't sure	whether	the boy	watched	the song	this morning.
	0	0	11.54	3.85	0	26.92	15.38

A: Mean reading time (ms)



B: Cumulative no-response rate (%)



[FG] The man / wasn't sure / which horse (*song) / the boy / watched / this morning.
[BL] The man / wasn't sure / whether / the boy / watched / the horse (*song) / this morning.

Figure 8. Mean reading time and no-response rate of simple transitive verbs: low proficiency group
Note. FG Pla = plausible filler-gap sentence, FG Imp = implausible filler-gap sentence, P 1 = phrase one, Ⓟ= critical region (gap-filling position in the L1 studies), asterisk = implausible object of embedded verb, underline indicates a critical region.

4.5.2 Dative Verbs

Table 15 and Figure 9 indicate mean reading times and no-response rates for each region of sentences with dative verbs for the high proficiency group. Although increased reading times were observed at the critical region (P6: to the student) in implausible FG sentences, there was no significant difference between plausible and implausible FG sentences. However, there was a significant interaction between plausibility and ambiguity before the critical region. A significant plausibility effect was found a word before the critical region (P5: *told*), which is similar to the result for sentences with simple transitive verbs (F (1, 55) = 5.70, $p < .05$, $\eta^2 = .09$). In addition, increased no-response rates in implausible FG sentences appeared at the embedded verb and became the highest in the following region, which is also quite similar to the tendency found in sentences with simple transitive verbs. These results suggest that high proficiency learners tend to regard embedded verbs as simple transitive verbs, and gaps seemed to be posited and filled at the embedded verbs. The overall no-response rate for implausible FG sentences was 61%, which is lower than that of L1 speakers in the previous studies. These results show that even high proficiency learners cannot use subcategorization information of dative verbs efficiently in processing FG sentences.

Table 15 Mean Reading Time and No-Response Rate of Dative Verbs: High Proficiency Group

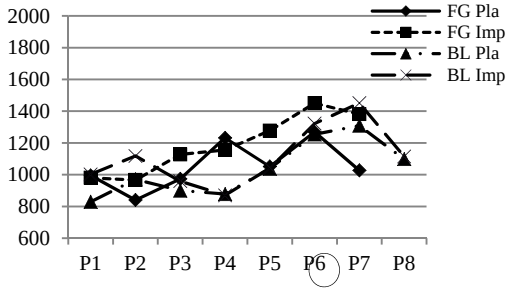
A: Mean Reading Time (ms) and SD

	P1	P2	P3	P4	P5	P6	P7	P8
FG Dative Pla	The teacher	was sure	which news	the coach	told	to the student	at school.	
	995(647)	840(239)	973(309)	1232(657)	1051(618)	1269(498)	1027(561)	
FG Dative Imp	The teacher	was sure	which boy	the coach	told	to the student	at school.	
	980(584)	966(302)	1127(472)	1155(475)	1277(679)	1450(274)	1381(661)	
BL Pla	The teacher	was sure	whether	the coach	told	the news	to the student	at school.
	829(335)	970(287)	900(304)	878(271)	1038(384)	1254(384)	1309(471)	1098(393)
BL Imp	The teacher	was sure	whether	the coach	told	the boy	to the student	at school.
	1002(445)	1118 (380)	959(367)	870(237)	1040(481)	1322(331)	1451(330)	1115(502)

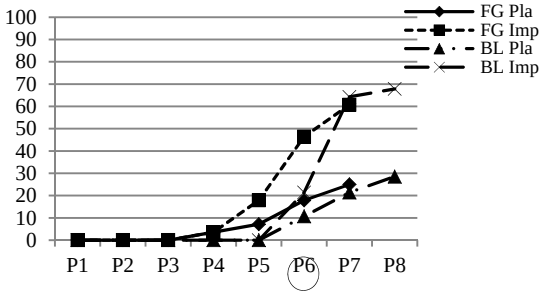
B: Mean No-Response Rate (%)

FG Dative Pla	The teacher	was sure	which news	the coach	told	to the student	at school.	
	0	0	0	3.57	3.57	10.71	7.14	
FG Dative Imp	The teacher	was sure	which boy	the coach	told	to the student	at school.	
	0	0	0	3.57	14.29	28.57	14.29	
BL Pla	The teacher	was sure	whether	the coach	told	the news	to the student	at school.
	0	0	0	0	0	10.71	10.71	7.14
BL Imp	The teacher	was sure	whether	the coach	told	the boy	to the student	at school.
	0	0	0	0	0	21.43	42.86	3.57

A: Mean reading time (ms)



B: Cumulative no-response rate (%)



[FG] The teacher / was sure / which news (*boy) / the coach / told / <u>to the student</u> / at school.
[BL] The teacher / was sure / whether / the coach / told / the news (*boy) / to the student / at school.

Figure 9. Mean reading time and no-response rate of dative verbs: high proficiency group
Note. FG Pla = plausible filler-gap sentence, FG Imp = implausible filler-gap sentence, P 1 = phrase one, Ⓟ= critical region (gap-filling position in the L1 studies), asterisk = implausible object of embedded verb, underline indicates a critical region.

Table 16 and Figure 10 indicate reading times and no-response rates for each region of sentences with dative verbs for the low proficiency group. Reading times and no-response rates increased at P3 position in both FG sentences and baseline, suggesting a difficulty in processing complex sentences. There was no significant plausibility effect either for reading time or no-response rate at the critical region (P6) of FG sentences. The overall no-response rate for implausible FG sentences was 54%, which is far lower than that of L1speakers in the previous studies.

Table 16 Mean Reading Time and No-Response Rate of Dative Verbs: Low Proficiency Group

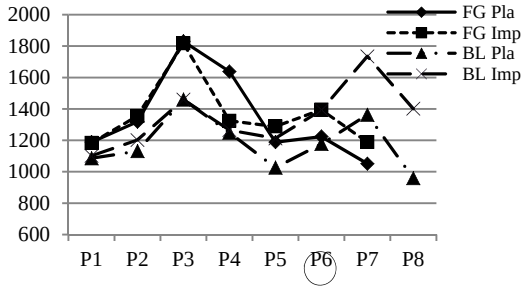
A: Mean Reading Time (ms) and SD

	P1	P2	P3	P4	P5	P6	P7	P8
FG Dative Pla	The teacher	was sure	which news	the coach	told	to the student	at school.	
	1188(613)	1318(804)	1830(820)	1638(862)	1188(641)	1224(398)	1051(509)	
FG Dative Imp	The teacher	was sure	which boy	the coach	told	to the student	at school.	
	1183(762)	1355(747)	1817(843)	1324(590)	1288(561)	1395(448)	1188(370)	
BL Pla	The teacher	was sure	whether	the coach	told	the news	to the student	at school.
	1086(659)	1131(567)	1460(786)	1249(635)	1026(387)	1177(694)	1363(846)	959(187)
BL Imp	The teacher	was sure	whether	the coach	told	the boy	to the student	at school.
	1101(683)	1202(415)	1459(742)	1265(671)	1212(690)	1392(347)	1735(794)	1401(475)

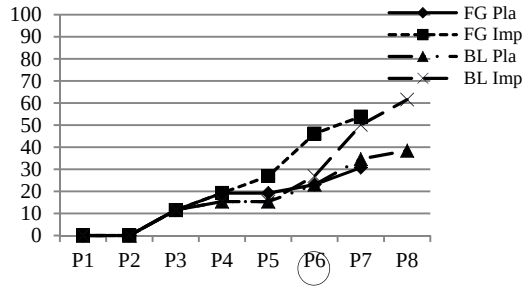
B: Mean No-Response Rate (%)

FG Dative Pla	The teacher	was sure	which news	the coach	told	to the student	at school.	
	0	0	11.54	7.69	0	3.85	7.69	
FG Dative Imp	The teacher	was sure	which boy	the coach	told	to the student	at school.	
	0	0	11.54	7.69	7.69	19.23	7.69	
BL Pla	The teacher	was sure	whether	the coach	told	the news	to the student	at school.
	0	0	11.54	3.85	0	7.69	11.54	3.85
BL Imp	The teacher	was sure	whether	the coach	told	the boy	to the student	at school.
	0	0	11.54	3.85	0	11.54	23.08	11.54

A: Mean reading time (ms)



B: Cumulative no-response rate (%)



[FG] The teacher / was sure / which news (*boy) / the coach / told / to the student / at school.
[BL] The teacher / was sure / whether / the coach / told / the news (*boy) / to the student / at school.

Figure 10. Mean reading time and no-response rate of dative verbs: low proficiency group
Note. FG Pla = plausible filler-gap sentence, FG Imp = implausible filler-gap sentence, P 1 = phrase one, Ⓟ= critical region (gap-filling position in the L1 studies), asterisk = implausible object of embedded verb, underline indicates a critical region.

4.5.3 Infinitive Complement Verbs

Table 17 and Figure 11 indicate mean reading times and no-response rates for each region of sentences with infinitive complement verbs for the high proficiency group. Reading time and no-response rates increased at a word before *to* infinitive (P6), and no significant plausibility effect was observed either for reading time or no-response rate at P7, indicating gaps were not posited and

filled at the position of *to* infinitive of FG sentences. These results suggest that high proficiency learners cannot use subcategorization information of infinitive complement verbs.

Table 17
Mean Reading Time and No-Response Rate of Infinitive Complement Verbs: High Proficiency Group

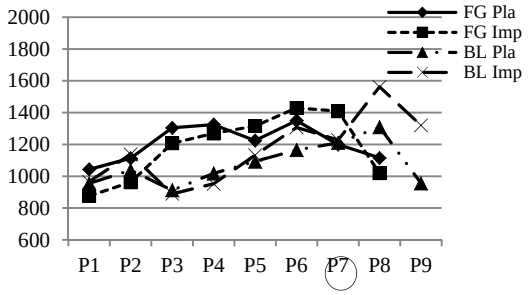
A: Mean Reading Time (ms) and SD

	P1	P2	P3	P4	P5	P6	P7	P8	P9
FG Infinitive Pla	The teacher	was sure	which party	the coach	permitted	the student	to attend	at school.	
	1043(613)	1113(561)	1304(560)	1325(637)	1224(496)	1350(604)	1199(339)	1115(263)	
FG Infinitive Imp	The teacher	was sure	which woman	the coach	permitted	the student	to attend	at school.	
	876(327)	962(332)	1207(474)	1269(602)	1316(574)	1372(425)	1409(153)	1019(399)	
BL Pla	The teacher	was sure	whether	the coach	permitted	the student	to attend	the party	at school.
	954(290)	1038(404)	912(397)	1018(411)	1093(409)	1165(513)	1210(348)	1309(475)	956(414)
BL Imp	The teacher	was sure	whether	the coach	permitted	the student	to attend	the woman	at school.
	965(342)	1138(579)	889(361)	952(409)	1132(355)	1307(343)	1228(346)	1562(637)	1320(360)

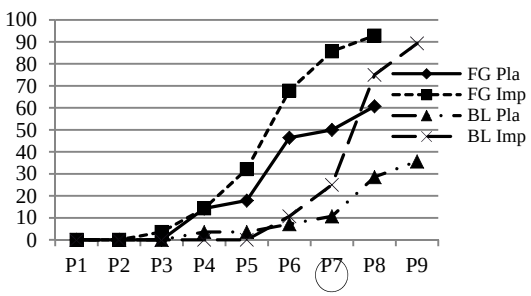
B: Mean No-Response Rate (%)

	P1	P2	P3	P4	P5	P6	P7	P8	P9
FG Infinitive Pla	The teacher	was sure	which party	the coach	permitted	the student	to attend	at school.	
	0	0	0	14.29	3.57	28.57	3.57	10.71	
FG Infinitive Imp	The teacher	was sure	which woman	the coach	permitted	the student	to attend	at school.	
	0	0	3.57	10.71	17.86	35.71	17.86	7.14	
BL Pla	The teacher	was sure	whether	the coach	permitted	the student	to attend	the party	at school.
	0	0	0	3.57	0	3.57	3.57	17.86	3.57
BL Imp	The teacher	was sure	whether	the coach	permitted	the student	to attend	the woman	at school.
	0	0	0	0	0	10.71	14.29	50	14.29

A: Mean reading time (ms)



B: Cumulative no-response rate (%)



[FG] The teacher / was sure / which party (*woman) / the coach / permitted / the student / to attend / at school.
[BL] The teacher / was sure / whether / the coach / permitted / the student / to attend / the party (*woman) / at school.

Figure 11. Mean reading time and no-response rate of infinitive complement verbs: high proficiency group

Note. FG Pla = plausible filler-gap sentence, FG Imp = implausible filler-gap sentence, P 1 = phrase one, Ⓟ= critical region (gap-filling position in the L1 studies), asterisk = implausible object of embedded verb, underline indicates a critical region.

Table 18 and Figure 12 indicate mean reading times and no-response rates for each region of sentences with infinitive complement verbs for the low proficiency group. Again, increased

reading times and no-response rates appeared at P3 and overall no-response rate for implausible FG sentences was low (58%), suggesting a difficulty in processing complex sentences. No significant plausibility effect was observed either on reading time or no-response rate at the position of *to* infinitive of FG sentences. This sentence type has the longest distance between the filler and the gap of all, which may be one of the factors that causes a difficulty in processing FG dependencies.

Table 18
Mean Reading Time and No-Response Rate of Infinitive Complement Verbs: Low Proficiency Group

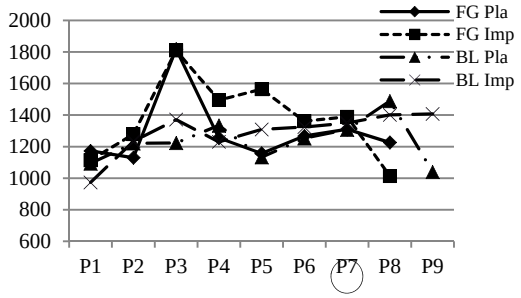
A: Mean Reading Time (ms) and SD

	P1	P2	P3	P4	P5	P6	P7	P8	P9
FG Infinitive Pla	The teacher	was sure	which party	the coach	permitted	the student	to attend	at school.	
	1173(569)	1130 (531)	1818(865)	1255(775)	1157(237)	1267(562)	1310(453)	1226(490)	
FG Infinitive Imp	The teacher	was sure	which woman	the coach	permitted	the student	to attend	at school.	
	1114(674)	1279(539)	1809(631)	1495(571)	1564(655)	1361(262)	1389(332)	1013(237)	
BL Pla	The teacher	was sure	whether	the coach	permitted	the student	to attend	the party	at school.
	954(290)	1038(404)	912(397)	1018(411)	1093(409)	1165(513)	1210(348)	1309(475)	956(414)
BL Imp	The teacher	was sure	whether	the coach	permitted	the student	to attend	the woman	at school.
	965(342)	1138(579)	889(361)	952(409)	1132(355)	1307(343)	1228(346)	1562(637)	1320(360)

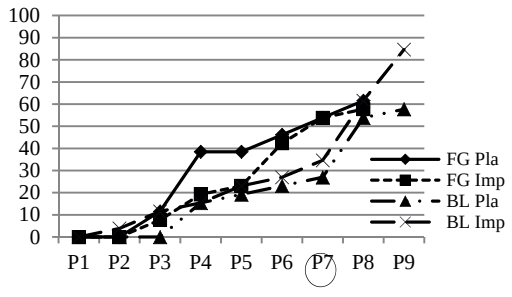
B: Mean No-Response Rate (%)

	P1	P2	P3	P4	P5	P6	P7	P8	P9
FG Infinitive Pla	The teacher	was sure	which party	the coach	permitted	the student	to attend	at school.	
	0	0	11.54	26.92	0	7.69	7.69	7.69	
FG Infinitive Imp	The teacher	was sure	which woman	the coach	permitted	the student	to attend	at school.	
	0	0	7.69	11.54	3.85	19.23	11.54	3.85	
BL Pla	The teacher	was sure	whether	the coach	permitted	the student	to attend	the party	at school.
	0	0	15.38	3.85	3.85	3.85	3.85	26.92	3.85
BL Imp	The teacher	was sure	whether	the coach	permitted	the student	to attend	the woman	at school.
	0	3.85	7.69	3.85	7.69	3.85	7.69	26.92	23.08

A: Mean reading time (ms)



B: Cumulative no-response rate (%)



[FG] The teacher / was sure / which party (*woman) / the coach / permitted / the student / to attend / at school.
[BL] The teacher / was sure / whether / the coach / permitted / the student / to attend / the party (*woman) / at school.

Figure 12. Mean reading time and no-response rate of infinitive complement verbs: low proficiency group

Note. FG Pla = plausible filler-gap sentence, FG Imp = implausible filler-gap sentence, P 1 = phrase one, Ⓟ= critical region (gap-filling position in the L1 studies), asterisk = implausible object of embedded verb, underline indicates a critical region.

4.5.4 Intransitive Preference Verbs

Table 19 and Figure 13 indicate mean reading times and no-response rates for each region of sentences with intransitive preference verbs for the high proficiency group. Although reading times increased at the embedded verb of implausible FG sentences, there was no significant difference between plausible and implausible FG sentences. This indicated that the gaps were not posited and filled at the embedded verb. Increased no-response rate was observed at the embedded verb in both plausible and implausible FG sentences, suggesting high proficiency learners regarded the embedded verb as an intransitive verb. Increased no-response rate was also observed at a word after the embedded verb, suggesting the gap-filling was delayed. These results show that high proficiency learners at least have knowledge of transitive and intransitive verbs.

