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문학석사학위논문

**The Role of Implicit Teaching for
Second Language Learners with Low
Working Memory Capacity**

암시적 교육법이 작업기억력이 낮은
제2언어 학습자에게 미치는 역할

2015년 2월

서울대학교 대학원
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The Role of Implicit Teaching for Second Language Learners with Low Working Memory Capacity

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이 논문을 문학석사 석사학위논문으로 제출함

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Abstract

The Role of Implicit Teaching for Second Language Learners with Low Working Memory Capacity

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The purpose of this study is to verify the relationship between working memory capacity and implicit teaching of complex structures such as English phrasal verb construction. After being theorized by Baddeley, Thomson, & Buchanan (1975), working memory has been hypothesized as one of the major individual differences which affect language acquisition. Many experimental studies have discovered a strong relationship between working memory capacity and learners' achievement in an explicit teaching condition; learners with high working memory capacity were likely to surpass those with low working memory capacity. Implicit teaching conditions, on the other hand, may provide an appropriate learning environment for those learners with limited cognitive capacity, since the activation of working

memory has been suggested to relate to conscious or explicit process. Hence, this study investigated whether an implicit teaching condition can provide an opportunity for learners with low working memory capacity to gain the same achievement as those with high working memory capacity.

Based on their working memory capacity measured by a reading span task, twenty four Korean college students were divided into three groups: high, mid, and low. All of them received two implicit teaching treatments of English phrasal verb structures over one week. These treatments were a modified version of Robinson (1996)'s and required learners to memorize the sentences containing the syntactic variations of phrasal verbs. In order to compare learners' achievement, pretest and immediate posttest were administered, and they assessed learners' vocabulary and grammaticality judgment both in timed and untimed conditions. Lastly, a short interview was conducted to investigate whether learners had noticed the goal or target grammar of the experiment and whether the treatments were too demanding for them.

The results suggested that the high and low groups gained the same achievement, whereas their errors conformed to different patterns from each other. Statistical analyses indicate that the differences between the pretest and immediate posttest were statistically different, which implies that the implicit treatment resulted in both groups' increased knowledge of the phrasal verb structure. Error patterns, however, exhibited a marked difference between these two groups; the high working memory capacity group tended to overgeneralize the phrasal verb alterations while

the low working memory capacity group preferred one of the possible syntactic variations over the other.

Several theoretical and pedagogical implications can be drawn from the results. First, the present study provided a positive evidence of the efficacy of implicit teaching of young adults. Second, many of the current frameworks of SLA also require modification with regard to way of teaching and its correlation with working memory capacity. Third, however, instructors should take care of various factors in order to ascertain that their implicit teaching can result in implicit learning of the target structure. Last but not least, instructors should provide high and low working memory capacity learners with different types of grammatical guidance respectively because test scores, identical as they are, do not predict different developmental patterns affected by learners' cognitive resources.

Keywords: Second Language Acquisition, working memory capacity, implicit teaching, English phrasal verbs, syntactic alterations, Korean learners

Student Number: 2012-22868

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Chapter 1 Introduction

1.1 Background of Research

Among many cognitive factors which affect second language acquisition (SLA), the role of working memory and its capacity have attracted many researchers' interest (see R. Ellis, 2008; Robinson, 2003; Williams, 2012). For the last thirty years, cognitive scientists and linguists have focused on *working memory*, which refers to a temporary and limited storage system (Baddeley & Hitch, 1994; Baddeley, Thomson, & Buchanan, 1975; Miyake & Friedman, 1998). It has been hypothesized that it stores and retains information of ongoing processes, particularly highly abstract ones. The speed and efficiency of cognitive processes, therefore, depend on its capacity, and a person with high working memory capacity is expected to excel at complicated cognition tasks, such as reasoning and comprehension including learning a language (N. C. Ellis & Sinclair, 1996; Robinson, 2002; Williams, 2012). Accordingly, the current framework of working memory in SLA can be encapsulated in one sentence: learners with higher working memory capacity are likely to succeed in language acquisition.

In consonance with this theoretical assumption, the focus of previous studies on working memory has been on refinement and verification of the hypothesis that high working memory capacity may facilitate the acquisition of a language (Wen, 2014; Williams, 2012). The working memory hypothesis proposed by Baddeley and

Hitch (1994), and Gathercole and Baddeley (1990) entails that working memory may be in the central position in language acquisition and involve all aspects of language acquisition. This specified version of the working memory hypothesis, in regards to language acquisition, has led researchers to explore the hypothetical relation between working memory capacity and the acquisition of various aspects of language such as vocabulary, grammar, reading, etc. (e.g. Baddeley, Gathercole, & Papagno, 1998; N. C. Ellis & Sinclair, 1996; Miyake & Friedman, 1998)

Many experimental studies, so far, have found a significant correlation between working memory capacity and language acquisition (e.g. N. C. Ellis & Sinclair, 1996; French & O'Brien, 2008; Harrington & Sawyer, 1992; Masoura & Gathercole, 1999; Walter, 2004; Williams & Lovatt, 2003). Not only was vocabulary acquisition proven to correlate to working memory capacity, but grammar acquisition was revealed to hinge on it (N. C. Ellis & Sinclair, 1996; French & O'Brien, 2008; Williams & Lovatt, 2003). Researchers further confirmed that this correlation was observed mainly in an explicit teaching condition, in which the instructor transmitted explicit knowledge on targeted items (Linck & Weiss, 2011; Tagarelli, Borges-Mota, & Rebuschat, 2011; Williams, 2012). Put otherwise, learners with high working memory capacity performed better than those with low working memory after receiving an explicit instruction. These findings have been the most compelling evidence of the working memory hypothesis in SLA.

Of interesting is that not much evidence has been observed between working memory capacity and learners' achievement in an implicit teaching condition.

Mackey, Philp, Egi, Fujii, and Tatsumi (2002) reported the experimental result that learners with high working memory performed better than those with low working memory capacity after receiving the same implicit treatment of recast. Their research, however, investigated only a limited number of cases, and failed to provide a sufficient explanation on the fact that learners with high working memory capacity did not significantly perform better than those with low working memory capacity in the immediate posttest. Another study by Erlam (2005) found no strong evidence of correlation between working memory capacity and learners' achievement in an implicit teaching condition. In fact, a similarly poor correlation has been reported by many cognitive scientists who contended that implicit treatment does not necessarily relate to the capacity of working memory (see Kaufman et al., 2010; Tagarelli, Borges-Mota, & Rebuschat, 2011).

Also surprisingly, no mention of learners with low working memory capacity has been made in the account of working memory and its role in language acquisition. In contrast to the voluminous research on the advantage of learners with high working memory capacity, there have been few studies on how to assist learners with low working memory capacity (c.f. Juffs & Harrington, 2011). Whereas the former has been proven to be highly successful in language acquisition under an explicit teaching environment, the latter has been simply described as unlikely to achieve the same proficiency as those with high capacity.

Therefore, this thesis will focus on investigating the relationship between working memory capacity and learners' achievement and development in an implicit

teaching condition. As noted earlier, little is known about low working memory capacity and its interaction with an implicit way of teaching. Evidence only suggests that working memory is effectively activated during conscious processing of information (Linck & Weiss, 2011; Tagarelli et al., 2011; Williams, 2012) and implicit learning does not necessarily require learners' activation of working memory (Kaufman et al., 2010; Tagarelli et al., 2011). Hence those with low working memory capacity might not suffer from limited cognitive abilities of their working memory during the implicit type of teaching activities. Under the same circumstances, learners with high working memory capacity, however, may not always be at an advantage over those with low working memory capacity.

Following these presumptions, the present study will explore the way to improve the language ability of learners with low working memory capacity by using an implicit teaching method. Following the definition of implicit teaching, given by R. Ellis (2001, 2008), Hulstijn (2005), and Norris and Ortega (2000), the implicit teaching method of the present study was organized to enhance learners' implicit learning of the target structure. This method was also grounded on the study by Robinson (1996), which re-examined the effect of an implicit teaching condition of Reber's (1989, 1996). Learners' achievement were measured in all of the high and low working memory learners after receiving the same implicit teaching treatment. This allows to investigate how much and what kind of difficulty learners with low working memory capacity encountered in learning a new rule in an implicit teaching condition, particularly in comparison to learners with high working memory capacity.

Through this investigation, a practical implication can be drawn, especially on how to incorporate individual differences such as working memory capacity into a teaching method, as Juffs and Harrington (2011) noted. In summary, the present study can contribute to resolving whether, and if so, in what manner implicit teaching can be applicable to learners with low working memory capacity in SLA.

1.2 Research Questions

In examining the effect of an implicit teaching method on learners with low working memory capacity, the following research questions are addressed:

1) Can learners with low working memory capacity exhibit the same level of achievement as learners with high working memory capacity after receiving the same implicit teaching on a complex structure such as English phrasal verbs?

2) Do learners with low working memory capacity show the same development in grammar acquisition as those with high working memory capacity after receiving the same implicit teaching method?

On the basis of the findings of the previous studies (Kaufman et al., 2010; Linck & Weiss, 2011; Tagarelli et al., 2011), which suggest that the general learning abilities in an implicit teaching condition may not pertain to working memory capacity, the possible hypotheses are formulated as follows:

1) Learners with low working memory capacity are likely to show the same achievement as those with high working memory capacity. That is, the grammaticality judgment scores and vocabulary knowledge of both groups may not be statistically different after an implicit teaching treatment.

2) Learners with low working memory capacity are likely to acquire all the syntactic variations of English phrasal verbs which those with high working memory capacity acquire. In other words, error patterns of learners with low working memory capacity may not differ greatly from those of learners with high working memory capacity.

These hypotheses assume that working memory capacity does not play a dominant role when learners receive an implicit teaching method. Learners with low working memory capacity, therefore, may exhibit the same achievement and developmental characteristics after the treatment.

1.3 Organization of the Thesis

The present thesis is organized as follows. Chapter 2 reviews previous studies on working memory and its capacity, particularly with regard to implicit and explicit teaching and learning. Chapter 3 provides the methods and design of the experiment for collecting data. Chapter 4 presents the results of the experiment and the statistical

analyses which were performed to assess the differences between groups, general learning effect, and specific effects on the acquisition of the target structure. Chapter 5 discusses the findings of the present study, drawing the implication from both of the theoretical and pedagogical perspectives in SLA. Finally, Chapter 6 summarizes all the findings and implications, reports the limitation of the study, and concludes with some suggestions for future research.

Chapter 2 Review of Literature

2.1 The Definition of Working Memory

Working memory refers to “a temporary storage system that lies at the core of complex cognition” (Williams, 2012). Owing to the rapid progress in neurology, recent years have witnessed growing attention to this temporary storage system in the fields of psychology and linguistics. The concept of this type of memory is grounded on the fact that the human brain needs cognitive resources, such as attention and memory, in performing everyday activities. More often than not, there are some tasks which require the brain to undergo processes of highly abstract nature, such as analyzing, deduction, induction, and reasoning, which are often called “complex cognition.” This complex cognition places heavy demands on the brain to coordinate its available cognitive resources since the brain has to deal with various types of information simultaneously. With regard to these cognitive processes during complex cognition tasks, cognitive scientists coined the term working memory; it is a hypothetical buffer memory which belongs to a series of information-related cognitive processes, and holds information required for ongoing processes for a limited time period. This memory represents the human’s ability to store and retrieve information in immediate need. The information stored in working memory decays rapidly so as to receive new information in need. In summary, working memory can be outlined as a cognitive concept of a certain type of buffer memory used during

the complex cognition tasks.

One of the key findings on working memory is that it divides into several components. The pioneering work on this compositionality was Baddeley and Hitch (1994)'s study. They administered the tasks which requested the subjects to simultaneously perform two different types of activities. The subjects' cognitive abilities in this circumstance were presumed to suffer a significant disadvantage since the brain had to allocate its cognitive capacity to two tasks which shared no commonality. In contrast to the expectation, the results partly contradicted the presumption that the cognitive abilities would decline. Ostensibly, the subjects' speed of performance was impeded and slowed down during the tasks. Their score and accuracy in the tasks, nevertheless, did not deteriorate to a significant level. This result indicated that the human brain can forestall a confusion of different types of information even when it has to multitask. In addition, the separation of information implies that the human brain can accommodate at least more than two distinctive working memories each of which takes charge of a different type of information. In short, the experimental result suggested the existence of components in working memory, and its components are assigned to manage a designated type of information.

Since working memory was proved to be a complex of several memories, researchers have continued to elucidate the compositionality of working memory, and they are in agreement on the existence of at least three components. The first, named the *visuo-spatial sketch pad*, stores visual stimuli, whereas the second, the

phonological loop, receives verbal stimuli. The last component, called the *central executive*, was hypothesized in order to explain the mechanism which controls and regulates the flow of information. Put otherwise, the central executive monitors and coordinates the activation of each component with the aid of consciousness, which ultimately helps the brain to discriminate and process different types of information. Hence it can be postulated that the central executive controls the process of discriminating information, and allocates the given information to other components. Visual and verbal stimuli, then, are processed by each component called the visuo-spatial sketch pad and the phonological loop, respectively. This illustration is structured on the finding that the human brain keeps different types of information apart in processing the complex cognition tasks.

Considering that working memory consists of several parts which are equipped to handle their assigned types of information, the capacity of each component can be suggested as the primary factor for the cause of differences in cognitive abilities among people, including learning a language. The capacity, here, refers to the amount of information that each component of working memory can manage. As each individual demonstrates a vast difference in the ability to retain information in his or her memory, cognitive scientists posited that the capacity of working memory vary among people, and the same variation in capacity between subjects can be observed among the working memory components. Then, it is hard to escape the expectation that each individual possesses different abilities in processing verbal stimuli when working memory is working because he or she

cannot process more information than the limited capacity of the verbal component of working memory. Analogously, in the language acquisition which requires the complex cognition, learners are expected to display different achievements, in consonance with their capacity of the component which handles verbal stimuli. Therefore, it can be hypothesized that variance in working memory capacity may result in different achievement in the language acquisition. This implies that low working memory capacity can be one of the primary causes of learners' low level of development in language learning.

2.2 The Measurement of Working Memory Capacity

In order to corroborate the relation between working memory and cognitive abilities with an objective measure, several empirical methods have been devised to measure the subjects' working memory capacity while they are conducting the complex cognition activities. There are two broad types to categorize objective measurements of working memory capacity: the one for administering a single task (simple span test), and the other for requiring handling of multiple tasks (complex span task). A simple span test measures the amount of information which a subject can store in and retrieve from working memory, during a single activity. The typical variants of the simple span tests are a *digit span test* and a *non-word repetition test* (NWR). The digit span test evaluates working memory capacity by calculating how many numbers (digits) a subject can recall after a short exposure. Numbers are presented within a limited amount of time, during which the subject is asked to focus

on memorizing them. After removing the given numbers, working memory capacity is assessed on the basis of the numbers that the subject recalled correctly. In a NWR test, a subject is provided with non-words or non-existent words. These non-words, however, observe the phonological constraints of the language which is used as the test medium in the experiment. The number of correctly recalled words is counted and considered to represent his or her working memory capacity. These simple span tests focus primarily on the aspect of information storage in working memory (Juffs & Harrington, 2011).

On the other hand, a complex span test quantifies the working memory capacity when a subject is engaging in multiple activities simultaneously. There are also two exemplary tests: a *reading or listening span test* (RST/LST), and an *operation span test* (OST). In the RST and LST, subjects are requested to read or listen to a short passage and given two questions: one for comprehension check, and the other for working memory capacity. The subjects, at first, receive instructions to memorize all the marked (targeted) words while reading. When the given time elapses, a question is given to the subjects to check whether they understand the passage or not. After they solve the question for comprehension, working memory capacity is gauged by checking how many (marked or targeted) words in the passage still remain in their memory. The OST is patterned after the RST or LST with slight difference in the type of activity during measurements. In this test, non-linguistic activities, such as solving an equation, are provided instead of a passage. The subjects, then, solve this non-linguistic problem, and recall the target items included

in the activity, the number of which is regarded as working memory capacity. In summary, it can be recapitulated that complex span tests such as RST or LST and OST request subjects to perform two cognitive activities simultaneously. The working memory capacity gained from these tests, then, represent both of the abilities of information storage and processing (Juffs & Harrington, 2011). The assessment measures of working memory capacity, as have been observed briefly here, provide an objective indicator of subjects' cognitive abilities. Subsequently, in the measurement, learners with low working memory capacity are inclined to gain a poor score.