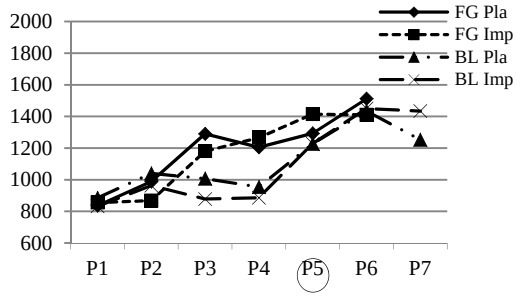
Table 19

Mean Reading Time and No-Response Rate of Intransitive Preference Verbs: High Proficiency Group

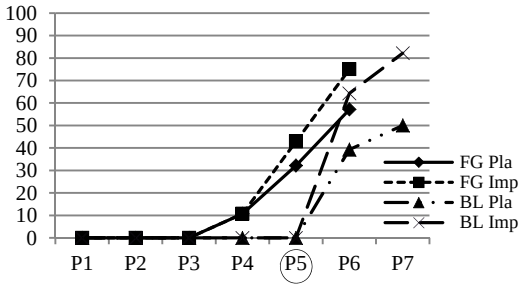
A: Mean Reading Time (ms) and SD

	P1	P2	P3	P4	P5	P6	P7
FG Intransitive Pla	The man	wasn't sure	which horse	the boy	raced	this morning.	
	836(269)	988(511)	1290(707)	1205(457)	1293(616)	1512(822)	
FG Intransitive Imp	The man	wasn't sure	which rock	the boy	raced	this morning.	
	855(274)	868(259)	1180(446)	1266(544)	1414(438)	1410(581)	
BL Pla	The man	wasn't sure	whether	the boy	raced	the horse	this morning.
	885(351)	1040(461)	1007(420)	954(358)	1227(697)	1434(516)	1253(631)
BL Imp	The man	wasn't sure	whether	the boy	raced	the rock	this morning.
	832(314)	963(400)	878(317)	886(255)	1228(493)	1450(752)	1434(860)
B: Mean No-Response Rate (%)							
FG Intransitive Pla	The man	wasn't sure	which horse	the boy	raced	this morning.	
	0	0	0	10.71	21.43	25	
FG Intransitive Imp	The man	wasn't sure	which rock	the boy	raced	this morning.	
	0	0	0	10.71	32.14	32.14	
BL Pla	The man	wasn't sure	whether	the boy	raced	the horse	this morning.
	0	0	0	0	0	39.29	10.71
BL Imp	The man	wasn't sure	whether	the boy	raced	the rock	this morning.
	0	0	0	0	0	64.29	17.86

A: Mean reading time (ms)



B: Cumulative no-response rate (%)



[FG] The man / wasn't sure / which horse (*rock) / the boy / raced / this morning.
[BL] The man / wasn't sure / whether / the boy / raced / the horse (*rock) / this morning.

Figure 13. Mean reading time and no-response rate of intransitive preference verbs: high proficiency group

Note. FG Pla = plausible filler-gap sentence, FG Imp = implausible filler-gap sentence, P 1 = phrase one, Ⓟ= critical region (gap-filling position in the L1 studies), asterisk = implausible object of embedded verb, underline indicates a critical region.

Table 20 and Figure 14 indicate mean reading times and no-response rates for each region of sentences with intransitive preference verbs for the low proficiency group. Again, reading times and no-response rates increased at P3 position in both FG sentences and baseline, suggesting a difficulty in processing complex sentences.

Table 20
Mean Reading Time and No-Response Rate of Intransitive Preference Verbs: Low Proficiency Group

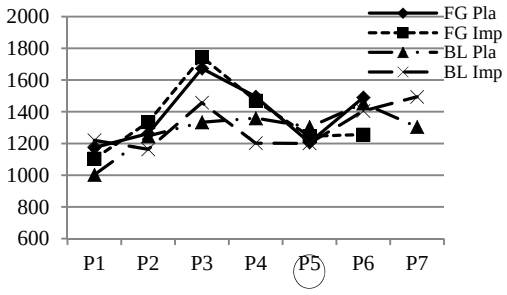
A: Mean Reading Time (ms) and SD

	P1	P2	P3	P4	P5	P6	P7
FG Intransitive Pla	The man	wasn't sure	which horse	the boy	raced	this morning.	
	1174(694)	1262(678)	1673(781)	1495(687)	1207(699)	1490(617)	
FG Intransitive Imp	The man	wasn't sure	which rock	the boy	raced	this morning.	
	1104(781)	1334(635)	1745(811)	1470(773)	1246(592)	1256(666)	
BL Pla	The man	wasn't sure	whether	the boy	raced	the horse	this morning.
	1003(337)	1247(551)	1334(689)	1360(634)	1304(552)	1453(608)	1305(675)
BL Imp	The man	wasn't sure	whether	the boy	raced	the rock	this morning.
	1365(947)	1163(429)	1457(684)	1202(294)	1201(220)	1405(851)	1494(666)

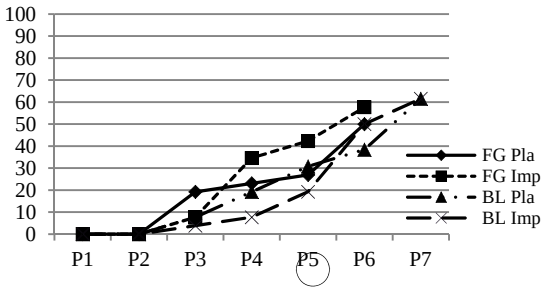
B: Mean No-Response Rate (%)

FG Intransitive Pla	The man	wasn't sure	which horse	the boy	raced	this morning.	
	0	0	19.23	3.85	3.85	23.08	
FG Intransitive Imp	The man	wasn't sure	which rock	the boy	raced	this morning.	
	0	0	7.69	26.92	7.69	15.38	
BL Pla	The man	wasn't sure	whether	the boy	raced	the horse	this morning.
	0	0	7.69	11.54	11.54	7.69	23.08
BL Imp	The man	wasn't sure	whether	the boy	raced	the rock	this morning.
	0	0	3.85	3.85	11.54	30.77	11.54

A: Mean reading time (ms)



B: Cumulative no-response rate (%)



[FG] The man / wasn't sure / which horse (*rock) / the boy / raced / this morning.
[BL] The man / wasn't sure / whether / the boy / raced / the horse (*rock) / this morning.

Figure 14. Mean reading time and no-response rate of intransitive preference verbs: low proficiency group

Note. FG Pla = plausible filler-gap sentence, FG Imp = implausible filler-gap sentence, P 1 = phrase one, Ⓟ= critical region (gap-filling position in the L1 studies), asterisk = implausible object of embedded verb, underline indicates a critical region.

4.6 Concluding Remarks and Implications

In Experiment 2, how Japanese EFL learners utilize verb subcategorization information during sentence comprehension with four types of verbs was investigated. The main result to consider in Experiment 2 was that high proficiency learners can use verb subcategorization of simple transitive verbs; however, they cannot use it as automatically as L1 speakers. This outcome implies that they seem to store lexical information in their mental lexicon as well as L1 speakers; however, they cannot use it efficiently for sentence processing. What may have occurred was that access to representation of syntactic information was slower and less-automated compared with L1 speakers. The results can also be explained by a deterioration of working memory activation. In sentence processing, readers need to store processed information while processing incoming

information, namely, they process and store information simultaneously (see 2.2.3). As working memory is assumed to have two functions, storage and processing, and because resources of working memory are limited, these two functions are competing with each other for the same resources. This means good readers can efficiently allocate resources for storage and processing. In other words, they cannot deal with the computation of allocation for storage and processing efficiently. As discussed in Chapter 1, this phenomenon occurs presumably because of a foreign language side effect (Takano & Noda, 1993, 1995) which temporarily deteriorates activation of working memory.

With regard to dative verbs, verbs that typically take infinitive complements, and intransitive preference verbs, they cannot use the subcategorization information in real time. As Jurafsky (2003) argues, it may reflect the frequency of syntactic frame because simple transitive is the most frequent verb frame for Japanese EFL learners. The outcomes of the experiment show how frequently Japanese EFL learners are exposed to sentences with simple transitive verbs, whereas they are infrequently exposed to sentences with dative, infinitive complement and intransitive preference verbs.

Low proficiency learners may have insufficient lexical representation in their mental lexicon, so that they are not able to use it for sentence processing. The results also reveal that low proficiency learners do not seem to have subcategorization representation itself, which can cause difficulty in processing sentences with long- distance dependencies.

In sum, it appears unlikely that Japanese EFL learners, even high proficiency learners, can use verb subcategorization information efficiently for parsing. Therefore, a logical next step is an investigation of factors that contribute to the representation of syntactic information of verbs in mental lexicon and to the automaticity of sentence processing of Japanese EFL learners.

CHAPTER 5

EXPERIMENT 3: The Effects of Exposure to Specific Syntactic Structures on Sentence Comprehension of Japanese EFL Learners: Evidence from a Psycholinguistic Experiment

5.1 Introduction

The findings from Experiment 2 (Nagai et al., 2010) raise the question; how do learners improve the representation of verb subcategorization information in their mental lexicon and develop the ability to use it for sentence processing? Experiment 3 explores types of activities or tasks that would establish verb syntactic representation and encourage parsing. This chapter presents some previous studies of language learning and the details of Experiment 3, including research questions, hypotheses, methods, results, discussion and conclusions.

5.2 Previous Studies

5.2.1 Effects of Prior Exposure to Language

McDonough and Trofimovich (2009) state that prior exposure to language somehow influences subsequent language processing. This is a phenomenon that they refer to as "priming" which may occur in the form of recognition and production. McDonough and Trofimovich note:

> In most scenarios, the initial language form or aspects of its meaning, referred as the prime, facilitate the recognition or production of a subsequent form or aspects of its meaning, which is referred to as the response or target. Priming is believed to be an implicit process that for the most part occurs with little awareness on the part of individual language users. Its implicit nature makes priming one manifestation of a larger system of human memory – implicit memory. Briefly, implicit memory involves memory for cognitive operations or procedures that are learned through repeated use, and includes memory for skills and habits and priming. (pp. 1-2)

In technical terms, priming is defined as "facilitative effects of an encounter with stimulus on subsequent processing of the same or a related stimulus" (Tulving, Schacter, & Stark, 1982, p. 336). Syntactic priming refers to a general tendency for language users to often produce a syntactic

structure following previous experience with that structure; however, it also seems to occur during processing a syntactic structure. It is not only the tendency for speakers to produce, but also for readers or listeners to comprehend a particular syntactic structure after recent exposure to that structure.

5.2.2 Repetition and Attention

In the1940 and 1950s, the audio-lingual approach (Fries, 1945; Lado, 1957) which is theoretically based on structural linguistics and behaviorist psychology, argued that imitation and repetition are important for language learning particularly at the early stage of learning. Language is believed to be acquired by habit formation. Therefore, in this approach, mimicry and memorization (Mim-Mem) and pattern practice should be repeated until learners are able to use the sentence patterns automatically.

In a more recent study of SLA, Swain (1985) puts forth the Output Hypothesis that argues that L2 acquisition is promoted by learners being pushed to produce language that is accurate and precise. She argues that repetition promotes fluency of language processing, which facilitates automatization of access to already acquired knowledge. This hypothesis is regarded as an addition to the Input Hypothesis (Krashen, 1985), and language acquisition is considered to require not only comprehensible input but also output. She pointed out four functions of output as instructional implications (Swain, 1993; 1995): enhancing fluency by repetition, promoting noticing, testing hypothesis by feedback, and talking about language (meta-linguistic function).

De Bot (1996) treats Swain's Output Hypothesis from a psycholinguistic perspective and attempted to clarify the psycholinguistic mechanisms behind it. Taking the language information processing approach, Levelt's model of language production (Levelt, 1993) and Anderson's learning theory (Anderson, 1982), he argues that output plays an important role in SLA because it generates highly specific input that the language processing system needs in order to build a coherent set of knowledge. It also plays a direct role in promoting fluency by turning declarative knowledge into procedural knowledge because procedural memory requires learners to repeat the procedures to acquire target knowledge. Output also can play an indirect role in acquisition of declarative knowledge by triggering input that the learner can use for new declarative knowledge. He hypothesizes that the effect of output occurs in the transition of declarative knowledge to procedural

knowledge (see 2.1 for declarative and procedural knowledge).

In a study of vocabulary learning, Nation (1990) states that seeing the word form and its meaning is not as effective as having to make an effort to recall its meaning before being shown the definition as feedback. This means that if the teacher does not use challenging ways to draw the learner's attention to a word, learning will not occur. If learning is unsuccessful, the word will need to be repeated for success. Nation provided evidence to show that there is a relationship between learning and repetition. Kachoo (1962) counted the number of repetitions of words in an English textbook and examined his Indian learners to see what words were learned. He found that words that occur seven or more times in the textbook were known by most of the learners, while over half of the words that occur only once or twice in the books were not known by most of them.

Salling (1959) obtained similar results, and he demonstrated that at least five repetitions were needed to ensure learning. Crothers and Suppes (1967) found six or seven repetition to be necessary. Saragi, Nation, and Meister (1978) found that sixteen or more repetitions were necessary to learn new vocabulary.

These results show that it is important for teachers, particularly who teach English as a foreign language, to know whether they can rely on a textbook to provide enough repetition for vocabulary learning to be possible. Teachers can work to check the repetition in the text book and if the textbook does not have enough repetition, then it will be necessary to add it. Nation (1990) stated, "If the teacher or textbook does not provide opportunity for sufficient repetition or for attention to vocabulary which will result in learning, then effort spent dealing with the vocabulary will be wasted" (p.45).

Yoshida et al. (2009) examined how the human brain works during the imitation and repetition of unknown words. They conducted an experiment using a functional MRI (fMRI) during practice of imitation and repetition of unknown foreign words by Japanese L1 speakers. The results showed that the neural substrates for vocal imitation learning appear in the left lateralized frontal mirror neuron system which seems to be involved in language processing. They also conducted a psychophysical experiment of vocabulary training to back up the results of fMRI and revealed the effectiveness of imitation and repetition in learning new vocabularies.

Thus, the previous studies demonstrate that imitation, repetition, and attention play important roles in language learning from the perspectives of both behavioral research and neuroscience.

5.2.3 Syntactic Awareness

Syntactic awareness refers to the ability to manipulate and reflect on the grammatical structure of language (Cain, 2007). To assess this ability, Cain conducted an experiment in 8- and 10-year old children using two syntactic awareness tasks; grammatical correction and word-order correction tasks. In word-order correction tasks, the words of a sentence are presented in a jumbled order and must to be rearranged; for example, “stroked the cat Sue.” In grammatical correction tasks, a grammatical or morphological anomaly in a sentence has to be corrected; for example, “The girl eat the chocolate.” Syntactic awareness is a meta-linguistic skill, distinct from the comprehension of a sentence because it concerns the ability to consider structure rather than the meaning of a sentence (Bowey, 1986, 1988). The research had two aims: to examine the influence made by vocabulary, grammatical knowledge and memory on syntactic awareness and to investigate whether these skills mediate the relationship between syntactic awareness and reading comprehension. The vocabulary, grammatical knowledge, and memory span of the participants were assessed and the skills influencing performance on measures of syntactic awareness were investigated. Reading ability was also assessed to investigate the relationship between syntactic awareness and reading comprehension. One interesting finding was the contrast between memory and grammatical knowledge as predictors. Memory was related to performance on the word-correction task in which words are stored and reordered, whereas grammatical knowledge was associated with the grammatical correction tasks. These findings support Bowey’s (1994) proposal that word-order correction tasks are more dependent on memory than grammatical correction tasks. They suggest that the relationship between syntactic awareness and reading comprehension is indirect and arises from the variance shared with vocabulary, grammatical knowledge and memory. In other words, it implies that cognitive demands that occur during the performance in word-correction tasks relates to the ability to manipulate syntactic structure of a sentence.

5.3 Research Questions

This experiment aims to examine whether exposure to a specific syntactic structure promotes sentence processing of Japanese EFL learners. In order to investigate what types of tasks are effective for processing of filler-gap sentences, three research questions guided Experiment 3.

1. Which task promotes processing of filler-gap sentences; A. reading aloud, B. repetition without looking, C. word-order correction tasks with reading aloud, D. word-order correction tasks with repetition without looking?
2. Is there any difference between repeating aloud and silent reading in the degree of effects?
3. How does verb subcategorization information affect the degree of effects?

5.4 Hypotheses

To answer the above research questions, five hypotheses guided the present study.

1. Memory required during repetition and word-order correction tasks promote parsing ability.
2. Tasks that require higher cognitive demand lead to better parsing performance.
3. Word-order correction tasks promote parsing ability.
4. Repeating aloud after silent reading is more effective than silent reading without repeating aloud on FG sentence processing.
5. The degree of effects varies depending on the type of verb subcategorization information.

5.5 Methods

5.5.1 Participants

Forty undergraduate and graduate students learning English as a foreign language at Konan Women's University and Kobe University participated in the experiment in the first semester of 2010. There were eight males and thirty two females, and their ages ranged from eighteen to forty-two. They took SLEP Test (Secondary Level English Proficiency Test) reading section, and eight participants whose scores were 63 and over or 38 and under were omitted from the data population. The rest (thirty-two participants) was divided into four homogeneous groups, A, B, C, and D group according to SLEP Test scores. The score ranges for A, B, C , and D group are 39-61, 40-61, 40-61, 40-60 and the mean scores and standard deviations are 48.1 (8.4), 47.4 (8.0), 47.2 (7.8), 47.9 (8.8) respectively (full-score = 75). None of them had known auditory or visual disorders.

5.5.2 Materials

Based on three verb norming studies, Connine et al. (1984), Pickering et al. (2000) and

Traxler (2005), three types of verb were selected: (1) transitive preference verbs (more than 60% of direct object continuation), (2) dative verbs, (3) verbs that are typically followed by infinitive complements. Eight verbs of each type were chosen and were identical to those in Experiment 2, except that intransitive preference verbs were omitted (see 4.4.2) and a dative verb *brought* was replaced by the dative verb *hand*. In Experiment 2, since low proficiency learners had difficulty in processing filler-gap sentences with embedded wh-question noun phrase, it was not possible to observe the critical region (gap-filling position) properly. Therefore, in Experiment 3, simple structured filler-gap sentences were constructed as experimental sentences. The selected verbs were placed as main verbs and the wh-question noun phrase was the object of the verb in the filler-gap sentences. Two types of fillers were used: fillers that were plausible as the object of the verb and fillers that were implausible objects. In addition, for each verb, the baseline was the condition in which there was no filler-gap dependency. Twenty-four sentences were constructed as experimental sentences using three types of verb and another twenty-four sentences were constructed as distracters. Four sets of experimental sentences were constructed in order to counterbalance the design. Next, twenty-four simple structured declarative sentences using the same verbs as in the experimental sentences were constructed as task sentences. Thus, 144 sentences were constructed overall. All the words used in experimental sentences and task sentences were more than 5.0 familiarity rate on a seven point scale (7 = highly familiar; Yokokawa, ed., 2006). The number of syllables of a wh-question noun phrase was also controlled. All the verbs used in the experimental sentences, the example of experimental and task sentences, and the positions in which gaps are posited and filled in the previous studies (critical regions) are shown in Table 21.