2.3 Working Memory Capacity as an Index of Language Aptitude in SLA

Working memory and its capacity, which can be objectively measured, have continued to be the object of statistical research, particularly in comparison to language aptitude. The linguistic aptitude refers to an ability to learn new linguistic knowledge. This ability is reckoned as one of the individual differences which determine how quickly and successfully a person acquires a language. What draws attention here is that working memory and its capacity also have a significant impact on language acquisition as follow: firstly, linguistic inputs, just as verbal inputs, are mainly processed in working memory during the complex cognition such as language acquisition, and secondly, working memory can only handle as much

linguistic information as its capacity. Hence high working memory capacity implies that a wealth of linguistic data can be processed during ongoing tasks, which is likely to accelerate development of new linguistic knowledge such as grammar rules. This possible impact of working memory, therefore, allows a preliminary conclusion that high working memory capacity is functionally analogous with high language aptitude. In considering this conceptual similarity, it can be presumed that working memory capacity has a significant connection to language aptitude (c.f. Robinson, 2002).

On the grounds of this possible connection between working memory capacity and language aptitude, several studies which conceived of working memory as language aptitude emerged. The best-known source of this view is Miyake and Friedman's study (1998) which directly linked working memory capacity to language aptitude. Since a person is expected to handle and process more linguistic inputs if his or her working memory capacity expands, they argued that language learners can benefit from high working memory capacity in significant ways. To begin with, they noted that noticing can occur more frequently for learners with high working memory capacity, because they are exposed to more hints as to the language than those with low working capacity. Along with noticing, pattern identification transpires more easily for learners with high working capacity, owing to their high capacity which enables them to find more commonalities or regularities in given inputs. Furthermore, errors are quickly avoided, inasmuch as learners can cope with a greater number of grammar rules and their expected outputs in their mind.

Significantly, all of these—more frequent noticing, easier pattern identification, and less errors—are contributing factors of automatization, which help learners advance in language acquisition. Consequently, in Miyake and Friedman's theory, working memory is in the position which mediates development and progression of learners' interlanguage. In this respect, learners with high working capacity are likely to show more advancement than those with low working memory capacity are in second language acquisition.

Conforming to the expectation that working memory capacity can be equated to language aptitude, empirical studies have confirmed a significant relation between working memory capacity and language learning. Masoura and Gathercole (1999) scrutinized the impact of working memory on vocabulary acquisition. Their study involves forty-five Greek children who attended a public primary school, studying English as a foreign language. The L1 and L2 working memory capacity were obtained from two NWR tests conducted in Greek, the participants' first language, and English, their second language. The level of the participants' vocabulary acquisition rested on the result of a translation test in which they had to provide the translation of given English expressions. On the scores from the NWR tests and the translation test, a two-way ANOVA analysis provided results that the L1 and L2 working memory capacities demonstrated significant correlations with the L1 and L2 vocabulary acquisition respectively (.50 and .39). In this experiment, therefore, high working memory capacity represented extensive knowledge of vocabulary both in L1 and L2. All these considered, working memory can be regarded as a strong

predictor of vocabulary achievement.

Another research by French and O'Brien (2008) identified the concordance between working memory capacity and level of grammar acquisition. The purpose of this study was to determine the relationship between working memory and grammar learning, particularly when learners' lexical knowledge is controlled for. 104 students participated in this experiment, and all of them enrolled in an intensive English program. Their first language was French, whereas English was taught as a foreign language. The participants took three tests: working memory measurement, a test for grammar comprehension, and a test for vocabulary acquisition. First, NWR tests assessed working memory capacity, once in English and once in Arabic. The Arabic language was used to make sure that the test procedures can exclude learners' prior knowledge on English vocabulary. Next, a written test evaluated the participants' comprehension on the English grammar through multiple choice, fill-in-the-blank, and paraphrasing questions. Lastly, a translation test checked the learners' acquisition of English vocabulary, using the same format of translation test as Masoura and Gathercole's study (1999). The result was analyzed by multiple regression analysis, and it indicated that working memory capacity predicted gains in L2 grammar scores (27.9~32.7%), even after controlling for the participants' level of grammar and vocabulary at the beginning. Accordingly, the learners' working memory capacity may offer predictions on grammar acquisition, even considering a possible effect from vocabulary acquisition.

Proceeding from the evidence that working memory capacity could provide a

statistically reliable prediction on vocabulary and grammar acquisition, many linguists have argued that working memory capacity bears upon language acquisition, and high working memory capacity can contribute to high level of language acquisition. Therefore, learners with low working memory capacity have long been expected to perform poorly at almost every test or under many circumstances.

2.4 Working Memory and Implicit, Explicit learning and teaching

Language aptitude which has a close connection with working memory capacity, however, is further divided into two subcategories: implicit aptitude and explicit aptitude (Granena, 2013). The distinction between these two types of aptitude derives from two major ways of learning: implicit learning and explicit learning. Implicit learning refers to learning without awareness of what to be learnt. The distinctive characteristics of implicit learning are as follows: first, awareness does not partake in the almost entire process of learning; second, procedural knowledge accumulates in an incidental manner or through repetition; and lastly, the knowledge obtained from implicit learning is hard to articulate verbally. Explicit learning, on the other hand, encompasses conscious learning mechanism, in which analytical abilities are activated and applied to learning materials. This type of learning features three characteristics: first, awareness is actively engaged in comprehension; second, declarative knowledge results from conscious analysis on

learning materials; and lastly, metalinguistic knowledge expands as much as learners can fully or almost completely formulate the rule that they derived from the analysis. Since language aptitude, as was suggested above, is divided into two distinct types on the basis of two different types of learning, it should be investigated to which type of language aptitude working memory is related.

Implicit and explicit types of teaching have particular relevance to these two types of learning. As R. Ellis (2001, 2008), Hulstijn (2005) and Norris and Ortega (2000) remarked, implicit and explicit teaching are defined as a series of instruction devised for stimulating learners' implicit and explicit learning, respectively. The primary aim of implicit teaching is to help learners to form implicit knowledge without any awareness of the target rule. This type of teaching primarily encompasses activities to require learners to memorize the stimuli which embody the target rule (R. Ellis, 2001). Explicit teaching, however, directly provides the metalinguistic description of the rule, which learners can comprehend consciously. Traditional grammar teaching such as *focus on forms* belongs to this type of teaching (Norris & Ortega, 2000). From the pedagogical perspective, therefore, implicit and explicit teaching represent feasible methods for inducing learners' implicit and explicit learning.

What cognitive scientists have set out to investigate is only the relationship between working memory and ways of learning. They have concentrated primarily on the receptive aspects of learners and discovered that working memory is rather associated with explicit learning (Kaufman et al., 2010; Tagarelli et al., 2011). Their

argument rests firmly on the presumption that conscious attention is the necessary condition for the activation of working memory. Therefore, they have formulated the concept of working memory as a cognitive storage space reserved for the activities requiring reasoning, such as formulating metalinguistic hypotheses. This assertion also has been supported by experimental evidence.

Unsworth and Engle (2005) investigated the activation of working memory under implicit and explicit learning conditions. 100 participants were split into two groups (50 for high, 50 for low) on the basis of their working memory capacities, which were measured by an OST. As a learning subject, nonlinguistic patterns, which consisted of numbers and asterisks, were dispensed and learned both in an implicit and explicit way. After the learning sessions, the participants took a test on whether they could discern the underlying patterns in given materials. The reaction time was obtained during this pattern recognition test. When all the tests were finished, a questionnaire was handed out to check the participants' awareness on the experiment. The finding from the results was conclusive; a mixed ANOVA discovered a significant interaction effect, and high working memory capacity correlated with acquisition of the patterns in the explicit learning condition. Low working memory capacity, on the contrary, exhibited no correlation. In summary, their experimental evidence suggested that working memory only operates under an explicit learning condition.

Tagarelli et al. (2011) also reported a similar result to Unsworth and Engle (2005). They studied on the interaction between working memory and learning

conditions. In this experiment, 62 native speakers of English learned a semi-artificial language which was a mixture of English vocabulary and German syntax. After the learning session, their working memory capacities were measured by an OST and letter-number ordering task for comparison. In the letter-number ordering task, a participant received test stimuli which were randomly arranged sequences of numbers and Roman alphabets. He or she, then, had to repeat the numbers and alphabets in a numerical and alphabetical order. A grammaticality judgment test was also administered to examine the participants' acquisition of the semi-artificial language. The results demonstrated that the explicit group, which searched the underlying rule, revealed a significant relation between the WMC (letter-number ordering task) and acquisition (GJT) ($r=.477$, $p<.05$). However, no such correlation existed in the implicit learning condition. Hence the conclusion which can be drawn from the studies of cognitive scientists is that working memory capacity may contribute to a significant difference in learning only under the explicit environments, but it was not associated with implicit learning.

On the other hand, researchers of SLA have attempted to validate the relation between working memory capacity and teaching conditions, particularly explicit ones, under the classroom environments. Linck and Weiss (2011) was one of the field researchers who tried to verify the relationship in a classroom environment. The object of their study was to examine the predictive validity of working memory capacity in describing achievement in proficiency. 48 university students who were engaged in this study were native speakers of English and attended an introductory

language classes of Spanish (30 people) and German (18 people). Their working memory capacities were measured through an OST. Each participant took the proficiency test of the language that they had learnt; for Spanish learners, one of the official tests, called *Diplomas de Español como Lengua Extranjera* was administered, whereas a fill-in-the-blank test evaluated the grammar and vocabulary achievement of the learners of German. The result of repeated measures regression suggested that there was a strong correlation between the WMC and the grammar and vocabulary achievement under the explicit teaching condition (linearity = 0.85). This study presented a possibility that working memory can only exploit the explicit teaching condition.

In contrast to explicit teaching, there have been relatively few studies on the relation between working memory and implicit teaching. Recent studies fail to provide conclusive evidence of a correlation between working memory capacity and learners' achievement in an implicit teaching condition. Mackey et al. (2002) investigated learners' achievement after receiving an implicit instruction: recast. They argued that learners with high working memory capacity have a long-term advantage over those with low working memory capacity. However, the size of their sample was too small ($n = 7$) in investigating learners' long-term achievement, and some learners with low working memory capacity, in fact, surpassed those with high working memory capacity in the immediate posttest. Erlam (2005) even discovered no significant correlation between working memory capacity and learners' score in an implicit teaching condition. In her study, the only type of teaching which showed

such correlation was one with a brief explicit instruction at the beginning although she provided some evidence that the extreme type of an explicit teaching condition (rule-focused instruction) did not correlate with working memory capacity.

To summarize, the relationship between working memory capacity and implicit teaching remains far from fully established, while the correlation between working memory capacity and both of explicit teaching and learning has been confirmed. Still, cognitive scientists have generally agreed that implicit learning does not necessitate activating working memory. With their opinions in view, it is hard to say that learners with high working memory capacity can also outperform learners with low working memory capacity in the implicit teaching condition, which is primarily operationalized for enhancing implicit learning.

2.5 The Motivation of the Present Study

While many studies have attempted to confirm the relationship between high working memory capacity and achievement in language learning, there is still a lack of clear understanding of the exact involvement of working memory in language acquisition. Of particular is the learners with low working memory capacity who have not, so far, received researcher's interest. In most previous studies, no educational implication has been drawn on how to assist those with low capacity with learning in the classroom environment. In attempting to ascertain how working memory works, many of the previous studies of SLA only provided an objective

description that high working memory capacity is likely to lead to success in second language acquisition. Namely, learners with high working memory capacity are expected to make more progress in second language acquisition than those with low capacity. The description, however, carries vague implications from a pedagogical perspective, as Juffs and Harrington (2011) pointed out; it only hints, with high probability, which types of students are likely to succeed and which are not. Furthermore, therein lies a hidden problem; for, as Hummel and French (2010) identified, the findings of previous studies indicate that the traditional classroom instruction can place learners with low working memory capacity at a disadvantage, because only learners with high working memory capacity can benefit from this explicit teaching conditions.

Given that learners with low working memory capacity are prone to fall behind in the classroom environment, where the explicit rule teaching method is emphasized, an alternative way of teaching these learners must be explored. Notably, some researchers offered an intriguing prospect for the existence of alternative methods, which may substitute the explicit and rule-based instructional method. Hummel and French (2010) suggested online learning activities for an effective method of eliciting the sufficient output from learners with low working memory capacity. Juffs and Harrington (2011) also emphasized the necessity of devising an instructional method which can help those with low capacity to compensate a lack of cognitive capacity. These studies held in common an assumption that, given a proper instructional method, a person with low working memory capacity can learn as much

as one with high capacity.

Assuming that learners with low working memory capacity can compensate their lack of linguistic ability, through other learning environments, an implicit teaching condition shall be a primary candidate for the alternative. As many previous studies claimed, learners with high working memory capacity can benefit from an explicit teaching method, such as in classroom environments where explicit grammar rules are provided. However, the achievement under implicit teaching conditions, as has been noted above, does not exhibit any reliable correlation with working memory capacity. Under implicit conditions, therefore, learners with low working memory capacity are likely to no longer suffer disadvantage. Hence it is possible that teaching those with low working memory capacity using an implicit method can be successful so much that their achievement does not differ from those with high capacity.

Therefore, the present study focuses on elucidating whether learners with low working memory capacity can benefit from an implicit teaching method as much as those with high working memory capacity can. The previous studies only have provided the expectation of the rate of success on the basis of working memory capacity, and offered no pedagogical implication for learners with low working memory capacity. An implicit teaching method can be one of the solutions for those learners since this does not relate to working memory capacity but still effective if a suitable condition is provided. As a result, this study will attempt to compare the achievement of low working memory capacity group and high working memory capacity group in an implicit teaching condition.

Chapter 3 Methodology

3.1 Participants

3.1.1 Participant Selection

Twenty-four college students participated in this study. In order to calculate the adequate sample size, a pilot test had been administered and it revealed that a sample size of nineteen can provide statistically meaningful differences between its pre-test and post-test. It is the minimum sample size for two-sample *t*-test, which can be used to compare the effects of implicit learning between low working memory capacity participants and high working memory capacity participants.

All the participants were undergraduate students at Seoul National University. Since they entered Seoul National University, one of the top universities in South Korea, it can be argued that their working memory capacities must be skewed in the high values, on the presumption that a person with high working memory capacity is likely to achieve academic success. However, academic achievement does not always correlate with working memory capacity. Although children's working memory capacity has a close relationship with their academic achievement (Alloway & Alloway, 2010), adolescents do not exhibit such a strong relationship in all subject areas (Gathercole, Pickering, Knight, & Stegmann, 2004), and young adults' academic achievement does not relate to working memory capacity significantly, in

terms of SAT and GPA scores (Rohde & Thompson, 2007). As the participants of this study were young adults, it cannot be assumed that their working memory capacities must be skewed. Therefore, it was surmised that sampling of the participants of this study is random and valid, in terms of the participants' working memory capacities.

All the participants volunteered after seeing fliers posted on campus, which contain the title, procedure, and schedule of the experiment with minimum requirements. They were told that the goal of the experiment was to measure their memory capacity because it was possible for them to find the metalinguistic information of the target structure by themselves when the real goal of the experiment was informed. When a participant applied for the study, the researcher explained the experiment by reiterating the entire processes of the experiment, the expected amount of time, the schedule of the treatment, and some precautions. After the explanation was provided, the participants signed a consent form out of their free will. When all the experiments were finished, every participant received monetary compensation for their efforts.

3.1.2 Control Variables

3.1.2.1 Biological Age

The age of the participants was controlled; only young adults, aged from

twenty to twenty six, participated in this study. Working memory and its capacity are related to subjects' biological age because working memory continues to develop over childhood and adolescence and starts to mature later (Luna, Garver, Urban, Lazar, & Sweeney, 2004). This relationship between working memory and age results from the fact that the development of working memory has a close connection with the maturation of several brain parts such as prefrontal cortex, parietal cortex, and striatum (Bunge & Wright, 2007). Since these brain regions reach full development throughout the twenties, working memory has been expected to mature after adolescence, which was confirmed through an experiment (Luna et al., 2004). This implies that the working memory of teenagers is biologically different from that of twenties. Therefore, this study included only the participants who are older than nineteen, but younger than twenty-seven years old, because they can be safely considered as homogeneous in terms of the developmental phase of working memory. The resulted mean of the age was 22.5; male participants are 23.37 years old and female participants are slightly younger, 21.77 years old.