Table 21 Examples of Experimental Sentence, Task Sentence and Verbs

1. Simple transitive preference verb (*call, choose, clean, kick, hear, paint, see, watch*)
[FG] Which game (*noise) / did / the boy / *watch* / this morning?
[BL] The boy / *watched* / the game (*noise) / this morning.
[Task] The boy watched a game.
2. Dative verb (*buy, give, hand, pass, send, show, teach, tell*)
[FG] Which toy (*girl) / did / the father / give / *to the boy* / this morning?

[BL] The father / gave / the toy (*girl) / to the boy / this morning.

[Task] The husband gave a present to his wife.

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3. Infinitive complement verb (*advise, allow, expect, force, order, permit, push, want*)

[FG] Which knife (*dog) / did / the father / allow / the boy / <u>*to use*</u> / this morning?

[BL] The father / allowed / the boy / to use / the knife (*dog) /this morning.

[Task] The father allowed his son to play a game.

Note. Asterisks = implausible fillers. Underlines = gap-filling positions. FG = filler-gap sentence, BL = baseline, Task = task sentence.

5.5.3 Instruments

In order to pace the presentation of stimuli and record reading time, the experiment task was conducted on a mainframe personal computer (Sony VAIO Notebook Computer running Microsoft Windows XP) with the psychological experiment software SuperLab Pro (Cedrus Corporation, 1995). All the stimuli sentences were recorded by an L1 speaker of English. The sound was recorded with a voice recorder (Olympus Voice Trek DM-20) and downloaded into the computer.

5.5.4 Procedure

Each participant in the experiment was tested individually while seated in front of a personal computer. The experiment was composed of three parts: (1) processing FG sentences, (2) performance of tasks (Task A, B, C or D), (3) processing FG sentences again. Before the experiment started, the instructions were given and a practice session was conducted with four trials for each part. In the first and third parts, a self-paced phrase-by-phrase reading task was conducted using the psychological experiment software program. All phrases appeared in the center of the computer screen. Each trial began with the mark "+++++" on the screen. When participants pressed the spacebar for the first time, the mark changed to the first phrase in the sentence. When participants pressed the spacebar for the second time, the first phrase changed to the second phrase. Participants were instructed to continue pressing the spacebar as long as the sentence continued to make sense. When they thought the sentence had stopped making sense, they were to immediately press a different key. This was called a "no-response." All times between presentations of a phrase were measured to millisecond accuracy by the software program. Thus, there were two ways to observe implausibility: increased reading times and increased number of no-responses at a

particular position. In the second part, participants wore headphones and were required to perform one of four tasks, Task A, B, C, or B. Each trial began with the presentation of "Press space key to start," and then a single sentence appeared in the center of the screen with an auditory presentation. In Task A, after the participants had read and listened to a sentence silently, they were required to read aloud the sentence while looking. In Task B, after the presentation of a sentence, the sentence disappeared and a mark, either "O" or "X," appeared on the screen. The participants were required to repeat aloud the sentence they had read and listened to only when the mark "O" was presented. In Task C, the words of a sentence were presented in a jumbled order; for example, "a movie / the man / watched," and participants had to arrange them into the correct order, and then read aloud while looking. Task D was also a word-order correction task, but after the presentation of a sentence, the sentence disappeared and a mark, either "O" or "X," appeared on the screen in the same way as Task B and participants had to repeat aloud the sentence they arranged into correct order only when the mark "O" was presented. Thus, on Task B and D, participants needed to memorize the sentence in order to repeat it without looking. The duration of each stimulus was controlled by the examiner. The duration of stimuli and time limit for repeat aloud are shown in Table 22. In the all parts of the experiment, the inter-stimulus interval is 0ms and the presentation order of the sentences was counterbalanced to avoid the impact on the sequence of stimuli. The required time of the experiment with Task A, B, C, and D was approximately 30, 40, 35, and 45 minutes including instructions and trial tests respectively.

Table 22 Duration of Stimuli and Time Limit of Repeat Aloud (ms)

Task		Transitive	Dative	Infinitive		Transitive	Dative	Infinitive
Duration	A	3000	5000	5000	B	3000	5000	5000
Time Limit						5000	7000	7000
Duration	C	5000	7000	8000	D	5000	7000	8000
Time Limit						5000	7000	8000

5.5.5 Data Analysis

FG processing in pre-tasks (Part 1)

Reading times and no-response rate at the critical regions between plausible and implausible filler-gap sentences in each group were compared to observe whether gap-filling was performed or not. The data for each type of verb were separately analyzed using two-way ANOVAs: (plausible:

implausible) x (FG: baseline). As in Experiment 2, increased reading times and increased number of no responses at the critical regions indicated that gaps were posited and filled at that position. Next, the data for each type of verb were separately analyzed, and reading times and no-response rates at the critical regions of implausible FG sentences of four groups were compared using a one-way ANOVA.

FG processing in post-tasks (Part 3)

The data analyses were identical to Part 1 except that the data for repeating aloud (overt) and silent reading (covert) on Task B and D were compared using three-way ANOVAs: (plausible: implausible) x (FG: baseline) x (overt: covert) to examine effects of utterance.

Comparison between pre-tasks and post-tasks

In order to examine the effects of activities, no-response rates at the critical regions were compared between pre-tasks and post-tasks for each group. The data for each verb type were separately analyzed using a *t*-test. All statistical analyses were conducted using Excel Statistics 2008 for Windows.

5.6 Results

As described before, increased reading times and no response rate at the critical regions indicated that gaps were posited and filled at that position. In order to examine whether Japanese EFL learners posited and filled the gaps at the same position as L1 speakers, reading times and no-response rates at the critical regions between ambiguous plausible sentences and ambiguous implausible sentences were compared. The critical regions of simple transitive verb sentences, dative verb sentences, and infinitive complement verb sentences were main verb position, a word after main verbs, and *to* infinitive position respectively.

5.6.1 FG Sentence Processing in Pre-Tasks

Table 23 and 24 indicate mean reading times and no-response rates for each region of sentences in FG sentence processing of pre-tasks (Part 1) of each group.

Table 23 Mean Reading Time (ms) and SD of Experiment 3 (Part 1)

		P1	P2	P3	P4	P5	P6	P7
FG Transitive	Pla	Which game	did	the boy	watch	this morning?		
	A	1261 (190)	1133 (420)	1228 (356)	1266 (662)	1367 (538)		
	B	1304 (432)	1065 (301)	1279 (540)	1217 (281)	1159 (325)		
	C	1074 (421)	1043 (479)	1250 (518)	1152 (342)	1230 (698)		
	D	1377 (382)	1040 (401)	1263 (410)	1304 (401)	1300 (413)		
	Imp	Which noise	did	the boy	watch	this morning?		
	A	1336 (300)	971 (235)	1292 (272)	1629 (552)	1757 (396)		
	B	1362 (4899	1012 (309)	1147 (418)	1597 (452)	1477 (355)		
	C	1252 (361)	767 (329)	1123 (571)	1454 (428)	1259 (460)		
	D	1361 (254)	1072 (446)	1264 (395)	1609 (298)	1519 (407)		
B L Pla		The boy	watched	the game	this morning.			
	A	1292 (418)	1177 (275)	1165 (245)	1377 (308)			
	B	1157 (467)	1282 (470)	1333 (464)	1099 (471)			
	C	1098 (383)	1193 (584)	1250 (484)	1089 (519)			
	D	1068 (389)	1329 (545)	1264 (461)	1229 (435)			
B L Imp		The boy	watched	the noise	this morning.			
	A	1271 (268)	1311 (294)	1871 326)	1530 (536)			
	B	1075 (408)	1227 (401)	1542 (474)	1107 (381)			
	C	1187 (465)	1042 (214)	1695 (583)	1113 (188)			
	D	1076 (337)	1234 (385)	1642 (534)	1477 (225)			
FG Dative	Pla	Which toy	did	the father	give	to the boy	this morning?	
	A	1356 (208)	1065 (437)	1351 (333)	1406 (497)	1534 (416)	1475 (515)	
	B	1275 (405)	1004 (481)	1301 (407)	1270 (410)	1393 (410)	1258 (510)	
	C	1161 (272)	851 (356)	1194 (460)	1200 (481)	1459 (341)	1342 (452)	
	D	1335 (278)	1065 (465)	1465 (307)	1105 (448)	1161 (482)	823 (236)	
	Imp	Which girl	did	the father	give	to the boy	this morning?	
	A	1398 (323)	952 (342)	1395 (397)	1386 (475)	1646 (411)	1377 (446)	
	B	1297 (435)	1017 (421)	1349 (539)	1330 (455)	1668 (457)	1360 (488)	
	C	1407 (542)	851 (283)	1386 (618)	1325 (510)	1793 (567)	1664 (796)	
	D	1299 (381)	908 (313)	1393 (444)	1287 (526)	1625 (430)	1191 (541)	
B L Pla		The father	gave	the toy	to the boy	this morning.		
	A	1193 (325)	1234 (267)	1499 (266)	1339 (473)	1050 (309)		
	B	1154 (454)	1233 (352)	1497 (420)	1495 (470)	1189 (484)		
	C	1133 (351)	1110 (421)	1481 (463)	1498 (593)	1139 (477)		
	D	1271 (529)	1110 (377)	1322 (413)	1330 (463)	1093 (455)		
B L Imp		The father	gave	the girl	to the boy	this morning.		
	A	1286 (311)	1227 (311)	1194 (396)	1725 (354)	1145 (138)		
	B	943 (293)	1320 (385)	1334 (413)	1519 (585)	1343 (482)		
	C	1062 (556)	1054 (375)	1159 (682)	1803 (566)	1257 (259)		
	D	1157 (388)	1221 (456)	1237 (538)	1630 (436)	1178 (506)		
FG Infinitive	Pla	Which knife	did	the father	allow	the boy	to use	this morning?
	A	1361 (309)	1109 (349)	1352 (340)	1479 (345)	1440 (323)	1263 (366)	1156 (403)
	B	1197 (399)	1074 (381)	1427 (385)	1408 (468)	1479 (430)	1306 (430)	908 (273)
	C	1165 (282)	907 (394)	1270 (500)	1392 (475)	1449 (344)	1366 (495)	1240 (547)
	D	1363 (315)	968 (301)	1350 (415)	1448 (392)	1463 (464)	1254 (580)	946 (447)
	Imp	Which dog	did	the father	allow	the boy	to use	this morning?
	A	1350 (158)	1022 (490)	1344 (401)	1395 (398)	1354 (307)	1501 (483)	1198 (594)
	B	1332 (375)	1084 (409)	1266 (389)	1227 (304)	1234 (487)	1367 (245)	1214 (488)
	C	1352 (494)	903 (324)	1370 (495)	1326 (438))	1429 (209)	1499 (324)	1063 (487)
	D	1360 (268)	1037 (401)	1464 (408)	1387 (374)	1141 (457)	1262 (242)	1333 (563)

B L Pla		The father	allowed	the boy	to use	the knife	this morning.
	A	1282 (363)	1386 (271)	1345 (308)	1411 (354)	1050 (380)	1083 (400)
	B	1020 (264)	1236 (483)	1336 (353)	1169 (215)	1058 (442)	1027 (440)
	C	1284 (563)	1267 (449)	1266 (414)	1132 (429)	1116 (379)	1167 (417)
	D	1074 (444)	1466 (512)	1180 (519)	1322 (463)	1128 (451)	972 (294)
B L Imp		The father	allowed	the boy	to use	the dog	this morning.
	A	1205 (354)	1322 (267)	1279 (344)	1176 (329)	1635 (453)	1227 (212)
	B	1009 (393)	1188 (339)	1282 (348)	1206 (373)	1525 (287)	1012 (374)
	C	1059 (473)	1366 (361)	1156 (333)	1067 (347)	1419 (593)	887 (307)
	D	1143 (270)	1288 (457)	1257 (363)	1169 (413)	1413 (370)	765 (210)

Note . FG Pla = plausible FG, FG Imp = implausible FG, BL Pla = plausible baseline, BL Imp = implausible baseline.

Table 24 No Response Rate of Experiment 3 (%) (Part 1)

		P1	P2	P3	P4	P5	P6	P7
FG Transitive	Pla	Which game	did	the boy	watch	this morning?		
	A	0	0	0	6.25	6.25		
	B	0	0	18.75	0	0		
	C	0	0	6.25	0	12.50		
	D	0	0	12.50	0	18.75		
	Imp	Which noise	did	the boy	watch	this morning?		
	A	0	0	6.25	25.00	31.25		
	B	0	0	12.50	31.25	18.75		
	C	0	0	0	25.00	43.75		
	D	0	0	12.50	25.00	25.00		
B L Pla		The boy	watched	the game	this morning.			
	A	0	0	6.25	0			
	B	0	0	12.5	12.50			
	C	0	0	0	12.50			
	D	0	0	6.25	6.25			
B L Imp		The boy	watched	the noise	this morning.			
	A	0	0	56.25	18.75			
	B	0	0	62.50	6.25			
	C	0	0	31.25	43.75			
	D	0	0	37.50	37.50			
FG Dative	Pla	Which toy	did	the father	give	to the boy	this morning?	
	A	0	0	6.25	6.25	6.25	18.75	
	B	0	0	6.25	25.00	6.25	6.25	
	C	0	0	12.5	6.25	6.25	12.5	
	D	0	0	18.75	6.25	6.25	0	
	Imp	Which girl	did	the father	give	to the boy	this morning?	
	A	0	0	6.25	12.50	37.5	6.25	
	B	0	0	0	12.50	25.00	18.75	
	C	0	0	0	18.75	31.25	18.75	
	D	0	0	6.25	6.25	31.25	12.50	
B L Pla		The father	gave	the toy	to the boy	this morning.		
	A	0	0	0	6.25	18.75		
	B	0	0	6.25	12.50	6.25		
	C	0	0	18.75	0	12.50		
	D	0	0	12.50	12.5	0		
B L Imp		The father	gave	the girl	to the boy	this morning.		
	A	0	0	12.50	43.75	25.00		
	B	0	0	25.00	25.00	18.75		
	C	0	0	0	56.25	25		
	D	0	6.25	18.75	25.00	12.50		

FG Infinitive	Pla	Which knife	did	the father	allow	the boy	to use	this morning?
	A	0	0	6.25	0	18.75	6.25	6.25
	B	0	0	12.50	0	12.50	6.25	0
	C	0	0	0	12.5	18.75	6.25	12.50
	D	0	0	6.25	0	18.75	18.75	6.25
	Imp	Which dog	did	the father	allow	the boy	to use	this morning?
	A	0	0	0	12.50	12.50	25.00	6.5
	B	0	0	0	6.25	18.75	18.75	12.50
	C	0	0	0	0	18.75	31.25	12.50
	D	0	0	0	6.25	12.50	18.75	12.50
B L Pla		The father	allowed	the boy	to use	the knife	this morning.	
	A	0	0	0	12.50	0	6.25	
	B	0	0	12.50	0	0	0	
	C	0	0	6.25	6.25	0	0	
	D	0	0	6.25	18.75	6.25	6.25	
B L Imp		The father	allowed	the boy	to use	the dog	this morning.	
	A	0	0	6.25	0	56.25	6.25	
	B	0	0	6.25	6.25	56.25	6.25	
	C	0	0	6.25	6.25	37.50	31.25	
	D	0	0	6.25	6.25	56.25	6.25	

Note . FG Pla = plausible FG, FG Imp = implausible FG, BL Pla = plausible baseline, BL Imp = implausible baseline.

Simple Transitive Verbs

There was a significant interaction between plausibility and ambiguity of reading time at the verb position (P4) in all the groups, Group A, B, C, and D in simple transitive verbs. Increased reading time was observed at the position of implausible FG sentences. They were read more slowly than plausible sentences which led to a main effect of plausibility. Group A, F (1, 30) = 4.73, $p < .05$, $\eta^2 = .21$; Group B, F (1, 27) = 5 .95, $p < .05$, $\eta^2 = .17$; Group C, F (1, 30) = 4.67, $p < .05$, $\eta^2 = .21$; Group D, F (1, 26) = 4.77, $p < .05$, $\eta^2 = .21$. These results suggest that the gaps were posited and filled at the verb position (P4). No-response rates started to increase at the verb position (P4) of FG sentences, but there was no significant plausibility effect. There were no statistically significant differences among the four groups in reading times and no-response rates at the critical regions, suggesting there were no differences in FG sentence processing among the four groups. Overall no-response rates for implausible FG sentences in Group A, B, C, and D were 62.50%, 62.50%, 68.75%, and 62.50 % respectively.

Dative Verbs

Although increased reading time was observed at the critical region (P5: to the boy) in implausible FG sentences, there was no significant interaction between plausibility and ambiguity at the critical region (P5: to the boy) in any groups in dative verbs. This suggests that the gaps were

not posited and filled at that position word. No-response rate started to increase at the critical region of FG sentences, but there was no significant plausibility effect for any of the groups. There were no statistically significant differences among the four groups in reading times and no-response rates at the critical regions, suggesting there were no differences in FG sentence processing among the four groups. Overall no-response rates for implausible FG sentences in Group A, B, C, and D were 62.50%, 56.25%, 68.75%, and 56.25% respectively.

Infinitive Complement Verbs

There was no significant interaction between plausibility and ambiguity at the critical region (P6: to use) either in reading times or no-response rates for any groups in infinitive complement verbs. These results suggest that the gaps were not posited and filled at the critical region. Again, there were no statistically significant differences among the four groups in reading times and no-response rates at the critical regions, suggesting no differences in FG sentence processing among the four groups. Overall no-response rates for implausible FG sentences in Group A, B, C, and D were 56.25%, 56.25%, 62.50%, and 56.25% respectively.

5.6.2 FG Sentence Processing in Post-Tasks

Table 25 and 26 indicate mean reading times and no-response rates for each region of sentences in FG sentence processing of post-task (Part 3) for each group.

Table 25 Mean Reating Time (ms) and SD of Experiment 3 (Part 2)

		P1	P2	P3	P4	P5	P6	P7
FG Transitive	Pla	Which game	did	the boy	watch	this morning?		
	A	1045 (311)	820 (259)	996 (441)	1073 (358)	932 (393)		
	B	1168 (482)	950 (280)	1134 (524)	1025 (309)	1090 (331)		
	C	1205 (531)	834 (364)	1010 (247)	1045 (213)	977 (369)		
	D	1328 (308)	993 (302)	1034 (167)	1012 (377)	1138 (490)		
	Imp	Which noise	did	the boy	watch	this morning?		
	A	1233 (354)	844 (318)	1040 (548)	1351 (363)	1389 (379)		
	B	1174 (340)	964 (381)	1072 (218)	1484 (159)	1295 (427)		
	C	1068 (472)	743 (184)	1025 (589)	1225 (498)	1379 (335)		
	D	1258 (235)	918 (150)	1214 (440)	1470 (535)	1361 (409)		
BL Pla		The boy	watched	the game	this morning.			
	A	898 (370)	899 (259)	1097 (417)	1170 (115)			
	B	936 (315)	1153 (362)	1170 (458)	1188 (438)			
	C	973 (407)	855 (261)	1001 (346)	1024 (439)			
	D	1007 (364)	1146 (410)	1167 (205)	1196 (494)			

BL Imp		The boy	watched	the noise	this morning.			
	A	939 (343)	991 (272)	1502 (437)	1112 (151)			
	B	918 (386)	1060 (340)	1468 (488)	1372 (306)			
	C	962 (535)	912 (395)	1459 (443)	1464 (304)			
	D	970 (341)	1018 (302)	1693 (302)	1292 (397)			
FG Dative	Pla	Which toy	did	the father	give	to the boy	this morning?	
	A	1042 (237)	721 (171)	1119 (500)	1204 (613)	1196 (374)	1125 (377)	
	B	1201 (489)	855 (154)	1004(571)	1092 (597)	1180 (552)	996 (581)	
	C	1140 (595)	829 (261)	1097 (496)	1010 (445)	1182 (338)	1020 (394)	
	D	1178 (234)	950 (446)	1178 (298)	1184 (197)	1201 (444)	967 (307)	
	Imp	Which girl	did	the father	give	to the boy	this morning?	
	A	1047 (375)	762 (113)	1100 (204)	1147 (350)	1321 (474)	1319 (359)	
	B	1121 (272)	875 (238)	1200 (386)	1215 (271)	1691 (549)	1281 (682)	
	C	1185 (388)	714 (289)	1023 (531)	1193 (593)	1482 (642)	1148 (131)	
	D	1173 (386)	877 (200)	1203 (207)	1206 (271)	1694 (363)	1332 (242)	
BL Pla		The father	gave	the toy	to the boy	this morning.		
	A	1018 (532)	891 (295)	1278 (437)	1220 (482)	1091 (452)		
	B	943 (348)	1048 (595)	1136 (526)	1108 (335)	1151 (402)		
	C	935 (363)	1030 (312)	998 (365)	911(286)	1092 (303)		
	D	978 (458)	1062 (460)	1115 (376)	1119 (413)	1149 (135)		
BL Imp		The father	gave	the girl	to the boy	this morning.		
	A	954 (187)	1007 (300)	1355 (523)	1538 (342)	1321 (470)		
	B	914 (398)	1104 (648)	1102 (401)	1620 (441)	1203 (511)		
	C	1016 (274)	980 (482)	1063 (456)	1479 (410)	1506 (294)		
	D	1002 (427)	975 (258)	1343 (356)	1436 (454)	1241 (487)		
FG Infinitive	Pla	Which knife	did	the father	allow	the boy	to use	this morning?
	A	1024 (208)	768 (296)	1059 (449)	1249 (395)	1262 (340)	1010 (184)	870 (150)
	B	1090 (250)	924 (166)	1098(436)	1146 (381)	1135 (265)	1193 (329)	1087 (204)
	C	1074 (360)	780 (205)	1251 (439)	1083 (439)	1182 (303)	1148 (352)	1157 (139)
	D	1194 (179)	839 (262)	1237 (286)	1224 (285)	1292 (295)	1239 (177)	1089 (211)
	Imp	Which dog	did	the father	allow	the boy	to use	this morning?
	A	1068 (197)	800 (156)	995 (210)	1214 (290)	1226 (177)	1299 (125)	794 (140)
	B	1236 (456)	923 (320)	1123(212)	1187 (485)	1195 (302)	1239 (422)	1017 (282)
	C	1113(346)	811 (117)	935 (395)	1143 (558)	1164 (331)	1319 (571)	1273 (385)
	D	1180 (299)	871 (175)	1066 (344)	1178 (241)	1192(199)	1413 (169)	1271 (231)
BL Pla		The father	allowed	the boy	to use	the knife	this morning.	
	A	1020 (345)	1025 (366)	1167 (481)	1197 (209)	1058 (429)	1107(153)	
	B	1124 (517)	1166 (465)	1279 (521)	1047 (509)	1067 (248)	810 (170)	
	C	955 (375)	892 (277)	1023(491)	1031 (384)	1037 (135)	1071 (356)	
	D	1094 (442)	1071 (284)	1091 (288)	1108 (269)	1082 (155)	1090 (271)	
BL Imp		The father	allowed	the boy	to use	the dog	this morning.	
	A	913 (259)	1157 (401)	1211 (356)	1014 (194)	1303 (348)	1023 (73)	
	B	1033(311)	1007 (409)	1233 (152)	1005 (112)	1366 (345)	1272 (367)	
	C	980 (207)	995 (146)	1183 (375)	1031(116)	1382 (433)	1199(303)	
	D	893 (313)	1068 (366)	1111 (332)	1218 (300)	1470 (365)	1118 (458)	

Note . FG Pla = plausible FG, FG Imp = implausible FG, BL Pla = plausible baseline, BL Imp = implausible baseline.

Table 26 No Response Rate (%) of Experiment 3(Part 2)

		P1	P2	P3	P4	P5	P6	P7
FG Transitive	Pla	Which game	did	the boy	watch	this morning?		
	A	0	0	0.00	6.25	0.00		
	B	0	0	6.25	0.00	12.50		
	C	0	0	6.25	6.25	0		
	D	0	0	0.00	6.25	6.25		

	Imp	Which noise	did	the boy	watch	this morning?		
	A	0	0	0.00	18.75	43.75		
	B	0	0	6.25	50.00	25.00		
	C	0	0	0	25.00	43.75		
	D	0	0	0	62.50	18.75		
BL Pla		The boy	watched	the game	this morning.			
	A	0	0	0	6.25			
	B	0	0	0	6.25			
	C	0	0	0	0			
	D	0	0	0	6.25			
BL Imp		The boy	watched	the noise	this morning.			
	A	0	0	43.75	37.50			
	B	0	0	62.50	31.25			
	C	0	0	31.25	50.00			
	D	0	0	50.00	37.50			
FG Dativ	Pla	Which toy	did	the father	give	to the boy	this morning?	
	A	0	0	0	12.50	0.00	12.50	
	B	0	0	0	0	12.50	0.00	
	C	0	0	0	0	25.00	6.25	
	D	0	0	0	6.25	6.25	0.00	
	Imp	Which girl	did	the father	give	to the boy	this morning?	
	A	0	0	0	12.50	25.00	25.00	
	B	0	0	0	12.50	50.00	6.25	
	C	0	0	0	6.25	37.50	25.00	
	D	0	0	0	6.25	43.75	25.00	
BL Pla		The father	gave	the toy	to the boy	this morning.		
	A	0	0	6.25	12.50	6.25		
	B	0	0	6.25	0.00	6.25		
	C	0	0	6.25	6.25	12.50		
	D			6.25	6.25	12.50		
BL Imp		The father	gave	the girl	to the boy	this morning.		
	A	0	0	6.25	50.00	25.00		
	B	0	0	12.50	31.25	25.00		
	C	0	0	12.50	25.00	43.75		
	D	0	0	12.50	37.50	25.00		
FG Infinitive	Pla	Which knife	did	the father	allow	the boy	to use	this morning?
	A	0	0	0	12.50	6.25	6.25	6.25
	B	0	0	0	6.25	0	6.25	12.50
	C	0	0	0	0.00	12.50	6.25	12.50
	D			0	0.00	12.50	12.50	6.25
	Imp	Which dog	did	the father	allow	the boy	to use	this morning?
	A	0	0	0	6.25	18.75	31.25	6.25
	B	0	0	0	12.50	12.50	31.25	12.50
	C	0	0	0	6.25	12.50	31.25	18.75
	D	0	0	0	6.25	6.25	43.75	18.75
BL Pla		The father	allowed	the boy	to use	the knife	this morning.	
	A	0	0	0	12.50	0	12.50	
	B	0	0	0	0	6.25	0	
	C	0	0	0	0	6.25	12.50	
	D	0	0	0	6.25	6.25	6.25	
BL Imp		The father	allowed	the boy	to use	the dog	this morning.	
	A	0	0	6.25	6.25	43.75	12.50	
	B	0	0	6.25	0.00	50.00	18.75	
	C	0	0	6.25	12.50	50.00	12.50	
	D	0	0	6.25	18.75	37.50	12.50	

Note . FG Pla = plausible FG, FG Imp = implausible FG, BL Pla = plausible baseline, BL Imp = implausible baseline.

Simple Transitive Verb

There was a significant interaction between plausibility and ambiguity of reading time at the verb position (P4) for all the groups, Group A, B, C, and D. Increased reading time was observed at the position of implausible FG sentences. They were read more slowly than plausible sentences which led to a main effect of plausibility. Group A, F (1, 31) = 4.76, $p < .05$, $\eta^2 = .21$; Group B, F (1, 27) = 6 .01, $p < .05$, $\eta^2 = .17$; Group C, F (1, 29) = 4.33, $p < .05$, $\eta^2 = .23$; Group D, F (1, 27) = 4.96, $p < .05$, $\eta^2 = .20$. These results suggest that the gaps were posited and filled at the verb position (P4). A significant interaction between plausibility and ambiguity of no-response rate at the verb position (P4) in implausible FG sentences was also observed in Group B and D. Higher no-response rates were observed in implausible FG sentences which led to a main effect of plausibility. Group B, F (1, 31) = 5.87, $p < .05$, $\eta^2 = .17$; Group D, F (1, 31) =10.91, $p < .01$, $\eta^2 = .09$. There were statistically significant differences in no-response rate of implausible FG sentences among four groups. F (3, 63) = 3.10, $p < .05$, $\eta^2 = .13$. Tukey's multiple comparison showed there was a significant effect of Group D (62.5%) compared to Group A (18.5%), F (1, 31) = 7.42, $p < .05$, $\eta^2 = .13$; and compared to Group C (25%), F (1, 31) = 5.00, $p < .05$, $\eta^2 = .20$. The no-response rate of Group B (50%) was 31.25% higher than that of Group A; however, no statistically significant difference was observed between the two groups ($p = .06$). Overall no-response rates for implausible FG sentences in Group A, B, C, and D were 62.50%, 81.25%, 68.75%, and 81.25% respectively.

Dative Verbs

There was a significant interaction between plausibility and ambiguity of reading time at the critical region (P5: to the boy) in implausible FG sentences in Group B and Group D. Increased reading time was observed and they were read more slowly than plausible sentences which led to a main effect of plausibility (Group B, F (1, 28) = 6 .03, $p < .05$, $\eta^2 = .17$; Group D, F (1, 19) = 5.96, $p < .05$, $\eta^2 = .17$), suggesting that the gaps were posited and filled at the verb position (P4) only in Group B and D. No-response rates started to increase at the critical region of implausible FG sentences, and there was a significant plausibility effect in Group B (F (1, 31) = 5.87, $p < .05$, $\eta^2 = .17$) and Group D (F (1, 31) = 6.92, $p < .05$, $\eta^2 = .14$). Although no-response rates of implausible FG sentences at the critical region of Group B was the highest (50%), there were no

statistically significant differences among the four groups, suggesting no differences in FG sentence processing among the four groups. Overall no-response rates for implausible FG sentences in Group A, B, C, and D were 62.50%, 68.75%, 68.75%, and 75.0% respectively.

Infinitive Complement Verbs

A significant interaction between plausibility and ambiguity of reading rate at the critical region (P6: to use) was observed only in Group D (F (1, 19) = 5.96, $p < .05$, $\eta^2 = .17$). No-response rates increased at the critical region in implausible FG sentences in Group D, but there was no statistically significant effect of plausibility. These results suggest that the gaps were not posited and filled at the critical region for any groups. Again, no statistically significant differences among the four groups in no-response rate were found at the critical regions, suggesting no differences in FG sentence processing among the four groups. Overall no-response rates for implausible FG sentences in Group A, B, C, and D were 62.50%, 68.75%, 68.75%, and 75.0% respectively.

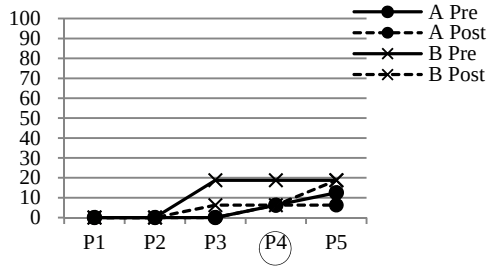
Comparison between repeat aloud and silent reading

In order to examine effects of utterance on FG sentence processing, no-response rates at the critical regions were compared between tasks with repeating aloud after silent reading and without repeating aloud after silent reading in Task B and D. The results demonstrated that there was no statistically significant difference between two types of tasks for any type of sentence.

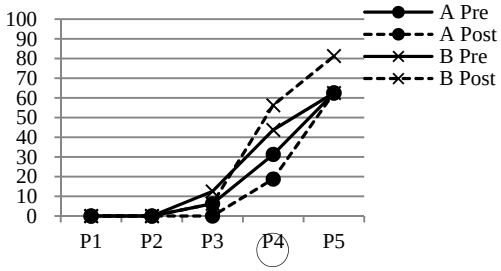
5.6.3 Comparison between pre-tasks and post-tasks of FG sentence processing

No-response rates at the critical regions were compared between pre-tasks and post-tasks in each group to examine the effects of the activities. The data for each verb type were separately analyzed using *t*-test. Figure 15 shows the cumulative no-response rates (%) of simple transitive FG sentences in pre-tasks and post-tasks.

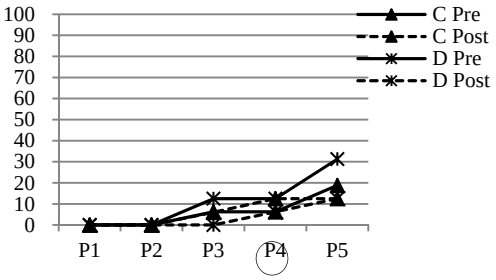
Group A and B: Plausible



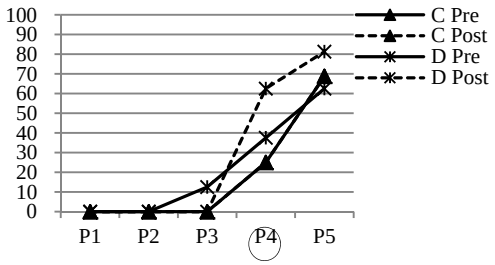
Implausible



Group C and D: Plausible



Implausible

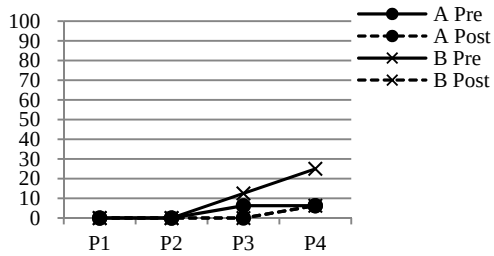


Which game (*noise) / did / the boy / watch / this morning?

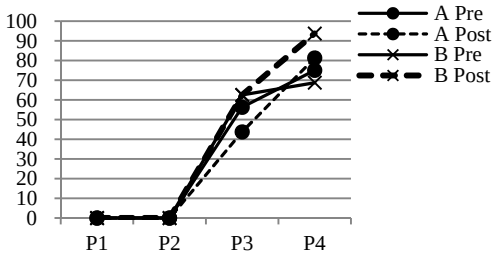
Figure 15. Cumulative no-response rate (%) of FG sentences with simple transitive verbs
Note. P 1 = phrase one, asterisk = implausible object of the verb, Ⓟ= gap-filling position.

In plausible sentences, the no-response rate of post-tasks at the P4 for Group B was 12.5% lower than that of pre-tasks. The no-response rate of post-tasks in Group D was also lower than that of pre-tasks; however, the difference was only 6.3%. In implausible sentences, an increase in the no-response rate of post-tasks was found at the P4 position in Group B (18.8%). A statistically significant difference was observed between pre-tasks and post-tasks at the P4 position for Group D, indicating a reliable effect of Task D ($p < .05$).

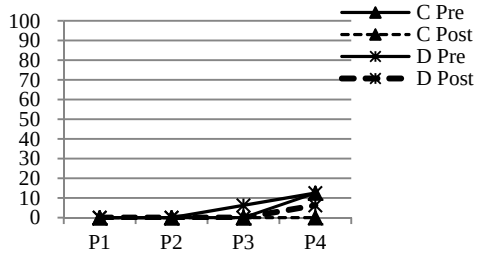
Group A and B: Plausible



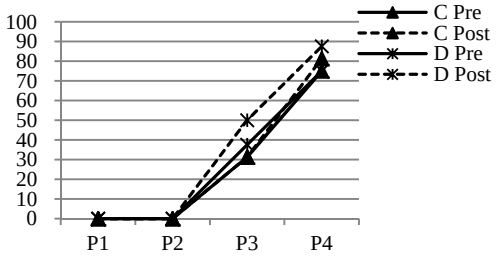
Implausible



Group C and D: Plausible



Implausible

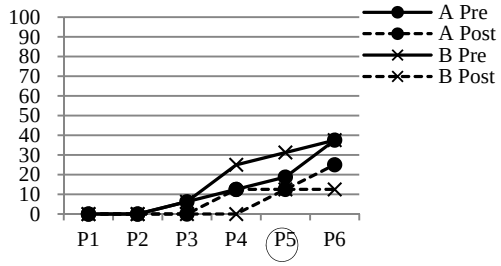


The boy / watched / the game (*noise) / this morning.