3.1.2.2 Fluency

Only intermediate learners of English were included in this study because the fluency of participants was also controlled. Before conducting an experiment, it had been investigated whether intermediate participants were ready to learn the target structure of this study: English phrasal verbs. These verbs require learners to perform

phrase-level analysis and appliance of syntactic rules, so learners must have an ability to manipulate phrase-level grammar. Beginners were not likely to possess such an ability and advanced learners were expected to fully internalize the grammatical processing of phrase-level elements. Therefore, the pilot study was conducted on the presumption that intermediate learners are likely to start to learn phrasal verbs and their syntactic traits. The results confirmed that both explicit and implicit learning of phrasal verbs were possible for intermediate students. In conclusion, this study selected intermediate students of English whose Test of English Proficiency of Seoul National University (TEPS) score ranged from 400 to 700. The average of their score was 631.25; it was 629.55 for the male participants and 632.69 for the female participants.

3.1.2.3 Previous experience of learning English

The participants' previous experience of learning English can be an intervening factor in the treatment, since learners who have received different types of instruction, particularly with regard to quantity of inputs and quality of input, cannot be considered as homogeneous. In order to control the variance attributable to learning experience, this study excluded learners either who graduated from foreign language high schools in Korea or who studied English abroad for a long time. Students in foreign language high schools receive various kinds of English lectures six to thirteen hours per week more than other Korean students. They also

have ample chances to practice speaking and writing in English, which are usually followed by immediate feedback of an instructor. To this situation, the term “intensive learning situation” can be applicable. Learners with long experience of studying abroad also receive incomparable quantity of input in everyday situations, and they can easily obtain authentic materials and various kinds of feedback. It can be said that the students in this learning environment are in the immersion learning situation. Both the intensive learning situation and the immersion learning situation differ from most classroom environments in Korea, which only provide six to eight hours of instruction per week, and offer little opportunity to receive feedback. Therefore, learners in the intensive learning situation and those in the immersion learning situation were excluded from the subjects of this study. It means that all the participants studied English as a foreign language, receiving limited quantity and quality of input under classroom environments.

3.1.3 Grouping of the Participants

The participants were grouped by their working memory capacity in a similar manner as suggested by Conway et al. (2005). The participants whose working memory capacities are in the upper quartile belonged to the high WMC group while those with working memory capacity of the lower quartile were considered as the low WMC group. The participants in the interquartile range were assigned to the middle WMC group, but the data gathered from them were not used in the analysis

of this study because the aim of this study is to compare high and low WMC groups.

The simple median split was not used because the pilot test had suggested that this method could be problematic. In the pilot test, the participants' working memory capacities approximated the normal distribution, and about 60 percent of the participants were densely packed into the Z-score range from -0.5 to 0.5. The difference between these 'mid-range' participants' WMC was too marginal to assign them to either high WMC or low WMC groups. Therefore, it was considered that using the simple median split without due consideration may compromise the results.

3.2 Target Structure

The target structure of this study is English phrasal verbs. They refer to a lexical unit which consists of a verb and either an adverb or a preposition (McCarthy & O'Dell, 2004). They have several syntactic and semantic characteristics unique to the English language, which make them difficult to learn for most L2 learners.

3.2.1 Linguistic Characteristics of Phrasal Verbs in English

The phrasal verb is a term which is widely accepted in English as a Second Language (ESL) programs, but slightly different from the definition of theoretical linguistics. In syntax and semantics, a single semantic unit of a verb and an adverb is called a particle verb while that of a verb and a preposition is named a prepositional verb (Dehé, 2002). They are regarded as fundamentally different since the

components are clearly distinctive in terms of their part of speech. In ESL, however, particle verbs and prepositional verbs are not separately taught but usually come under the same section named 'phrasal verbs.' This is because it is usually too difficult and confusing for second language learners to distinguish between particle verbs and prepositional verbs, particularly considering that they did not differ from each other with regard to their surface or morphological forms (Dirven, 2001). Many ESL textbooks and studies, therefore, have adopted and used the single term, phrasal verbs, to cover both particle verbs and prepositional verbs. In order to provide the pedagogical implication in classroom instruction, this study chose the definition used in ESL, which includes both particle verbs and prepositional verbs.

3.2.2 Syntactic and Semantic Traits of English Phrasal Verbs

As conceptualized in the theoretical linguistics, English phrasal verbs can be divided into two separate categories: particle verbs and prepositional verbs, and they have different syntactic traits. Particle verbs consist of a verb and a particle or adverb, such as *on* or *in*. The adverb of particle verbs, similar to what common adverbs do, has a relatively free position within the verbal phrase. It shows two syntactic variations when followed by an object which is not such an unstressed pronoun as *me*, *him*, *her*, etc. (Dehé, 2002): either the adverb can directly follow the verb and precede the object, which is called the *continuous order*, or the object can precede the adverb, which is called the *discontinuous order*. When the object is an unstressed

pronoun, however, the adverb has to be in the discontinuous order, which means the particle verb must be interrupted by the object. Prepositional verbs consist of a verb and a preposition, such as *across* or *with*. Unlike adverbs, prepositions have a syntactic constraint: they always precede their object just as ordinary prepositions do. Hence, prepositional verbs always precede its object, and they cannot be interrupted by its object in any case (Dehé, 2002). Only the continuous order, which both the verb and the preposition precede the object, can be observed in prepositional verbs, even if the object is an unstressed pronoun.

Semantic opaqueness is also an important trait of English phrasal verbs. It refers to a lack of compositionality in predicting the meaning of phrasal verbs by their components. The adverbs and prepositions of phrasal verbs usually denote several meanings, depending on the context, and it makes hard to guess the meaning of phrasal verbs. Even though there are some phrasal verbs of which meanings are a juxtaposition of their elements, not all the phrasal verbs are transparent or literal in terms of their semantic compositions. A substantial number of phrasal verbs have the meanings irrelevant to those of their elements, and learners must be able to recognize which phrasal verbs are literal or figurative, and memorize their meanings especially when they are figurative. Therefore, it seemed reasonable that many learners find it hard to acquire phrasal verbs because their meanings are opaque or non-compositional (Celce-Murcia, Larsen-Freeman, & Williams, 1999).

3.2.3 Characteristics of Phrasal Verbs from the SLA Perspective

From the SLA perspective, phrasal verbs have two noticeable characteristics: first, it is possible to exclude any L1 influence, and second, learners exhibit significant difficulty in the acquisition.

L1 influence, which can be an intervening factor in most cases, can be easily excluded because phrasal verbs and their syntactic variations are typologically marked. As having observed above, phrasal verbs have their unique syntactic variations, and these variations are unique to the Germanic languages (Dehé, 2002). If a learner's L2 is English and his or her L1 is not Germanic, his or her L1 does not have any syntactic variations similar to English phrasal verbs. This further entails that L1 influence, particularly from similar structures in his or her L1, is negligible in the acquisition of English phrasal verbs. All of the participants of this study speak Korean as their L1, and the Korean language does not have syntactic variation such as English phrasal verbs (Shin & Christianson, 2012). Therefore, the participants were expected to learn English phrasal verbs largely unaffected by L1 influence, and the analysis of this study will not include L1 influence as an explaining factor.

Considerable learning difficulty is another noticeable phenomenon that L2 learners experience in learning English phrasal verbs, particularly among learners whose L1 does not have any syntactic variations similar to those of phrasal verbs. Studies on Chinese and Japanese learners of English have confirmed this difficulty

in an experimental situation. Chinese learners mostly avoided using phrasal verbs because they felt it too difficult to apply their grammatical knowledge (Liao & Fukuya, 2004). Japanese learners were reported to have trouble learning figurative or metaphorical meanings of phrasal verbs, and they needed to be taught about these non-literal meanings (Yasuda, 2010). Korean learners also can be presumed to experience a similar difficulty in learning phrasal verbs, because the Korean language has many syntactic similarities with Japanese.

3.3 Design

This study used a pretest, two treatments, and immediate post-test design. In order to administer all the treatments and tests in the same environment, the external conditions of the experiment were controlled, particularly with regard to three factors: human factor, spatial and environmental factor, and temporal factor. The human factor refers to who participated in this study and what kind of behaviors were allowed during the experiment. The spatial and environmental factor mainly concerns what physical or environmental circumstances, such as location and settings, were provided. The temporal factor involves when each of the tests and treatments was conducted and in what sequence they were arranged. This section elaborates mainly on these external factors, and the next sections will cover the internal factors of the tests and the treatments, such as the selection of the target vocabulary and the stimulus sentences (materials), the specific procedures of the

treatment (treatment), and the test administration and scoring (tests).

3.3.1 Human Factor

The first external factor to consider is the human factor, which concerns who conducted the tests and the treatments and what was allowed for him or her to do during the experiment. The researcher of this study undertook the roles of the examiner and supervisor during the entire experiment. He prescribed the exact lines of what he was going to tell so that the same instruction was delivered to each participant. Neither an additional hint nor a spontaneous guide was provided unless the prescribed procedures allowed it. He also supervised all the tests in person in order to make sure that each participant followed the given directions. The participants of this study was elaborated in the previous section.

3.3.2 Spatial and Environmental Factor

The spatial or environmental factor refers to the place of the experiment and its physical environments. The place of the experiment was a quiet room which could avoid any interference of noise. No observer was allowed during the experiment. The researcher prepared all the materials required for the treatments and the tests, such as the computer, a ball-pointed pen, and the answer sheets.

3.3.3 Temporal Factor

The last external factor to mention is the temporal one, which refers to the entire schedule of the experiment. Two appointments with each of the participants were arranged in order to administer the tests and the treatments. Each participant spent approximately two hours over two weeks to perform the entire experiment. At the first appointment, the pretest and the 1st treatment were administered. After one week, the participants received the second treatment and the immediate the post-test.

First appointment the pretest and the 1st treatment
--

After about three to five days

Second appointment the 2nd treatment, the immediate posttest, and a short interview
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3.3.3.1 First Appointment (the Pretest and the 1st Treatment)

The first appointment took an hour, and it consisted of working memory measurement (10 minutes), pretest (25 minutes), vocabulary learning (5 minutes) and first treatment (15 minutes). At first, working memory measurement was conducted for ten minutes; the precise procedures of the working memory measurement are described in the test section. After the measurement finished, the pretest was administered for twenty five minutes. The pretests contained three

subtests: the measurement of vocabulary knowledge (5 minutes), the timed grammaticality judgment test (10 minutes), and the untimed grammaticality judgment test (about 10 minutes or so). At first, the participants' vocabulary knowledge was briefly measured in order to evaluate their vocabulary knowledge before the treatment. Next, the timed grammaticality judgment test was performed, which measured the participants' implicit knowledge of the target structure. The participants' explicit knowledge was assessed by the untimed grammaticality judgment test. After the pretest, the participants were given an opportunity to learn the target vocabulary. They were allowed to memorize the phrasal verbs and their meanings for five minutes. When the short vocabulary learning activity was ended, the first treatment was provided. The participants received implicit teaching of the target structure for fifteen minutes.

3.3.3.2 Second Appointment (the 2nd Treatment and the Immediate Posttest)

The second appointment was scheduled three to five days after the first appointment. It lasted for about 50 minutes and consisted of the vocabulary learning activity (5 minutes), the second treatment (25 minutes), a short break (1 minutes), and the immediate delayed posttest (25 minutes). Firstly, the participants repeated the same vocabulary learning activity which they had engaged in at the first appointment. They were allowed to memorize the target vocabulary and its meanings

for five minutes. Secondly, each participant received the second treatment. After the time allotted to the treatment had passed, all the participants had a short break for one minutes. Finally, the immediate posttest was administered. Just as at the first appointment, the participants took two grammaticality judgment tests: a timed grammaticality judgment test and an untimed grammaticality judgment test. At the end of the appointment, a short interview was conducted to ascertain how the participants felt about the experiment.

3.4 Materials

The materials used in this study are twofold: the target vocabulary and the stimulus sentences which were based on this vocabulary. All of these stimuli were presented on a computer screen, and no auditory stimuli or recorded sounds were given. It implies that the participants relied solely on the visual stimuli or reading comprehension during the treatments and the tests. This section covers (1) how the target vocabulary was selected and (2) how the stimulus sentences were generated, while fulfilling the requirements above.

3.4.1 Target vocabulary

The target vocabulary of this study is the phrasal verbs which were considered to be adequate for learners in the immediate level.

Sixteen phrasal verbs were chosen for the target vocabulary, particularly the

ones used in personal communication or describing social interaction. The half of them (eight) are particle verbs and the rest (eight) are prepositional verbs as following:

Particle verbs	Prepositional verbs
back up (to provide support) bottle up (to conceal feelings) bring up (to start to talk about) fill in (to inform) let down (to fail to do as expected) play down (to underestimate) put down (to criticize) spell out (to explain clearly)	count on (to depend on) feel for (to feel sympathy for) finish with (to end a relationship with) get onto (to begin to talk about) go against (to oppose) lay into (to criticize) run through (to read, or explain carefully) take to (to start to like)

All of these verbs have a metaphorical meaning, and this study aims to teach these verbs when used in the metaphorical sense because the figurative expressions have been reported to be difficult for most L2 learners (Celce-Murcia et al., 1999; Liao & Fukuya, 2004; Yasuda, 2010).

3.4.1.1 Syntactic Order

The syntactic order can vary depending on what order each phrasal verb allows. The particle verbs can be used either in the discontinuous order or the continuous order; a noun object can either precede or follow the particle, such as *bottle up my*

feelings and *bottle my feelings up*. All the prepositional verbs require the continuous order, so the object must follow the preposition, such as *count on my father*.

From learners' perspective, however, the syntactic order of the prepositional verbs can be difficult to discern because some of them have misleading cues for the syntactic order. The prepositional verbs such as *count on* and *run through* can be easily confused with a particle verb since their prepositions, *on* and *through*, have particle homonyms. Hence, the participants were likely to make the mistake of using these prepositional verbs in the discontinuous order. Other prepositional verbs such as *get onto* and *lay into* can be confounding because it can be misunderstood that their prepositions, *into* and *onto*, consist of a particle and a preposition. The rest are the prepositional verbs which have an obvious and easily discernible preposition, such as *feel for*, *finish with*, *go against*, and *take to*. Neither do the prepositions of these verbs have homonyms nor seem to consist of a particle and a preposition. Hence, the participants were likely to show the least error in the grammaticality judgment of these verbs.

3.4.1.2 Semantic Features of the Object

Phrasal verbs require a certain object with specific semantic features. For instance, the required semantic features of the phrasal verb *let down* can be roughly formulated as (1) a person, (2) reliable and trustworthy, and (3) possible to be disappointed, or expecting something to be done. Intermediate learners, however,

tend to be affected by these semantic features more than required. The interview of the pilot test revealed that some of the subjects based their judgment solely on the semantic features of the object. In order to achieve effective teaching within a short period, the semantic features of the object were controlled. This also could neutralize a possible compounding effect of semantic features; that is, we could safely disregard the possibility that the participants' grammaticality judgment hinged on the semantic features of the object.

All the phrasal verbs of the target vocabulary were transitive verbs, of which objects are either (1) animate and (mostly) family members, or (2) inanimate and information. Four of the particle verbs—*back up*, *let down*, *fill in*, and *put down*—were presented with animate objects, and the rest of the particle verbs—*bottle up*, *play down*, *spell out*, and *bring up*—were used with inanimate objects. Five of the prepositional verbs—*count on*, *feel for*, *finish with*, *lay into*, and *take to*—were shown with animate objects, and the rest—*get onto*, *go against*, and *run through*—always appeared with inanimate objects.

3.4.1.3 Meanings of the Phrasal Verbs

The meanings of the phrasal verbs are also worthy to be noted. The phrasal verbs used as the target vocabulary are a polyseme just as most phrasal verbs are, and they have many different or correlated meanings. One of the example is the phrasal verb *back up*, which can mean (1) to support in argument, (2) to provide help,

(3) to make a copy of information, (4) to make a vehicle move backwards, or (5) (of traffic) to be in a queue. Not only can phrasal verb have many different meanings, but the difficulty of learning them varies greatly among semantic categories. If the meanings of the phrasal verbs are not controlled, the learning difficulty of each phrasal verb is likely to differ, depending on its semantic category. Then, the meanings can have a considerable impact on teaching and learning of phrasal verbs, which makes them an intervening variable. This study, therefore, controlled the meaning of each phrasal verb. Only the metaphorical or figurative senses of the phrasal verbs were taught to the participants. And all the instructed meanings were limited to a certain semantic category which can be formularized as personal relationship and communication. For instance, as for the verb *back up*, only the figurative sense which is related to personal relationship and communication was taught: to support in argument. Consequently, the meanings of the phrasal verbs were strictly controlled so that the participants received the instruction of the metaphorical meanings of phrasal verbs, particularly used in personal relationship and communication.

3.4.1.4 Learnability of the Phrasal Verbs

Before entering into the sentence generation processes, it was necessary to evaluate the learnability of the phrasal verbs chosen as the target vocabulary. Learnability here refers to whether the materials were developmentally appropriate

for the subjects to learn, and this was satisfied (1) by choosing the target vocabulary from the textbook for intermediate learners, and (2) by investigating whether the learners at the immediate level could learn these verbs. All the phrasal verbs came from the widely used textbook for intermediate learners written by McCarthy and O'Dell (2004), and it can be said that these verbs have been considered as suitable for intermediate learners. Moreover, the pilot test showed that there was a learning effect for intermediate learners. The pretest of the pilot test revealed that many learners at the intermediate level did not know the most of the target vocabulary of this study. Still, even after one treatment, they showed the significant increase in the vocabulary knowledge. This change confirmed that the target vocabulary of this study was suitable for the intermediate learners.

3.4.2 Stimulus Sentences

The sentences used as the stimuli were generated from the authentic English sentences. Any sentences which contained the target vocabulary were collected from the Google Books service and several English dictionaries. The researcher, then, manually selected the sentences in which the phrasal verbs were used in the targeted meanings. Both the treatments and the tests utilized these stimulus sentences only after they underwent a modification to make them easily comprehensible to learners at the intermediate level. Generating the stimulus sentences and their modification, therefore, consisted of three steps: (1) extraction of the model sentences, (2)

modification of their grammar and vocabulary, and (3) control of their lengths.

3.4.2.1 Extraction of the Model Sentences

This study used the Google Books service and several English dictionaries in order to collect the model sentences. Only the publications produced in and after 2000 were the objects of investigation, and the mean of their publication year was 2008.653 (standard deviation was 3.524266), which implies that model sentences used the contemporary English. From these publications, the researcher carefully selected 288 sentences, (1) which contained one of the target vocabulary, and (2) of which phrasal verb was used in the targeted meaning. 91 sentences were from English dictionaries (31.60%), and 197 sentences were collected from the publications in Google Books (68.4%). Most of these publications (149 books) used the North American English, which amounts to 75.63 percent of the total model sentences. Specifically, 143 books (72.59 percent) were printed in the United State of American and only 6 books (3.05 percent) were published in Canada. The remaining 48 sentences (24.37%) were selected from the publications from England (36 sentences, 18.27%), Australia (10 sentences, 5.08%), and South Africa (2 sentences, 1.02%). All of these sentences underwent some modification, but the theme or main idea of the sentences remained mostly intact.

3.4.2.2 Modification of the Grammar and Vocabulary

Since many of these authentic sentences collected from the publications could be too demanding for intermediate learners, they required a few modification to their grammar and vocabulary. At first, all the sentences were rewritten with a simpler grammar. On average, each of the model sentences contained more than two difficult grammatical constructions such as periphrastic tense or aspect, gerunds, and participles. These could distract the participants from focusing on the target structure so much that they might cause misguided judgment on the grammaticality. Therefore, all the sentences were paraphrased into grammatically simpler ones; (1) they only used the simple past tense, and (2) gerunds or participles were converted into the paratactic or coordinating constructions.

The vocabulary of the model sentences was also modified in a similar manner. Many sentences contained at least one specialized or technical vocabulary such as a jargon, a slang, or an idiomatic expression. These words were replaced with easier words or everyday expressions. When the resulted sentences lacked of contextual information, supporting information or sentences were given. At last, a native English speaker judged the grammaticality of all of the stimulus sentences and helped further modification of problematic ones. (See appendices 2 to 13 for the stimulus sentences)

3.4.2.3 Control of the Length

The lengths of the stimulus sentences were controlled since their variance can be an intervening factor in the participants' understanding of the sentences. Intermediate learners possess a limited capability of reading English sentences so that they were expected to have difficulty in making the grammaticality judgment of a very long sentence. For this reason, the length of every stimulus sentence was controlled; it could just vary from ten words at minimum to fourteen words at maximum. The mean length of the stimulus sentences was twelve words, and the standard deviation was small (around one). It was not before the lengths of the stimulus sentences were adjusted completely that the treatments and the tests utilized them in order to teach the target structure and assess the participants' achievement.

3.5 Treatments

This part aims to provide a comprehensive explanation of the treatments of this study, including the precise procedures of teaching activities. The term treatment refers to the presentations of the stimuli which informed the participants of the target vocabulary and the target structure. The treatment of this study, therefore, consisted of two separate activities: learning of the target vocabulary and implicit teaching of the grammar of phrasal verbs.

3.5.1 Vocabulary Learning

The vocabulary learning of this study is to teach the morphological forms of the target vocabulary and their meanings. It was intended to minimize a possible confounding effect from poor vocabulary knowledge of intermediate learners. The pilot study and its post-experimental interview confirmed that phrasal verbs caused serious trouble in understanding the stimulus sentences. Some of the subjects even reported that they had considered some sentences as grammatically wrong just because they were not able to understand their meanings. Subjects' poor vocabulary knowledge, therefore, can lead to a confounding factor of the treatment. Hence all the participants received the same vocabulary learning activity before the treatment.

During the vocabulary learning session, the participants were allowed to memorize the target vocabulary as many as they could within five minutes. Its procedure started with the presentation of half (eight) of the target vocabulary; the computer screen showed four particle verbs and four phrasal verbs in a random order, and the meanings of these verbs were presented right next to them. Then, the participants were allowed to memorize these verbs and their meanings within two minutes and thirty seconds. For convenience, a single A4 sheet of paper and a ball-pointed pen were provided to every participant. After the given time, the other half of the target vocabulary appeared on the screen. Just as in learning the first half of the phrasal verbs, four particle verbs and four phrasal verbs were presented in a random order. Their meanings were also within view of the participants. And two minutes and thirty seconds were allowed for the participants to memorize the rest of

the target vocabulary. Reciting the vocabulary and its meanings was strictly forbidden so that the participants relied on visual stimuli, which was enforced in order to eliminate a possible confounding variable: learners' comprehension of aural stimuli.

3.5.2 Implicit Teaching Treatment

The implicit teaching method used in this study was a modified version of the implicit teaching method developed by Robinson (1996). It was repetitive implicit exposure to the target structure, which was intended to trigger implicit learning of the target structure. This differs from the incidental learning, in which learners keep watching the stimulus sentences. The implicit method used here was comprised of two recursive steps: (1) memorizing the stimulus sentences, and (2) solving the question on the position of the particle or the preposition. This was constructed with due consideration that the treatment used in the test should be applicable to classroom environment.

Instead of teaching the explicit rule, the participants were instructed to memorize the stimulus sentences within a limited time span (three seconds). An automatized PowerPoint presentation enabled these stimuli to be exposed within the exactly same amount of time. The verb and the particle or the preposition which the participants should notice were written in bold. After the given moment, the stimulus sentence disappeared immediately and a question was presented on the screen. It was

about the position of the particle or the preposition: whether the particle (or the preposition) immediately followed the verb or not. When the phrasal verb in the stimulus sentence was in the continuous order, the answer was yes because either a particle or a preposition must be right next to the verb in the continuous order such as in *put down the bag* or *look at the window*. If the phrasal verb was a particle verb and used in the discontinuous order, the answer to the question was no because an object must intervene between the verb and the particle, and the particle cannot immediately follow the verb (*put the bag down*).

For instance, when a sentence such as *I put down my bag* was presented on the screen, the participants were given the question such as ‘did the word “down” immediately follow the verb “put”?’ All of these questions were delivered in Korean so that they may not feel difficulty understanding the questions. Then, they must retrieve the sentence which they memorized and investigate whether the description of the question was correct or not; that is, whether the word *down* immediately followed the verb *put*. Since the phrasal verb of the stimulus sentence was in the continuous order, and the particle was placed exactly next to the verb, the correct answer was yes. Even after the participants were exposed to a sentence such as *I look at the window*, in which a prepositional verb was used, they were provided with the same type of question as the instance above: ‘did the word “at” immediately follow the verb “look”?’ The participants, again, must recall what they just read and verify whether the question was correct or not; i.e. whether the word *at* did follow the verb *look* or not. As every prepositional verb must be used in the continuous order, and

therefore, the preposition *at* must be placed right next to the verb *look*, the correct answer to the question was yes. After solving each question, the participants were provided with its correct answer, and they were asked to score their own answers in order to make sure that they understood the feedback.

For the given time, the participants repeated reading the stimulus sentences and solving the questions without a pause. This aimed to expose as many stimuli to the participants as possible and facilitate their implicit learning of the target structure. The researcher who supervised the treatment gave the instruction in person and guided the participants along the implicit treatment.

3.6 Tests

This section describes how to measure the most important variables of this study: the working memory capacity and the grammaticality judgment of the participants. Working memory capacity was calculated by using a modified version of Reading Span Task of Mackey et al. (2002), and two types of grammaticality judgment tests (GJT) were administered: timed GJT and untimed GJT. Both of the two types of GJTs were administered before and after the treatment in order to evaluate the changes in the participants' knowledge on the target structure.

3.6.1 Working Memory Measurement

The major purpose of the working memory measurement was to evaluate how

much information each participant could retain while performing several activity simultaneously. Since the treatments relied on reading comprehension, this study used the timed L1 reading span task, in which, within the given time, the participants must read sentences and solve the relevant questions while memorizing the recall items.

3.6.1.1 Test Materials

The reading span task used in this study was a modified version of Mackey et al. (2002)'s listening span task. Their test required a few adjustment for Korean students at the intermediate levels; the procedure remained almost intact but the test materials were replaced with Korean sentences because the source study had used the Japanese language for its Japanese subjects. It was also possible to utilize the English language because this study concerns the L2 proficiency, but poor fluency of intermediate learners forbade using English sentences for measuring the working memory capacity. The pilot test suggested that most of learners in the intermediate level possessed limited proficiency in reading the English language, and their reading proficiency, particularly in terms of the speed of reading, could have an effect on the measured score when working memory measurement was conducted in English. This limitation in English proficiency necessitated the use of the Korean language, the L1 of the participants of this study, in order to minimize the intervening effect of L2 fluency.

Generating the test materials followed the procedure which Mackey et al. (2002) adopted. Thirty two Korean sentences were selected from the government-issued Korean textbooks for middle school students; these sentences were presented in the appendices. Technical vocabulary, proper names and place names were eliminated so that the participants could comprehend all the words used in the sentences. The lengths of these sentences, also, were controlled, considering that it could be an intervening factor in the participants' performance. All the sentences consist of twelve to sixteen syllables, which took less than two seconds to read each of them. The meaning of each sentence was clear enough to not require further clarification on its context. After all of these potential confounding factors were controlled, four Korean native speakers evaluated these sentences and confirmed that (1) they were all comprehensible, (2) they were not much demanding for the readers, and (3) they did not seem to relate to each other. Therefore, it was expected that all the Korean learners would not be confronted with a problem in reading these sentences.

3.6.1.2 Measurement Procedures

The procedure of the working memory measurement involves two steps: (1) reading the sentence and solving the question related to the exposed sentence, and (2) repeating the recall items embedded in the exposed sentences. The first step, the sentence exposure and question, was repeated several times until the recall signal

was given. The automatized PowerPoint presentation exposed each sentence for two seconds, after which it automatically displayed the relevant question. Each sentence contains a recall item, which is one of the nineteen major consonant letters of the Korean alphabet: ㄱ, ㅋ, ㆁ, ㄷ, ㅌ, ㄹ, ㄴ, ㄷ, ㄹ, ㄴ, ㅁ, ㅂ, ㅅ, ㅆ, ㅇ, ㅈ, ㅊ, ㅊ, ㅌ, ㅋ, ㆁ, ㅍ, and ㅎ (*k, kk, n, t, tt, l, m, p, pp, s, ss, ng, c, cc, ch, kh, th, ph* and *h* in the Yale Romanization). The participants were requested to memorize the recall item while reading the Korean sentence on the screen simultaneously. After the given time (two seconds), a short question appeared on the screen, asking a simple truth-value question or yes-no question about the sentence that the participants just read. For instance, when the participants were provided with such a sentence as ‘소나무는 한겨울에도 푸른 빛을 ㄱ 간직하고 있다.’ (The pine tree retained its blue color *k* even in the worst of the winter.), they must cope with two tasks at the same time: (1) they must read and understand the given sentence, and (2) they must memorize the recall item, the Korean alphabet ㄱ (*k*). After two seconds, they saw the question such as ‘did the pine tree retain its color during the winter?’

Also of importance is memorization of the recall items; the participants were not allowed to write them down until the recall signal appeared on the screen. The recall sign appeared on the screen after at least six sentences and questions were finished. Therefore, the participants must retain several recall items in their memory while they were reading more than six sentences and solving the six relevant questions. When they recalled the items, they were requested to write them down in the same sequence as presented on the screen. For instance, when they read six

sentences, of which recall items were ‘ㄱ, ㄴ, ㄷ, ㄹ, ㅁ, ㅂ’ (*k, n, t, l, m, p*) in sequence, they must write them down on the paper in the same sequence as they saw: ‘ㄱ, ㄴ, ㄷ, ㄹ, ㅁ, ㅂ’ (*k, n, t, l, m, p*). (See Appendix 1 for the test sentences)

3.6.1.3 Scoring

The participants received a single point each time they correctly wrote down the recall item in the correct order. One point was given only if each of their answers sufficed for both of the following requirements: (1) it was one of the recall items, and (2) it was put down on the answer sheet in the same order as presented. No partial point was provided for the recall items that was not written down in the proper order. For example, when the recall items were ‘ㄱ, ㄴ, ㄷ, ㄹ, ㅁ, ㅂ’ (*k, n, t, l, m, p*) in sequence and when a participant put down their answers such as ‘ㄱ, ㄴ, ㄹ, ㄷ, ㅁ, ㅂ’ (*k, n, l, t, m, p*), he or she received four points for the correct answers: ‘ㄱ, ㄴ, ㅁ, ㅂ’ (*k, n, m, p*). Two of their answers were not scored because, although they were among the recall items, the participant did not submit them in the correct order (‘ㄹ, ㄷ’ (*l, t*) not ‘ㄷ, ㄹ’ (*t, l*)). At last, the sum of the points was used to represent each participant’s working memory capacity. The highest possible score is 22.

3.6.2 Timed Grammaticality Judgment Test (Timed GJT)

The primary purpose of the timed grammaticality judgment test (GJT) was to evaluate the participants' implicit knowledge of the target structure. The participants must judge the grammaticality of each sentence within the limited time span, and an automatized PowerPoint presentation assisted the entire procedure. Eighteen out of forty eight sentences had one of the grammatical errors with regard to the position of a particle or a preposition: (1) a particle preceded a pronominal object, or (2) an object preceded a preposition. In order to make the correct judgment within the given time, the participant must have the implicit knowledge about the correct syntactic order. Each participant must read the given sentence within two seconds and judge its grammaticality within the next five seconds. In addition to the grammaticality judgment, every participant was asked to write down which part of the sentences he or she based his or her judgment on. This was also conducted within the given five seconds. In this manner, all the participants provided his or her judgments on 48 sentences for about ten minutes.

As for scoring, each participant received one point for each correct answer only if his or her judgment was accurate, particularly with regard to which part they thought was grammatically incorrect. No partial point was given for the correct answers if the participants considered the grammatical correct parts as wrong. When the sentence contained no grammatical error, all the participants who judged it correctly received one point for each of their correct answers. But when the sentence did contain one of the possible grammatical errors, not all the participants who

considered it as grammatically wrong received one point; it was given only to those who wrote down the grammatically wrong part of the sentence as the basis of their judgment. At the end, the sum of each participant's point was calculated and used for the representation of his or her implicit knowledge. The highest possible score is 48.

3.6.3 Untimed Grammaticality Judgment Test (Untimed GJT)

In contrast to the timed GJT, the aim of the untimed GJT was to assess the participants' explicit knowledge of the target structure. The untimed GJT here refers to the grammaticality judgment test without time-related constraints, and each participant were allowed to spend as much time as he or she wanted in judging the grammaticality of each sentence.

Although there was no time limitation on the procedures, a PowerPoint presentation was used to display each sentence in order to make sure that there was no intervening external factor, particularly in comparison with the timed GJT. The computer showed a series of sentences, just as in the timed GJT. Eighteen out of forty eight sentences contained one of the grammatical errors related to the position of a particle or preposition: (1) a particle precedes a pronominal object, or (2) an object preceded a preposition. Each participant was under no pressure to judge the grammaticality of each sentence as fast as possible, and the given sentence did not disappear automatically until he or she pressed the button to move on to the next

sentence. Only if he or she decided to proceed, the next sentence was shown on the screen. As in the timed GJT, every participant must write down the part of the sentences where he or she based his or her judgment.