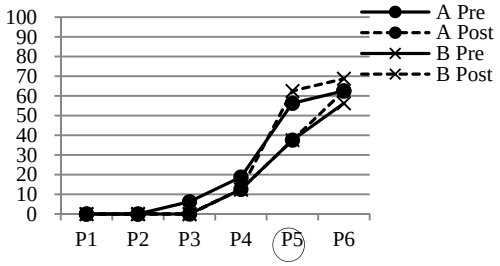
Figure 16. Cumulative no-response rate (%) of baseline sentences with simple transitive verbs
Note. P 1 = phrase one, asterisk = implausible object of the verb.

Figure 16 shows the cumulative no-response rate (%) of simple transitive baseline sentences in pre-tasks and post-tasks. Since baseline sentences are easier to process than FG sentences, no-response rates were quite low for plausible sentences, and quite high for implausible sentences at P3 and P4 for any group both in pre-tasks and post-tasks. Still, a decreased no-response rate was found for Group B (12.5%), and an increased no-response rate was found for Group D (12.5%) at the P3 position.

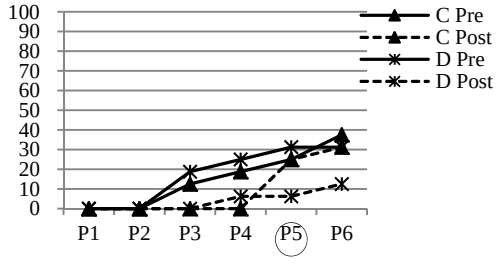
Group A and B: Plausible



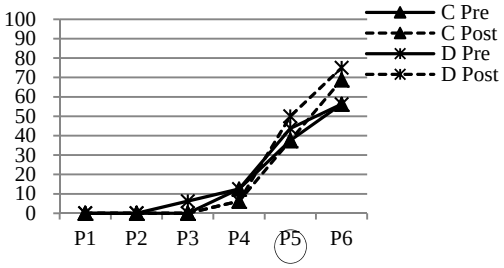
Implausible



Group C and D: Plausible



Implausible

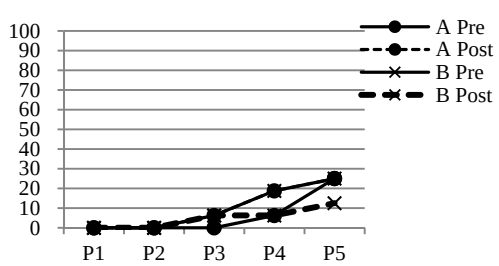


Which toy (*girl) / did / the father / give / <u>to the boy</u> / this morning?

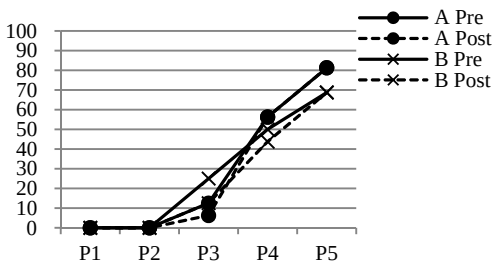
Figure 17. Cumulative no-response rate (%) of FG sentence with dative verbs
Note. P 1 = phrase one, asterisk = implausible object of the verb, Ⓟ= gap-filling position.

Figure 17 shows the cumulative no-response rate (%) of dative verb FG sentences for pre-tasks and post-tasks. In plausible sentences, the no-response rate of post-tasks at P5 was 18.8% lower than that of pre-tasks for Group B, and 25% lower in Group D. For implausible sentences, an increased no-response rate for post-tasks was observed at the P5 position for Group B (25.0%, p = .052) and for Group D (12.5%), showing the effects of Task B and D.

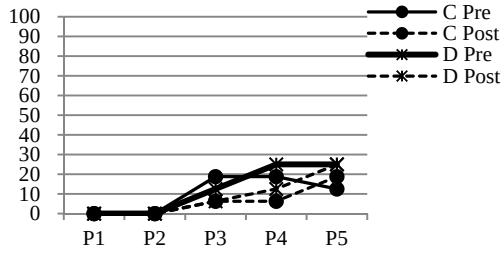
Group A and B: Plausible



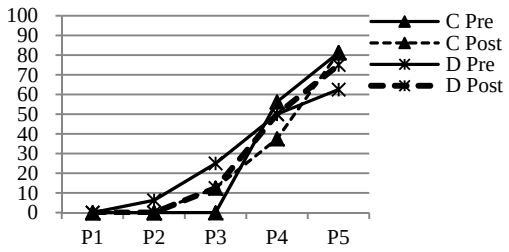
Implausible



Group C and D: Plausible



Implausible

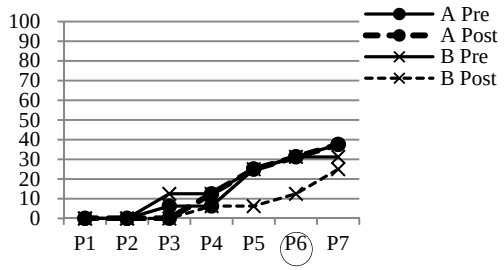


The father /gave / the toy (*girl) / to the boy / this morning.

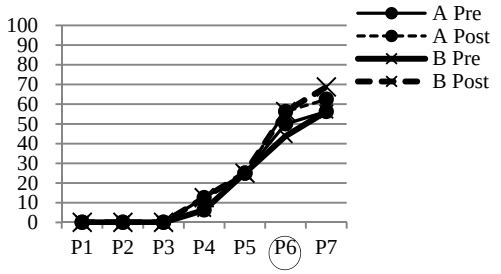
Figure 18. Cumulative no-response rate (%) of baseline sentences with dative verbs
Note. P 1 = phrase one, asterisk = implausible object of the verb.

Figure 18 shows the cumulative no-response rate (%) of dative verb baseline sentences in pre-tasks and post-tasks. As seen in simple transitive verb sentences, there was little difference between pre-tasks and post-tasks. Yet, a 12.5 % decreased no-response rate at the P4 position was found for Group B, C, and D for plausible sentences. For implausible sentences, an increased no-response rate was observed for Group D (12.5%).

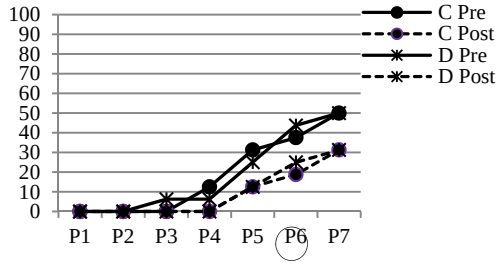
Group A and B: Plausible



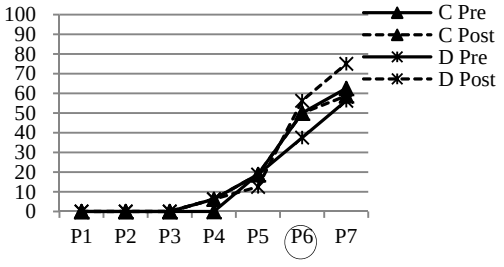
Implausible



Group C and D: Plausible



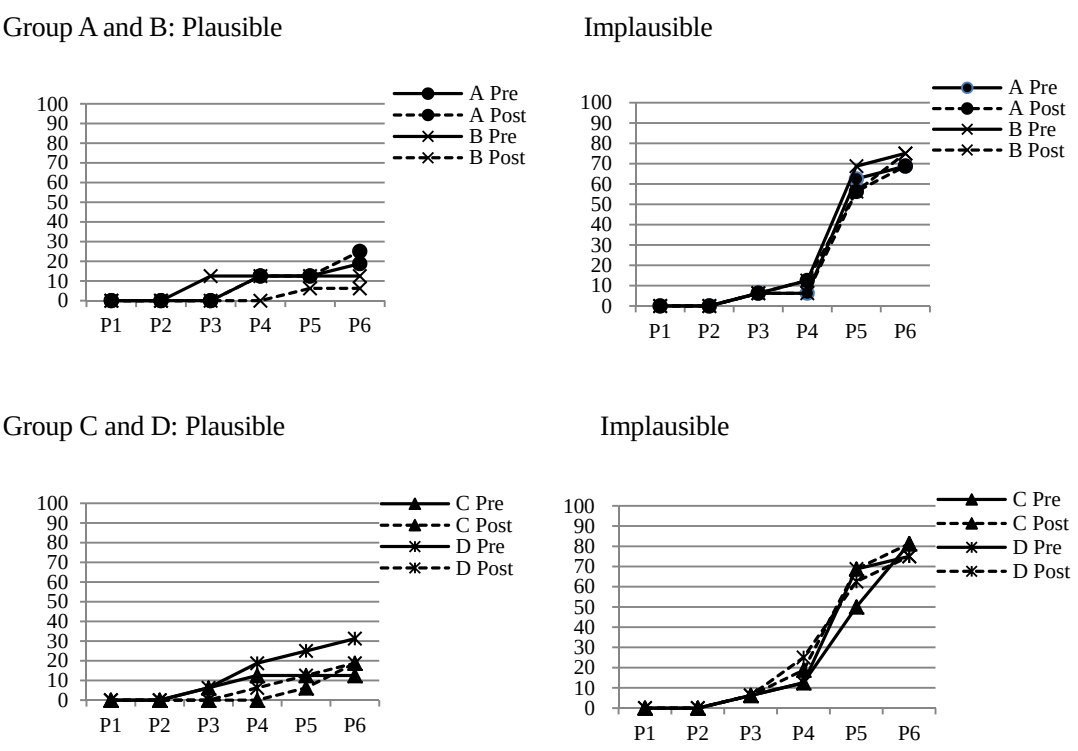
Implausible



Which knife (*dog) / did / the father / allow / the boy / to use / this morning?

Figure 19. Cumulative no-response rate (%) of FG sentences with infinitive complement verbs
Note. P 1 = phrase one, asterisk = implausible object of the verb, Ⓟ= gap-filling position.

Figure 19 shows the cumulative no-response rate (%) of infinitive complement verb FG sentences for pre-tasks and post-tasks. For plausible sentences, a decreased no-response rate at the P4 position (18.8%) was found for Group B, C, and D. For implausible sentences, an increased no-response rate at the P4 was found for Group B (12.5%), and Group D (25.0%, p = .0519), suggesting the effects of Task B and D.



The father / allow / the boy / to use / the knife (*dog) / this morning.

Figure 20. Cumulative no-response rate (%) of baseline sentences with infinitive complement verbs
Note. P 1 = phrase one, asterisk = implausible object of the verb.

Figure 20 shows the cumulative no-response rate (%) of infinitive complement verb base line sentences for pre-tasks and post-tasks. Again, there was little difference between pre-tasks and post-tasks. Decreased no-response rates were found for Group D (12.5%) for plausible sentences and an increased no-response rate was observed for Group C (12.5%) for implausible sentences.

5.7 Hypotheses Verification

Based on the results above, the hypotheses mentioned in 5.7 can be verified.

Hypothesis 1: *Memory required during repetition and word-order correction tasks promote parsing ability.*

In the post-task experiment, the effect of word-order correction tasks with repetition without looking (Task D) was statistically significant compared to word-order correction task with reading aloud (Task C) with simple transitive sentences ($p < .05$). Although the effect of repetition without looking (Task B) was not statistically significant compared to reading aloud (Task A), 50 % of the participants processed FG sentences correctly, whereas only 18.75% did so for Task A ($p = .06$). These outcomes supported Hypothesis 1.

Hypothesis 2: *Tasks that require higher cognitive demand lead to better parsing performance.*

Repetition without looking and word-order correction tasks with repetition without looking (Task B and D) tended to promote FG sentence processing more than reading aloud and word correction task with reading aloud (Task A and C). These outcomes supported Hypothesis 2.

Hypothesis 3: *Word-order correction tasks promote parsing ability.*

The effect of word-order correction tasks with repetition without looking (Task D) was statistically significant compared to reading aloud (Task A) with simple transitive sentences ($p < .05$) and there was a statistically significant difference between pre-tasks and post-tasks for Group D, whereas the word-order correction task with reading aloud (Task C) was not statistically effective compared to other tasks. These outcomes suggested that word-order correction tasks promote ability of parsing only with memory demanding tasks, which partially supported Hypothesis 3.

Hypothesis 4: *Repeating aloud after silent reading is more effective than silent reading without repeating aloud on FG sentence processing.*

There was no statistically significant difference between repeating aloud after looking and silent reading for any of the types of sentences. This outcome did not support Hypothesis 4.

Hypothesis 5: *The degree of effects varies depending on the type of verb subcategorization information.*

The significant effects of word-order correction tasks with repetition without looking were observed only in simple transitive verb sentences, which supported Hypothesis 5.

5.8 Discussion

There are four main outcomes to discuss in Experiment 3. First, the fact that repetition without looking was more effective than reading aloud and word-order correction tasks with repetition without looking were more effective than word-order correction tasks with reading aloud indicates that the tasks that require temporal memory, namely, tasks that relied heavily on working memory have contributed to the on-line assignment of the structure of the sentence. It may have occurred through the activation of a phonological loop in working memory. It is likely that the phonological loop was activated through sub-vocal rehearsal in order to store the sentence and this activation of a phonological loop may have contributed to the structure building of the sentence. Working memory is believed to comprise of a central executive controlling mechanism and two subsidiary systems; the phonological loop and the visuo-spatial sketchpad. The phonological loop is specialized for processing and temporary maintenance of verbally coded information (Baddery & Logie, 1999). Clark and Wagner (2003) examined the contribution of phonological control (phonological loop) to phonological assembly and word learning using an fMRI. The results showed that in the course of contributing to the assembly of a new word representation, phonologically control components of phonological systems seemed to play a central role in the encoding of new words into long-term memory. Such effects may have also occurred during sentence processing in Experiment 3. One more possible reason for promoting sentence processing can be the reinforcement of procedural knowledge. As de Bot (1996) argues (see 5.2.2), repetition practice promotes language fluency by turning declarative knowledge into procedural knowledge because procedural memory requires learners to repeat the procedures to acquire the target skill (see 2.1 for declarative and procedural knowledge).

Second, the evidence that word-order correction tasks with repetition without looking was the most effective on FG sentence processing implies that tasks with high cognitive demands were efficient for establishing representation of lexical information, particularly verb subcategorization information in their mental lexicon and promoting parsing. As Cain (2007) argues, memory is also associated with performance on word-correction tasks because words are stored and reordered. It

may account for the effectiveness of word-order correction tasks with repetition without looking.

Third, the fact that there was no difference between silent reading without repeating aloud and repeating aloud after silent reading in the degree of effects is consistent with the finding that activation of the phonological loop promotes assignment of a syntactic frame. In both tasks, participants stored the words of the sentence without regard to utterance, suggesting that the effects were concerned with memory but not related to whether they utter them or not. It means that as long as their phonological loop was activated during a sub-vocal rehearsal in order to store information, it helped with establishing a specific syntactic structure in their mental lexicon. In other words, the priority is to store lexical information in their mental lexicon and then to facilitate the ability to use it for sentence comprehension.

The fourth result to consider is that significant effects were observed for simple transitive verb sentences, whereas no significant effects were found for dative verb sentences and infinitive complement verb sentences. It suggests that the degree of effects varies depending on the type of verb subcategorization information. This finding is consistent with the results in Experiment 2 and can be explained by the frequency of syntactic frame. Again, it shows that Japanese EFL learners are exposed to sentences with simple transitive verbs most frequently. Another possible account for the results is the distant effect. Sentences with dative verbs and infinitive complement verbs have longer distances between the filler and the gap than the distances in simple transitive verb sentences, which may have required the readers to use greater resources to store. As a result, this caused difficulty in sentence processing. Just and Carpenter (1992) state that “an intrinsic part of language comprehension is the ability to interrelate information that comes from different constituents, such as clauses or sentences. Consequently, there is a need to retain information over time and intervening computations” (p.133). Working memory provides the resources to store information from preceding constituents while simultaneously providing the resources to process subsequent information. Therefore, the longer distance (or more numbers of words) between two constituents to be connected, the more errors and the longer time of the integration process, namely, gap filling in FG sentences. Not all the causes of deterioration of processing can be explained by distance effects; however, it can be one of the reasons why they could not use verb subcategorization information from dative and infinitive complement verbs for the structure assignment in Experiment 2 and why effects of exposure to these two syntactic frames were not

observed in Experiment 3.

In the experiment, one sentence appeared eight times in each task, in other words, the participants were exposed to the same syntactic structure eight times. For dative and infinitive complement verb sentences, they may have needed more repetitions for establishing the syntactic structure in their mind. It means that the number of repetitions they need to ensure learning should be further examined.

5.9 Concluding Remarks and Implications

Although the degree of effects varies depending on the type of verb subcategorization information, there are possibilities for improving the representation of lexical information in their mental lexicon and promoting automatization of parsing through intensive exposure to specific syntactic structures with high cognitive demands.

One major question needs to be addressed by further research; when do Japanese EFL learners tend to determine the syntactic structure during sentence processing? Is the timing of their decision different from that of L1 speakers? To answer the question, the data needs to analyzed not only in the critical regions or a following phrase, but also the regions before the critical regions. The results should be reviewed more precisely so that more accurate tendencies with regard to structure assignment during the sentence comprehension can be obtained.

CHAPTER 6

GENERAL DISCUSSION

6.1 Summary of the Study

This study aims to investigate the automatization process of syntactic parsing of Japanese EFL learners. The main factor that leads L2 learners to non-automatic parsing is believed to be an insufficient knowledge of lexical information. Previous studies on the relationship between lexical information and sentence processing both in L1 and L2 along with human information processing system from the perspective of recent psycholinguistics were reviewed. Three psycholinguistic experiments with focusing on sentence processing in L2 examined how lexical information relates to sentence processing of Japanese EFL learners.

In Experiment 1, the relationship between the knowledge of syntactic categories and reading comprehension was observed in an off-line manner. Forty-six Japanese university students participated in the experiment, and they first took a syntactic category test and then took a reading comprehension test. On the reading comprehension test, both correct answer rates and reading speed were measured. The data was analyzed using correlation tests and a one-way AVOVA to determine the relationship between the scores of the syntactic category test and those of the reading comprehension test. First, the results demonstrated that there was a significant correlation between the scores of syntactic category test and correct answer rates of reading comprehension test; however, no correlation was observed between the syntactic category test scores and reading speed. Second, in the syntactic category test, the mean score of high familiarity and frequency words was significantly higher than that of low familiarity and frequency words. Also, there was a significant correlation between the syntactic category test and correct answer rate of reading comprehension test for high familiarity and frequency words. Third, the degree of correlation between the syntactic category test scores and correct answer rates of the reading comprehension test appeared differently depending on the type of syntactic category. From these results, the following findings were determined; (1) there is a positive relationship between the knowledge of syntactic categories and the accuracy of reading comprehension, (2) word familiarity and frequency affect the relationship between the knowledge of syntactic categories and accuracy of reading

comprehension, (3) the syntactic category knowledge of verbs has a stronger relationship to reading comprehension than other syntactic categories such as adjectives and adverbs. Since Experiment 1 showed that there is a relationship between syntactic category knowledge, especially the knowledge of verbs, and reading comprehension, how syntactic information of verbs affects sentence processing was addressed next.

Experiment 2 investigated the use of verb subcategorization information for sentence comprehension of Japanese EFL learners by using a self-paced reading task and anomaly technique. Thirty-five Japanese university students participated in the experiment, and they were divided into three groups according to an English proficiency test. Filler-gap sentences with four different types of verbs were used as stimuli in order to observe when the syntactic structure was determined. The plausibility of the direct object of the embedded verb was also manipulated. The results demonstrated that the high proficiency learners utilized verb subcategorization information of simple transitive verbs on-line; however, they did not use information from dative verbs, infinitive complement verbs, and intransitive preference verbs. The results also revealed that the low proficiency learners had difficulty in processing complex sentences. The findings from Experiments 1 and 2 lead to another experiment which explores the effects of learners' activities on sentence comprehension.

Experiment 3 (Nagai & Yokokawa, 2010) examined types of activities that affect FG sentence processing. Forty university students learning English as a foreign language participated in the experiment. First, participants performed a self-paced reading task on FG sentences using the embedded anomaly technique. Second, they performed one of the following tasks on simple declarative sentences with three types of verbs used in Experiment 2: reading aloud, repetition without looking, word-order correction tasks with reading aloud and word-order correction tasks with repetition without looking. Then, they performed FG sentence processing again. To examine the effects of the activities, the results of the pre-tasks and post-tasks were compared. The results indicated that the word-order correction tasks with repetition without looking were more effective on FG sentence processing than other three types of tasks. This suggests that tasks that relied heavily on working memory may have improved sentence processing and that tasks with high cognitive demands were efficient for representing lexical information in their mental lexicon and promoting parsing.

From the three experiments in the present study, three main issues are addressed: (1) how L2 reading processing works, (2) how verb syntactic information is represented in Japanese EFL learners' mental lexicon, and (3) how the representation of syntactic information is promoted and established in their mental lexicon.

6.2 How L2 Reading Processing Works

In this section, how reading processing of Japanese EFL learners works is discussed in terms of outcomes of the experiments. The correlation between the knowledge of syntactic categories and reading comprehension revealed the significance of identifying and assigning syntactic categories for reading processing. Specifically, the knowledge of syntactic categories is considered to be a prerequisite for parsing, and appears to affect structural assignments at an early stage of sentence processing. Friederici and Hahne (1996) reported from their event-related brain potentials (ERP) study that an early left anterior negativity was observed when participants listened to or read sentences with a violation of the required syntactic category. The results showed that an initial phrase structure was built on the basis of syntactic category information at an early stage of processing and it led to successful processing. Lau, Stroud, Plesch, and Colin (2006) also reported the role of structural prediction in rapid syntactic analysis from their ERP study. They conducted an experiment using violation of a word order constraint and sentence context to manipulate the expectation for a certain word category. The results showed that an early anterior negativity was elicited by the word category violation 200ms after the onset of the violation, suggesting that very fast structural assignment was made by word category information. Both studies demonstrate that syntactic category information plays a crucial role for structural expectation which supports the findings from Experiment 1.

On the other hand, Experiment 1 revealed that Japanese EFL learners' knowledge of syntactic categories is insufficient as they could not explicitly identify the names of syntactic categories. However, they seemed to be able to distinguish syntactic categories suggesting that they are likely to have implicit knowledge. With regard to the relationship between language processing and knowledge of language in language production, Pienemann (2005) advocates the *processability theory* that argues if a learner produces a certain grammatical structure in an utterance, it can be regarded as acquisition of required grammatical knowledge for the structure. Following this point

of view, it seems reasonable that learners in this study possessed knowledge of syntactic categories when the word was processed correctly. The present study did not investigate how knowledge of syntactic categories is acquired; however, as the effects of repeated exposure on parsing were shown in Experiment 3, it is suggested that learners achieve the knowledge of syntactic category or at least enhance sensitivity toward it.

The results from Experiment 2 that Japanese EFL learners cannot perform parsing automatically raise the question of how their sentence processing is non-automatic and what distinguishes L2 processing from L1 processing with respect to automaticity. Based on a psycholinguistic experiment, Nagai (2008) argues that both semantic information and inter-phrase pauses affect parsing at a relatively early stage of sentence processing for Japanese EFL learners. This is similar to L1 speakers' tendencies indicating an interaction of syntactic and semantic information on parsing. However, it cannot be readily concluded from similar results that syntactic and semantic information also interact on parsing of L2 speakers. For L1 processing, whether semantic information is used at an early stage or not is examined on the premise that syntactic structure is automatically assigned. In contrast, when structure building is insufficiently automatic for L2 sentence processing, they may attempt to search for a trigger for a structure assignment. As a result, they appear to rely on semantic information and attempt to use it as a strategy to lead to successful interpretation. This tendency was seen in processing of FG sentences with dative verbs in Experiment 2. High proficiency learners tended to regard embedded dative verbs as simple transitive verbs and gaps seemed to be posited and filled at the embedded verb which was a word before the gap-filling position for L1 speakers. In addition, for processing of implausible FG sentences with infinitive complement verbs for high proficiency learners, reading times and no-response rates increased at the first verb in the embedded phrase which was two words before the gap-filling position for L1 speakers. It means that L2 learners seem to verify plausibility of the sentence when they encounter the first verb in the embedded phrase and then attempt to fill the gaps. The similar tendency was also seen in processing of FG sentences using dative and infinitive complement verbs in Experiment 3. No-response rates for both plausible and implausible sentences started to appear or increase when the verb was recognized. These facts imply that they tend to use semantic information rather than syntactic information for a structure assignment, which often leads to misanalysis of the structure. Considering these findings,

non-automatic parsing is believed to be the first and biggest barrier to reading comprehension for L2 learners.

6.3 How Verb Syntactic Information is Represented in L2 Mental Lexicon

The second issue to consider is how verb syntactic information is represented in Japanese EFL learners' mental lexicon. The results of Experiment 1 showed their insufficient knowledge of syntactic categorization, and the results of Experiment 2 indicated a lack of verb subcategorization information in their mental lexicon. However, as discussed above, even though they cannot identify syntactic categories explicitly, they may have implicit representations of syntactic categories in their mental lexicon. Experiment 2 showed that high proficiency learners appear to have verb subcategorization information of simple transitive verbs; however, they cannot use it automatically for syntactic structure building as L1 speakers. This suggests that syntactic information of simple transitive verbs seems to be represented; however, it is not sufficiently represented for performance even in high proficiency learners' mental lexicon. With regard to dative verbs and infinitive complement verbs, they cannot use the subcategorization information in real time indicating deficiency of representations of verb syntactic information. This can be explained by the frequency of verb frames because simple transitive is the most frequent verb frame for Japanese EFL learners. It indicates how frequently Japanese EFL learners are exposed to sentences with simple transitive verbs, while they are infrequently exposed to sentences with dative and infinitive complement verbs.

Low proficiency learners, in contrast, do not even appear to have the representation of verb subcatrgorization itself which can be a major deficit that causes inadequate performance on sentence processing.

6.4 How the Representation of Syntactic Information is Promoted and Established in L2 Mental Lexicon

The final issue to consider is how the representation of syntactic information of L2 learners is established and promoted in their mental lexicon and what its nature is like. Experiment 3 showed possibilities in improving the representation of verb subcategorization information and promoting parsing through repeated exposure to specific syntactic structures with high cognitive demands.

This outcome can explain the effectiveness of traditional audio-lingual instruction such as imitation and repetition, mimicry and memorization, and pattern practice on sentence comprehension from the perspective of cognitive science. Audio-lingual method is theoretically based on structural linguistics and behaviorist psychology that argue that language is believed to be acquired by habit formation. Therefore, in this approach, memorization and pattern practice should be repeated until learners are able to use the sentence patterns automatically. In Experiment 3, repetition of a certain sentence pattern with memorization led readers to promote sentence processing. This occurred probably because tasks with high cognitive demands which required temporal memory store in working memory activated the phonological loop, and this activation played a crucial role for establishing representations of lexical information in mental lexicon and appeared to contribute to the automatization of parsing. Thus, the effectiveness of repetition with high cognitive demands on parsing has been accounted for through a psycholinguistic approach in this study. This finding is consistent with de Bot (1996) who attempts to clarify the psychological mechanisms of repetition. He argues that repetition practice enhances language fluency because it promotes automatic access to previously acquired knowledge and hypothesizes that its effect occurs in the transition of declarative knowledge to procedural knowledge. The present study supports this hypothesis as repetition that relied heavily on working memory may have helped turn declarative knowledge into procedural knowledge (see 2.1 for declarative and procedural knowledge).

The effects of repeated exposure were observed only in sentences with simple transitive verbs in Experiment 3, which shows that Japanese EFL learners are exposed to simple transitive verb frames most frequently. This finding supports a study of syntactic priming in which prior exposure to specific syntactic structures affects subsequent sentence processing (McDonough & Trofimovich, 2009). In other words, if readers or listeners comprehend a particular syntactic structure after recent exposure to that structure, their processing will be facilitated. This facilitative effect of syntactic priming is believed to occur due to repeated exposure to specific syntactic structures. Priming is assumed to be an implicit process that occurs with little awareness. McDonough and Trofimovich state:

> The process of comprehending or producing a syntactic structure is believed to activate the structural information stored with individual lexical items (like subcategorization information

stored in verbs) and/or phrase structure frames. Once this activation occurs, residual activation remains and facilitates the subsequent use of that same structure. (p.99)

Traxler and Tooley (2007) report that syntactic priming effects occur in the kinds of sentences where the preceding sentence has the same verb. The effects occur due to the activation in the lexical representation of specific verbs. They state when the target sentence is processed, it leads to a temporary increase in activation in representations that are tied to the specific verb and that have the same frame of arguments as the prime sentence. When the target sentence requires the same syntactic frame, it is more activated than normal, and ambiguity solution is facilitated.

Although the traditional audio-lingual methods such as imitation and repetition have been believed to be efficient ways to learn language, there are very few studies that investigate why they are effective or what mechanism of the brain they facilitate for language learning. There are some studies which investigated the relationship between vocabulary learning and activation of the neural substrates (e.g., Clark & Wagner, 2003; Yoshida et al., 2009); however, very few examined how imitation and repetition work on L2 sentence processing based on cognitive science. Findings from the current study suggest that tasks that rely heavily on working memory promote the automatization process in sentence comprehension of L2 learners probably by activation of phonological loops. This could be a major contribution toward psycholinguistics and improvement of second language learning.

6.5 Pedagogical Implications

The present study revealed that the knowledge of lexical information strongly connects to structure building of Japanese EFL learners. The positive effect of repeated exposure to specific syntactic structures on parsing was thus well grounded in cognitive science. This is believed to have helped with the establishment of representations of verb syntactic information and also promoted automaticity of syntactic processing. This position is supported by a recent training study of L1 using sentences with reduced relatives which showed that readers can learn to process reduced relatives more efficiently as long as sentences in the test have the same verb as the training set (Long & Prat, 2002). This shows that readers are not learning how to deal with a particular rare structure (like reduced relatives), but they are learning that the rare structure is more likely

when a specific verb appears in the sentence (Traxler & Tooley, 2007). In other words, readers' lexical representations, such as representations of verb subcategorization information, are more likely to have strong associations with syntactic structure building. This approach of lexically mediated parsing predicts a number of possibilities in improving parsing of Japanese EFL learners.

To successfully promote automatic processing during instruction, instructors should first give learners tasks with high cognitive demands such as word-order correction tasks or repetition without looking. Seeing the particular syntactic frame is not an effective way of learning compared with having to recall the form of the structure. With regard to verbs in the training sentences, it is important to use verbs which have the same type of subcategorization information until learners mentally establish the representations of the specific syntactic structures and use the sentence patterns automatically.

CHAPTER 7

CONCLUSION AND FURTHER RESEARCH

The results of the psycholinguistic behavioral experiments in the present study suggest a numbers of possibilities in helping the establishment of syntactic representations in mental lexicon of L2 learners and promoting the automatization process in sentence comprehension through intensive exposure to specific syntactic structures with high cognitive demands.

For further research, attention should be focused on the number of exposures that are presented to learners and how this affects sentence processing. In Experiment 3, one sentence appeared eight times, and effects on simple transitive verb frames were found, but no statistically significant effect was found on sentences with dative and infinitive complement verbs. This indicates that learners should be exposed to dative and infinitive complement verb frames at least more than eight times to establish the syntactic structures. The way to present target syntactic frames and the number of exposures need to be examined in the further study in order to develop more effective reading instructions.

Another concern is distinguishing between syntactic and semantic lexical information on sentence processing of L2 learners. Boland (1993) investigated how syntactic and semantic lexical information becomes available to the sentence processing systems of L1 speakers. From the results, she reported that "contextual information is used to evaluate semantic representation at an early stage while syntactic representations inconsistent with context are temporarily maintained" (p.149). Then, further research should explore how lexical information is used to build syntactic and semantic representations and distinguish between the use of subcategorization and thematic frames in an L2 setting.

Last, but not least, the findings from the present study should be verified in terms of neuroscientific investigation. As Yoshida et al. (2009) demonstrated from the results of their fMRI experiment and training sessions on vocabulary learning (see 5.2.2), the neural substrates of vocal imitation learning which is activated during the repetition of task sentences are concerned with a mirror neuron system, and it may have contributed to sentence processing. Clark and Wagner (2003) also argue from their experiment on new word learning using fMRI that the left inferior

prefrontal cortex and bilateral parietal cortices activate during phonological assembly, suggesting the phonological system may contribute to the formation of long-term word representations. However, it cannot be suggested that such activation of the circuit also occurs during sentence comprehension. There might be a limitation to examining these issues through psycholinguistic behavioral experiments. For further research on sentence processing, there is a need to conduct neuroscientific experiments using functional neural imaging techniques such as fMRI and event related potentials to investigate the following issues: how fluctuations of brain activation occur during exposure to sentences, how it affects processing of syntactic categories, semantics and parsing in real time, and how the neural basis is concerned with syntax to explore the automatization process of parsing of L2 learners.

It can be concluded that readers who are exposed to a greater number of different structures may have stronger connections between their lexical information and syntactic structures. It is hoped that the present study will help towards the further investigation of the automatization process in sentence comprehension and also, towards efficient reading instruction for Japanese EFL learners.

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APPENDIXES

Appendix A (Experiment 1)

英単語に関する知識テスト

大学名（　　大学）　学年（　　）

学籍番号（　　）　氏名（　　）

■このテストは，大学生の皆さんを対象に，英単語の品詞や意味に関する知識を試すものです。以下の各英単語について，その語の品詞を，名詞，動詞，形容詞，副詞，前置詞，接続詞，冠詞の中から主なものを１つだけ選んで○を付けてください。また，（　　）内には，その語の意味を日本語で書いてください。問題は，とばさずに順番に，あまり考え込まずにできるだけすばやく解答してください。

1 money	名詞	動詞	形容詞	副詞	前置詞	接続詞	冠詞	（　　）
2 same	名詞	動詞	形容詞	副詞	前置詞	接続詞	冠詞	（　　）
3 family	名詞	動詞	形容詞	副詞	前置詞	接続詞	冠詞	（　　）
4 actually	名詞	動詞	形容詞	副詞	前置詞	接続詞	冠詞	（　　）
5 young	名詞	動詞	形容詞	副詞	前置詞	接続詞	冠詞	（　　）
6 get	名詞	動詞	形容詞	副詞	前置詞	接続詞	冠詞	（　　）
7 at	名詞	動詞	形容詞	副詞	前置詞	接続詞	冠詞	（　　）
8 quite	名詞	動詞	形容詞	副詞	前置詞	接続詞	冠詞	（　　）
9 important	名詞	動詞	形容詞	副詞	前置詞	接続詞	冠詞	（　　）
10 come	名詞	動詞	形容詞	副詞	前置詞	接続詞	冠詞	（　　）
11 different	名詞	動詞	形容詞	副詞	前置詞	接続詞	冠詞	（　　）
12 a	名詞	動詞	形容詞	副詞	前置詞	接続詞	冠詞	（　　）
13 old	名詞	動詞	形容詞	副詞	前置詞	接続詞	冠詞	（　　）
14 have	名詞	動詞	形容詞	副詞	前置詞	接続詞	冠詞	（　　）
15 world	名詞	動詞	形容詞	副詞	前置詞	接続詞	冠詞	（　　）
16 again	名詞	動詞	形容詞	副詞	前置詞	接続詞	冠詞	（　　）
17 beautiful	名詞	動詞	形容詞	副詞	前置詞	接続詞	冠詞	（　　）
18 driver	名詞	動詞	形容詞	副詞	前置詞	接続詞	冠詞	（　　）
19 from	名詞	動詞	形容詞	副詞	前置詞	接続詞	冠詞	（　　）
20 life	名詞	動詞	形容詞	副詞	前置詞	接続詞	冠詞	（　　）