The scoring of the untimed GJT was exactly the same as the timed GJT; each participant gained one point for each correct answer only if his or her judgment was based on the proper reasons. No partial point was given to the correct answers if the participant found the grammatically incorrect sentences but failed to detect their errors; one point was provided for each of correct answers only if the participant successfully detected the grammatically incorrect parts of the sentences. The sum of the points was regarded as representing each participant's explicit knowledge, and used in the analysis. The highest possible score (48) is the same as the timed GJT.

Chapter 4 Results

4.1 Descriptive Statistics

Descriptive statistics of all the participants are presented in the Table 4.1. The participants made a correct judgment on only half of the sentences (23.944 sentences) in the timed grammaticality judgment test (timed GJT). They achieved slightly higher score (28.778) in the untimed grammaticality judgment test (untimed GJT). In the posttest, their timed GJT score increased to 36.333 in the timed GJT and the mean of the untimed GJT also rose to 37.222. As for vocabulary, most of the participants knew less than half of the target vocabulary (4.944), but they could acquaint themselves with more vocabulary after the treatment; the mean of their vocabulary knowledge increased from 4.944 to 14.556,

Table 4.1 Descriptive statistics for all tests

Variable (Total Possible)	N	Mean (SD)	Min.	Max.	Median
Working Memory Capacity (22)	24 ¹	12.917	2	20	14.0

¹ When the middle WMC group (6 participants) was included. This group was excluded in the analysis of the result in order to provide a clear comparison of the high working memory capacity group and low working memory capacity group.

		(4.242)			
Grammaticality Judgment Test					
Pretest / Timed (48)	18	23.944 (3.719)	17	30	24.5
Pretest / Untimed (48)	18	28.778 (4.237)	23	39	28.0
Posttest / Timed (48)	18	36.333 (6.155)	25	47	37.5
Posttest / Untimed (48)	18	37.222 (5.391)	28	44	39.0
Vocabulary					
Pretest (16)	18	4.944 (1.957)	1	8	5
Posttest (16)	18	14.556 (2.432)	7	16	16

The Table 4.2 presents the descriptive statistics for the test results of the high working memory capacity (high WMC) group. Similar to the entire participants, they obtained 24.333 and 28.333 points in the timed GJT and the untimed GJT, respectively. They also exhibited a significant increase after the treatment; they provided a correct judgment on 36.333 sentences in the timed GJT and 37.556 in the untimed GJT. The vocabulary knowledge of the high WMC group also increased from 5.333 in the pretest to 15.444 in the posttest.

Table 4.2 Descriptive statistics for the high working memory capacity group

Variable (Total Possible)	N	Mean (SD)	Min.	Max.	Median
Working Memory Capacity (22)	9	16.889 (1.792)	15	20	16.0
Grammaticality Judgment Test					
Pretest / Timed (48)	9	24.333 (3.590)	19	30	25.0
Pretest / Untimed (48)	9	28.333 (4.807)	23	39	26.0
Posttest / Timed (48)	9	36.333 (5.831)	28	47	38.0
Posttest / Untimed (48)	9	37.556 (5.398)	30	44	40.0
Vocabulary					
Pretest (16)	9	5.333 (2.055)	2	8	5
Posttest (16)	9	15.444 (0.831)	14	16	16

Some participants of the high WMC group, however, required a close inspection. In the interview after the posttest, two participants reported that they had used their own test strategies based on their metalinguistic knowledge. Both of them noticed the goal of the experiment and focused only on particles and prepositions. They said that they solved all the timed and untimed tests even without reading the entire sentences, including the verbs. Their increased scores, therefore, did not result from the direct effect of the implicit treatment, but from their own explicit test

strategies formulated during the treatment. When these learners are excluded, the descriptive statistics of the high WMC group differs slightly, as in the Table 4.3. Most of the scores are not far different from those in the Table 2, but the mean of timed GJT in the posttest score decreased from 36.333 to 34.286.

Table 4.3 Descriptive statistics for the high working memory capacity group (only the participants who did not notice the goal of the experiment)

Variable (Total Possible)	N	Mean (SD)	Min.	Max.	Median
Working Memory Capacity (22)	7	16.571 (1.591)	15	20	16.0
Grammaticality Judgment Test					
Pretest / Timed (48)	7	23.714 (3.844)	19	30	23.0
Pretest / Untimed (48)	7	27.429 (3.156)	23	33	26.0
Posttest / Timed (48)	7	34.286 (4.620)	28	41	32.0
Posttest / Untimed (48)	7	36.469 (5.577)	30	44	34.0
Vocabulary					
Pretest (16)	7	5.571 (2.259)	2	8	5
Posttest (16)	7	15.429 (0.904)	14	16	16

The tests for the low working memory capacity (low WMC) group yielded a

similar descriptive statistics to those for the high WMC group, which can be confirmed in the Table 4.4. The timed and untimed GJT scores, 23.556 and 29.222, were not far different from either that of the entire participants or that of the high WMC group. In the posttest, this group also demonstrated increase in both the timed GJT (36.333) and the untimed GJT (36.889). The vocabulary score tripled from 4.556 in the pretest to 13.667 in the posttest.

Table 4.4 Descriptive statistics for the low working memory capacity group

Variable (Total Possible)	N	Mean (SD)	Min.	Max.	Median
Working Memory Capacity (22)	9	8.444 (2.910)	2	12	8.0
Grammaticality Judgment Test					
Pretest / Timed (48)	9	23.556 (3.804)	17	29	24.0
Pretest / Untimed (48)	9	29.222 (3.521)	23	35	30.0
Posttest / Timed (48)	9	36.333 (6.464)	25	45	37.0
Posttest / Untimed (48)	9	36.889 (5.363)	28	44	38.0
Vocabulary					
Pretest (16)	9	4.556 (1.771)	1	8	5
Posttest (16)	9	13.667 (3.091)	7	16	16

Descriptive statistics for the GJT scores, categorized by the types of the stimuli, are provided in the Table 4.5 and Table 4.6. As observed in the previous methodology section, all the stimuli divide into two categories: those with a particle verb and those with a preposition verb. Since these verbs could take either a pronoun or a noun phrase as its object, there are four different types of the stimuli: a particle verb with a pronoun as its object, a particle verb with a noun phrase, a preposition verb with a pronoun, and a preposition verb with a noun phrase.

The Table 4.5 shows the descriptive statistics for the results of the timed GJT. In the pretest, both high WMC and low WMC groups gained 2.22 out of 8 sentences with a particle and its pronominal object. These scores increased to 5.22 for the high WMC group and 5.56 for the low WMC group in the posttest. With regard to the sentences with a particle and a nominal phrase as its object, all the participants obtained 11.78 out of 16, which increased to 14.11 for the high WMC participants and 12.78 for the low WMC participants. The GJT score on the sentences with a preposition verb and a pronominal object increased from 3.11 (high WMC) and 2.78 (low WMC) to 5.67 (high WMC) and 5.89 (low WMC). The judgment on the sentences with a preposition verb and a noun phrase as its object also changed: the score rose from 7.22 (high WMC), 6.71 (high WMC, not noticing) and 6.78 (low WMC) to 11.33 (high WMC), 10.43 (high WMC, not noticing) and 12.11 (low WMC). A similar pattern of increase was observed even after the high WMC participants who notice the goal of the experiment were excluded.

Table 4.5 Descriptive statistics for the timed GJT scores with regard to each type of the stimuli

Type (Total Possible)	Pretest			Posttest		
	High Mean (SD)	High/Not noticing Mean (SD)	Low Mean (SD)	High Mean (SD)	High/Not noticing Mean (SD)	Low Mean (SD)
Particle / Pronoun (8)	2.22 (1.40)	2.00 (1.51)	2.22 (1.13)	5.22 (2.15)	4.86 (2.17)	5.56 (1.71)
Particle / Noun (16)	11.78 (1.23)	12.00 (1.20)	11.78 (2.57)	14.11 (1.66)	14.00 (1.85)	12.78 (2.57)
Preposition / Pronoun (8)	3.11 (1.10)	3.00 (1.20)	2.78 (0.79)	5.67 (2.54)	5.00 (2.51)	5.89 (2.60)
Preposition / Noun (16)	7.22 (1.75)	6.71 (1.58)	6.78 (1.69)	11.33 (3.30)	10.43 (3.11)	12.11 (2.85)

Note: Type, the type of the verb and its object in the stimulus sentence; High/Not noticing, the high WMC participants who did not notice the goal of the experiment.

The descriptive statistics for the results of the untimed GJT are indicated in the Table 4.6. For the sentences with a particle verb and a pronominal object, the high WMC and low WMC groups provided 4.22 and 4.56 correct judgments, respectively. Their judgment improved after the treatment, reaching 5.89 (high WMC) and 5.67 (low WMC). What requires consideration is the stimuli with a particle verb and a noun phrase; the score of the high WMC group increased from 12.33 to 14.22 while that of the low WMC group decreased from 13.56 to 11.67. With regard to the sentences with preposition verbs, both the high WMC and low

WMC groups exhibited increase: the score of the sentences with a pronominal object changed from 3.33 (high WMC) and 3.44 (low WMC) to 5.33 (high WMC) and 6.00 (low WMC), and that of the stimuli with a noun phrase also increased from 8.44 (high WMC) and 7.67 (low WMC) to 12.11 (high WMC) and 13.56 (low WMC). The high WMC group retained the same pattern of increase in the posttest even if the participants who used the test strategy were excluded, as shown in the High/Not noticing column of the Table 4.6.

Table 4.6 Descriptive statistics for the untimed GJT scores with regard to each type of the stimuli

Type (Total Possible)	Pretest			Posttest		
	High Mean (SD)	High/Not noticing Mean (SD)	Low Mean (SD)	High Mean (SD)	High/Not noticing Mean (SD)	Low Mean (SD)
Particle / Pronoun (8)	4.22 (2.20)	4.14 (2.10)	4.56 (2.17)	5.89 (2.42)	5.57 (2.61)	5.67 (1.70)
Particle / Noun (16)	12.33 (2.00)	12.43 (2.19)	13.56 (2.36)	14.22 (1.75)	14.86 (1.36)	11.67 (3.23)
Preposition / Pronoun (8)	3.33 (1.49)	3.14 (1.25)	3.44 (0.83)	5.33 (2.31)	4.86 (2.36)	6.00 (2.49)
Preposition / Noun (16)	8.44 (3.10)	7.71 (2.31)	7.67 (2.00)	12.11 (3.11)	11.14 (2.85)	13.56 (2.87)

Note: Type, the type of the verb and its object in the stimulus sentence; High/Not noticing, the high WMC participants who did not notice the goal of the experiment.

4.2 Inferential Statistics

4.2.1 Differences between the High WMC and Low WMC groups

In order to confirm the homogeneity of the high WMC and low WMC groups, with a special regard to the GJT scores and vocabulary knowledge in the pretest, both the non-parametric and parametric tests were conducted. As in the Table 4.7, Mann-Whitney U test and independent samples t test were used and both of the tests provided the same statistical outcome; all of the exact significances of Mann-Whitney U test far exceed the threshold of $p < 0.05$, and all the p -values of the independent samples t test also are greater than 0.05. These imply that the high WMC and low WMC groups were not statistically different from each other in the pretest, particularly with regard to the timed and untimed GJT scores and their vocabulary knowledge.

Table 4.7 Homogeneity tests of the results from the pretest

Group	Mann-Whitney U test				Independent samples t test		
	Mann-Whitney U	Wilcoxon W	Z	Exact Sig.	t	df	p
Pretest /	36.500	81.500	-.355	.730	.421	16	.680

Timed							
Pretest / Untimed	32.500	77.500	-.710	.489	-.422	16	.679
Pretest / Vocabulary	33.000	78.000	-.678	.549	.811	16	.429

Note: Exact Sig, the exact significance

The same homogeneity tests were again administered to the posttest results as presented in Table 4.8, and it also revealed that both the high WMC and low WMC groups did not perform significantly differently from each other in all of the given tests. Not only does Mann-Whitney *U* test return the exact significance more than 0.05 but also the independent samples *t* test yields *p*-values greater than 0.05, the threshold for substantial difference. These statistical analyses also carry the implication that both the high WMC and low WMC group obtained the statistically same scores in the posttest.

Table 4.8 Homogeneity tests of the results from the posttest

Group	Mann-Whitney <i>U</i> test				Independent samples <i>t</i> test		
	Mann-Whitney <i>U</i>	Wilcoxon <i>W</i>	<i>Z</i>	Exact Sig.	<i>t</i>	<i>df</i>	<i>p</i>
Posttest / Timed	40.000	85.000	-.044	1.000	0	16	1
Posttest /	36.500	81.500	-.345	.730	.248	16	.807

Untimed							
Posttest / Vocabulary	29.000	74.000	-1.118	.340	1.571	16	.136

Note: Exact Sig, the exact significance

The same result was obtained even after the high WMC learners who exploited their test strategy during the tests were excluded. Mann-Whitney U test and the independent samples t test show that all the scores of the high WMC and low WMC groups did not differ at the 0.05 level of statistical significance as in the Table 4.9.

Table 4.9 Homogeneity tests of the results from the posttest (of the participants who did not notice the goal of the experiment)

Group	Mann-Whitney U test				Independent samples t test		
	Mann-Whitney U	Wilcoxon W	Z	Exact Sig.	t	df	p
Posttest / Timed	25.000	53.000	-.691	.536	-.663	14	.518
Posttest / Untimed	31.000	59.000	-.053	1.000	-.157	14	.878
Posttest / Vocabulary	22.000	67.000	-1.110	.351	1.366	14	.158

Note: Exact Sig, the exact significance

In summary, all the statistical tests, whether non-parametric or parametric, led

to the same conclusion that the high WMC group did not perform significantly better than the low WMC group throughout the entire experiment. Both the high WMC group and low WMC group are homogenous in the pretest, with regard to their scores of the timed GJT, the untimed GJT, and vocabulary knowledge. After receiving the same implicit treatment, the low WMC group showed the statistically same performance as the high WMC group.

4.2.2 General Learning Effect of the Treatment

In order to verify whether the treatment of this study did have a significant effect on the performance of the participants of both groups, non-parametric and parametric tests were conducted. Wilcoxon signed ranks tests and paired-samples *t* test were used to examine whether the scores of the pretest are significantly different from those of the posttest. The results of these statistical tests are in accord with each other: all the groups performed significantly better after the treatment.

At first, the result on the untimed GJT scores is presented in the Table 4.10. Wilcoxon signed ranks test provided the asymptotic significances enough to reject the null hypothesis that the score of the pretest equals to that of the posttest (.008 for the high WMC group and .011 for the low WMC). This result coincides exactly with the result of a paired-samples *t* test. The *p* values of the *t* test are significantly lower than .01, which strongly rejects the possibility of coincidence between the scores of the pretest and those of the posttest.

Table 4.10 Non-parametric and parametric tests for the results of the timed GJT

Group	Pretest	Posttest	Wilcoxon Signed Ranks Test		Paired-samples <i>t</i> test		
	Mean (SD)	Mean (SD)	<i>Z</i>	Asymp. Sig (2-tailed)	<i>t</i>	<i>df</i>	<i>p</i>
High	24.333 (3.590)	36.333 (5.831)	-2.670	.008**	-4.910	8	.001**
Low	23.556 (3.804)	36.333 (6.464)	-2.547	.011*	-4.951	8	.001**

Note: Asymp. Sig, the asymptotic significance

* < .05, ** < .01

Secondly, the Table 4.11 demonstrates the result of the statistical analysis on the scores of the untimed GJTs. The asymptotic significances obtained from Wilcoxon signed ranks test were so strong that it is safe to postulate that the performance of both groups in the posttest improved significantly. The paired-samples *t* test provides the same result; all the *p*-values are less than .01, which implies that there is a fairly high probability that the scores of the pretest differ from those of the posttest.

Table 4.11 Non-parametric and parametric tests for the results of the untimed GJT

Group	Pretest	Posttest	Wilcoxon Signed Ranks Test		Paired-samples <i>t</i> test		
	Mean (SD)	Mean (SD)	Z	Asymp. Sig (2-tailed)	<i>t</i>	<i>df</i>	<i>p</i>
High	28.333 (4.807)	37.556 (5.398)	-2.670	.008**	-3.975	8	.004**
Low	29.222 (3.521)	36.889 (5.363)	-2.527	.012*	-5.498	8	.001**

Note: Asymp. Sig, the asymptotic significance

* < .05, ** <.01

Lastly, the statistical comparison of vocabulary achievement is also in accord with the result on the timed GJTs and the untimed GJTs, as the Table 4.12 shows. The asymptotic significances, again, are significantly small to dismiss the possibility that the vocabulary knowledge in the pretest coincides with the increased knowledge in the posttest. The *p*-values of paired-samples *t* test are also extremely small (both groups exhibited the *p*-values less than .000).