21 of 名詞 動詞 形容詞 副詞 前置詞 接続詞 冠詞 （ ）

22 particular 名詞 動詞 形容詞 副詞 前置詞 接続詞 冠詞 （ ）

23 church 名詞 動詞 形容詞 副詞 前置詞 接続詞 冠詞 （ ）

24 if 名詞 動詞 形容詞 副詞 前置詞 接続詞 冠詞 （ ）

25 into 名詞 動詞 形容詞 副詞 前置詞 接続詞 冠詞 （ ）

26 system 名詞 動詞 形容詞 副詞 前置詞 接続詞 冠詞 （ ）

27 the 名詞 動詞 形容詞 副詞 前置詞 接続詞 冠詞 （ ）

28 political 名詞 動詞 形容詞 副詞 前置詞 接続詞 冠詞 （ ）

29 rich 名詞 動詞 形容詞 副詞 前置詞 接続詞 冠詞 （ ）

30 sing 名詞 動詞 形容詞 副詞 前置詞 接続詞 冠詞 （ ）

31 movie 名詞 動詞 形容詞 副詞 前置詞 接続詞 冠詞 （ ）

32 live 名詞 動詞 形容詞 副詞 前置詞 接続詞 冠詞 （ ）

33 coffee 名詞 動詞 形容詞 副詞 前置詞 接続詞 冠詞 （ ）

34 ever 名詞 動詞 形容詞 副詞 前置詞 接続詞 冠詞 （ ）

35 song 名詞 動詞 形容詞 副詞 前置詞 接続詞 冠詞 （ ）

36 newly 名詞 動詞 形容詞 副詞 前置詞 接続詞 冠詞 （ ）

37 tennis 名詞 動詞 形容詞 副詞 前置詞 接続詞 冠詞 （ ）

38 whether 名詞 動詞 形容詞 副詞 前置詞 接続詞 冠詞 （ ）

39 wonderful 名詞 動詞 形容詞 副詞 前置詞 接続詞 冠詞 （ ）

40 rather 名詞 動詞 形容詞 副詞 前置詞 接続詞 冠詞 （ ）

41 fulfill 名詞 動詞 形容詞 副詞 前置詞 接続詞 冠詞 （ ）

42 an 名詞 動詞 形容詞 副詞 前置詞 接続詞 冠詞 （ ）

43 behave 名詞 動詞 形容詞 副詞 前置詞 接続詞 冠詞 （ ）

44 healthy 名詞 動詞 形容詞 副詞 前置詞 接続詞 冠詞 （ ）

45 although 名詞 動詞 形容詞 副詞 前置詞 接続詞 冠詞 （ ）

46 dangerous 名詞 動詞 形容詞 副詞 前置詞 接続詞 冠詞 （ ）

47 council 名詞 動詞 形容詞 副詞 前置詞 接続詞 冠詞 （ ）

48 undergo 名詞 動詞 形容詞 副詞 前置詞 接続詞 冠詞 （ ）

49 authority 名詞 動詞 形容詞 副詞 前置詞 接続詞 冠詞 （ ）

50 bring 名詞 動詞 形容詞 副詞 前置詞 接続詞 冠詞 （ ）

51 committee 名詞 動詞 形容詞 副詞 前置詞 接続詞 冠詞 （ ）

52 modest 名詞 動詞 形容詞 副詞 前置詞 接続詞 冠詞 （ ）

53 industry 名詞 動詞 形容詞 副詞 前置詞 接続詞 冠詞 （ ）

54 purely 名詞 動詞 形容詞 副詞 前置詞 接続詞 冠詞 （ ）

55 whole 名詞 動詞 形容詞 副詞 前置詞 接続詞 冠詞 （ ）

56 and 名詞 動詞 形容詞 副詞 前置詞 接続詞 冠詞 （ ）

57 available 名詞 動詞 形容詞 副詞 前置詞 接続詞 冠詞 （ ）

58 advise 名詞 動詞 形容詞 副詞 前置詞 接続詞 冠詞 （ ）

59 various 名詞 動詞 形容詞 副詞 前置詞 接続詞 冠詞 （ ）

60 among 名詞 動詞 形容詞 副詞 前置詞 接続詞 冠詞 （ ）

61 relax 名詞 動詞 形容詞 副詞 前置詞 接続詞 冠詞 （ ）

62 upon 名詞 動詞 形容詞 副詞 前置詞 接続詞 冠詞 （ ）

63 desperate 名詞 動詞 形容詞 副詞 前置詞 接続詞 冠詞 （ ）

64 vendor 名詞 動詞 形容詞 副詞 前置詞 接続詞 冠詞 （ ）

65 because 名詞 動詞 形容詞 副詞 前置詞 接続詞 冠詞 （ ）

66 per 名詞 動詞 形容詞 副詞 前置詞 接続詞 冠詞 （ ）

67 swim 名詞 動詞 形容詞 副詞 前置詞 接続詞 冠詞 （ ）

68 towards 名詞 動詞 形容詞 副詞 前置詞 接続詞 冠詞 （ ）

69 within 名詞 動詞 形容詞 副詞 前置詞 接続詞 冠詞 （ ）

70 poetry 名詞 動詞 形容詞 副詞 前置詞 接続詞 冠詞 （ ）

71 residential 名詞 動詞 形容詞 副詞 前置詞 接続詞 冠詞 （ ）

72 wholly 名詞 動詞 形容詞 副詞 前置詞 接続詞 冠詞 （ ）

73 linguistic 名詞 動詞 形容詞 副詞 前置詞 接続詞 冠詞 （ ）

74 consider 名詞 動詞 形容詞 副詞 前置詞 接続詞 冠詞 （ ）

75 roughly 名詞 動詞 形容詞 副詞 前置詞 接続詞 冠詞 （ ）

76 machinery 名詞 動詞 形容詞 副詞 前置詞 接続詞 冠詞 （ ）

77 carefully 名詞 動詞 形容詞 副詞 前置詞 接続詞 冠詞 （ ）

78 proof 名詞 動詞 形容詞 副詞 前置詞 接続詞 冠詞 （ ）

79 absorb　名詞　動詞　形容詞　副詞　前置詞　接続詞　冠詞　（　　）

80 portrait　名詞　動詞　形容詞　副詞　前置詞　接続詞　冠詞　（　　）

81 receive　名詞　動詞　形容詞　副詞　前置詞　接続詞　冠詞　（　　）

82 silly　名詞　動詞　形容詞　副詞　前置詞　接続詞　冠詞　（　　）

83 believe　名詞　動詞　形容詞　副詞　前置詞　接続詞　冠詞　（　　）

84 never　名詞　動詞　形容詞　副詞　前置詞　接続詞　冠詞　（　　）

85 always　名詞　動詞　形容詞　副詞　前置詞　接続詞　冠詞　（　　）

86 really　名詞　動詞　形容詞　副詞　前置詞　接続詞　冠詞　（　　）

87 or　名詞　動詞　形容詞　副詞　前置詞　接続詞　冠詞　（　　）

88 exploit　名詞　動詞　形容詞　副詞　前置詞　接続詞　冠詞　（　　）

89 certainly　名詞　動詞　形容詞　副詞　前置詞　接続詞　冠詞　（　　）

90 anticipate　名詞　動詞　形容詞　副詞　前置詞　接続詞　冠詞　（　　）

91 commonly　名詞　動詞　形容詞　副詞　前置詞　接続詞　冠詞　（　　）

92 though　名詞　動詞　形容詞　副詞　前置詞　接続詞　冠詞　（　　）

93 describe　名詞　動詞　形容詞　副詞　前置詞　接続詞　冠詞　（　　）

94 nor　名詞　動詞　形容詞　副詞　前置詞　接続詞　冠詞　（　　）

95 perhaps　名詞　動詞　形容詞　副詞　前置詞　接続詞　冠詞　（　　）

96 communicate　名詞　動詞　形容詞　副詞　前置詞　接続詞　冠詞　（　　）

97 during　名詞　動詞　形容詞　副詞　前置詞　接続詞　冠詞　（　　）

※以上で問題は終わりです。終わったら，静かに待っていてください。

Appendix B (Experiment 1)

Reading Comprehension Test – J. K. Rowling

Page 1

Time yourself as you read the following passage. Read the passage and answer the questions on the following page. Do not look back at the passage as you answer the questions.

Starting Time_____:_____

Harry Potter and the Philosopher's Stone is a best-selling book in fifty-five languages. So are the other Harry Potter books. The Harry Potter books have also been made into very popular movies. Millions of people around the world know Harry's story. They know about his magical powers, his friends and his enemies, and the school of magic called Hogwarts. But where did the idea of Harry Potter come from? And what led the author, J. K. Rowling, to invent such a popular character?

J. K. Rowling's full name is Joanne Kathleen Rowling. She was born in 1966 in Chipping Sodbury, near Bristol, England. Chipping Sodbury is a strange name for a town. But Rowling likes the name of her birthplace. She likes places with strange names, and she remembers those names when she writes her books.

In fact, books were always important to Rowling and her family. There were lots of books in their house. Her mother loved reading, and so did her father. They often read books aloud to her. Then she learned to read by herself. When she was only six, she even wrote a book. It was called *Rabbit*. She wanted to publish it like a real book. From then on, that was her dream. She wanted to be a writer.

Rowling and her younger sister started school in Bristol. She was very happy at the elementary school there. But when she was nine, Rowling's parents decided to move to the country. They were both from the city, but they had always dreamed of living in the country. So they moved to the village of Tutshill, near Chepstow, in South Wales. The village was in the Forest of Dean, not far from the River Wye. The family's house was next to the church and the cemetery. Rowling's friends were afraid of the cemetery, but she and her sister liked it. She liked reading the names of all the dead people. She says she still likes cemeteries and still goes to them

to look for names to use in her books.

There were many interesting and unusual places to visit near Tutshill. For example, near Chepstow there was an old castle on a hill. There was also the river and lots of big rocks to climb on. Rowling and her sister loved to play outdoors. They didn't have computers or video games, and they didn't watch much television. Instead, they invented games and adventures for themselves. (408 words)

Finishing Time _____:_____

Reading Time _____:_____

Answer the questions on the following page.

Questions for J. K. Rowling

Circle the best answer for each item. Do not look back at the passage.

1. This passage is about
    a. the Harry Potter books.
    b. a writer of children's books.
    c. the early life of J. K. Rowling.
    d. J. K. Rowling's birth place.

2. Rowling was born
    a. in Chipping Sodbury.
    b. in a town near London.
    c. in a town called Hogwarts.
    d. near Chestow, South Wales.

3. In her books, Rowling likes to write about
    a. people in her family.
    b. places with strange names.
    c. places with English names.
    d. people around the world.

4. Her parents
    a. played music often.
    b. never read books.
    c. published many books.
    d. loved to read books.

5. When she was six, she
    a. read a book.
    b. wrote a book.

c. went to Tutshill.

d. had a rabbit.

6. Rowling's parents moved to Tutshill because

a. there was no school in Chipping Sodbury.

b. they wanted to live near city.

c. there was no work near Bristol.

d. they wanted to live in the country.

7. In Tutshill, the Rowlings lived near a

a. cemetery.

b. school.

c. library.

d. city.

8. When she was young, Rowling enjoyed

a. playing outdoors.

b. watching television.

c. playing on the computer.

d. going to church.

APPENDIX C

Experiment 2 and Experiment 3 (Part 1and 3)

実験の手順

1. 右手の人差し指をスペースバーに、左手の人差し指を **”C”** のキーに軽く置いてください。**PC** 画面中央に+++++が現れます。準備ができればスペースバーを押してください。+++++の位置に語あるいは句が現れます。

2. 再びスペースバーを押すとその語は消え、次の語が現れます。意味を考えながらできるだけ正確に速く読んでください。

3. スペースバーを押し続けると文が終わり、次に+++++が現れます。

4. 準備ができればスペースバーを押して次の文に進んでください。

5. また、文の意味がおかしいと思った時点ですぐに **”C”** のキーを押してください。その後は文が終わるまでスペースバーを押してください。

6. 操作に慣れるための練習が **4** 文あります。

7. 練習が終わると **Test Starts** が現れ実験が始まります。

8. 実験文は **48** 文あります。所要時間は約 **15** 分です。

Experiment 3 (Part 2)

実験 2 (Part 1)の手順

1. 右手の人差し指をスペースバーに軽く置いてください。
2. **PC** 画面中央に **Press Space Key** が現れます。準備ができればスペースバーを押してください。
3. 次に英文が現れます。音声を聞きながら黙読してください。
4. 次の画面に **“O”** が現れたら前の画面の文を復唱してください。

   “X” が現れたら何も言わないでください。
5. 再び **Press Space Key** が現れます。準備ができればスペースバーを押してください。次の英文が現れます。
6. 操作に慣れるための練習が **4** 文あります。質問があれば、練習後に聞いてください。
7. 練習が終わると **Start** が現れ実験が始まります。
8. 同じような文が何度か繰り返されます。所要時間は約 **25** 分です。

Appendix D (Experiment 2)

Experimental Sentences for Experiment 2

1.

Simple Transitive Verb

[Pl] The man / wasn't sure / which horse / the boy / watched / this morning.

[Imp] The man / wasn't sure / which song / the boy / watched / this morning.

Baseline

[Pl] The man / wasn't sure / whether / the boy / watched / the horse / this morning.

[Imp] The man / wasn't sure / whether / the boy / watched / the song / this morning.

Dative Verb

[Pl] The man / wasn't sure / which horse / the boy / gave / to the mother / this morning.

[Imp] The man / wasn't sure / which girl / the boy / gave / to the mother / this morning.

Baseline

[Pl] The man / wasn't sure / whether / the boy / gave / the horse / to the mother / this morning .

[Imp] The man / wasn't sure / whether / the boy / gave / the girl / to the mother / this morning.

Infinitive Complement Verb

[Pl] The man / wasn't sure / which horse / the boy / allowed / the mother / to sell / this morning.

[Imp] The man / wasn't sure / which girl / the boy / allowed / the mother / to sell / this morning.

Baseline

[Pl] The man / wasn't sure / whether / the boy / allowed / the mother / to sell / the horse / this morning.

[Imp] The man / wasn't sure / whether / the boy / allowed / the mother / to sell / the girl / this morning.

Intransitive Preference Verb

[Pl] The man / wasn't sure / which horse / the boy / raced / this morning.

[Imp] The man /wasn't sure / which rock / the boy / raced / this morning.

Baseline

[Pl] The man / wasn't sure / whether / the boy / raced / the horse / this morning.

[Imp] The man / wasn't sure / whether / the boy / raced / the rock / this morning.

2.

Simple Transitive Verb

[Pl] The woman / knew / which doctor/ the man / called / at the office.

[Imp] The woman / knew / which coffee / the man / called / at the office.

Baseline

[Pl] The woman / knew / whether / the man / called / the doctor / at the office.

[Imp] The woman / knew / whether / the man / called / the coffee / at the office.

Dative Verb

[Pl] The woman / knew / which letter / the man / sent / to the doctor / to the office.

[Imp] The woman / knew / which baby / the man / sent / to the doctor / to the office.

Baseline

[Pl] The woman / knew / whether / the man / sent / the letter / to the doctor / to the office.

[Imp] The woman / knew / whether / the man / sent / the baby / to the doctor / to the office.

Infinitive Complement Verb

[Pl] The woman / knew / which letter / the man / advised / the doctor / to send / to the office.

[Imp] The woman / knew / which party / the man / advised / the doctor / to send / to the office.

Baseline

[Pl] The woman / knew / whether / the man / advised / the doctor / to send / the letter / to the office.

[Imp] The woman / knew / whether / the man / advised / the doctor / to send / the party/ to the office.

Intransitive Preference Verb

[Pl] The woman / knew / which doctor / the man / hurried / to the office.

[Imp] The woman / knew / which movie / the man / hurried / to the office.

Baseline

[Pl] The woman / knew / whether / the man / hurried / the doctor / to the office.

[Imp] The woman / knew / whether / the man / hurried / the movie / to the office.

3.

Simple Transitive Verb

[Pl] The wife / wondered / which wall / the husband / painted / this evening.

[Imp] The wife / wondered / which sound / the husband / painted / this evening.

Baseline

[Pl] The wife / wondered / whether / the husband / painted / the wall / this evening.

[Imp] The wife / wondered / whether / the husband / painted / the sound / this evening.

Dative Verb

[Pl] The wife / wondered / which wall / the husband / showed / to the worker / this evening.

[Imp] The wife / wondered / which son / the husband / showed / to the worker / this evening.

Baseline

[Pl] The wife / wondered / whether / the husband / showed / the wall / to the worker / this evening.

[Imp] The wife / wondered / whether / the husband / showed / the son / to the worker / this evening.

Infinitive Complement Verb

[Pl] The wife / wondered / which wall / the woman / ordered / the worker / to paint / this evening.

[Imp] The wife / wondered / which sound / the husband / ordered / the worker / to paint / this evening.

Baseline

[Pl] The wife / wondered / whether / the husband / ordered / the worker / to paint / the wall / this evening.

[Imp] The wife / wondered / whether / the husband / ordered / the worker / to paint / the sound / this evening.

Intransitive Preference Verb

[Pl] The wife / wondered / which boy / the husband / stood / in front of the mirror.

[Imp]The wife / wondered / which pond / the husband / stood / in front of the mirror.

Baseline

[Pl] The wife / wondered / whether / the husband / stood / the boy / in front of the mirror.

[Imp] The wife / wondered / whether / the husband / stood / the pond / in front of the mirror.

4.

Simple Transitive Verb

[Pl] The father / found out / which dog / the boy / kicked / in the park.

[Imp] The father / found out / which milk / the boy / kicked / in the park.

Baseline

[Pl] The father / found out / whether / the boy / kicked / the dog / in the park.

[Imp] The father / found out / whether / the boy / kicked / the milk / in the park.

Dative Verb

[Pl] The father / found out / which dog / the boy / bought / for the sister / in the park.

[Imp] The father / found out / which girl / the boy / bought / for the sister / in the park.

Baseline

[Pl] The father / found out / whether / the boy / bought / the dog / for the sister / in the park.

[Imp] The father / found out / whether / the boy / bought / the girl / for the sister / in the park.

Infinitive Complement Verb

[Pl] The father / found out / which ball / the boy / wanted / the dog / to get / in the park.

[Imp] The father / found out / which day / the boy / wanted / the dog / to get / in the park.

Baseline

[Pl] The father / found out / whether / the boy / wanted / the dog / to get / the ball / in the park.

[Imp] The father / found out / whether / the boy / wanted / the dog / to get / the day / in the park.

Intransitive Preference Verb

[Pl] The father / found out / which dog / the boy / walked / in the park.