Table 4.12 Non-parametric and parametric tests for the results of the vocabulary achievement

Group	Pretest	Posttest	Wilcoxon Signed Ranks Test		Paired-samples <i>t</i> test		
	Mean (SD)	Mean (SD)	Z	Asymp. Sig (2-tailed)	<i>t</i>	<i>df</i>	<i>p</i>
High	5.333 (2.055)	15.444 (0.831)	-2.692	.007**	-13.417	8	.000**
Low	4.556 (1.771)	13.667 (3.091)	-2.670	.008**	-12.090	8	.000**

Note: Asymp. Sig: the asymptotic significance

* < .05, ** <.01

All of these inferential statistics, therefore, support the same conclusion: the treatment did have an overall effect on the performances of both groups. Both the non-parametric test and the parametric test suggest significantly small possibility of coincidence between the scores of the pretest and the posttest. It naturally leads to the conclusion that, overall, both of the high WMC and low WMC groups did benefit from the treatment of this study.

4.2.3 Specific Effects of the Treatment on the Acquisition of the Target Structure

Even though all the groups exhibit a significant improvement, it is still necessary to evaluate the specific effect of the implicit treatment on the knowledge

of the syntactic variance of the target structure. To investigate which kind of syntactic structure the participants did learn, non-parametric Wilcoxon signed ranks test was used since the sample size was considered to be too small for comparison of the answers for each different syntactic structures.

The Table 4.13 presents the result of statistical analysis on the timed GJT scores. For the high WMC group, many of the asymptotic significances were notable: a particle verb with a pronominal object (.011), a particle verb with a noun phrase (.020), and a prepositional verb with a noun phrase (.028). However, the result turns out to be different the participants who noticed the goal of the experiment and used the test strategy were excluded. For the rest of the high WMC group, only the two syntactic structures exhibited a significant difference: a particle verb with a pronoun (.017) and a prepositional verb with a noun phrase (.034). The low WMC group showed a slightly contrasting result. The Wilcoxon test provided significant values in three types: a particle verb with a pronoun (.011), a prepositional verb with a pronoun (.027), and a prepositional verb with a noun phrase (.008).

Table 4.13 Wilcoxon Signed Ranks Test for the timed GJT scores

Type	High		High/Not noticing		Low	
	Z	Asymp. Sig. (2-tailed)	Z	Asymp. Sig. (2-tailed)	Z	Asymp. Sig. (2-tailed)
Particle + Pronoun	-2.558	.011*	-2.384	.017*	-2.530	.011*

+ Noun	-2.319	.020*	-1.897	.058	-.987	.323
Preposition						
+ Pronoun	-1.919	.055	-1.638	.101	-2.207	.027*
+ Noun	-2.201	.028*	-2.120	0.34*	-2.67.	.008**

Note: Type, the type of the verb and its object in the stimulus sentence; High/Not noticing, the high WMC participants who did not notice the goal of the experiment; Asymp. Sig, asymptotic significance

* < .05, ** <.01

The difference between the high WMC and low WMC groups can also be observed in the analysis of the untimed GJT scores, as in the Table 4.14. The high WMC group presents a significant difference in the particle-with-a-noun and preposition-with-a-noun types (the asymptotic significance of .045 and .035, respectively). Interestingly, when those who noticed the goal of the experiment are removed, it turns out that the high WMC group did improve in the particle-with-pronoun type. The asymptotic significances of the low WMC group were neither the same as their performance in the timed GJT nor the performance of the high WMC group. Three types provide significant values: a particle with a noun phrase (.017), a preposition with a pronoun (.018), and a preposition with a noun (.007). What should be noted here is that the score of the low WMC group, in fact, significantly decreased in judging the particle-with-a-noun type sentences.

Table 4.14 Wilcoxon Signed Ranks Test for the untimed GJT scores

Type	High		High/Not noticing		Low	
	Z	Asymp. Sig. (2-tailed)	Z	Asymp. Sig. (2-tailed)	Z	Asymp. Sig. (2-tailed)
Particle						
+ Pronoun	-1.364	.172	-2.041	.041*	-1.807	.071
+ Noun	-2.003	.045*	-2.003	.045*	-2.388	.017*
Preposition						
+ Pronoun	-1.838	.066	-1.476	.140	-2.360	.018*
+ Noun	-2.103	.035*	-2.032	.042*	-2.684	.007**

Note: Type, the type of the verb and its object in the stimulus sentence; High (not noticing), the participants who the post-experimental interview revealed that they had not noticed the goal of the experiment and used the metalinguistic knowledge during the tests; Asymp. Sig, asymptotic significance

* < .05, ** <.01.

All the statistical analyses above can be summarized as in the Table 4.15, which excludes some confounding cases of the high WMC group. The timed GJT was to measure the participants' implicit knowledge so that it is reasonable to exclude the performance of some high WMC participants who noticed the goal of the experiment and used the explicit type of test strategy; for their achievement did not result from the implicit knowledge increased by the treatment. However, the result of the untimed GJT includes the performance of these learners since the ultimate aim of the untimed GJT is to assess the participants' explicit or metalinguistic knowledge, and their test strategies significantly hinged on the

metalinguistic information which they formulated during the treatment.

Table 4.15 The summary of the inferential statistical analysis

Type	High	Low
Timed / Overall	Effective**	Effective*
Particle / Pronoun	Effective*	Effective*
Particle / Noun	-	-
Preposition / Pronoun	-	Effective*
Preposition / Noun	Effective*	Effective**
Untimed / Overall	Effective**	Effective*
Particle / Pronoun	-	-
Particle / Noun	Effective*	Effective* ²
Preposition / Pronoun	-	Effective*
Preposition / Noun	Effective*	Effective**
Vocabulary	Effective**	Effective**

Note: Type, the type of the verb and its object in the stimulus sentence; Asymp. Sig, asymptotic significance

* < .05, ** <.01

As shown in the Table 4.15, the implicit treatment of this study has a statistically significant effect on the performance of both of the high WMC and low WMC groups. All of them presented a significant increase in the timed and untimed

² On the contrary to other types of the stimuli, the low WMC group exhibited a significant decrease in the GJT score after the treatment.

GJT scores and vocabulary knowledge. With regard to learning of the syntactic variations of phrasal verbs, however, each group exhibited differences. As for the high WMC group, there were statistically significant changes in four types of the stimuli: a particle verb with a pronoun and a prepositional verb with a noun phrase in the timed GJT, and a particle verb with a noun phrase and a prepositional verb with a noun phrase in the untimed GJT. The low WMC group showed a significant change in six types: a particle with a pronoun, a preposition with a pronoun, and a preposition with a noun phrase in the timed GJT, and a particle with a pronoun, a preposition with a pronoun, and a preposition with a noun in the untimed GJT. What should be clarified here is that the low WMC group obtained a significantly decreased untimed GJT score in judging the sentences containing a particle verb with a noun phrase after the treatment.

Chapter 5 Discussions

5.1 Working Memory Capacity and Its Relationship with the Test Results

Considering that the syntactic variation of English phrasal verbs is conditioned by both the type of a verb and the type of an object, the result from the inferential statistical analysis can be surmised further as in the Table 4.16.

Table 4.16 The summary of the effect of the treatment

Type	High	Low
Timed / Overall	Effective	Effective
Timed / Particle	Partially Effective	Partially Effective
Timed / Preposition	Partially Effective	Effective
Untimed / Overall	Effective	Effective
Untimed / Particle	Partially Effective	Not Effective ³
Untimed / Preposition	Partially Effective	Effective
Vocabulary	Effective	Effective

Note: Effective, the implicit treatment contributes to a statistically significant increase of grammatical knowledge; Partially Effective, the implicit treatment results in a statistically significant increase only in the acquisition of a certain type of syntactic order; Not

³ The low WMC group presented a statistically significant decrease in the accuracy of the grammaticality judgment of particle verbs used with a noun.

Effective, the implicit treatment fails to a statistically significant increase.

The results partially support the hypotheses of this study. The first hypothesis is proven correct since the low WMC group achieved the scores which did not differ significantly from those of the high WMC group. The second hypothesis, however, turned out to be incorrect. Although the low WMC group exhibited successful acquisition of prepositional verbs, it only showed partial (in the timed GJT) and even unsuccessful acquisition of particle verbs (in the untimed GJT). It is worth noting that the high WMC group demonstrated partial knowledge of both particle verbs and prepositional verbs.

5.2 The Implications of the Learners' Achievement

5.2.1 Learners' Achievement and Their Learning Mechanisms

After receiving the same implicit teaching, both of the high and low WMC groups achieved the same GJT scores. The high WMC group did not outperform the low group while the low WMC group presented a significant increase in grammatical judgment. This result is in contradiction to the results under explicit teaching conditions, in which many studies have reported that high WMC learners outperform low WMC learners with ease (c.f. French & O'brien, 2008; Masoura & Gathercole, 1999). The results of learners' acquisition in implicit teaching conditions, therefore,

differ from those of many previous studies conducted in the explicit environments.

From the post-experimental interviews, it was found that only the low WMC learners relied heavily on implicit learning mechanisms. Every participant of the low WMC group seemed to have no trouble following the procedures of the implicit teaching treatment of this study. Nonetheless, most of them expressed psychological difficulty in processing the stimuli; many of them rated the implicit treatment as not difficult but quite demanding. Limited WMCs were likely to impose a limit on their processing ability, which is supported by learners' remarks that they could not even make a rough estimate of the target structure rule of the experiment. Being unaware of the rule implies that these learners relied on implicit learning in the acquisition of English phrasal verbs. Therefore, it can be argued that the participants with low WMC may not utilize any kind of explicit learning mechanism during the treatment.

In marked contrast to the low WMC group, most learners of the high WMC group used both implicit and explicit learning mechanism. The interview discovered that they tried to identify or formulate the rule governing the stimuli. The implicit teaching treatment indeed demanded the use of significant working memory capacities, but their high working memory capacities enabled them to afford the time to speculate on what underlies the given stimuli. Many of them, in fact, stated that it had been too easy for them to follow the procedures and some of them even succeeded to formulate their own metalinguistic rules. Therefore, the cognitive activities of high WMC learners partake of the characteristics of explicit learning mechanisms, even though they received the implicit treatment. In summary, the

scores of both groups are not statistically different but they reacted differently to the same implicit treatment.

5.2.2 Theoretical Implications of the Learners' Achievement

The learners' achievements in the implicit teaching condition support the cognitive scientists' assertion. They have held a view that the correlation between learners' achievement and working memory capacity only exists under the explicit environments (Kaufman et al., 2010; Tagarelli, Borges-Mota, & Rebuschat, 2011). The results of this study are in agreement with their assumption, since the low WMC group's performance was not statistically different from that of the high WMC. This also refutes a claim by Mackey et al. (2002) that, after receiving implicit treatment, high WMC learners would outperform low WMC learners. Even supposing that the learners of the high WMC group did utilize their WMC during the treatment, their scores showed no significant benefit of their high-functioning cognitive ability. Therefore, it is reasonable to presume that, in second language acquisition, (1) effective use of working memory capacity requires activation of conscious or explicit awareness, (2) implicit teaching does not place low WMC learners at a disadvantage, which has been reported under the explicit conditions.

High WMC learners' achievement of Mackey et al. (2002)'s can be explained by learners' explicit understanding of the given rules. They reported that high WMC learners were more likely to benefit from implicit teaching treatment than low WMC

learners, in the acquisition of English question constructions. The present study, however, suggested a possibility that high WMC learners could afford to put an effort into discovering the explicit rule during the implicit teaching. Although (1) the implicit teaching was intended to induce implicit learning, and (2) the rule governing the stimuli is one of the most demanding grammars of English syntax, some of learners did formulate their own metalinguistic description, which led to their high scores. Therefore, the possibility of high WMC learners' explicit understanding of the stimuli cannot be ignored in implicit teaching designs. Furthermore, Mackey et al. (2002) did not request the participants to memorize the vocabulary, which demanded less cognitive load of the learners than in the present study. This must facilitate high WMC learners to use the explicit approach to the implicit stimuli, since they could allocate more resources to conscious rule-searching. All of these raise the possibility that high WMC learners may achieve higher scores than low WMC learners through explicit learning mechanisms in their study. Therefore, it must be investigated whether the results from Mackey et al. (2002)'s study and similar ones do provide evidence that high WMC learners excel at implicit learning.

The present study also demonstrated that young adult learners as well as children may benefit from the implicit teaching. Traditionally, researchers hold a skeptical view of the validity of implicit teaching for adult language learners (Doughty, 2003). They emphasized that (1) the successful acquisition of adult learners results from high analytic abilities (DeKeyser, 2000, 2003) and (2) most adult learners rely on explicit learning mechanism (Ullman, 2001). Some even

insisted that adult learners lost neural plasticity completely so that they have no choice but to notice the metalinguistic information, which leads to explicit learning mechanism (Paradis, 2004, 2009). However, the results of the present study provided a significant learning effect even in the implicit teaching of complex structures. This means that young adult learners still have implicit learning ability, and they retain brain plasticity required for implicit learning. Studies using Event-Related Potentials (ERP) (Osterhout, McLaughlin, Kim, Greenwald, & Inoue, 2004), in fact, provided evidence of possible brain plasticity of adult language learners. Furthermore, Sagarra and Herschensohn (2010) also suggested that even adult learners could develop implicit or procedural knowledge. In agreement with these studies, the results of this study support the view that implicit learning mechanism is still available for adult language learners, and they also suggest that implicit teaching can contribute to this implicit type of learning.

What is new in this study is the possibility that high WMC may hinder learners' implicit intake of target structure. Previous studies on adults' implicit learning have propounded individual differences as mediating variables in learners' acquisition (Osterhout et al., 2004; Sagarra & Herschensohn, 2010). The interview of this study demonstrated that working memory capacity can be one of these mediating variables. High working memory capacity enables learners to search a rule consistently during the treatment, and induces them to adopt an explicit approach to the implicit treatment. Hence it can be presumed that high-functioning cognitive ability allows conscious processing of the inputs which leads to the explicit type of intakes. This

presumption is in line with Ullman (2001)'s explanation on decreased implicit learning ability in adulthood. He ascribed poor implicit learning in adults to increased declarative memory capacity, which triggers them to depend on explicit learning mechanism. What can be drawn from both the presumption of this study and Ullman's explanation is a possible scenario that adults with poor memory capacity may not rely on explicit learning mechanism, which was observed in the interview for the low WMC learners in this study. Therefore, working memory capacity can be one of intervening factors which determines implicit intake of adult learners.

5.2.3 Pedagogical Implications of the Learners' Achievement

The findings of this study highlight the importance of working memory capacity in language teaching. Instructors must consider working memory since learners' achievement may vary with their WMC. Choosing an explicit teaching method may give an advantage to those with high WMC, as many previous studies confirmed. Conversely, an implicit teaching method can open up an opportunity for those with low WMC to keep up with those with high WMC. Therefore, WMC must be under consideration when instructors decide the teaching method most suitable for their learners.

This study also presents the efficacy of implicit grammar teaching for adult learners. Many researchers regarded an explicit instruction as more suitable for adult

learners than an implicit instruction. For instance, Norris and Ortega (2000) argued that awareness of learners resulted in tangible outcomes in language acquisition, and therefore, explicit teaching is more effective than implicit one. The results of this study showed that even adult learners could make significant achievement in an implicit teaching condition. In particular, implicit teaching can be more beneficial for learners with low WMC since (1) they cannot outperform those with high WMC after receiving explicit instruction, (2) but they can reach the same achievement as those with high WMC after receiving implicit instruction. Hence implicit grammar teaching can be suitable for learners with relatively poor cognitive abilities.

As for learners with high WMC, a delicate adjustment must be carried out in order to ascertain that they are able to learn the stimuli implicitly. Not only is it hard to precisely define what implicit is, but it is difficult to ensure that implicit teaching produces a desired effect or implicit learning, as Ellis and Sheen (2006) noted. Just as in this study, learners may adapt explicit learning mechanisms to implicit instruction. As this unintended adaptation results from remaining cognitive resources of high WMC learners, instructors should increase the cognitive load of their teaching procedures. The solution which can be inferred from the interviews of this study is that (1) the time which learners spend in the implicit treatment must be adjusted, and (2) difficulty level of the stimulus sentences must be raised. These could increase cognitive load of high WMC learners so that they can no longer afford the time to formulate the explicit rule of the stimuli.

5.3 The Implications of the Learners' Error Patterns.

5.3.1 Learners' Error Patterns and Working Memory Capacity

The high and low WMC groups exhibited different error patterns. The low WMC learners showed insufficient application of the grammar while the high WMC learners overgeneralized the rule. The low WMC learners acquired the rule governing prepositional verbs, but they exhibited an unsuccessful acquisition of particle verbs, particularly when measured by the untimed GJT. The cause of their errors in the untimed GJT was that they strongly preferred either the continuous order or the discontinuous order in phrasal verbs. As in the Table 5.1, four out of nine participants showed a tendency to prohibit one of the two possible orders of English particle verbs

Table 5.1 Participants' tendency of grammaticality judgment of particle verbs in the untimed GJT of the posttest

Type	High	Low
Prohibiting the discontinuous order	0	1
Tending to prohibit the discontinuous order	1	2
Tending to prohibit the continuous order	0	1

Allowing both orders	8	5
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Note: Prohibiting the discontinuous order, the participants who judged almost all the discontinuous order as grammatically incorrect; *Tending to prohibit the discontinuous order*, the participants who judged more than three discontinuous order as incorrect; *Tending to prohibit the continuous order*, the participants who judged more than three continuous order as incorrect; *Allowing both order*, the participants who does not exhibit no skewed tendency in grammaticality judgment.

The high WMC learners made errors in grammatical judgment of both prepositional verbs and particle verbs. Their errors, however, resulted from overgeneralization of the particle verb rule; they even allowed the discontinuous order of prepositional verbs. As the Table 5.2 presents, many of the high WMC learners considered the wrong sequences of the prepositional verbs as correct, particularly when they are used with a pronominal object, such as *count him on* or *lay her into*.

Table 5.2 The number of the participants who made more errors in judging prepositional verbs used in the discontinuous order

Type	High	Low
Timed	3 / 9	2 / 9
Untimed	4 / 9	2 / 9

In summary, error patterns demonstrate that the acquisition of the rule differs between the high WMC and low WMC learners. Even though their scores are not statistically different from each other, both groups adopted different ways of rule

acquisition.

5.3.2 Theoretical Implications of the Learners' Errors

The difference in the rule acquisition cannot be explained easily by the present theoretical frameworks of SLA. The Processability Theory (Pienemann, 1998, 2005) only provides a partial explanation. As this theory assumes learners' gradual development from shallow structure to deep structure, the low WMC learners can be said to only acquire the shallow structure rule of English phrasal verbs. It can explain why they failed to understand more complex structure, the usage of particle verbs, and why they had a strong preference for one of the two possible syntactic orders. The overgeneralization of the high WMC learners, however, is hard to explain in view of the Processability Theory. These learners failed to acquire the shallow structure, prepositional verbs, whereas they acquired the deep structure rule, the particle verb rule, and applied it to prepositional verbs. One might argue that the high WMC learners' errors in prepositional verbs arose from miscategorization of prepositions as particles. Still, a problem remains regarding why shallow structure, or prepositions were miscategorized as deep structure, or particles. Furthermore, this framework cannot offer a plausible explanation on the working memory's role in the difference of two groups.

VanPatten (1996, 2004)'s Input Hypothesis also cannot provide a satisfactory exposition. He suggested a possibility that learners may fail to notice grammatical

phenomena since they are likely to value communication because the constraints on working memory forced them to focus on limited aspects of a language. This may cause low WMC learners' insufficient application of the rule because they have not much problem with communication even in using either continuous or discontinuous order. High WMC learners' overgeneralization may also result from this primacy of meaning. These learners may find that the syntactic order of English phrasal verb does not contribute to the meaning of the sentence so that they may not take care of the syntactic order of phrasal verbs. However, this hypothesis cannot elucidate why low WMC and high WMC learners exhibit different error patterns. As it can only suggest possible causes of learners' errors from the pragmatic view, the precise role of working memory capacity still remains obscure, particularly with regard to learners' errors.

One of the developmental models which may clarify the underlying mechanisms of learners' error patterns is the Autonomous Induction Theory (AIT) by Carroll (2001). She posited that acquisition of grammatical rules depends on a particular type of learners' induction. She referred to this type of induction as autonomous constrained induction, which presumes that learners modify their internalized rule when they cannot parse new inputs. In the induction process, she suggested that the consistency of the rule is one of the most important elements of learners' acquisition. Insufficient application of low WMC learners, therefore, can be regarded as a consequence of rule induction, since these learners exhibited consistency in using the syntactic order. The induction process may result in the

overgeneralization of high WMC learners, which can provide wrong but consistent parsing on the stimuli. What AIT is incapable of, however, is giving the explanation for why two groups obtained different results by using the same induction process.

Only the Acquisition by Processing Theory (APT) by Smith and Truscott (2004, 2014) can give a systematic account of the differences of the two WMC groups. The APT hypothesizes that frequency of inputs have a close correlation with the probability of activation of a certain rule in our brain. From the perspective of the APT, the low WMC learners failed to activate the rules relevant to the stimuli, while the high WMC learners have excessively high probability of activation of the particle verb rule. The APT also particularizes the role of working memory as cognitive resources used in the activation of the rule. This allows explanation of different consequences of high and low WMC learners. High WMC may facilitate activation of the rule, which leads to high probability of activation, and ultimately, the overgeneralization of the particle verb rule. On the other hand, low WMC may impede rule activation, which contributes to low WMC learners' insufficient adaptation of the rule. Accepting the explanation based on the APT, however, still has a problem to solve; why failed or impeded activation of low WMC did not lead to poorer achievement than those with high WMC obtained. In summary, the present theoretical frameworks of language acquisition can only provide a partial explanation with regard to the acquisition patterns of the learners.

5.3.3 Pedagogical Implications of the Learners' Errors

Even though current theoretical frameworks could not provide sufficient explanation, learners' error patterns may have some crucial implications for instructors. (1) Learners whose scores are the same may follow different developmental patterns, particularly depending on their working memory capacity, (2) learners with low working memory capacity require feedback on their insufficient use of the target grammar, and (3) learners with high working memory capacity should be guided not to overgeneralize the rule.

Since the high WMC learners exhibited error patterns different from those of the low WMC learners, working memory capacity must be one of the first considerations of instructors. If the high WMC learners, who are prone to overgeneralize the rule, are given only the positive stimuli of the target structure, they are likely to persist with their overgeneralization, which may hinder their acquisition. What they need in order to fully achieve the phrasal verb rules is negative evidence of prepositional verbs used in the discontinuous order. On the other hand, the low WMC learners may continue to use only one of the possible syntactic order unless they are provided examples which prove that both of the continuous and discontinuous orders can be allowed in particle verbs. Therefore, instructors must present positive evidence of both of the syntactic orders for them. From the prospect of the APT, the former may contribute to lowering the probability of activation of overgeneralized rules while the latter is expected to raise the probability of activation of underapplied rule. Hence instructors should consider

WMC in providing appropriate feedbacks for their learners since it may be a contributing factor of variance in their grammar acquisition.

Chapter 6 Conclusion

This study investigated the relationship between the working memory capacity (WMC) and learners' achievement of the phrasal verb structure in an implicit teaching condition. The high WMC group did not outperform the low WMC group in the scores of the timed and untimed grammaticality judgment tests and vocabulary test. That is, the low WMC participants exhibited the performance not significantly different from the high WMC group. The error patterns of both groups, however, contrast with each other. The high WMC learners overgeneralized the particle verb rule while the low WMC learners showed insufficient application of the phrasal verb rule. The post-experimental interview confirmed that only the low WMC group learned the target structure implicitly. The high WMC participants, on the other hand, kept using conscious explicit learning mechanisms in order to find the rule governing the stimuli.

These results, therefore, carry two important theoretical implications. First, working memory capacity does not necessarily correlate with learners' achievement under implicit teaching conditions, and implicit leaning is still an available option for adult learners. What should be remarked here is high WMC learners' explicit understanding of implicit instruction. Their achievement may not result from implicit learning of the target structure, and their high-functioning cognitive abilities may even hinder their implicit learning. Secondly, the differences observed between

high WMC learners and low WMC learners requires reconsideration of the present theoretical frameworks of SLA. Acquisition by Processing Theory (APT) by Smith and Truscott (2004, 2014) may provide a systematic explanation on the differences of the two types of learners, but it still has a problem to solve with regard to the significant achievement of low WMC learners.

Several pedagogical implications can also be drawn from the results of this study. First, implicit teaching can be an alternative method for those who have limited cognitive abilities. For these learners, teaching the target structure in an implicit way might be more effective than teaching it in an explicit way since they are not hampered by their lack of cognitive resources. Secondly, however, learners with high WMC require instructors' care in order to ascertain their implicit learning of the target structure. They are prone to explicitly understand even the stimuli intended for implicit learning. Lastly, instructors should provide different solutions to each type of learners according to their WMC. Low WMC learners require a positive feedback of the correct stimuli while high WMC learners must receive a negative feedback which can prevent their overgeneralization of the grammar.

As with most experimental studies, the present research has some limitations. First, it is hard to generalize the result since the sample size of the present study is not large enough ($n = 18$). Due to the innate traits of the working memory research, the data gained from the mid-range group, comprised of 25 percent, could not be used in the comparison. Therefore, only eighteen participants were included in the analysis, which makes it hard to make a strong generalizable claim on the

relationship between WMC and the implicit treatment. Another important issue in this study is that, by using the grammaticality judgment test, it only measured so-called passive knowledge of the target structure. The results may differ when learners' achievement is measured by their writing or speaking. One of the directions for the future research would be to examine the relationship between WMC and the implicit teaching of English writing or speaking. Furthermore, the number of vocabulary is too small to adapt the treatment of this study to the actual classroom environments. Hence, studies on the more number of phrasal verbs must be conducted in order to utilize the implicit treatment in classrooms. Lastly, a delayed posttest is required in order to investigate whether the learning effect of implicit teaching of the present study is transitory or not, since learners' long-term achievement, mediated by various environmental factors, may be disparate.

In spite of these limitations, this study presented a possibility that the effectiveness of implicit teaching can vary depending on the learners' WMC. All the statistical analyses strongly support that even the participants with low WMC can reach the same level of achievement as those with high WMC when they received the same implicit teaching treatment. Therefore, it can be said that this research provides basic directions for future research.

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Appendices

Appendix A

Practicing sentences used for the Reading Span Task

교과서나 신문에서는 ㅅ 표준어를 사용한다.

사투리는 지방마다 다르며 ㅇ 각각의 특색이 있다.

개똥벌레를 쫓아서 다리로 ㅁ 눌러 가곤 했다.

강에서는 물오리나 다름없이 ㄱ 헤엄도 잘 쳤다.

Appendix B

Sentences used for the Reading Span Task

옛날 집은 창문에 ㄷ 종이를 발라서 바람을 막았다.
파르르 어머니 손가락이 ㄴ 떠는 것을 보았습니다.
책상이 지저분해 보여서 ㅎ 일단 정리를 시작했다.
기름을 먹여서 만든 ㄱ 샛노란 부채를 들어 보여줬다.
인형을 가지고 놀고 ㅈ 있는데 선생님이 들어오셨다.
해가 지고 어두워지자 ㄹ 골짜기 안은 추워지기 시작했다.
연어는 강 밑바닥으로 ㅅ 내려가서 물살을 피했다.

아침에 수업을 시작하기 전 ㄷ 선생님이 나를 불렀다.
할머니께서는 구수한 ㄱ 옛 이야기를 해 주셨다.
마지막에 남은 찌개를 ㅇ 손가락으로 피 먹었다.
동화책 속을 달리는 것 같은 ㅁ 열차를 타고 왔다.
쓰레기를 먹고 병에 걸린 ㅂ 새들이 누워 있었다.
그릇에는 냉면이 한 가득 ㅅ 맛있게 담겨 있었다.
경찰관이 범인을 강제로 ㅈ 연행하여 감방에 넣었다.
동전을 주면서 과자 ㅊ 몇 개를 사오라고 시켰다.
피아노를 연주하는 소리가 ㅋ 들려서 밖을 내다 보았다.
따뜻한 물 한잔을 동생에게 ㅌ 가져오라고 시켰다.

강물이 너무 깊고 또 차가워서 ㄱ 건너기가 쉽지 않았다.
눈물이 볼을 타고 흘러 ㅎ 손으로 얼른 닦아냈다.
민들레가 우리집 ㅈ 베란다에 샛노랗게 피어 있었다.
오래 된 신문 옆에 거울이 ㅅ 벽에 걸려 있었다.
사진 한 가운데에는 물을 ㄹ 뿜어대는 고래가 있었다.

Appendix C

Sentences used for the implicit treatment

(particle verbs)

Betty's mother backed her husband up, and she was a great help.
My father always backed me up, and he provided support when needed.
I always backed my sister up when she asked for more money.
Jane knew that the work was unfair. But she bottled her feelings up inside.
You should learn how to express anger. You bottled it up too much.
I was angry but I didn't cry. I bottled up my feelings inside.
Paul brought up the topic for me, and I started to talk about it.
My mother didn't know about my salary and brought this subject up in conversation.
No one talked about the marriage, but my sister brought it up at lunch.
Jenna filled her mother in on the details after she fully awoke.
There were important events. My father filled my family in on the situation.
I didn't know what exactly happened, so Lisa filled me in later.
Paul let his mother down utterly because he failed to get a job.
Michael let his parents down badly. He disappointed them with his failure.
Minho failed to help his friends. He let them down in the end.
Paul made this project seem less important. He played it down as always.
My father played the significance of the problem down, so we were worried.
Sharon played the game down, and she insisted that it was less important.
Kate put down my husband in public. She made him feel silly.
My mother put me down in front of others. She always criticized me.
Gina usually put her friends down by making jokes about them.
Michael explained the point in detail. He spelled it out fully.
John spelled out the problem for me. He explained it in detail.
We finally reached an agreement and spelled the point out very clearly.

Appendix D

Sentences used for the implicit treatment

(particle verbs)

John was young, so his mother backed him up on almost everything.

My parents backed my sister up because they truly believed her.

Ben backed his friend up with witty comments. He really liked them.

We bottled our true feelings up because we didn't want to show them.

Lee bottled up his emotions over a long time. He concealed his feelings.

When Mac felt anger, he bottled it up and tried to be polite.

My partner mentioned about his problems. He brought them up at the meeting.

My boss brought up the topic at lunch and kept talking about it.

I was worried, so I brought the matter up with my father.

My parents informed me fully of the matter. They filled me in completely.

I received a new project, so I filled my partner in on the details.

I worried about the contract, so I filled my parents in on the details.

Ken didn't let his best friend down and remained her advisor.

I was a bit late but I didn't let my friends down completely.

My father was so disappointed in me. I'd let him down terribly.

The doctor played the severity of my illness down, but I didn't trust him.

I told the news. But Courtney played it down because she was not concerned.

Sharon played the severity of the accident down and said nothing about it.

Paul put down our family in front of everybody. We looked foolish.

He put me down when other people were present. I was embarrassed.

My mother put her friends down, and she insulted them badly.

My mother didn't understand the story, so I spelled it out for her.

The mayor didn't spell the problem out clearly. She just refused to explain it.

Martin spelled out the point clearly. He explained it in front of us.

Appendix E

Sentences used for the implicit treatment

(prepositional verbs)

Bob counted on me in a difficult situation. He truly trusted me.

I counted on my father and expected him to solve all my problem.

My parents counted on my brother to take care of them after the retirement.

My friends felt sympathy for me. They felt for me deeply.

Many students felt for the victims and responded in many ways.

Everyone felt for the patient because they could understand his pain.

I ended the relationship with Jake. I finished with him this time.

Gloria finished with her boyfriend and had nothing more to do with him.

Greg finished with his girlfriend yesterday, and he was no longer her boyfriend.

We talked about the subject of the election. We got onto it somehow.

We got onto the next item, and we started talking about it.

My family got onto the next subject and began to talk about it.

The order was to arrest everyone. Jane went against it for some reason.

Mary went against her father's wishes and did the exact opposite.

I went against my parents' words because I always disagreed with them.

The critics laid into the actress for her weak and boring performance.

John laid into my sister angrily. He attacked and criticized her.

My parents laid into me for my habits. They attacked me with words.

The teacher ran through the names quickly and repeated them several times.

Mina read today's events very fast. She ran through them quickly.

I ran through the schedule and quickly checked it as a reminder.

I took to my girlfriend at once. I formed a liking for her immediately.

The exercises were fun and basic, so children took to them very easily.

Charles never took to my sister because she was an odd character.