[Imp] The father / found out / which milk / the boy / walked / in the park.

Baseline

[Pl] The father / found out / whether / the boy / walked / the dog / in the park.

[Imp] The father / found out / whether / the boy / walked / the milk / in the park.

5.

Simple Transitive Verb

[Pl] The doctor / remembered / which story / the nurse / heard / last night.

[Imp] The doctor / remembered / which mirror / the nurse / heard / last night.

Baseline

[Pl] The doctor / remembered / whether / the nurse / heard / the story / last night.

[Imp] The doctor / remembered / whether / the nurse / heard / the mirror / last night.

Dative Verb

[Pl] The doctor / remembered / which song / the nurse / taught / to the child / last night.

[Imp] The doctor / remembered / which boy / the nurse / taught / to the child / last night.

Baseline

[Pl] The doctor / remembered / whether / the nurse / taught / the song / to the child / last night.

[Imp] The doctor / remembered / whether / the nurse / taught / the boy / to the child / last night.

Infinitive Complement Verb

[Pl] The doctor / remembered / which food / the nurse / forced / the child / to eat / last night.

[Imp] The doctor / remembered / which house / the nurse / forced / the child / to eat / last night.

Baseline

[Pl] The doctor / remembered / whether / the nurse / forced / the child / to eat / the food / last night.

[Imp] The doctor / remembered / whether / the nurse / forced / the child / to eat / the house / last night.

Intransitive Preference Verb

[Pl] The doctor / remembered / which bed / the nurse / moved / last night.

[Imp] The doctor / remembered / which bank / the nurse / moved / last night.

Baseline

[Pl] The doctor / remembered / whether / the nurse / moved / the bed / last night.

[Imp] The doctor / remembered / whether / the nurse / moved / the bank / last night.

6.

Simple Transitive Verb

[Pl] The teacher / was sure / which boy / the coach / saw / at school.

[Imp] The teacher / was sure / which noise / the coach / saw / at school.

Baseline

[Pl] The teacher / was sure / whether / the coach / saw / the boy / at school.

[Imp] The teacher / was sure / whether / the coach / saw / the noise / at school.

Dative Verb

[Pl] The teacher / was sure / which news / the coach / told / to the student / at school.

[Imp] The teacher / was sure / which boy / the coach / told / to the student / at school.

Baseline

[Pl] The teacher / was sure / whether / the coach / told / the news / to the student / at school.

[Imp] The teacher / was sure / whether / the coach / told / the boy / to the boy / at school.

Infinitive Complement Verb

[Pl] The teacher / was sure / which party / the coach / permitted / the student / to attend / at school.

[Imp] The teacher / was sure / which woman / the coach / permitted / the student / to attend / at school.

Baseline

[Pl] The teacher / was sure / whether / the coach / permitted / the student / to attend / the party / at school.

[Imp] The teacher / was sure / whether / the coach / permitted / the student / to attend / the woman /

at school.

Intransitive Preference Verb

[Pl] The teacher / was sure / which student / the coach / swam / at school.

[Imp] The teacher / was sure / which music / the coach / swam / at school.

Baseline

[Pl] The teacher / was sure / whether / the coach / swam / the student / at school.

[Imp] The teacher / was sure / whether / the coach / swam / the music / at school.

7.

Simple Transitive Verb

[Pl] The mother / didn't know / which table / the girl / cleaned / at home.

[Imp] The mother / didn't know / which lesson / the girl / cleaned / at home.

Baseline

[Pl] The mother / didn't know / whether / the girl / cleaned / the table / at home.

[Imp] The mother / didn't know / whether / the girl / cleaned / the lesson / at home.

Dative Verb

[Pl] The mother / didn't know / which dish / the girl / passed / to the sister / at home.

[Imp] The mother / didn't know / which boy / the girl / passed / to the sister / at home.

Base line

[Pl] The mother / didn't know / whether / the girl / passed / the dish / to the sister / at home.

[Imp] The mother / didn't know / whether / the girl / passed / the boy / to the sister / at home.

Infinitive Complement Verb

[Pl] The mother / didn't know / which table / the girl / expected / the sister / to clean / at home.

[Imp] The mother / didn't know / which lesson / the girl / expected / the sister / to clean / at home.

Baseline

[Pl] The mother / didn't know / whether / the girl / expected / the sister / to clean / the table / at home.

[Imp] The mother / didn’t know / whether / the girl / expected / the girl / to clean / the lesson / at home.

Intransitive Preference Verb

[Pl]The mother / didn’t know / which baby / the girl / sat / on the chair.

[Imp] The mother / didn’t know / which water / the girl / sat / on the chair.

Baseline

[Pl] The mother / didn’t know / whether / the girl / sat / the baby / on the chair.

[Imp] The mother / didn’t know / whether / the girl / sat / the water / on the chair.

8.

Simple Transitive Verb

[Pl] The woman / noticed / which car / the man / chose / last week.

[Imp] The woman / noticed / which eye / the man / chose / last week.

Baseline

[Pl] The woman / noticed / whether / the man / chose / the car / last week.

[Imp] The woman / noticed / whether / the man / chose / the eye / last week.

Dative Verb

[Pl]The woman / noticed / which car / the man / brought / to the driver / last week.

[Imp] The woman / noticed / which king / the man / brought / to the driver / last week.

Baseline

[Pl] The woman / noticed / whether / the man / brought / the car / to the driver / last week.

[Imp] The woman / noticed / whether / the man / brought / the king / to the driver / last week.

Infinitive Complement Verb

[Pl] The woman / noticed / which car / the man / pushed / the driver / to use / last week.

[Imp] The woman / noticed / which cat / the man / pushed / the driver / to use / last week.

Baseline

[Pl] The woman / noticed / whether / the man / pushed / the driver / to use / the car / last week.

[Imp] The woman / noticed / whether / the man / pushed / the driver / to use / the cat / last week.

Intransitive Preference Verb

[Pl] The woman / noticed / which bus / the driver / ran / last week.

[Imp] The woman / noticed / which hand / the man / ran / last week.

Baseline

[Pl] The woman / noticed / whether / the driver / ran / the bus / last week.

[Imp] The woman / noticed / whether / the driver / ran / the hand / last week.

Filler Sentences for Experiment 2

1. The teacher / let / the student / go / home / this morning.
2. The doctor / was loved / by the patients / in the hospital.
3. The boy / met / Mary's mother / at the mall / yesterday.
4. Mary / helped / her sister / write / the paper / last week.
5. Steve / saw / his cousin / jogging / in the park.
6. The girl / promised / her mother / to wash / the dishes / this morning.
7. The man / wondered / whether / Tom / went / to the party / last night.
8. The wife / bought / her husband / a watch / downtown.
9. John / taught / Cathy / how to use / the computer / in the office.
10. The woman / didn't know / who / cooked / dinner / last night.
11. The father / knew / his son / took / the test / at school.
12. Nancy / borrowed / a CD / from her cousin / last week.
13. The teacher / expected / the student / to come / to school / that day.
14. The mother / let / the children / play / in the park.
15. The boy / asked / his father / to buy / a new bicycle / today.
16. The father / allowed / his son / to go abroad / last year.
17. Mike / doesn't know / where to go / for nice French food.
18. Susan / sent / an e-mail / to her mother / this morning.

19. Mary / always / called / her husband / darling.
20. The man / asked / his wife / to cook / fish / this evening.
21. Peter / lent / some money / to his friend / last week.
22. Jane / invited / her boyfriend / to dinner / last Sunday.
23. The father / advised / his son / to become / a doctor.
24. The mother / read / the book / for the child / today.
25. The woman / knew / who / went / to the party / yesterday.
26. The boy / wanted / to play / baseball / in the park.
27. The girl / went / shopping / with her sister / last Friday.
28. The father / gave / the boy / a jacket / yesterday.
29. The man / was called / Joe / by his friends / in town.
30. The mother / sent / a letter / to her son / in New York.
31. The boy / was swimming / in the river / this afternoon.
32. John / sent / flowers / to his girlfriend / on her birthday.

Appendix E (Experiment 3)

Experimental Sentences for Experiment 3(Part 1 and 3)

1.

Simple Transitive Verb

[Pl] Which game / did the boy / watch / this morning?

[Imp] Which noise / did the boy / watch / this morning?

Baseline

[Pl] The boy / watched / the game / this morning.

[Imp] The boy / watched / the noise / this morning.

Dative Verb

[Pl] Which knife / did the father / give / to the boy / this morning?

[Imp] Which girl / did the father / give / to the boy / this morning?

Baseline

[Pl] The father / gave / the knife / to the boy / this morning.

[Imp] The father / gave / the girl / to the boy / this morning.

Infinitive Complement Verb

[Pl] Which knife / did the father / allow/ the boy / to use / this morning?

[Imp] Which dog /did the father / allow / the boy / to use / this morning?

Baseline

[Pl] The father / allowed / the boy / to use / the knife / this morning.

[Imp] The father / allowed / the boy / to use / the dog / this morning.

2.

Simple Transitive Verb

[Pl] Which doctor / did the man / call / yesterday?

[Imp] Which coffee / did the man / call / yesterday?

Baseline

[Pl] The man / called / the doctor / yesterday.

[Imp] The man / called / the coffee / yesterday.

Dative Verb

[Pl] Which letter / did the man / send / to the doctor / yesterday?

[Imp] Which baby / did the man / send / to the doctor / yesterday?

Baseline

[Pl] The man / sent / the letter / to the doctor / yesterday.

[Imp] The man / sent / the baby / to the doctor / yesterday.

Infinitive Complement Verb

[Pl] Which doctor / did the man / advise/ the woman / to call / yesterday?

[Imp] Which letter / did the man / advise / the woman/ to call / yesterday?

Baseline

[Pl] The man / advised / the woman / to call / the doctor / yesterday.

[Imp] The man / advised / the woman / to call / the letter / yesterday.

3.

Simple Transitive Verb

[Pl] Which wall /did / the husband / paint / today?

[Imp] Which sound / did / the husband / paint / today?

Baseline

[Pl] The husband / painted / the wall / today.

[Imp] The husband / painted / the sound / today.

Dative Verb

[Pl] Which wall / did / the husband / show / to the worker / today?

[Imp] Which son / did / the husband / show / to the worker / today?

Baseline

[Pl] The husband / showed / the wall / to the worker / today.

[Imp] The husband / showed / the son / to the worker / today.

Infinitive Complement Verb

[Pl] Which wall / did / the woman / order / the worker / to paint / today?

[Imp] Which sound / did / the husband / order / the worker / to paint / today?

Baseline

[Pl] The husband / ordered / the worker / to paint / the wall / today.

[Imp] The husband / ordered / the worker / to paint / the sound / today.

4.

Simple Transitive Verb

[Pl] Which stone / did the boy / kick / down the road?

[Imp] Which class / did the boy / kick / down the road?

Baseline

[Pl] The boy / kicked / a stone / down the road.

[Imp] The boy / kicked / the class / down the road.

Dative Verb

[Pl] Which flower / did the man / buy / for his wife / down the road?

[Imp] Which woman / did the man / buy / for his wife / down the road?

Baseline

[Pl] The man / bought / a flower / for his wife /down the road.

[Imp] The man / bought / a girl / for his wife / down the road.

Infinitive Complement Verb

[Pl] Which bike / did / the man / want / the boy / to ride / down the road?

[Imp] Which cat / did / the man / want / the boy / to ride/ down the road?

Baseline

[Pl] The man / wanted / the boy / to ride / a bike / down the road.

[Imp] The boy / wanted / the boy / to ride / a cat / down the road.

5.

Simple Transitive Verb

[Pl] Which story / did the nurse / hear / last night?

[Imp] Which mirror / did the nurse / hear / last night?

Baseline

[Pl] The nurse / heard / the story / last night.

[Imp] The nurse / heard / the mirror / last night.

Dative Verb

[Pl] Which song / did / the nurse / teach / to the child / last night?

[Imp] Which boy / did / the nurse / teach / to the child / last night?

Baseline

[Pl] The nurse / taught / the song / to the child / last night.

[Imp] The nurse / taught / the boy / to the child / last night.

Infinitive Complement Verb

[Pl] Which food / did the nurse / force / the child / to eat / last night?

[Imp] Which book / did the nurse / force / the child / to eat / last night?

Baseline

[Pl] The nurse / forced / the child / to eat / the food / last night.

[Imp] The nurse / forced / the child / to eat / the book / last night.

6.

Simple Transitive Verb

[Pl] Which team / did / the coach / see / at school?

[Imp] Which sound / did / the coach / see / at school?

Baseline

[Pl] The coach / saw / the team / at school.

[Imp] The coach / saw / the sound / at school.

Dative Verb

[Pl] Which news / did / the teacher / tell / to the student / at school?

[Imp] Which boy / did / the teacher / tell / to the student / at school?

Baseline

[Pl] The teacher / told / the news / to the student / at school.

[Imp] The coach / told / the boy / to the student / at school.

Infinitive Complement Verb

[Pl] Which party / did / the coach / permitted / the player / to attend / at school?

[Imp] Which water /did / the coach / permitted / the player / to attend / at school?

Baseline

[Pl] The coach / permitted / the player / to attend / the party / at school.

[Imp] The coach / permitted / the player / to attend / the water / at school.

7.

Simple Transitive Verb

[Pl] Which window / did the girl / clean / today?

[Imp] Which lesson / did the girl / clean / today?

Baseline

[Pl] The girl / cleaned / the window / today.

[Imp] The girl / cleaned / the lesson/ today.

Dative Verb

[Pl] Which dish / did / the girl / pass / to her sister / today?

[Imp] Which boy / did / the girl / pass / to her sister / today?

Baseline

[Pl] The girl / passed / the dish / to her sister / today.

[Imp] The girl / passed / the boy / to her sister / today.

Infinitive Complement Verb

[Pl] Which window / did / the girl / expect / her sister / to clean / today?

[Imp] Which lesson / did / the girl / expect / her sister / to clean / today?

Baseline

[Pl] The girl / expected / her sister / to clean / the window / today.

[Imp] The girl / expected / her sister / to clean / the lesson / today.

8.

Simple Transitive Verb

[Pl] Which car / did / the man / choose / last week?

[Imp] Which eye / did / the man / choose / last week?

Baseline

[Pl] The man / chose / the car / last week.

[Imp] The man / chose / the eye / last week.

Dative Verb

[Pl] Which map /did / the man / hand / to the boy / last week?

[Imp] Which girl / did / the man / hand / to the boy / last week?

Baseline

[Pl] The man / handed / the map / to the boy / last week.

[Imp] The man / handed / the girl / to the boy/ last week.

Infinitive Complement Verb

[Pl] Which car / did / the man / push / the driver / to use / last week?

[Imp] Which cat / did / the man / push / the driver / to use / last week?

Baseline

[Pl] The man / pushed / the driver / to use / the car / last week.

[Imp] The man / pushed / the driver / to use / the cat / last week.

Filler Sentences for Experiment 3

1. The teacher / let / the student / to go / home / this morning.
2. The doctor / was loved / by the patients / in the hospital.
3. The boy / met / Mary's mother / at the mall / yesterday.
4. Mary / helped / her sister / write / the paper / last week.
5. Steve / saw / his cousin / jogging / in the park.
6. The wife / bought / her husband / a watch / in downtown.
7. The woman / didn't know / who / cooked / dinner / last night.
8. The father / knew / his son / took / the test / at school.
9. Nancy / borrowed / a CD / from her cousin / last week.
10. The mother / let / the children / play / in the park.
11. The boy / asked / his father / to buy / a new bicycle.
12. Mike / doesn't know / where to go / for nice French food.
13. Susan / sent / an e-mail / to her mother / this morning.
14. Mary / always / called / her husband / darling.
15. The man / asked / his wife / to cook / fish / this evening.
16. Peter / rent / some money / from his uncle / last week.
17. Jane / invited / her boyfriend / to dinner / last Sunday.
18. The mother / read / the book / for the child / today.
19. The woman / knew / who / went / to the party / yesterday.
20. The boy / wanted / to play / baseball / in the park.
21. The girl / went / shopping / with her sister / last Friday.
22. The man / was called / Jo / by his friends / in town.
23. The mother / sent / a letter / to her son / in New York.
24. The boy / was swimming / in the river / this afternoon.

Appendix E (Experiment 3)

Task Sentences for Experiment 3 (Part 2)

Task A and B

Set 1 and 2:

[Simple Transitive Verb]

The man called the police.

The girl cleaned the table.

The boy kicked a ball.

The man painted the door.

[Dative Verb]

The teacher handed a book to the student.

The husband gave a present to his wife.

The woman sent a letter to the doctor.

The mother told a story to her child.

[Infinitive Complement Verb]

The doctor advised the man to take a rest.

The woman expected her son to study English.

The father ordered his son to get a job.

The man pushed the woman to wash the dishes.

Task A and B

Set 3 and 4

[Simple Transitive Verb]

The woman chose the dress.

The student heard the song.

The boy saw a monkey.

The man watched a movie.

[Dative Verb]

The mother bought a hat for her child.

The woman passed the salt to the guest.

The girl showed a picture to her friend.

The teacher taught English to his students.

[Infinitive Complement Verb]

The father allowed his son to play a game.

The teacher forced the student to read a book.

The doctor permitted the nurse to take a break.

The husband wanted his wife to cook dinner.

Task C and D (Word-Order Correction Task)

Set 1 and 2:

called / the man / the police

cleaned / the table / the girl

a ball / the boy / kicked

the door / the man / painted

handed / the teacher / to the student / a book

gave / to his wife / a present / the husband

an e-mail / sent / to the doctor / the woman

a story / told / to her child / the mother

advised / a rest / to take / the man / the doctor

expected / the woman / English / to study / her son

a job / ordered / the father / to get / his son

the dishes / the man / to wash / the woman / pushed

Set 3 and 4:

chose / the woman / the dress

heard / the song / the student

a monkey / the boy / saw

a movie / the man / watched

bought / the mother / for her child /a hat

passed / to the guest / the salt / the woman

a picture / showed / the girl / to her friend

English / taught / to his students / the teacher

allowed / a game / to play / his son / the father

forced / the teacher / a book / to read / the student

a break / permitted / the doctor / to take / the nurse

dinner / the husband / to cook / his wife / wanted