Appendix F

Sentences used for the implicit treatment

(prepositional verbs)

I counted on my mother for good advice. She was a good listener.
Emily's parents retired and counted on their daughter to run the hotel.
The whole team counted on me, so I practiced harder than before.
Many people lived in poverty in Africa. We felt for them very keenly.
I felt for the refugees after watching the documentary about their lives.
My parents felt for my sister because they knew she felt very lonely.
Wilson finished with his girlfriend, and he stopped believing in love.
I decided to finish with my boyfriend today. He never admitted his mistakes.
Rick got angry with his girlfriend, and he finished with her immediately.
We wanted to talk about the problem, so we got onto it straight away.
We got onto the problems through discussions. Somehow we talked about them.
I'm sorry we got onto this subject and made you remember it.
The mayor suggested a new city plan, and my neighbors went against it publicly.
Harold went against the suggestion in public. He strongly opposed it.
My parents went against the advice and refused to take my sister home.
My mother was really upset, and she laid into my brother for one hour.
I laid into my son when he came home. He was too late.
My father laid into me for being late. He attacked me with cruel words.
John ran through his proposal again, and he briefly made his point.
Mary quickly ran through the reasons, and her teacher listened to her.
Sam needed to practice the speech, so he ran through it several times.
My father took to my girlfriend immediately. He began to like her.
When I met Sandra, I started to like her and took to her immediately.
My wife took to her neighbors at once. She seemed to like them.

Appendix G

Sentences used for the timed GJT in the pretest

(particle verbs)

Michael had an easy life. His parents backed him up in everything he did.
Anne backed her brother up, and she offered comfort when he needed it.
My father backed my mother up in everything. He loved her too much.
Kim bottled up her anger for years. She always refused to show it.
Jamie was embarrassed about his feelings, and he bottled them up inside.
Rose knew the truth, and she bottled her emotions up over a long period.
I brought the matter up at the meeting, but no one seemed interested.
Brown brought up the issue and started arguing with other friends.
I started to talk about Glenn's trip, and I brought it up with him.
Alice filled her friends in on her childhood, including her first love.
Kathy filled her boyfriend in about her family, so he knew about them.
During the conversation, my friends filled me in on the recent news.
My mother had great hope in me, but I let her down terribly.
Sean let his family down badly. He did not fulfill his promise.
I chose the wrong career. I let my father down in his eyes.
The owner said that the incident was nothing. He played it down deliberately.
Sam played the severity of my idea down because it seemed impossible to him.
My family played the importance of some problems down and ignored them.
Many people devalued Bob and put him down for a long time.
Jane put her brother down all the time. She often criticized him.
Tom put down his brothers by making fun of their clothes.
The coach spelled the point out to the players until everyone got it.
After a quick explanation of the events, Lewis spelled out the situation to us.
No one understood our analysis, so we spelled it out in detail.

Appendix H

Sentences used for the timed GJT in the pretest

(prepositional verbs)

Olivia counted on her brothers because her parents were away from home.
Pierre trusted Evelyn, so he counted on her when he needed her.
Thomas counted on his mother to help with babysitting. He had five sons.
John felt for his brother very much. He experienced sympathy for him.
Sarah cried for her husband because she felt for him most sincerely.
Mike felt for his mother because she suffered from severe depression.
Gina tried to finish with her boyfriend, but he didn't listen to her.
Bert finished with his girlfriend last week because he met someone else.
Martha was mad at her boyfriend, and she wanted to finish with him today.
We got onto the subject, but David didn't want to talk about it.
We felt awkward, so we got onto other subjects and had a great time.
We didn't always talk about our future. We just got onto it last night.
Carol went against her friends' advice and sent a letter to her boyfriend.
My doctor recommended more rest, but I went against his advice and ran around.
Kate never accepted the proposal. She went against it for a long time.
Brian laid into his daughter, and she started crying on the road.
The cops laid into the suspect yelling in his face. Everyone was surprised.
My sister really laid into me for borrowing her dress without asking.
Anne ran through the details with me, and it helped me a lot.
I ran through the names, and made sure that everyone was here.
I didn't understand the details, so Harold ran through them again.
Graham took to my sister on sight. He even gave a flower to her.
Liz took to my brother immediately. He was tall and very handsome.
Manny was supportive, strong, kind, and helpful. Gloria took to him right away.

Appendix I

Sentences used for the untimed GJT in the pretest

(particle verbs)

Lisa always backed her husband up on anything to do with the business.
Brig backed his sister up that day. He agreed with her on many points.
Sarah knew that Peter always backed her up and trusted her.
Janet's efforts were fruitless, but she bottled up her feelings inside.
My anger started to affect my relationships, so I bottled it up deep inside.
Simon was honest. He didn't bottle his feelings up for too long.
We talked about our lives only when someone brought them up with us.
David brought up the issue several times, but no one listened to him.
James wanted to talk about movies. So he brought this subject up again.
The cab driver filled me in on some news. He gave me some details.
Sam filled his family in on everything, and they heard about the town.
No one filled my mother in on the procedures, so she remained silent.
Martha quit her job for unknown reasons. She let her boss down badly.
I sensed my father's embarrassment. I felt that I let him down badly.
Daniel was so worried. He let his father down by his own mistake.
There was a growing fear among people, but Miriam played it down deliberately.
The government played the severity of the new disease down with ease.
My friends played the significance of their problems down over and over.
Robin was judgmental and put down his colleagues whenever he could.
My mother always put my sister down by making insensitive comments.
My wife was deeply hurt because I put her down for spending money.
Carol spelled the story out clearly, but her father did not understand it.
We reached a breaking point, and Anne spelled it out for me.
Larry didn't understand at first, so Janice spelled out the point for him.

Appendix J

Sentences used for the untimed GJT in the pretest

(prepositional verbs)

My parents counted on us to help with chores, and we did them.

I always counted on my brother when needed. He was my most honest critic.

Sean counted on his sister for relief from stress. She was a great help.

Carry really felt for her father because he was in a difficult situation.

I felt for my sister very much. She was underpaid the first few years.

It was an accident, but Patricia blamed herself. I felt for her very much.

Nolan finished with his fiancée face to face, not over the phone.

Sherlyn accepted her mother's advice. She finished with her boyfriend right away.

My first boyfriend finished with me, and he went back to his first girlfriend.

People quickly got onto other subjects, and Jesse seemed more comfortable.

Philip hated this subject. When we got onto it, he looked uncomfortable.

Isaac got onto the same subject again. He always talked about robots.

I went against my father's demands because I didn't want to stop practicing.

Although many people gave the same opinion, Roosevelt went against it in public.

Every board members went against the proposal and requested a new negotiation.

Max laid into me a little. He asked me why I ruined his works.

Bob laid into his roommate for not cleaning up the room.

Alison laid into her students pretty hard. She yelled at them for ten minutes.

Helen summarized the class. She ran through it from the beginning.

Robert ran through his speech again. He was even better this time.

Lisa ran through the speech, and I had to try hard to understand her.

Tracy's grey eyes were warm and genuine. Kane took to her immediately.

John took to my sister right away. He followed behind her all the time.

Richard took to my daughter from the start. He thought she was very amusing.

Appendix K

Sentences used for the timed GJT in the posttest

(particle verbs)

My mother always backed my father up in many bad decisions.
David said that Jenna was right. He backed her up on these problems.
Billie backed his wife up, and he also scolded his children gently.
When I felt uncomfortable, I bottled my emotions up inside of me.
Stewart bottled up his feelings, and he accepted his new surroundings.
I felt anger because no one listened. But I bottled it up again.
When I brought up the issue at the meeting, Dan said nothing.
I thought about having a baby, and I brought it up with my husband.
I brought the issue up once again and asked other people's opinions.
Bill filled his girlfriend in on the fact, and it was quite shocking.
Mary filled us in on her grandchildren. She said they were in the military.
Maria filled her friends in on her childhood. They felt more intimate with her.
My sister's feelings were hurt. I let her down with my rude attitude.
John always let his mother down when she needed him most.
Jane let her family down terribly, but they still supported her.
Many people didn't realize the situation. They played it down with humor.
Jeff played the severity of his illness down as always, but I was concerned.
Wilson played the importance of the meeting down because his partner was worried too much.
George put his mother down by saying that her dinner was horrible.
Donald put down his mother and continued to criticize her haircut.
I never got an award, and my parents put me down for that.
I spelled the point out for Sarah, and she seemed to understand it.
David spelled out the situation to his top managers, and it was disastrous.
The formula of the drink had five ingredients. Russ spelled it out to me.

Appendix L

Sentences used for the untimed GJT in the posttest

(prepositional verbs)

My sister was a very strong woman. I counted on her for her support.

I counted on my father, and he took care of me for many years.

Haman counted on his wife for comfort because he was sick and weak.

Alan felt for his mother very much, but he didn't show his sympathy.

I truly felt for my son because he just made a careless mistake.

Richard's wife died after an accident. I felt for him like a brother.

Dave finished with his girlfriend, but he quickly found another girlfriend.

Rose finished with her boyfriend several days ago, and she caused complete chaos.

Park finished with me after a month, but I got myself another boyfriend.

We talked about Reed's new song. Somehow we got onto this subject today.

We got onto this topic after I told Duncan's story to the others.

The topic was murder. We got onto it after reading the newspaper.

I went against my mother's wishes and sent the money to her.

Many people believed in the idea of soul mates. Moore went against it publicly.

Kate went against her father's advice because she fell in love with John.

I laid into my sister pretty hard. I told that she was totally wrong.

My brother made a serious mistake. My mom laid into him at supper.

Sam laid into his mother with difficult questions. He was quite angry.

David ran through his theory again, but no one agreed with him.

The plan was not complicated, but Sean ran through it three times.

Adele ran through her theory quickly, but no one couldn't understand it.

Cathleen took to my brother at once. He had strikingly good looks.

I liked Tom at first sight. I also took to his family right away.

Anna's smile was sympathetic and fantastic. Cole took to her right away.

Appendix M

Sentences used for the untimed GJT in the posttest

(particle verbs)

Larry was a nice guy. He backed my family up throughout the court case.

Laurie backed his daughter up, and he allowed her to do what she wanted.

Catherine loved her father. He always backed her up in everything.

I bottled my anger up inside, so I started to feel depressed about everything.

Sue didn't bottle up her feelings all the time. She just expressed it.

Luna felt a sense of anger, but she bottled it up inside her mind.

Kane brought some issues up at the meeting, and they were important.

I brought up some issues in the discussion, and we talked about them.

I said nothing on that matter. Mrs. Benning brought it up last night.

At last, Thomas filled his family in on some very disturbing news.

I asked about the situation, and Jim filled me in on the happening.

Bill lowered his voice and filled his boss in on the news.

Tom was one reason. Jane didn't want to let him down in any case.

James let his best friend down terribly. He never introduced his girlfriend to him.

Beatrice really let her friends down when they needed her most.

My mother had a heart disease, but she played it down deliberately.

Clinton received advice from his wife, but played the importance of her role down deliberately.

My sister played the importance of the problem down and ignored it deliberately.

The coach didn't put his students down, but he just kept on encouraging them.

When people put me down for no reason, I got angry right away.

Richard put down his girlfriend for her grades. No one agreed with him.

John was nervous in the presentation but spelled out his argument in more detail.

Smith had many ideas about the interior, so he spelled them out to us.

The teacher spelled the point out clearly because no one seemed to understand.

Appendix N

Sentences used for the timed GJT in the posttest

(prepositional verbs)

Kevin counted on his mother for everything. She cleaned and cooked for him.

Edward was strong and smart, so we counted on him to be on our side.

Jennie counted on her friends far more than anyone else. She needed them.

Mary knew Josh was very lonely. She felt for him at that time.

Julie felt for her friend because she also was worried about her future.

I felt for my father, and I tried to encourage him every day.

Vicki finished with her boyfriend because she fell in love with a total stranger.

Hanna finished with her boyfriend a week ago, but she seemed normal.

Jack finished with me yesterday. I cried and cried until my eyes were swollen.

We got onto this topic because I wanted to talk about it.

When we got onto this item, Andrew started to talk about his family.

We talked about the accident. Somehow we got onto it and talked about it.

I went against my doctor's advice although he strongly opposed a change.

Michael went against his family's advice and set up a very beautiful shop.

My doctor's advice was clear, but I went against it and started smoking.

The teacher laid into her students, and they never forgot her words.

Randy laid into his girlfriend viciously. He said that she lied to everyone.

Yesterday, Brenda laid into me about my temper. She even screamed at me.

Maria ran through the contract with me, and she explained every detail shortly after.

Tommy ran through the song one time before he tried his best.

Robinson started to read the will. He ran through it rapidly, without any pause.

I took to a new teacher immediately. We had a lot in common.

The nurse had a pleasant smile. Gordon took to her immediately.

Aaron took to my friend right away because she had a pleasant disposition.

국문 초록

암시적 교육법이 작업기억력이 낮은 제2언어 학습자에게 미치는 역할

본 논문의 목적은 구동사와 같은 복합적인 문법 구조에 대한 암시적 교육법과 작업기억력(working memory capacity) 사이의 관계를 검증하는 것이다. Baddeley, Thomson, & Buchanan (1975)의 연구로 이론화 된 이후로 작업기억은 언어 습득에 있어 영향을 미치는 주요한 개인차 요인 중 하나로 상정되어왔다. 많은 실험연구가 명시적 교육 환경에서 작업기억력과 학습자의 성취도 간에 강한 상관관계가 있다는 것을 밝혔으며, 높은 작업기억력을 가진 학습자가 낮은 작업기억력을 가진 학습자보다 더 우수한 것으로 드러났다. 반면, 암시적 학습 환경은 제한된 인지적 능력을 가지고 있는 학습자들에게 적절한 학습 환경을 제공할 개연성이 있는데, 이것은 작업기억이 의식적이고 명시적인 의식 과정과 관련이 있는 것으로 제기되어 왔기 때문이다. 따라서 이 연구는 암시적 교육 환경이 작업기억력이 낮은 학습자들이 작업기억력이 높은 학습자들과 동일한 성취도를 얻을 수 있게끔 하는지를 살펴보고자 하였다.

24명의 한국인 대학생들은 읽기폭과제(reading span task)를 통해서 얻은 작업기억력을 기준으로 상, 중, 하의 세 그룹으로 나뉘었다. 모든 학생들은 1주일에 걸쳐서 영어 구동사에 대한 암시적 교육을 받았다. 이

암시적 교육방법은 Robinson (1996)의 암시적 교육 방법을 수정한 것으로서 학습자들이 구동사의 통사적 변이형이 있는 문장들을 암기하게끔 요청하는 것이었다. 학습자들의 성취도를 비교하기 위해서 사전검사와 사후검사가 이루어졌으며, 이를 통해 학습자의 어휘와 제한 시간 상황과 제한 시간이 없는 상황에서의 문법성 판단(grammarality judgment) 능력을 측정하였다. 마지막으로 학습자가 실험의 목적이나 실험 대상이 되는 구문을 인지했는지, 그리고 교육 과정이 지나치게 어렵지 않았는지를 파악하기 위해 짧은 인터뷰가 이루어졌다.

실험 결과, 상과 하 그룹은 동일한 성취도를 달성하였으나 두 그룹의 오류는 서로 다른 양상을 보였다. 통계적 분석 결과, 사전검사와 사후검사 간의 차이는 통계적으로 유의미하였는데, 이것은 암시적 학습법이 두 그룹 모두에게 있어 구동사 구조에 대한 지식을 향상시켰다는 것을 의미한다. 그러나 오류 패턴은 두 그룹 사이에 분명한 차이를 보였는데, 상 그룹은 구동사 구문 변이를 과도하게 일반화하는 반면, 하 그룹은 가능한 통사적 변이형 중 어느 하나만을 선호하는 양상을 보였기 때문이다.

이 결과에 관해 몇 가지 이론적 및 교육적 함의를 확인할 수 있었다. 우선 본 논문은 젊은 성인에 있어서 암시적 학습법이 유용할 수 있다는 증거를 제시하였다. 그리고 학습 방식과 작업기억력에 관해 현재의 제2 언어 습득 이론 모형에 있어도 수정이 필요하다는 것을 밝혔다. 다만, 암시적 교육법이 의도한 구문에 대한 암시적 학습으로 확실하게 이어지기 위해서는 교육자는 몇 가지 요인들에 주의를 기울여야 할 필요는

있다. 마지막으로 교육자는 작업기억력이 높은 학습자와 작업기억력이 낮은 학습자들에게 각기 다른 문법 지도를 해야 한다는 점으로서, 이것은 시험 성적이 같다고 하더라도 이것이 학습자의 인지적 능력에 영향을 받아 발전 양상이 다르게 나타날 수 있기 때문이다.

주요어 : 제2언어 습득, 작업기억력, 암시적학습법, 영어 구동사, 통사적 변이, 한국인 학습자

학 번 : 2012-22868